Food-shopping Environment Disparities in Texas WIC Vendors: A Pilot Study

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***Objective*: To identify differences in food-shopping environments of Texas WIC vendors using a culturally adapted instrument. *Methods*: A survey tool was developed for measuring food availability, accessibility, and affordability in 111 WIC vendors in Texas. Two-tailed t-tests and Mann-Whitney tests were used for rural/urban and Texas-Mexico border/non-border area comparisons. *Results*: Prices were higher in rural areas than in urban areas for 2 key foods, fruits (p = .024) and milk (p = .007); non-border vendors had overall better food availability than border vendors; non-border vendors had better accessibility for fruits (p = .007) than border vendors. *Conclusion*: In Texas, disparities in food-shopping environments are evident and can be assessed using a culturally adapted survey tool.**

***Key words*: food-shopping environment disparities, WIC vendors, food availability, food accessibility, food affordability**

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The food-shopping environment (eg, food availability, accessibility, and affordability) has a strong influence on dietary behavior and subsequent health outcomes.[1] For example, the percentage of shelf space devoted to low-fat milk in the diary section was positively associated with the percentage of community residents who reported drinking low-fat milk.[2,3] Increasing evidence indicates that segregation by geographic location, income, and race/ethnicity contributes to food-shopping disparities.[4,5] For instance, researchers have reported that food items sold in stores vary by neighborhood types.[6] Further, compared with higher income and white residents in urban areas, lower-income, racial/ethnic, and rural populations in the United States (US) generally have less access to healthy foods and are faced with higher prices and poorer product quality.[7,8] Given that food inadequacies can place vulnerable populations at increased risk for diet-related health problems such as obesity and diabetes, it is important to assess the nature and extent of food-shopping environment disparities systematically to inform effective interventions and potential policy changes.

The US Department of Agriculture's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) provides a pragmatic context for measuring the food-shopping environment of low-income populations. This federally-funded food assistance program, administered at the state level, serves qualifying pregnant and lactating women, infants, and children up to age 5 years from low-income families with the overall goal of improving nutritional intake for these vulnerable populations. WIC foods are readily available in many grocery stores,[9] but it is unclear how the availability differs by region or type of store, the condition of these foods, and whether or not

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they are labeled, especially in a culturally diverse population.

Many instruments have been developed to measure different aspects of the food environment within stores, including food availability, quality, and prices.[10] However, most instruments target commonly consumed foods across US populations[10-12] and are not culturally sensitive enough to assess food-shopping environments in ethnic minority communities. According to the 2010 Census data, 37.6% of Texas residents are of Hispanic or Latino origin, much higher than the national average of 16%.[13] Considering Hispanic culture, whole grain tortillas, for example, may be more desirable to Hispanic WIC participants compared to whole wheat bread or other grain options.

The Texas Nutrition Environment Assessment of Retail Food Stores (TxNEA-S),[14] adapted from the Nutrition Environment Measurement Survey (NEMS),[12] includes additional foods that are culturally specific to the minority populations of Texas (Hispanic and African-American). However, the instrument is not specific to foods allowed or promoted by WIC. To address this gap, we developed a new instrument modeled after the TxNEA-S instrument. Our tool, here after referred to as the TXNEMS-WIC instrument, was designed to provide better evaluation of the food environment in WIC-authorized stores across Texas and inform appropriate approaches to combating food environment disparities.

The purpose of the study was to examine the differences in the food-shopping environment across Texas prior to the implementation of the revised WIC food package policy using the TXNEMS-WIC instrument. We hypothesized that differences in the availability, accessibility, and affordability of certain food options would be revealed between rural and urban areas, as well as between Texas-Mexico border, where most residents are of Hispanic or Latino origin, and non-border areas.

METHODS

This study is one component of the Texas Childhood Obesity Policy Prevention Evaluation (T-COPPE) Project. The overarching goal of the T-COPPE project is to measure the impact of 2 national policy changes as they are implemented in Texas: the WIC Revised Food Package and the Safe Routes to School (SRTS) program. The overall goal of the WIC-related component of the T-COPPE project is to measure the impact of a policy change in the US Department of Agriculture's Special Supplemental Nutrition Program for WIC. The policy change, implemented in October of 2009, expands qualifying food options to include healthier foods, such as fresh produce and whole grain products, in an effort to provide a more nutrient dense – yet less calorie dense – food package. Also available in the new package in Texas are culturally specific options, such as whole grain tortillas, which may be more desirable to Hispanic WIC participants than would whole wheat bread. The revision was made in response to recommendations from the American Academy of Pediatrics, the American Academy of Family Physicians, and the Institute of Medicine.[15-17] The current study represents a pilot assessment of the WIC program before the implementation of the policy change to provide a baseline for evaluating the efficacy of the new WIC program.

Survey Instrument Development

The TXNEMS-WIC instrument was developed and pilot-tested during Year 1 of the 5-year T-COPPE project. To customize the instrument to match our study aims, we included variables that measure the availability, accessibility, and affordability of certain food items in the new WIC food package (eg, fresh and frozen produce, grains, juice, and milk), including those commonly consumed by members of Hispanic populations in Texas (eg, whole grain tortillas, whole wheat tortillas, and yellow/white corn tortillas) along with certain less healthy counterpart food items, such as frozen 100% fruit juices and cereals. In addition, we omitted foods that were not specific to this study (eg, meats) to streamline data collection.

Operationalization of Constructs

Three important constructs captured by the TXNEMS-WIC instrument are *availability*, *accessibility*, and *affordability* of certain food items (Table 1).

Availability. Four distinct measures were utilized to address the concept of food availability: (1) amount of shelf space dedicated to each product; (2) number of varieties of fruits and vegetables to assess the diversity in availability of each; (3) stocking of products; and (4) quality of fresh produce (acceptable when more than 50% of the product displays good color, is fresh looking, firm, and clean; unacceptable when more than 50% of the product is bruised, old-looking, mushy, over-ripe, dark sunken spots in irregular patches, cracked or broken surfaces, signs of shriveling, mold, or excessive softening).

Accessibility. Marketing principles that suggest eye-level merchandise sells the most successfully[18-20] guided our assessment of this construct, in which we determined the display profile of each product, ie, how easily a product could be seen and reached by shoppers. We operationalized and measured this construct with the use of a color-coded folding ruler that delineated visibility zones (horizontal planes) considered high (the best visibility), medium, or low (the worst visibility) (Figure 1). For this survey, the determination of visibility zones was based on an assumption that the height of the average woman in Texas is slightly shorter than the national average of 5'4" given the steadily increasing Hispanic population over the last 30 years in Texas and a documented lower average height among this segment of the US popu-

Table 1
Constructs Measured by the TXNEMS-WIC Instrument and the Operationalization of the Measures

Constructs	Measures	Descriptions or examples
Availability	Amount of shelf space	Shelf width in inches
	Number of varieties of fruits and vegetables	eg, If only Granny Smith, Red Delicious, and Gala apples were present, the total variety count for apples was "3."
	Stocking of products	Whether certain products were carried/in stock or not
	Quality of fresh produce	*Acceptable quality*: when more than 50% of the product displays good color, is fresh looking, firm, and clean *Unacceptable quality*: when more than 50% of the product is bruised, old looking, etc.
Accessibility	Visibility, or display profile of each product	*High visibility zone*: the center plane of the shopper's vision and encompasses eye level *Medium visibility zone*: between the horizontal planes just above and below the high zone *Low visibility zone*: very top and very bottom planes of the store displays
	Presence of WIC labels	Whether WIC labels are present or absent on the shelves of WIC products
Affordability	Cost of the Least Expensive Brand (LEB) Item	LEB for WIC milk, juice, dry beans, cereal, etc. Price per ounce for bread products Price per pound for fresh produce

lation.[21,22] The visibility score was based on where the majority of the product was located, or if it was equally divided between 2 or 3 zones (50-50%, or 33-33-33%, respectively). As shown in Figure 1, the high visibility zone is in the center plane of the shopper's vision and encompasses eye level; the medium zone is split between the horizontal planes just above and below the high zone; the low visibility zones, which are the most difficult for shoppers to see and reach, are located at the very top and very bottom planes of the store displays.

Another variable related to accessibility was the presence or absence of WIC labels on the shelves of WIC products. Regulations for vendor use of WIC labels vary by state; in Texas vendors are required to label shelves for some, but not all, WIC products for the purpose of promoting cost-efficiency, easier identification of eligible WIC foods, and to reduce the time needed for WIC food selections.[23]

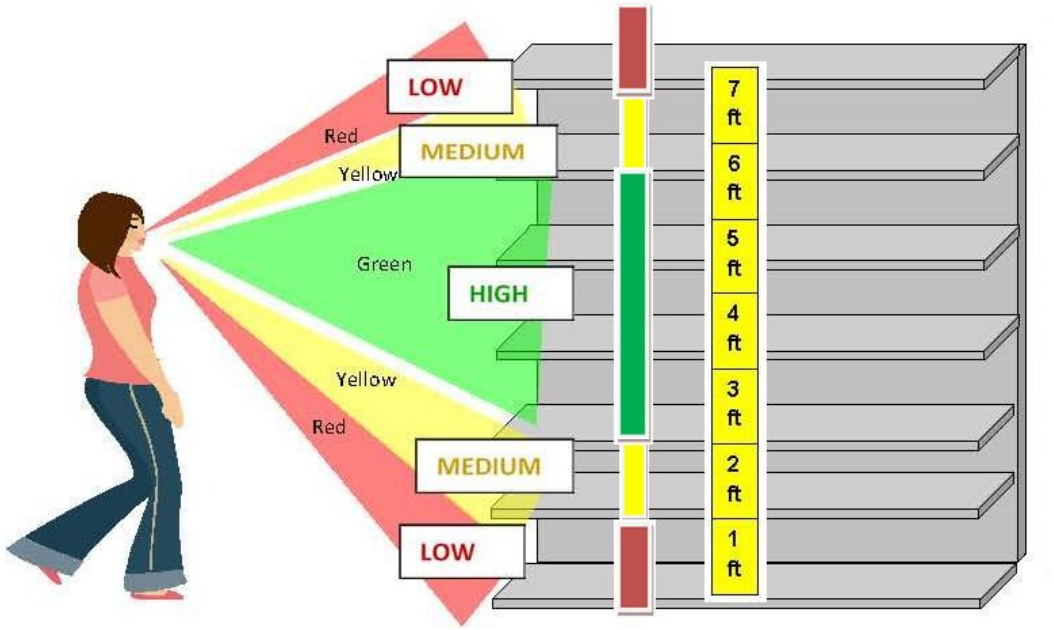
Affordability. The cost of the Least Expensive Brand item (LEB) for each product was recorded. With reference to milk, juice, and dry bean items for WIC participants, only the LEB is WIC-allowable, facilitating the collection of price data. For the other products included in the WIC packages (eg, cereals), items of any price are WIC-allowable if the package fits the exact description in terms of content and size. In those cases, all prices were reviewed in order to determine the LEB for that product. Price per ounce was calculated for bread products, including whole grain/whole-wheat tortillas, and yellow/white corn tortillas, and price per pound was calculated for fresh produce, with the LEB being recorded for each item. Special sale items, such as overstocked or damaged products on clearance, were not included in this study. In stores where repeat-shopper member cardholders benefit from reduced prices on certain items, it was assumed that the regular shoppers in these stores would possess a member card because there are no eligibility requirements. Therefore, any repeat-shopper "sale" items were *not* excluded from our study, but any overstocked, damaged, and clearance items with reduced prices were excluded.

Geographic Comparisons

Two geographic comparisons were assessed**:** Rural vs Urban and Texas-Mexico Border vs Non-border.

Rural vs urban. Comparisons of availability, accessibility, and affordability were first conducted between rural versus urban areas in Texas. Whether a store was located in a rural or urban area was determined by the rural/urban designation for the T-COPPE selected SRTS schools around which the stores were located. The school locale codes developed by the National Center for Education Statis-

Figure 1
Depiction of the 3-category Visibility Zone Measure



tics (NCES) were used to categorize rural and urban schools.[24]

Border vs non-border. Texas-Mexico border and non-border areas of Texas were also compared. According to the Department of State Health Services (DSHS), the Texas-Mexico border area is defined as the area within 100 kilometers (or 62 miles) of the Rio Grande in the La Paz Agreement of 1986, which includes 32 Texas Border Counties.[25] In the present study, stores from 2 border counties were sampled, Hidalgo and El Paso. All other stores were considered non-border stores.

Sampling Protocol

Another component of the T-COPPE project involved an examination of policy implementation at selected 2007 SRTS grantees in Texas. Twenty of the 81 participating SRTS elementary schools were chosen to serve as community nuclei around which the WIC-vendor sampling took place. The selection of the schools involved as community nuclei for the WIC study was purposeful, with the objective of including communities from all 4 SRTS regions of the state of Texas. Figure 2 (a) depicts the geographic spread of the 20 community nuclei chosen.

Using a list of WIC approved vendors provided by the Texas Department of State Health Services (DSHS), a custom web-based mapping application was created to allow random sampling of WIC food outlets around the chosen community nuclei (Figure 2). The WIC approved stores were categorized by the average monthly WIC sales for the previous 12-months as follows (sales information also provided by the DSHS): small $\leq$ \$5999.99; medium \$6,000 - \$19,999.99; and large $\geq$ \$20,000. Two vendors from each category were randomly computer-generated by the mapping tool, resulting in a sample of 6 WIC vendors in each of the 20 communities.

The custom mapping tool functioned by searching first for WIC approved stores within a 2-mile radius of the specified nucleus of each SRTS school and randomly selecting 2 of each size category. In Figure 2(b), a different circle is used for each size category, and the randomly selected stores were signaled with flags. If at least 2 vendors of each size category within the 2-mile radius were not available, the application expanded to a 5-mile radius and randomly selected the number of vendors to fill the required sample. This procedure continued using 8, 11, 14, and 17-mile radii, as needed. In general, larger radii were required for rural areas than for urban, and the 17-mile radius was the largest needed to complete the entire sample. If at least 2 vendors of each size category did not exist within the 17-mile radius of a school, another size vendor was randomly selected to fill the sample.

Although our original WIC approved vendor sample was randomly computer-generated, participation in the study was voluntary. In cases where store participation was declined, another vendor was selected using the WIC mapping application, and recruitment efforts were made. Accessing

Figure 2
The Custom WIC Mapping Application: Depiction of Random Selection of WIC Vendors around 20 Selected SRTS Schools Serving as Community Nuclei

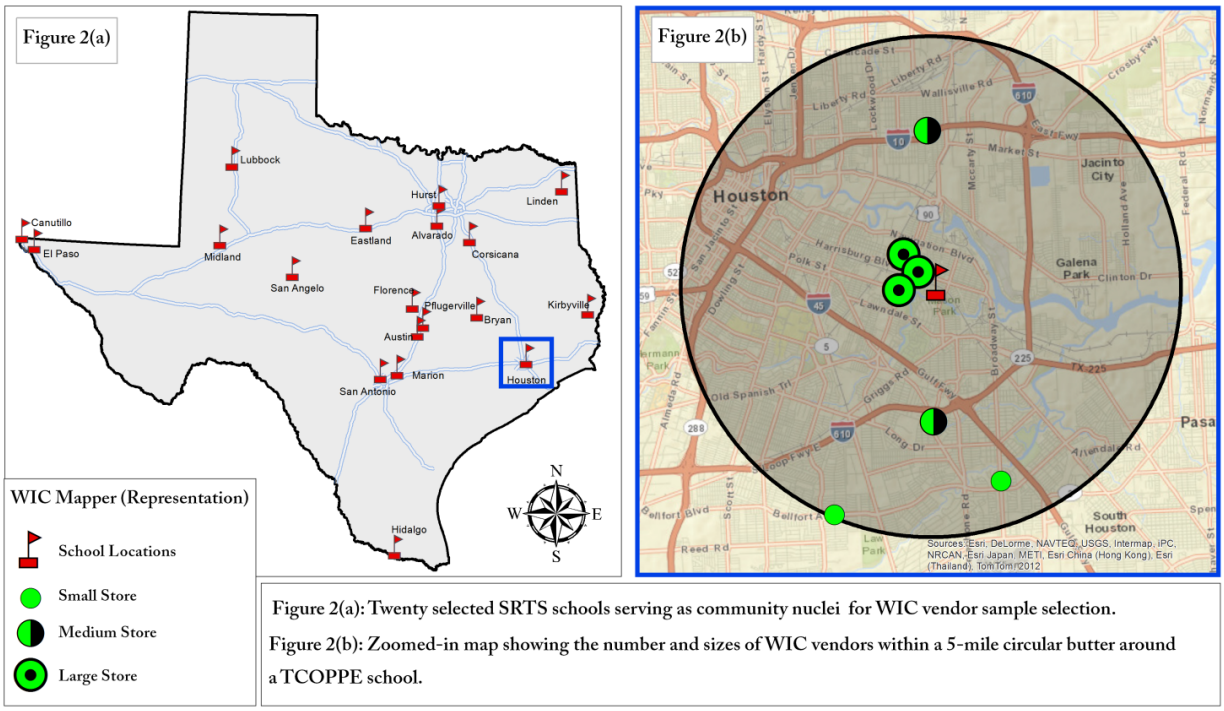


Figure 2(a): Twenty selected SRTS schools serving as community nuclei for WIC vendor sample selection.
Figure 2(b): Zoomed-in map showing the number and sizes of WIC vendors within a 5-mile circular butter around a TCOPPE school.

Note.
Store sizes were based on WIC sales amount. The 20 flags represent 20 SRTS school nuclei.

stores for data collection was contingent upon cooperation and, therefore, outside our control. Consequently, due to time constraints near the end of the data collection period, and travel logistics, we did not always complete the 6-store sample size desired for each community. We attempted to access 126 stores in total, of which 40 were within 2-mile radius of the school nuclei. Twelve stores denied access, one was out of business, and 2 had broken freezers. Denial of access was usually due to lack of communication between the corporate offices and the store sampled, compounded by management changes at the store and corporate levels for chain-retailers. Our final sample consisted of 111 WIC-authorized vendors.

Data Collector Training and Certification

An in-depth training protocol and certification process were created to prepare our team of data collectors. Training consisted of approximately 3 hours of didactic instruction followed by 2 to 4 hours of field time, when trainees went to preselected grocery stores to conduct practice audits. To have credible comparison data, the trainers completed surveys in the same training vendor locations as the trainees during the same day. After the trainees conducted their practice audits, their TXNEMS-WIC instruments were reviewed by the trainers and checked for accuracy. Trainees achieving a minimum of 95% accuracy were certified and authorized to conduct surveys, and we found high inter-rater reliability.

Data Collection

To establish the quantitative measures of the food-shopping environments, a round of surveys was conducted at the end of Year 1 in a sample of 111 WIC approved food vendors across Texas, 2 months prior to the rollout of the new WIC food package. The surveys took place over 2 months and were conducted by a team of 17 data collectors. All surveys were conducted in pairs, with one person measuring and the other recording the data onto the TEXNEMS-WIC tool.

Data Entry

A data cleaning process included investigating missing data, checking/completing calculations, and other steps, followed by coding and data input into a Microsoft Office Access 2007 database tai-

Table 2
Food Availability Measured by Shelf Space, Varieties of Fresh Produce, Food Stocking, and Quality of Fresh Produce in Texas WIC Vendors (N = 111)

	Foods	Rural (N = 20)	Urban (N = 91)	p-value[a]	Non-border (N = 96)	Border (N = 15)	p-value[a]
		Mean (SD)			Mean (SD)		
Shelf Space[b]	Fruits	2098.85 (1648.00)	1963.51 (1245.82)	.957	1971.27 (1291.93)	2094.27 (1531.26)	.883
	Vegetables	1452.58 (1088.23)	1231.65 (72.37)	.613	1301.61 (805.46)	1078.47 (742.84)	.325
	WIC cereal	314.10 (13.19)	393.79 (156.51)	.034*	366.35 (14.32)	463.13 (213.56)	.092
	Bread	67.38 (48.66)	93.58 (63.40)	.091	86.83 (59.02)	101.03 (79.71)	.777
	Dry grain beans	6.75 (27.44)	56.51 (17.02)	.905	56.62 (18.93)	61.43 (21.27)	.144
	Frozen fruits	4.55 (23.21)	37.57 (2.96)	.641	39.68 (21.38)	28.76 (19.06)	.045*
	Frozen vegetables	164.55 (92.10)	164.38 (91.61)	1.000	165.10 (9.11)	158.82 (102.20)	.568
	Frozen juice	69.05 (39.35)	52.34 (24.27)	.138	56.22 (29.43)	48.93 (14.96)	.721
	WIC fresh juice	91.58 (56.69)	13.66 (112.14)	.186	109.42 (81.43)	214.50 (178.23)	.009*
	Milk	341.83 (184.05)	39.04 (231.05)	.452	367.74 (224.33)	468.50 (202.43)	.060
Varieties[c]	Fruit	16.90 (5.29)	17.09 (4.84)	.551	17.26 (4.93)	15.73 (4.62)	.264
	Vegetable	16.45 (4.55)	15.56 (3.80)	.267	16.02 (3.88)	13.80 (3.88)	.041
Food Stocking[d]	Fruit	7.75 (.64)	7.85 (.57)	.457	7.84 (.55)	7.80 (.77)	.787
	Vegetable	7.60 (.68)	7.48 (.85)	.567	7.57 (.74)	7.07 (1.16)	.025*
	WIC cereal	7.70 (1.59)	8.43 (1.72)	.084	8.29 (1.64)	8.33 (2.19)	.094
	Bread	2.80 (1.32)	3.11 (1.51)	.398	3.17 (1.41)	2.33 (1.72)	.041*
	Dry grain beans	4.90 (1.17)	4.81 (.94)	.722	4.88 (.92)	4.53 (1.30)	.211
	Frozen fruit	2.20 (.77)	2.13 (1.01)	.778	2.15 (.98)	2.13 (.92)	.963
	Frozen vegetables	5.50 (1.40)	5.55 (1.12)	.865	5.56 (1.10)	5.40 (1.55)	.618
	Frozen juice	3.85 (1.04)	3.93 (.98)	.731	3.93 (.92)	3.87 (1.36)	.826
	WIC fresh juice	4.35 (.99)	4.43 (.87)	.722	4.41 (.87)	4.47 (1.06)	.808
	Milk	7.55 (.83)	7.45 (1.18)	.721	7.53 (1.04)	7.07 (1.53)	.135
Quality	Fruit	.97 (.09)	.98 (.12)	.661	.99 (.06)	.91 (.26)	.011*
	Vegetable	.99 (.04)	.97 (.12)	.594	.99 (.04)	.88 (.27)	.000**

*** p < .05**

Note.
a Based on 2-sample t test of equality of means with equal variances assumed for normally distributed variables and on Mann–Whitney non-parametric test of equality of medians for non-normally distributed variables (ie, shelf space).
b Shelf space was in inches.
c Total number of varieties.
d Proportion of items carried and in stock.

lored to this project. Every fifth survey (20% of the sample) was re-entered by a different data-entry person to check the accuracy of data entry, and greater than 98% accuracy was demonstrated. Any discrepancies were investigated to correct errors and increase accuracy.

Data Analysis

A cross-sectional observational study design was used to collect baseline data. Summary scores for fruit, vegetable, WIC cereal, non-WIC cereal, bread, dry grain beans, frozen fruit, frozen vegetable, frozen juice, WIC fresh juice, non-WIC fresh juice, and milk were calculated by combining items under each category, and descriptive statistics were derived. Comparisons of shelf space, variety and quality (fresh produce only), food stocking, visibility, and price were made between border versus non-border areas, and between urban versus rural areas, using the 2-tailed t-test or the Mann–Whitney test. The t-test was performed on variables with close to normal distributions, whereas its nonparametric counterpart, the Mann–Whitney test, was performed on variables whose distributions were not close to normality.[26] All analyses were performed with SPSS version 18.

RESULTS

Among the 111 WIC approved stores in the present study, 28 (25.2%) were small, 40 (36.0%) were medium, and 43 (38.7%) were large stores based on average monthly WIC sales. The majority of stores were in urban (N = 91, 82%) and non-border (N = 96, 86.5%) areas, with only a small percentage in rural (N = 20, 18%) and border (N = 15, 13.5%) areas. All stores in the border area (N = 15) were also located in urban areas.

Availability

Table 2 presents and compares food availability between rural versus urban areas and between border versus non-border areas, as determined by shelf space, varieties of fresh produce, food stocking, and quality of fresh produce. WIC cereal had less *shelf space* in rural areas than in urban areas ($p = .034$). Compared with border areas, the non-border areas had more shelf space for frozen fruits ($p = .045$) but less space for WIC fresh juice ($p = .009$). *Variety* count of fruits and vegetables did not differ between rural and urban areas, but non-border areas had more varieties of vegetables ($p = .041$) than border areas. *Food stocking* (ie, whether food items were carried and in stock) did not differ between rural and urban areas. However, the non-border areas carried more vegetables ($p = .025$) and bread products ($p = .041$) than the border areas. *Quality* of fruits or vegetables did not differ between rural and urban areas, but non-border areas had fruits ($p = .011$) and vegetables ($p < .000$) of better quality than border areas.

Accessibility

Accessibility was measured by visibility and WIC labeling (Table 3). *Food visibility* didn't differ between rural and urban areas. In contrast, visibility for fruit was better in non-border areas than in border areas ($p = .007$). *WIC labeling* was not different for any product either between rural versus urban areas or between border versus non-border areas.

Affordability

Prices for fruit ($p = .024$) and milk ($p = .007$) were significantly higher in rural areas than those in urban areas, though no significant difference was observed for vegetables or other products. Compared with border areas, non-border areas had higher prices for fruits ($p = .049$) and vegetables ($p = .006$) (Table 4).

DISCUSSION

The purpose of this study was to examine and identify differences in food-shopping environments across Texas using the TXNEMS-WIC instrument. We hypothesized differences would be found at WIC-authorized stores across Texas regarding availability, accessibility, and affordability of certain food options. The findings of our study supported the hypothesis, as well as confirmed that our adapted instrument was successful in capturing differences in the 3 food environment dimensions between both rural versus urban areas and border versus non-border areas.

The affordability of fruits and milk best discriminated rural stores from urban stores. Compared with urban areas, fruits and milk (2 key WIC foods) were more expensive in rural areas. This result was consistent with findings from most previous studies, indicating that rural individuals often face higher prices for food than those living in urban or suburban areas.[27-29] Kaufman[28] has reported that transportation expenses boosts real costs of food to rural groceries, which causes rural residents to pay 4% more for foods in local grocery stores than suburban residents. Constrained by a lack of public transportation and personal vehicles,[29] many rural residents depended upon personal gardens, friends, and neighbors' gardens for attaining recommended vegetable and fruit servings.[30] This, however, further highlights the great challenges that low-income rural residents who didn't have access to garden produce and public transportation faced for purchasing affordable and healthy foods. Considering the higher prices in rural stores might discourage low income families from purchasing these foods, the WIC vouchers are needed potentially more in rural areas compared to urban areas.

Border and non-border areas of Texas were delineated by food availability, as revealed by results from our study. Overall, stores in non-border areas of Texas had better food availability than stores in low-resourced border areas, with non-border Texas stores having more varieties of vegetables, a greater variety of foods sold, and better quality of fresh produce. These results were consistent with findings from previous studies' findings that the availability of healthy foods is generally poor in low-income or minority neighborhoods.[8,32] Note that in Texas, over 80% of the population in counties along the Texas-Mexico border are of Hispanic or Latino origin. The 2 border counties included in our study, Hidalgo and El Paso, have a Hispanic

Table 3
Food Accessibility Measured by Visibility and the Presence or Absence of WIC Labels in Texas WIC Vendors (N = 111)

	Foods	Rural (N = 20)	Urban (N = 91)	p - value[a]	Non-border (N = 96)	Border (N = 15)	p - value[a]
		Mean (SD)			Mean(SD)		
Visibility[b]	Fruits	6.00 (.00)	5.99 (.07)	.413	5.99 (.06)	5.97 (.88)	.007*
	Vegetables	6.00 (.00)	6.00 (.00)	1.000	6.00 (.00)	6.00 (.00)	1.000
	WIC cereal	4.86 (.56)	5.04 (.53)	.212	4.97 (.54)	5.21 (.48)	.130
	Bread	4.94 (1.08)	5.34 (1.17)	.093	5.30 (.97)	4.98 (.97)	.212
	Dry grain beans	5.35 (1.17)	5.17 (1.16)	.886	5.17 (1.18)	5.42 (1.04)	.188
	Frozen fruits	5.57 (.66)	5.60 (.63)	.487	5.64 (.59)	5.45 (.84)	.630
	Frozen vegetables	5.82 (.35)	5.86 (.24)	.943	5.86 (.25)	5.83 (.29)	.778
	Frozen Juice	5.69 (.47)	5.67 (.51)	.979	5.67 (.49)	5.69 (.57)	.449
	WIC fresh Juice	5.19 (.57)	5.01 (.89)	.544	5.00 (.84)	5.36 (.76)	.101
	Milk	5.83 (.33)	5.70 (.42)	.154	5.72 (.41)	5.74 (.39)	.860
WIC Labeling[c]	Fruits	0 (0)	0(0)	N/A	0 (0)	0(0)	N/A
	Vegetables	.02 (.05)	.01 (.04)	.312	.01 (.04)	0 (0)	.269
	WIC cereal	.31 (.36)	.30 (.37)	.96	.30 (.37)	.30 (.39)	.988
	Bread	0 (0)	0 (0)	N/A	0 (0)	0(0)	N/A
	Dry grain beans	.87 (.24)	.75 (.36)	.177	.78 (.33)	.71 (.40)	.431
	Frozen fruits	0 (0)	0 (0)	N/A	0 (0)	0(0)	N/A
	Frozen vegetables	0 (0)	0 (0)	N/A	0 (0)	0(0)	N/A
	Frozen juice	.74 (.35)	.81 (.31)	.409	.79 (.32)	.83 (.28)	.7
	WIC fresh juice	.94 (.16)	.82 (.29)	.084	.85 (.27)	.76 (.30)	.251
	Milk	.94 (.13)	.85 (.28)	.201	.86 (.28)	.91 (.15)	.536

*** p < .05**

Note.
a Based on 2-sample t test of equality of means with equal variances assumed for normally distributed variables and on Mann–Whitney non-parametric test of equality of medians for non-normally distributed variables (ie, visibility).
b Visibility had a scale of 1 to 6, with 6 being the best.
c WIC labeling represents the proportions of items with WIC labels.

population of 9.6% and 82.2%, respectively.[33,34] Between 2007 and 2011, the average proportion of residents below the poverty line of these counties was 31.2%, much higher than the percentage reported for Texas (17.0%).[33,34] Therefore, the finding that food availability was poorer in Hispanic-predominant border areas of Texas underscores the importance of incorporating culturally desirable food options into the nutrition environment survey instrument. This finding further supported recommendations from the American Academy of Pediatrics, the American Academy of Family Physicians, and the Institutes of Medicine that culturally specific options be included in the WIC package changes for ethnic minority WIC participants.[15-17] A future research question is whether the implementation of the revised WIC food package will reduce documented food disparities.

Border and non-border areas were further differentiated by food accessibility, with better visibility for fruits in the non-border stores than those in the border stores. To measure food visibility, we developed a tool based on marketing principles that eye-level merchandise sells most successfully (described fully in the methods section). This instrument may indirectly measure the vendors' efforts to promote selling of WIC items. This finding highlighted the importance of working with stores

Table 4
Food Affordability Measured by Mean Prices (USD) in Texas WIC Vendors (N = 111)

Foods	Rural (N = 20)	Urban (N = 91)	p - value[a]	Non-border (N = 96)	Border (N = 15)	p - value[a]
	Mean (SD)			Mean (SD)		
Fruit[b]	1.40 (.29)	1.27 (.21)	.024*	1.31 (.23)	1.18 (.19)	.049*
Vegetable[b]	1.05 (.10)	.99 (.20)	.141	1.02 (.17)	.88 (.21)	.006*
WIC cereal[d]	4.84 (.91)	4.99 (1.03)	.540	4.91 (.87)	5.37 (1.61)	.097
Bread[c]	.13(.02)	.13 (.03)	.738	.13 (.03)	.14 (.04)	.461
Dry grain beans[d]	.90 (.13)	.93 (.13)	.262	.93 (.13)	.91 (.11)	.605
Frozen fruit[d]	2.66 (.64)	2.66 (.49)	.986	2.65 (.51)	2.72 (.58)	.581
Frozen vegetables[d]	1.32 (.32)	1.24 (.25)	.217	1.26 (.27)	1.25 (.28)	.920
Frozen juice[d]	1.48 (.30)	1.54 (.31)	.419	1.53 (.30)	1.54 (.32)	.902
WIC fresh juice[d]	1.79 (.27)	1.82 (.25)	.708	1.80 (.24)	1.89 (.34)	.243
Milk[d]	3.51 (.54)	3.24 (.50)	.034*	3.30 (.52)	3.22 (.50)	.590

*** p < .05**

Note.
a Based on 2-sample t test with equal variances assumed.
b Price in US dollars per pound.
c Price in US dollars per ounce.
d Price in US dollars per unit. Cereal: converted to price per 36-oz package; Milk: converted to price per gallon; Other items had 16-oz units;

to facilitate purchase of WIC items through common marketing practices. For WIC labeling, no difference was observed because the WIC policy was implemented across the state and, the labeling was expected to be consistent in different areas. Understandably, no fruit item (fresh or frozen) and vegetable items were labeled, except for carrots in a handful of stores and for qualifying women, because fruit and vegetables were not included in WIC food packages before October 2009. Another future research question is whether there will be a wider variety of produce packaging and more items labeled after the implementation of the revision to promote cost-efficiency and easier identification of eligible WIC foods.

Our findings confirmed that the measures we developed in our TXNEMS-WIC instrument had good discriminant validity to detect the hypothesized differences at food availability, affordability and accessibility in culturally and geographically different areas. The findings suggest that large disparities may exist in food-shopping environments across Texas, especially in food affordability, availability and accessibility. The findings also underscore the importance of revising the original WIC food package to create an improved food-shopping environment. Although there are established criteria for eligibility to participate in the WIC program, designated WIC food products are accessed, generally, in public shopping outlets, including convenience stores, neighborhood supermarkets, and the large chain grocery stores, thereby making these products available to a broader population. Therefore, we hypothesize that an improved food-shopping environment in WIC stores will benefit not only WIC participants but also the general public.

An important limitation of the study is that our sample size, especially for rural and border subgroups, was not large enough to detect significant differences across all observed food domains. The study is also limited by a lack of rural-border stores; all stores in the border area were located in urban areas. We call for future studies to include rural stores located in border areas because this combination may have the greatest disparities. In addition, our study is limited to WIC approved stores in Texas; therefore, the findings may not be generalizable to other states in the US. Another potential limitation is related to the measurement of food stocking, ie, whether certain foods were carried or not. The data collectors went to stores to collect data on different days and at different times during a day, so certain items might be more likely to be out of stock during certain days or hours. Lastly, we tested many associations in this study, but chose not to adjust for multiple testing because we considered this study exploratory. There-

fore, significance should be interpreted with caution and replication of results is needed.

Despite the limitations, the strengths of the study warrant mention. First, our study represents one of the most extensive evaluations of WIC vendors. We conducted a statewide study, which provides rich information and provides a foundation for conducting many comparisons of interest. Second, the TXNEMS-WIC instrument that we developed was culturally sensitive to Hispanic foods, eg, grain products other than bread such as tortillas, which allowed us to assess with some sensitivity the food-shopping environment in predominantly Hispanic areas. Third, the study was part of the larger Texas Childhood Obesity Prevention Policy Evaluation Project, so it is possible to examine the WIC store data as they relate to more extensive parent and child survey responses collected on food preferences and eating behaviors. Fourth, the TXNEMS-WIC instrument is comprehensive, and, to our best knowledge, it has for the first time introduced marketing principles to measure food visibility.

CONCLUSION

The food-shopping environment is an important determinant of healthier food choices, affecting both WIC shoppers and potentially the general population. This is an important observation because families, according to their circumstances, go on and off WIC eligibility. Thus, changes in the availability of WIC package foods can influence availability for a wider consumer base. Utilizing the newly developed TXNEMS-WIC audit tool, this study demonstrated the existence of disparities in food-shopping environments across the state, especially in the border, low-income areas. Work is needed to improve availability, accessibility, and affordability of healthy food options, including fresh fruits, vegetables, and whole grain products, in underserved communities. Further research is needed to test whether the implementation of the revised WIC food package can reduce the disparities and establish a more equitable food-shopping environment across Texas.

Human Subjects Statement

The WIC-related research component of the T-COPPE project, described herein, is an observational study and exempt by the Texas A&M University Division of Research and Graduate Studies, Office of Research Compliance for Human Subjects approval.

Conflicts of Interest Statement

No potential conflict of interest was reported by the authors.

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