



A cross-sectional investigation of relationships between food pleasure and worry, eating behaviors, and cultural attributes among Mexican American adults

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ABSTRACT

Food pleasure and worry may operate differently across cultural contexts; however, no studies have examined food pleasure or worry and eating-related outcomes among Mexican Americans. This study explored whether: (1) food pleasure/worry were associated with individual-level cultural attributes; (2) food pleasure/worry were associated with eating-related outcomes; and (3) relationships between food pleasure/worry and eating-related outcomes were moderated by cultural attributes. Data were collected with 3329 Mexican American adults recruited through online panels to complete an online survey between November and December 2022. Participants had unique IP addresses, were aged 18–100, lived in the U.S., were able to read in English or Spanish, and had Mexican heritage. The survey assessed food pleasure, food worry, six cultural attributes (e.g., language use), and five eating-related outcomes believed to be associated with eating pleasure (e.g., sugary drink consumption) or nutrition monitoring (e.g., use of Nutrition Facts labels). Most participants rated food pleasure as important (83.6%) and had no food worry (83.1%). Rating food pleasure as important (vs. not) was associated with more Latino-oriented cultural attributes, higher sugary drink intake, consuming food prepared outside the home, and greater importance of sugary drinks at social gatherings. Having food worry (vs. not) was associated with being foreign-born, lower sugary drink intake, lower importance of sugary drinks at social gatherings, and greater likelihood of using Nutrition Facts labels. There was no strong evidence of moderation by cultural attributes. Food pleasure was associated with more obesogenic behaviors, and food worry was associated with more nutrition monitoring behaviors. More nuanced measurement of these food attitudes is needed to elucidate how food pleasure and worry influence eating behaviors, as well as whether nutrition interventions should target these food attitudes to promote healthy eating among Mexican American adults.

1. Introduction

Examining food attitudes can further understanding of relationships between food culture and eating behaviors. Food culture refers to what

people “do, think and feel around food” within specific sociocultural environments (Mingay et al., 2021). Food culture is shaped by individual-level factors (e.g., attitudes and beliefs), structural factors (e.g., food marketing), and sociocultural factors (e.g., group-level cultural

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practices). As such, food culture may be conceptualized as the types of foods that a given cultural group consumes, as well as practices and attitudes related to food preparation and consumption.

Multiple food cultures may influence food attitudes and behaviors among Mexican Americans,² who represent 11.3% of the U.S. population (U.S. Census Bureau, 2025). For example, Mexican Americans may adhere to one of two main dietary patterns observed in Mexico: “traditional,” which includes higher consumption of beans/legumes, corn, and corn-based foods such as tortillas; or “refined,” which is characterized by higher consumption of refined foods such as soda, white bread, fast food, and candy and sweets (Flores et al., 2010). However, many Mexican Americans may be more oriented toward U.S. food culture, which is associated with a Western diet characterized by high consumption of processed foods, red meat, refined grains, and added sugars (Azzam, 2021; Newby and Tucker, 2004). Acculturation likely plays a role in determining the food culture(s) in which an individual engages. Acculturation refers to the dynamic processes that occur as an individual is exposed to more than one culture for a sustained period, thereby leading to potential changes in attitudes, behaviors, and beliefs over time. Acculturation may involve dietary acculturation, which is typically defined as dietary changes experienced by immigrant populations after exposure to a new host culture (Satia-Abouta et al., 2002), but which was more broadly conceptualized for this study as dietary changes that occur as an individual is exposed to how other cultures access, prepare, consume, and think about food. For Mexican Americans, these processes may be complex, as individuals may have been exposed to multiple cultural influences within Mexico and/or the U.S., including diverse Mexican, Mexican American, Latino, and non-Latino cultures. Acculturation is often operationalized by classifying Mexican Americans as more oriented toward Mexican culture, oriented toward both Mexican and U.S. cultures (i.e., bicultural), or more oriented toward U.S. culture (Cuellar et al., 1995). Research suggests that Mexican Americans who are more oriented toward Mexican culture are more likely to consume a Mexican diet, whereas Mexican Americans who are more oriented toward U.S. culture (Ayala et al., 2008) or bicultural (Ramírez et al., 2018) are more likely to consume a U.S. diet. However, even Mexican Americans who consume a more Mexican diet may do so differently in the U.S. For example, Mexican Americans may have more frequent consumption of foods that are considered special occasion foods and eaten less frequently in Mexico, both because some ingredients are more readily available in the U.S. and because engaging with such foods enables them to maintain ties with their Mexican heritage (Ramírez et al., 2018). Mexican Americans may also be exposed to unique Latino (e.g., Tex-Mex), regional (e.g., Southern), and localized food cultures within the U.S. As such, Mexican Americans are a culturally diverse, dispersed population embedded within a heterogeneous U.S. food culture that may shape relationships between food attitudes and eating behaviors.

This study focused on two attitudes shaped by food culture – food pleasure and food worry – that have not been previously examined among Mexican Americans. Food pleasure represents enjoyment derived from eating food, the sensory experiences associated with food and eating, and the meanings associated with foods (Cornil and Chandon, 2016b; Marty et al., 2018; Rozin et al., 1999). This study focused on the sensory, social, and cultural conceptualization of food pleasure (Cornil and Chandon, 2016b). Food pleasure has been shown to have nonexistent to weak correlations with visceral eating pleasure, which is less volitional, more urge-driven, and transient (Cornil and Chandon, 2016b). Food worry refers to the extent to which people associate food with concern about weight instead of savoring food (Rozin et al., 1999). Food pleasure has been shown to be independent of concern about the health aspects of food (Roininen et al., 1999), which indicates that individuals may find certain foods to be highly enjoyable while

having low concern that consuming those foods will cause them to gain weight. This is promising, as it means that people can derive intrinsic pleasure from eating healthy foods.

A growing body of research suggests that enhancing food pleasure may be an effective strategy for promoting healthy eating (Bédard et al., 2020; Marty et al., 2018). In a review of 35 studies, Bédard et al. (2020) observed that 57% of studies found that food pleasure was associated with healthy dietary outcomes (e.g., healthier food choices, portion size moderation). Food pleasure interventions appeared to be particularly effective, with 11 of 13 intervention studies observing positive relationships between food pleasure and healthy dietary outcomes, particularly when enhancing sensory experiences (Bédard et al., 2020). For example, engaging hungry participants in mental imagery focused on the sensory experiences of eating hedonic foods (e.g., cake) has been associated with selecting smaller portion sizes and expecting greater sensory pleasure from smaller portions (Cornil and Chandon, 2016a). Within the U.S., the promotion of healthy eating often occurs within a context in which consumers are inundated by food marketing emphasizing the pleasurable sensory characteristics of unhealthy foods. Given this competitive marketplace, highlighting the pleasurable aspects of consuming healthy foods may be more effective in promoting healthy eating than a deficit-focused approach that encourages people to abstain from appealing obesogenic foods (Pettigrew, 2016).

Research on the perceptions of food healthiness versus tastiness further supports the contention that food pleasure influences food choice and consumption. Raghunathan and colleagues (Raghunathan et al., 2006) proposed that some people perceive unhealthy foods to be more tasty and enjoyable and, as a result, think of healthier foods as less tasty and enjoyable. This “unhealthy = tasty intuition” stems from core cultural values that are reinforced by the marketing of unhealthy foods as fun, tasty, and indulgent (Raghunathan et al., 2006). Research indicates that the unhealthy = tasty intuition is operant in the U.S. (Choi and Springston, 2014; Cooremans et al., 2017; Raghunathan et al., 2006; Turnwald and Crum, 2019). Endorsement of the unhealthy = tasty intuition has been associated with higher body mass index (BMI) (Briers et al., 2020; Cooremans et al., 2017), lower fruit and vegetable intake (Briers et al., 2020), choosing healthier foods when primed to prioritize hedonic eating (Raghunathan et al., 2006), and greater enjoyment of foods described as unhealthy (vs. healthy; Raghunathan et al., 2006). It is possible that the unhealthy = tasty intuition could be disrupted if healthy foods could be re-conceptualized as tasty and enjoyable. For example, brain imaging research suggests that people who are asked to think about the tastiness of healthy foods choose more healthy food options, particularly if they have a higher BMI (Petit et al., 2016). These findings suggest that promoting the pleasure associated with eating healthy foods may be an effective strategy for encouraging healthy eating.

There are several ways in which food pleasure may influence eating behaviors. The anticipation of experiencing pleasure while eating, or anticipatory pleasure, may increase the selection and consumption of healthy foods perceived to be enjoyable. Experiencing pleasure while eating may also enhance sensory-specific satiation, wherein sensory pleasure peaks during the first bite and declines with continued consumption, leading to voluntary moderation of the intake of unhealthy foods (Cornil and Chandon, 2016a, 2016b). Another possibility is that anticipatory pleasure pre-emptively decreases portion sizes of unhealthy foods by heightening the salience of sensory pleasure while simultaneously minimizing competing influences such as hunger (Cornil and Chandon, 2016a).

In contrast to food pleasure, food worry (i.e., worry about weight gain rather than savoring food; Rozin et al., 1999) has received relatively little research attention, and most research on this construct was conducted several decades ago. Yet, food worry may serve as an important influence on eating behaviors among Mexican American adults. For example, in other populations, mentally associating chocolate cake with “guilt” (vs. “celebration”) has been linked to greater weight gain over time (Kuijer and Boyce, 2014), and greater food worry has also been associated with higher body mass index (BMI; Rozin et al., 1999). Research suggests a consistent pattern of greater food worry among U.S. women than men

² The term “Mexican American” is used to refer to people with self-reported Mexican heritage living in the U.S.

(Gokee LaRose et al., 2011; Rozin et al., 1999, 2003). Food worry may also increase with age (Roininen et al., 1999). A comparative study found that higher concern about weight was associated with more symptoms of depression and anxiety among college students in Costa Rica and the U.S. (Rodríguez Arauz et al., 2016). Food worry may be particularly relevant for Mexican Americans, who may feel conflicted between consuming Mexican foods as a means of maintaining ties with their cultural heritage versus holding beliefs that Mexican foods tend to be unhealthy (Davis et al., 2015; Ramírez et al., 2018). Immigrants who adhere to the traditional Mexican dietary pattern (Flores et al., 2010) may also feel stressed or anxious as they attempt to maintain this eating pattern after immigrating to the U.S., where it may be more difficult to access tasty, familiar ingredients and fast food restaurants and food advertising may be more prevalent. Consuming ethnically relevant foods has also been shown to be generally associated with better mental health among immigrant populations, possibly as a result of maintaining connection with one's cultural heritage and enhancing a positive ethnic identity (Elshahat et al., 2023). This limited research on food worry suggests that it may be detrimentally associated with health outcomes.

Most studies suggest that food pleasure and worry operate differently across cultural contexts. For instance, food pleasure has been found to be more important among adults in France, Belgium, and Japan than in the U.S. (Rozin et al., 1999), whereas food worry appears to be higher in the U.S. than in Costa Rica (Rodríguez Arauz et al., 2016), Belgium, France, or Japan (Rozin et al., 1999). Experimental evidence suggests that heightening the salience of sensory food pleasure may be more effective in reducing food intake in cultural contexts in which food pleasure has greater value (e.g., France; Chandon and Cornil, 2022). However, most cross-cultural research on food pleasure and food worry was conducted over 20 years ago, and it is possible that cross-national differences may be less operant in an increasingly globalized food market in which the unique aspects of national or group food cultures may be less influential (Chandon and Cornil, 2022). Prior research has also exclusively focused on comparing food attitudes across countries, with country affiliations operationalized as proxies for culture. Within culturally diverse societies, it is possible that individual-level cultural attributes have a stronger influence on relationships between food attitudes and eating behaviors. To our knowledge, however, no studies have examined whether individual-level cultural attributes moderate relationships between food pleasure or worry and eating behaviors within a culturally diverse population embedded within a heterogeneous national food culture.

Food attitudes appear to be promising targets for efforts to promote healthy eating among Mexican Americans, of whom approximately 47.0% have obesity (Hales et al., 2017). However, no studies have examined relationships between food pleasure or worry and eating-related outcomes within this population. We are also not aware of any studies that have tested whether individual-level cultural attributes moderate associations between food pleasure or worry and eating behaviors. Thus, we do not know if relationships observed in prior studies of food pleasure or worry operate similarly among Mexican Americans. Using data from a survey with 3329 Mexican American adults, this study explored whether: (1) individual-level cultural attributes were associated with food pleasure or worry; (2) food pleasure or worry were associated with eating-related outcomes; and (3) individual-level cultural attributes moderated associations between food pleasure or food worry and eating-related outcomes. No hypotheses were specified, as it was not clear from the extant literature how food attitudes might operate among Mexican Americans or within a culturally diverse ethnic subgroup within the context of U.S. food culture.

2. Methods

2.1. Sample and study design

Participants were recruited through online panels to complete an

online survey between November and December 2022 as part of the International Food Policy Study (IFPS; Hammond et al., 2022). After targeting for demographics and excluding panelists who were known to be ineligible, participants were recruited by sending emails and panelist dashboard application invitations with unique survey access links to a random sample of panelists. Eligible respondents had to have unique IP addresses and report being aged 18–100 years, being able to read in English or Spanish, living in the U.S., and having Mexican heritage. In order to ensure participation by lower-socioeconomic-status respondents, approximately half of the respondents had to additionally report having a high school-level education, with the other half reporting less than a high school-level education. Data were collected in English and Spanish. Eligible respondents provided informed consent prior to starting the questionnaire. Participants who completed the survey received a post-incentive in accordance with their panel's usual incentive structure (e.g., points-based rewards, chances to win prizes). A total of 3596 eligible respondents completed the survey, of whom 267 individuals were excluded from the present analyses due to data quality concerns (e.g., failing data quality checks, speeding). These procedures yielded an analytic sample of 3329 Mexican American adults. All study procedures received ethics clearance by a University of Waterloo Research Ethics Board and the Institutional Review Board at the University of South Carolina.

2.2. Measures

Food pleasure was assessed using a single item in which participants rated the following statement as “True” or “False”: “Enjoying food is one of the most important pleasures in my life” (Rozin et al., 1999). True was recoded as “Important,” whereas false was recoded as “Not important.” **Food worry** was assessed by asking participants to choose whether the word “Fattening” or “Delicious” first came to mind after reading “Which word below belongs best with ‘ice cream?’” (Rozin et al., 1999). Fattening indicated the presence of food worry (=“Yes”), while delicious denoted the absence of food worry (=“No”).

Six individual-level cultural attributes were examined. Culture is a broad, multidimensional construct that is variously defined and difficult to assess. The IFPS questionnaire assessed six individual-level cultural attributes that were used as indicators of participants' cultural orientations. These constructs were believed to have *a priori* potential to be associated with the food attitudes and eating-related outcomes under examination. These indicators were assessed separately, as each attribute was conceptualized as a unique indicator. Correlations among these attributes ranged from weak ($r = -0.14$) to strong ($r = 0.74$), with most in the moderate range (Table 1). **Current language use** was assessed using 7 items from the Acculturation Rating Scale for Mexican Americans-II (ARMSA-II; $\alpha = .95$; Cuellar et al., 1995), with responses ranging from 1 (=“Only Spanish”) to 5 (=“Only English”). This response scale was also used with an ARMSA-II item to assess **childhood language use**: “What was the language(s) you used as a child?” Four adapted ARMSA-II items assessed **ethnic social interaction** by querying whether participants tended to have close friends, prefer going to social gatherings, visit with, or want their children's friends to be Latino versus non-Latino ($\alpha = .88$; 1 = “All Latinos/Hispanics” to 5 = “All Americans”). **Nativity** was measured by asking if participants were born in the U.S. (“Yes”/“No”). Participants were asked about the **frequency of purchasing food in Mexican stores** or markets in the prior month as a proxy for their orientation toward Mexican food culture (recoded as “Never/rarely”, “Sometimes”, or “Often/all the time”). Since immigrating to the U.S. before the age of 20 is associated with increased obesity risk (Chrisman et al., 2017), age and the number of years lived in the U.S. were used to calculate whether foreign-born participants had **immigrated to the U.S. before 20 years of age** (“Yes”/“No”).

Four eating-related behaviors and one attitude were selected based on their conceptual associations with eating pleasure or nutrition monitoring. The **number of meals prepared away from home in the past 7 days** was

Table 1Weighted correlations between cultural attributes among Mexican-heritage adults, 2022 (n = 2190)^a.

	1	2	3	4	5	6
1. Current language use	1.00					
2. Childhood language use	0.75***	1.00				
3. Ethnic social interaction	0.53***	0.46***	1.00			
4. Nativity	0.46***	0.44***	0.23***	1.00		
5. Frequency of purchasing food in Mexican stores	−0.39***	−0.33***	−0.31***	−0.13***	1.00	
6. Immigrated to the U.S. before 20 years of age (calculated only with foreign-born participants; n = 314)	0.49***	0.39***	0.22***	N/A	−0.17**	1.00

= $p < .10$; * = $p < .05$; ** = $p < .01$; *** = $p < .001$.^a Unless otherwise noted, all correlations were computed with the full sample.

determined by tallying the number of times that participants had obtained a meal from eight location types (e.g., sit-down restaurant with a server) or “some other kind of place” in the prior 7 days. The **number of sugary drinks consumed in the past 7 days** was assessed using the Beverage Frequency Questionnaire (BFQ; Vanderlee et al., 2018), with additional questions included to assess intake of *aguas frescas*, which is a culturally relevant beverage among Mexican Americans (Davis et al., 2024). The number of sugary drinks was calculated as the total number of drinks consumed in 10 BFQ categories (e.g., regular soda, 100% fruit or vegetable juice) plus *aguas frescas*. A single item measured the **importance of having sugary drinks at social gatherings** (recoded as “Not at all important” vs. “Slightly to very important”). A single item was accompanied by a Nutrition Facts label image to assess **Nutrition Facts label awareness**: “How often have you seen this type of food label on packages or in stores?” (recoded as “Never/rarely/sometimes” vs. “Often/all the time”). For participants who did not answer “Never,” a second item displaying a Nutrition Facts label was administered to measure **Nutrition Facts label use**: “How often do you use this type of food label when deciding to buy a food product?” (recoded as “Never/rarely/sometimes” vs. “Often/all the time”).

Several covariates were assessed: sex assigned at birth; age (recoded as 18–29, 30–44, 45–59, 60 or older); education (“Low” = 12 years or less, “Medium” = Associate’s, vocational, technical, commercial training, or “High” = Bachelor’s degree or higher); and perceived income adequacy (“Thinking about your total monthly income, how difficult or easy is it for you to make ends meet?”; recoded as “Difficult”, “Neither easy nor difficult”, or “Easy” (Litwin and Sapir, 2009). Height and weight data were used to compute four BMI categories (“Obese”, “Overweight”, “Healthy weight”, vs. “Underweight or missing”). Nutrition knowledge was recoded as “Low”, “Medium”, or “High.” Chronic disease diagnosis was coded as “Yes” if a participant had ever been diagnosed with high blood pressure, heart attack, angina or coronary disease, diabetes, high cholesterol, or cancer other than skin cancer and “No” if they had never been diagnosed with these diseases.

2.3. Data analyses

All analyses were conducted using SAS (version 9.4; SAS Institute, Cary, NC) and included survey weights to approximate population-level estimates for Mexican Americans. Weights were derived using nationally representative data for sex, age, education, and region of residence for Mexican Americans from the 2021 American Community Survey Public Use Microdata Sample files (<https://www.census.gov/programs-surveys/acs>). Derived survey weights were applied in all regression analyses using SAS survey procedures (e.g., PROC SURVEYLOGISTIC, PROC SURVEYREG), as well as a custom macro (surveygenmod) that incorporated sampling weights to obtain population-representative adjusted parameter estimates. To maximize sample sizes, casewise deletion was used rather than removing participants from the data set.

To address the first research question, separate logistic regression models estimated relationships between each of the six cultural attributes and food pleasure while controlling for sex, age, education, perceived income adequacy, and chronic disease diagnosis. These

models were replicated with food worry as the dependent variable. The second research question was addressed by fitting separate models to predict relationships between food pleasure or food worry and each eating-related outcome. Due to the overdispersion issue of Poisson regression models, negative binomial regressions were used to estimate the number of meals prepared away from home and number of sugary drinks consumed. The remaining models were estimated using logistic regression. All models controlled for sex, age, education, perceived income adequacy, BMI classification, and nutrition knowledge. The food pleasure models were additionally adjusted for current language use, as language use was largely associated with food pleasure in the first set of models and was correlated with the other cultural attributes (Table 1). The food worry models were adjusted for nativity, as this was the only cultural indicator associated with food worry in the first set of models. Additional analyses (not shown) indicated that the pattern of results was the same when language use and nativity were removed from the models. The third research question was addressed by adding an interaction term to examine whether current language use or nativity moderated relationships between food pleasure (food pleasure x current language use) or food worry (food worry x nativity), respectively, and each eating-related outcome.

Since self-reported height and weight data can be affected by social desirability, the regression models used to test the three research questions were repeated as sensitivity analyses after removing BMI as a covariate.

3. Results

Half of the weighted sample was female (Table 2), and three-quarters had low education levels. Most participants (83.6%) rated food as one of the most important pleasures in life, which indicated that food pleasure was important. The majority associated “ice cream” with “delicious” (83.1%), which denoted no food worry. Food pleasure and worry were weakly correlated ($r = 0.17$). Participants were generally more oriented toward non-Latino U.S. culture than toward Latino or Mexican culture, with evidence of biculturality. Most participants used English more than Spanish (mean language use = 3.8), were born in the U.S. (84.8%), and purchased food in Mexican stores sometimes, often, or all the time (69.5%). On average, participants had consumed 4.8 meals prepared away from home and 11.3 sugary drinks in the prior week. Of those participants who noticed Nutrition Facts labels rarely to all the time, most (75.8%) reported using these labels sometimes, often, or all the time when making food purchasing decisions.

As shown in Table 3, a one-point increase in using English more than Spanish was associated with lower odds of rating food pleasure as important (OR = 0.78, 95% CI [0.69, 0.89]). Childhood language use was generally unassociated with food pleasure; however, participants who only spoke English during childhood were marginally less likely to rate food pleasure as important than participants who only spoke Spanish (OR = 0.67, 95% CI [0.45, 1.00]). A one-point increase in having social interactions with more non-Latinos (vs. Latinos) was associated with lower odds of rating food pleasure as important (OR = 0.78, 95% CI [0.68, 0.88]). Mexican Americans who purchased food in

Table 2
Weighted characteristics of Mexican-heritage adults, 2022 (n = 3329)^a.

Sex assigned at birth = Female (% , n)	50.1% (1836)
Age in years (% , n):	
18-29	34.4% (1042)
30-44	28.9% (1189)
45-59	27.0% (785)
60 or older	9.7% (313)
Education (% , n):	
Low	76.3% (1594)
Medium	7.4% (748)
High	16.3% (987)
Perceived income adequacy (ease/difficulty to make ends meet; % , n):	
Difficult	40.9% (1247)
Neither easy nor difficult	38.4% (1231)
Easy	20.8% (788)
Food pleasure = Important (% , n)	83.6% (2749)
Food worry = Yes (% , n)	16.9% (588)
Cultural attributes:	
Current language use (higher values = more English; mean, SD) ²	3.8 (1.0)
Childhood language use (% , n):	
Only Spanish	15.6% (469)
More Spanish than English	16.4% (565)
Both equally	24.0% (856)
More English than Spanish	17.5% (586)
Only English	26.5% (843)
Ethnic social interaction (higher values = more interactions with non-Latinos; mean, SD)	2.9 (0.9)
Nativity (Born in the U.S. = No; % , n)	15.2% (463)
Frequency of purchasing food in Mexican stores (% , n):	
Never/rarely	30.5% (1017)
Sometimes	35.7% (1165)
Often/all the time	33.8% (1115)
Immigrated to the U.S. before 20 years of age = Yes (Foreign born only; % , n)	54.2% (253)
Eating-related outcomes:	
Mean number of meals prepared away from home in the past 7 days (SD)	4.8 (5.1)
Mean number of sugary drinks consumed in the past 7 days (mL; SD)	11.3 (9.8)
Importance of having sugary drinks at social gatherings (% , n):	
Not at all important	36.6% (1174)
Slightly to very important	63.4% (2113)
Nutrition Facts label awareness (% , n):	
Never/rarely/sometimes	24.0% (786)
Often/all the time	76.1% (2512)
Nutrition Facts label use (% , n):	
Never/rarely/sometimes	60.6% (1887)
Often/all the time	39.4% (1395)
Chronic disease diagnosis (% , n):	

Table 2 (continued)

Sex assigned at birth = Female (% , n)	50.1% (1836)
None	58.8% (1943)
1 or more	41.2% (1386)
Nutrition knowledge (% , n):	
Low knowledge	37.0% (1080)
Medium knowledge	41.1% (1374)
High knowledge	22.0% (840)
BMI classification (% , n):	
Obese	28.9% (902)
Overweight	28.7% (897)
Healthy weight	28.8% (982)
Underweight or missing	13.6% (414)

2 = Current language use is presented as a mean because this variable is based on a 7-item scale. Childhood language use is presented as a distribution because this variable is based on a single item. These two variables were based on survey items using the same response scale.

^a The percentages presented in the table are weighted. The n's are unweighted. SD = Standard deviation.

Mexican stores sometimes or often/all the time were more likely to rate food pleasure as important (OR = 1.82, 95% CI [1.37, 2.44] and OR = 2.19, 95% CI [1.61, 3.00], respectively). Among participants who were born outside of the U.S., participants who immigrated to the U.S. before age 20 had marginally lower odds of rating food pleasure as important than participants who immigrated to the U.S. at age 20 or older (OR = 0.52, 95% CI [0.26, 1.04]). Nativity was not associated with food pleasure; however, it was associated with food worry. Participants who were born in the U.S. had lower odds of reporting food worry than foreign-born participants (OR = 0.70, 95% CI [0.52, 0.95]). No other relationships were observed between cultural attributes and food worry.

Table 4 displays the associations observed between food pleasure and the eating-related outcomes after adjusting for current language use in addition to the sociodemographic covariates (i.e., sex, age, education, perceived income adequacy, BMI classification, and nutrition knowledge). Participants who rated food pleasure as important had a greater likelihood of consuming meals prepared away from home in the prior week (RR = 1.21, 95% CI [1.11, 1.32]), higher odds of consuming a larger number of sugary drinks in the past 7 days (RR = 1.18, 95% CI [1.07, 1.30]), and higher odds of reporting that having sugary drinks at social gatherings was slightly to very important (OR = 2.03, 95% CI [1.57, 2.62]). No relationships were observed between food pleasure and use or awareness of Nutrition Facts labels.

Associations between food worry and the eating-related outcomes are shown in Table 5. These models were adjusted for nativity in addition to the sociodemographic covariates. Participants with food worry had a lower likelihood of consuming a larger number of sugary drinks in the past 7 days (RR = 0.86, 95% CI [0.78, 0.94]), lower odds of reporting that sugary drinks were slightly to very important to have at social gatherings (OR = 0.61, 95% CI [0.48, 0.78]), a marginally higher likelihood of reporting seeing Nutrition Facts labels on food packages or in stores often or all the time (OR = 1.28, 95% CI [0.97, 1.69]), and higher odds of using Nutrition Facts labels when deciding to buy a food product sometimes, often, or all the time (OR = 1.94, 95% CI [1.52, 2.49]).

There was a marginally significant interaction between food pleasure and current language use for Nutrition Facts label awareness ($p = .05$; Table 4); however, this interaction was significant in the sensitivity analysis ($p = .02$). To aid with interpretation, participants were categorized into three groups based on their mean language use scores:

Table 3

Weighted logistic regression estimates of relationships between food pleasure, food worry, and cultural attributes among Mexican-heritage adults, 2022^a.

	Food Pleasure (ref = Not important) Odds Ratio (95% CI)
Primary predictor in each model:	
Current language use (higher values = more English; n = 3223)	0.78 (0.69, 0.89)***
Childhood language use (ref = Only Spanish; n = 3222):	
More Spanish than English	0.79 (0.50, 1.23)
Both equally	0.99 (0.69, 1.52)
More English than Spanish	0.74 (0.48, 1.15)
Only English	0.67 (0.45, 1.00)[#]
Ethnic social interaction (higher values = more interactions with non-Latinos; n = 3192)	0.78 (0.68, 0.88)***
Nativity (Born in the U.S.; ref = No; n = 3218)	1.04 (0.74, 1.45)
Frequency of purchasing food in Mexican stores (ref = Never/rarely; n = 3208):	
Sometimes	1.82 (1.37, 2.44)***
Often/all the time	2.19 (1.61, 3.00)***
Immigrated to the U.S. before 20 years of age (ref = No; n = 432, foreign-born participants only)	0.52 (0.26, 1.04)[#]
	Food Worry (ref=No) Odds Ratio (95% CI)
Primary predictor in each model:	
Current language use (higher values = more English; n = 3242)	0.97 (0.87, 1.08)
Childhood language use (ref = Only Spanish; n = 3240):	
More Spanish than English	0.91 (0.61, 1.36)
Both equally	0.89 (0.61, 1.29)
More English than Spanish	0.89 (0.60, 1.32)
Only English	0.85 (0.60, 1.22)
Ethnic social interaction (higher values = more interactions with non-Latinos; n = 3211)	0.96 (0.85, 1.08)
Nativity (Born in the U.S.; ref = No; n = 3237)	0.70 (0.52, 0.95)[*]
Frequency of purchasing food in Mexican stores (ref = Never/rarely; n = 3224):	
Sometimes	0.87 (0.66, 1.14)
Often/all the time	0.94 (0.71, 1.24)
Immigrated to the U.S. before 20 years of age (ref = No; n = 429, foreign-born participants only)	0.82 (0.45, 1.51)

[#] = $p < .10$; * = $p < .05$; ** = $p < .01$; *** = $p < .001$.

^a Each model was estimated independently. All models were weighted and adjusted for sex, age, education, perceived income adequacy, and chronic disease diagnosis.

mostly used Spanish ($1.0 \geq \text{mean} < 2.5$), mostly used English ($3.5 \geq \text{mean} \geq 5.0$), or used both languages ($2.5 > \text{mean} < 3.5$). Among Spanish-dominant participants, Nutritional Facts label awareness was slightly higher among participants who rated food pleasure as important

(3.85) versus not important (3.79). Among participants who used both Spanish and English, mean label awareness was slightly lower among participants who rated food pleasure as important (4.02) versus not important (4.07). Among English-dominant participants, mean label awareness was lower among participants who rated food pleasure as important (4.34) versus not important (4.46).

A marginally significant interaction was also observed between food pleasure and current language use for the number of meals prepared away from home ($p = .06$; Table 4).

With the exception of the interaction between food pleasure and current language use for Nutrition Facts label awareness that was described above, the sensitivity analyses, in which the regression models were repeated after removing BMI as a covariate, indicated a similar overall pattern of results as those shown in Tables 4 and 5. The sensitivity analysis results are available upon request from the first author.

4. Discussion

This is the first study to investigate associations between individual-level cultural attributes and food pleasure or worry, relationships between these food attitudes and eating-related outcomes, and whether cultural attributes moderated these relationships among Mexican American adults. Most participants rated food pleasure as important (83.6%) and no food worry (83.1%), suggesting that this sample of Mexican Americans tended to savor food rather than worry about the weight implications of eating. Food pleasure was found to be more prevalent and food worry less prevalent among this sample of Mexican Americans than in earlier research with U.S. adults (Rozin et al., 1999). It is not clear if these differences were attributable to the passage of time, differences in measurement, or the race and ethnicity of participants (i.e., Mexican Americans vs. a general U.S. sample). However, the high value for food pleasure observed in this study is consistent with the central role of food in Mexican culture. Traditional Mexican cuisine is an UNESCO-designated Intangible Cultural Heritage of Humanity that is celebrated as a valued cultural heritage by the Government of Mexico through an annual National Day of Mexican Gastronomy. As such, adults in Mexico associate gastronomy with culture, tastiness, sensory characteristics, identity, emotions, and other concepts inherent to the conceptualization of food pleasure (Rojas-Rivas et al., 2020). Mexican Americans, particularly if more affiliated with Mexican culture, may have attributed similar pride and meaning to Mexican cuisine, not only due to the sensory enjoyment of foods but to pleasure derived from food-related memories and the association of food with cultural identity. Since promoting food pleasure has been positively associated with healthy eating behaviors (Chandon and Cornil, 2022), findings from this study suggest that emphasizing food pleasure may be similarly effective

Table 4

Relationships between food pleasure, cultural attributes, and eating-related outcomes among Mexican-heritage adults, 2022^a.

	Number of Meals Prepared Away from Home in the Past 7 Days Rate Ratio (95% CI) (n = 2966)		Number of Sugary Drinks Consumed in the Past 7 Days Rate Ratio (95% CI) (n = 2672)		Importance of Having Sugary Drinks at Social Gatherings (ref = Not at all important) Odds Ratio (95% CI) (n = 3059)		Nutrition Facts Label Awareness (ref = Never/rarely/sometimes) Odds Ratio (95% CI) (n = 3067)		Nutrition Facts Label Use (ref = Never/rarely/sometimes) Odds Ratio (95% CI) (n = 3059)	
Food pleasure (ref = Not important)	1.21 (1.11, 1.32)***	0.86 (0.60, 1.24)	1.18 (1.07, 1.30)***	0.92 (0.61, 1.38)	2.03 (1.57, 2.62)***	0.82 (0.24, 2.73)	0.91 (0.67, 1.24)	2.99 (0.89, 9.98)[#]	0.94 (0.72, 1.23)	1.26 (0.44, 3.61)
Current language use (higher values = more English)	0.94 (0.91, 0.97)***	0.87 (0.80, 0.95)**	0.99 (0.96, 1.02)	0.94 (0.85, 1.03)	0.74 (0.67, 0.83)***	0.61 (0.47, 0.80)***	1.37 (1.23, 1.53)***	1.80 (1.34, 2.41)***	0.95 (0.87, 1.05)	1.01 (0.80, 1.29)
Food pleasure x current language use	-	1.09 (1.10, 1.19) [#]	-	1.06 (0.97, 1.17)	-	1.25 (0.94, 1.68)	-	0.73 (0.54, 1.00)[#]	-	0.93 (0.72, 1.20)

[#] = $p < .10$; * = $p < .05$; ** = $p < .01$; *** = $p < .001$.

^a All models were weighted and adjusted for sex, age, education, perceived income adequacy, BMI classification, and nutrition knowledge. The meals prepared away from home and number of sugary drinks consumed models were estimated using negative binomial distributions. All other models were estimated using logistic regression.

Table 5Relationships between food worry, cultural attributes, and eating-related outcomes among Mexican-heritage adults, 2022^a.

	Number of Meals Prepared Away from Home in the Past 7 Days Rate Ratio (95% CI)		Number of Sugary Drinks Consumed in the Past 7 Days Rate Ratio (95% CI)		Importance of Having Sugary Drinks at Social Gatherings (ref = Not at all important) Odds Ratio (95% CI)		Nutrition Facts Label Awareness (ref = Never/rarely/sometimes) Odds Ratio (95% CI)		Nutrition Facts Label Use (ref = Never/rarely/sometimes) Odds Ratio (95% CI)	
	(n = 2975)		(n = 2675)		(n = 3071)		(n = 3067)		(n = 3068)	
Food worry (ref = No)	1.01 (0.93, 1.10)	1.15 (0.95, 1.39)	0.86 (0.79, 0.95)**	0.88 (0.71, 1.08)	0.61 (0.48, 0.78)***	0.58 (0.31, 1.09)[#]	1.28 (0.97, 1.69)[#]	0.93 (0.48, 1.79)	1.94 (1.52, 2.49)***	1.82 (0.99, 3.33)[#]
Nativity (Born in the U.S.; ref = No)	0.97 (0.89, 1.06)	1.00 (0.91, 1.11)	1.08 (0.99, 1.19) [#]	1.09 (0.98, 1.21)	0.71 (0.53, 0.94)*	0.70 (0.50, 0.96)*	1.36 (1.01, 1.82)*	1.26 (0.90, 1.74)	1.01 (0.77, 1.33)	1.00 (0.73, 1.35)
Food pleasure x current language use	-	0.86 (0.69, 1.06)	-	0.98 (0.78, 1.24)	-	1.07 (0.54, 2.14)	-	1.50 (0.73, 3.12)	-	1.09 (0.56, 2.10)

[#] = $p < .10$; * = $p < .05$; ** = $p < .01$; *** = $p < .001$.^a All models were weighted and adjusted for sex, age, education, perceived income adequacy, BMI classification, and nutrition knowledge. The meals prepared away from home and number of sugary drinks consumed models were estimated using negative binomial distributions. All other models were estimated using logistic regression.

in encouraging healthy eating among Mexican American adults.

The first research question explored whether cultural attributes were associated with food pleasure or worry among Mexican American adults. Evidence from the cultural attributes related to current, adult attributes (i. e., language use, ethnic social interaction, food shopping) indicates that Mexican Americans with a stronger orientation toward Latino culture were more likely to rate food pleasure as important. Particularly strong associations with food pleasure were found for those who shopped frequently at Mexican stores, perhaps because this cultural attribute more closely reflected engagement with Mexican food culture and food-related behaviors than the other cultural attributes. Nativity was the only cultural attribute that was not associated with food pleasure, which indicated that culturally affiliated food behaviors persist after immigrating to a new food environment. Altogether, these findings suggest that greater orientation toward Latino culture is associated with greater food pleasure.

In contrast with food pleasure, nativity was the only cultural indicator associated with food worry. Although a minority of participants had food worry, these participants were more likely to be foreign-born. It is not clear why foreign-born Mexican Americans were more likely to have food worry. These findings may reflect the concerns of immigrant Mexican Americans as they navigate differences in food culture between Mexico and the U.S. Previous studies indicate that Latino adults experience many barriers to healthy eating after immigrating to the U.S., such as reduced access to flavorful, fresh, healthy foods (Colón-Ramos et al., 2017; Pineda-Leano et al., 2019; Sussner et al., 2008) and increased exposure to sugary drinks and fast food (Colón-Ramos et al., 2017; Lindsay et al., 2009) that may increase concerns about weight gain. Since individual-level cultural orientation was generally unassociated with food worry, these data suggest that food worry was not as strongly associated with culture as food pleasure. Altogether, these results indicated that Mexican Americans may not be overly influenced by what Rozin et al. (1999) referred to as a national U.S. food culture that considers food “as much a poison as it is a nutrient, and that eating is almost as dangerous as not eating” (p. 164).

The second research question examined whether food pleasure or worry were associated with eating-related outcomes among Mexican American adults. When looking at the main models without the interaction terms, food pleasure was associated with three of the five eating-related outcomes, and food pleasure was associated with four eating-related outcomes. These distinct patterns of results suggest that the two items used to measure food pleasure and worry, respectively, were effective indicators of different patterns in eating-related outcomes. Food pleasure and worry were weakly correlated, as consistent with earlier research showing that food pleasure and health concerns were unrelated (Roininen et al., 1999) and the conceptualization of food pleasure as orthogonal to food worry (Cornil and Chandon, 2016b; Marty et al., 2018; Rozin et al., 1999).

Overall, the pattern of results for food pleasure suggested that Mexican Americans who rated food pleasure as important were more likely to report engaging in obesogenic behaviors and to endorse the attitude that sugary drinks are important at social gatherings. These findings diverged from those found in previous studies, in which higher food pleasure has generally been associated with healthier eating outcomes (Bédard et al., 2020). However, no comparable research has assessed relationships between food pleasure or worry and the specific eating-related outcomes reported here. Although the food pleasure item used in this study was drawn from a food pleasure scale, it is possible that the single item captured visceral eating pleasure more than the intended conceptualization of food pleasure. The use of a single item to assess food pleasure, which solely queried whether enjoying food was “one of the most important pleasures” in participants’ lives, may have also insufficiently captured the multidimensional construct of food pleasure, for which sensory experiences appear to play a prominent role (Bédard et al., 2020; Marty et al., 2018). It is further possible that food pleasure transpires differently in the U.S. than in other countries, where most prior research on pleasure from eating has been conducted. For example, it may be more culturally normative to focus on food pleasure in France than in the U.S. Additional research using more expansive, multidimensional measures to capture the full meaning of food pleasure is needed to further disentangle relationships between the dimensions of food pleasure and eating-related outcomes.

Unlike food pleasure, the pattern of results for food worry suggests that Mexican Americans with food worry were less likely to engage in obesogenic behaviors (e.g., consuming fewer sugary drinks) and more likely to be engaged in nutrition monitoring behaviors (e.g., greater use of Nutrition Facts labels). These results were consistent with both theoretical expectations and empirical data indicating that fear of an outcome can promote health behaviors to reduce the likelihood that the feared outcome will occur (Tannenbaum et al., 2015). The finding that Mexican Americans who worried more about weight may have been less engaged in obesogenic behaviors was consistent with the conceptualization of food worry. As compared to food pleasure, food worry may have also been a simpler attitude to assess, as concern about gaining weight from food is relatively straightforward.

In response to the third research question, these findings indicate that individual-level cultural attributes did not moderate relationships between food pleasure or food worry and eating-related outcomes among Mexican American adults. Current language use and nativity were related to selected eating-related outcomes; thus, cultural associations were observed. However, no strong evidence of moderation by cultural attributes emerged in the ten relationships examined. This lack of moderation suggests similarities in food attitudes among Mexican Americans embedded within a diverse U.S. food culture, possibly

because most Mexican Americans are likely exposed to the heterogeneous U.S. food culture, regardless of their cultural orientations. Thus, in contrast with prior research on food pleasure and worry, in which cross-country differences were observed (Chandon and Cornil, 2022; Rodríguez Arauz et al., 2016; Rozin et al., 1999), findings from this study are more consistent with the suggestion that cross-cultural differences in food attitudes may be less influential in multi-cultural, globalized food cultures (Chandon and Cornil, 2022).

Nonetheless, one potentially meaningful interaction emerged, which indicated that participants who mostly used English may have been somewhat more aware of Nutrition Facts labels than participants who used mostly Spanish or both Spanish and English. These findings would be consistent with other research indicating that Spanish speakers report lower use of Nutrition Facts labels than English speakers (Ollberding et al., 2010) and likely reflect the fact that U.S. Nutrition Facts labels are printed in English. However, Spanish-dominant participants were more likely to be aware of Nutrition Facts labels if they rated food pleasure as important, whereas participants who used both languages or mostly English were more likely to report awareness of Nutrition Facts labels if food pleasure was not important. These results may indicate that Spanish-dominant Mexican Americans who valued food pleasure paid more attention to Nutrition Facts labels in order to inform their evaluation of whether or not foods were expected to bring pleasure. However, this heightened awareness of nutrition labels did not transfer to Spanish-dominant participants' higher use of the labels in making food purchases, perhaps because the English labels were difficult to interpret. In contrast, bilingual and English-dominant participants who did not value food pleasure were more aware of Nutrition Facts labels (vs. bilingual and English-dominant participants who valued food pleasure), which suggests that they prioritized the information provided in the labels over food pleasure when making food choices.

5. Strengths and limitations

This study had several strengths, which included a large analytical sample, data from a large sample of U.S. adults with Mexican heritage (vs. grouping adults from varied Latino heritages, as is often done in the U.S.), and a novel opportunity to examine relationships among food pleasure, food worry, and eating behaviors within an ethnic subgroup. The sample also tended to be more bicultural or oriented toward non-Latino American culture than toward Latino culture, which contrasts with much of the extant nutrition research with U.S. Latino populations, which often focuses on samples that are more oriented toward Mexican culture. Although the data were weighted for several sociodemographic characteristics, no nationally representative data were available to incorporate cultural attributes such as language use, acculturation, or nativity into the creation of survey weights. The study findings should therefore be interpreted with the sample characteristics in mind, as different results may be observed among Mexican Americans who are bicultural or more oriented toward U.S. culture, as well as participants from other Latino heritage groups. As noted, food pleasure and worry were each assessed via a single dichotomous item. These simplified measures may have inadequately represented the full conceptualizations of these food attitudes or a wider range of values for these constructs, and additional research is needed to determine whether enhancing food pleasure promotes healthy eating among Mexican American adults. Nonetheless, these limited measures were associated with distinct patterns in eating-related outcomes. Respondents were recruited using online panels and non-probability-based sampling; therefore, the findings do not necessarily provide nationally representative estimates, even with the use of post-stratification survey weights. All data were based on self-report, which introduces the possibility that social desirability may have influenced some survey responses (e.g., potential underreporting of weight). The data set included multiple individual-level cultural attributes, which was a study strength, as it captured different aspects of cultural integration. However, most cultural attributes were not specific to food-related attitudes or behaviors, and the survey did not examine

participants' affiliations with specific food cultures. Finally, the cultural attributes assessed a limited range of individual-level constructs in lieu of operationalizing culture as a multidimensional social determinant of health. Assessing culture comprehensively at the societal level may yield a different understanding of the relationships among food attitudes, eating-related outcomes, and culture than those presented here.

6. Conclusion

The importance of food pleasure observed in this study suggests that promoting pleasure from healthy eating may be an effective strategy for improving diet-related health outcomes among Mexican American adults. Attending to the pleasure of eating healthy foods may be particularly effective within obesogenic environments in which nutrition promotion efforts, which often focus on avoiding and limiting the consumption of pleasurable foods, compete with marketing efforts emphasizing the pleasure of consuming unhealthy foods. Efforts to enhance the salience of food pleasure may be most effective among Mexican Americans with stronger ties to Mexican culture. The current study indicates that, in contrast with most prior studies, food pleasure may be more indicative of unhealthy eating behaviors among Mexican Americans. Food worry appears to have a low prevalence among Mexican Americans overall but to be more likely to occur among immigrants. Although food worry was associated with healthier eating outcomes in this study, it may be associated with unhealthy outcomes over time or reduced enjoyment of food, including healthy foods.

Implications for gastronomy

This study suggests that chefs, restaurants, caterers, and food producers may appeal more to Mexican Americans if they offer foods that highlight sensory experiences (e.g., tastes, textures, sounds, aromas, appearances) and have strong connections to Mexican culture. Many Mexican dishes contain ingredients seldom seen in the U.S. that provide opportunities for the culinary industry to offer novel, pleasurable, sensory experiences to consumers and connect these unique food experiences to Mexican culture. For example, a chef could create a unique dish that uses an unusual, traditional Mexican ingredient in a novel way that exaggerates its sensory properties (e.g., extreme crunch or creaminess, using steam to exude a stronger aroma). Such experiences may be particularly appealing to U.S.-born Mexican Americans, who may value opportunities to strengthen connections with their Mexican heritage and identity. The culinary industry should provide healthy options for consumers seeking healthy foods, who may be more likely to be foreign-born. For example, marketing materials, menus, and food packaging can highlight the freshness of ingredients, make nutrition information available, and note homemade dishes. Healthy foods are important to many Mexican American consumers, as well as for promoting the health of the Mexican American community. However, food pleasure should also be highlighted for healthy foods, as this study suggests that Mexican Americans prioritize the enjoyment they derive from the pleasurable, sensory aspects of foods, including healthy foods, more than considering the health characteristics of foods when engaging in gastronomic experiences.

CRedit authorship contribution statement

Rachel E. Davis: Writing – review & editing, Writing – original draft, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Dai Fang:** Writing – review & editing, Formal analysis. **Christine M. White:** Writing – review & editing, Project administration, Methodology, Investigation, Formal analysis, Data curation. **Alejandra Jáuregui:** Writing – review & editing, Project administration, Methodology, Investigation, Funding acquisition. **Alejandra Contreras Manzano:** Writing – review & editing, Methodology, Investigation. **Kathia Larissa**

Quevedo: Writing – review & editing, Methodology, Investigation. **Indira Gutierrez Orozco:** Writing – review & editing, Investigation. **Laura Patricia Arellano-Gómez:** Writing – review & editing, Investigation. **David Hammond:** Writing – review & editing, Project administration, Methodology, Investigation, Funding acquisition. **James F. Thrasher:** Writing – review & editing, Project administration, Methodology, Investigation, Funding acquisition.

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Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests. Rachel Davis reports financial support was provided by National Institute of Diabetes and Digestive and Kidney Disorders. David Hammond reports financial support was provided by Canadian Institutes of Health Research. James Thrasher reports financial support was provided by National Institute of Diabetes and Digestive and Kidney Disorders. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The dataset analyzed during the current study is available upon reasonable request to the Principal Investigator of the International Food Policy Study: David Hammond (dhammond@uwaterloo.ca).

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