Texas nutrition environment assessment of retail food stores (TxNEA-S): development and evaluation

Christian T Gloria* and Mary A Steinhardt
Department of Kinesiology and Health Education, College of Education, The University of Texas at Austin, 1 University Station D3700, Austin, TX 78712-0306, USA

Submitted 27 September 2009: Accepted 22 April 2010: First published online 11 June 2010

Abstract

Objective: Current nutrition environment instruments are typically designed to measure a small number of healthy foods based on national trends. They lack the depth to accurately measure the unique dietary choices of subpopulations, such as Texas consumers whose food preferences are influenced by Hispanic/Latino culture. Thus the purposes of the present study were to: (i) develop a comprehensive observational tool to measure the availability of healthy foods from retail stores in Texas; and (ii) conduct a pilot test to examine the tool’s reliability, as well as differences in the availability of healthy foods in stores between high- and low-income neighbourhoods.

Design: Grocery and convenience stores were assessed for availability of healthy foods. Reliability was calculated using percentage agreement, and differences in availability were examined using 2 (store type) × 2 (neighbourhood income) ANOVA.

Setting: One high-income and one low-income neighbourhood in Austin, Texas.

Subjects: A sample of thirty-eight stores comprising twenty-five convenience stores and thirteen grocery stores.

Results: The low-income neighbourhood had 324% more convenience stores and 56% fewer grocery stores than the high-income neighbourhood. High inter-rater (mean = 0.95) and test–retest reliability (mean = 0.92) and a significant interaction (P = 0.028) between store type and neighbourhood income were found.

Conclusions: The TxNEA-S tool includes 106 healthy food items, such as fruits, vegetables, dairy, proteins and grains. The tool is reliable and face validity is affirmed by the Texas Department of Health. Grocery stores have more healthy foods than convenience stores, and high-income grocery stores offer more healthy foods than low-income grocery stores.

The obesity epidemic is one of the leading national health concerns due to its serious consequences and rapidly increasing prevalence in the USA(11-3). Currently, about 66% of US adults and 32% of children and adolescents are either overweight or obese(4,5). Similar trends are also experienced in Texas(6,7), which was ranked as the fifth unhealthiest state in the nation(8). If current patterns continue, 75% of Texas adults could become overweight or obese by 2040, and health-care costs would quadruple from US$10.5 billion to over US$39 billion(9).

Individuals can only be as healthy as the community in which they reside(10,11). Simply educating individuals and increasing awareness regarding the importance of healthy eating cannot effectively change behaviour and promote healthier lifestyles if their neighbourhoods fail to provide healthy food options. In order to improve health, it is imperative to improve the surrounding food environment. Organizations such as the Centers for Disease Control and Prevention, the Institute of Medicine, the International Obesity Task Force and the WHO insist that environmental interventions are the most effective strategies for positively ‘shifting the curve’ and creating population-wide improvements in dietary intake and weight status(12-16).

A growing body of research suggests that the food environment – the presence of food outlets and the available food products therein – influences consumer eating behaviour and contributes to overweight and obesity in the USA and around the world(11,17-22). Glanz et al(11) identified ‘nutrition environments’ as having the highest priority in research as they are the least understood yet could have the greatest impact on overweight and obesity. Research suggests that dietary intake is the main determinant of obesity and a greater predictor of weight outcome as compared with physical activity and energy expenditure(23-24). Greater availability of healthy

*Corresponding author. Email ctgloria@mail.utexas.edu

© The Authors 2010
foods (e.g. fruits, vegetables, low-fat dairy) within neighbourhoods is associated with greater consumption of such healthy foods among the neighbourhood residents\(^{(15, 25–33)}\). Alternatively, a similar pattern is observed with the presence of unhealthy foods (e.g. soft drinks, potato chips); greater availability of unhealthy food products is associated with greater consumer intake of such unhealthy items, which in turn may lead to poor health and diminished quality of life\(^{(32, 33)}\).

The availability of healthy foods appears to be associated with neighbourhood income and the presence of certain stores. Low-income neighbourhoods have significantly fewer grocery stores and more convenience stores as compared with high-income neighbourhoods, and grocery stores offer greater amounts of healthy foods than convenience stores\(^{(34–36)}\). Experts believe that the lack of availability of healthy foods contributes to a higher incidence of overweight and obesity in lower-income populations\(^{(37–40)}\).

A number of instruments have been developed to evaluate the availability of healthy foods within nutrition environments\(^{(35, 36, 38, 41–49)}\). Some of these measures obtained reliability scores ranging from low to good\(^{(30, 41–45)}\), while others did not report the reliability of their tools\(^{(35, 36, 46–49)}\). Furthermore, some of these instruments present limitations such as having only a small number of healthy food items to observe (five to thirty-nine items), which were typically selected according to consumer trends based on the general US population\(^{(41–49)}\). The limited number of items observed by such tools consequently ignores a large range of healthy foods recommended by the Dietary Guidelines for Americans\(^{(50)}\), such as soya milk or cheese, beans or legumes, assorted grains, and canned/frozen fruits and vegetables.

According to a panel of dietitians, nutritionists and public health professionals from the Division of Nutrition, Physical Activity, and Obesity Prevention (NPAOP) of the Texas Department of State Health Services, these nutrition environment instruments not only need an increase in the number of items observed, but they also overlook and inadequately measure the distinct differences between different subgroups and cultures of the US population. For instance, the dietary preferences of Texas residents having a strong Hispanic or Latino influence vary distinctly from the dietary preferences of residents from other states; 36% of Texas residents are of Hispanic or Latino origin, as compared with the national average of 15%\(^{(51)}\). Therefore, the NPAOP collaborated with the researchers to develop the Texas Nutrition Environment Assessment of Retail Food Stores (TxNEA-S) tool, which was designed to expand the number of foods observed, as well as to more accurately capture the dietary preferences of the Texas population. With the instrument’s greater depth and emphasis towards the Texas food culture, the TxNEA-S tool could provide greater understanding of how the nutrition environment affects the diet and health of Texas residents.

Therefore the purposes of the present study were to: (i) develop a comprehensive observational tool to measure the availability of healthy foods from grocery and convenience stores located in the State of Texas; and (ii) conduct a pilot test to examine the tool’s inter-rater and test–retest reliability, as well as differences in the availability of healthy foods from grocery and convenience stores between high- and low-income neighbourhoods. It was hypothesized that grocery stores would have greater availability of healthy foods than convenience stores, and that stores from high-income neighbourhoods would have greater availability of healthy foods than stores from low-income neighbourhoods.

**Methods**

**Development of TxNEA-S tool**

The NPAOP developed the TxNEA-S tool, which was adapted from the instrument Nutrition Environment Measures Survey in Stores (NEMS-S)\(^{(42)}\). While the NEMS-S was an acceptable tool for observing the dietary preferences of the average US consumer, the NPAOP believed that the items of the NEMS-S tool could be strengthened to more comprehensively observe the food choices of the Texas population. Thus, the list of food items was modified and expanded to include a large number of additional products such as mangoes, collard greens, rice, beans/legumes, tortillas, yoghurts and cheeses. The list of healthy foods was determined by a team of dietitians, nutritionists and public health professionals from the eight regional offices of the Texas NPAOP\(^{(52)}\). One food category that was not included in the TxNEA-S tool was meat products, as the NPAOP believed that Americans already consume greater than recommended amounts of such items; instead, the tool measured the less consumed yet more recommended sources of protein such as beans and legumes. Additionally, the TxNEA-S also measured the availability of canned and frozen alternatives to account for low-income neighbourhoods which have been shown to have limited or no resources for fresh products\(^{(30)}\). A total of 106 healthy foods were measured by the TxNEA-S tool from a variety of food categories recommended by the Dietary Guidelines for Americans\(^{(50)}\) (see Appendix). The TxNEA-S tool was used for assessments of both convenience and grocery stores. A copy of the tool is available from the corresponding author.

**Neighbourhood selection**

The study was conducted in one low- and one high-income neighbourhood located in central Austin, Texas. Each neighbourhood was composed of two adjacent zip-code areas. Zip-code areas were used as they are larger than census tracts and thus captured more stores per neighbourhood. In addition, it was found that a single...
zip-code did not offer enough stores, and so neighborhood size was doubled by the combination of two adjacent zip-code areas. The US Census\(^{[53]}\) was used to determine median household income per zip-code area, with income divided into seven categories of median household income as illustrated by the Census geographic information mapping (see Fig. 1)\(^{[54]}\). Two zip-code areas with the lowest median household income were selected to represent the low-income neighbourhood, and then contrasted against two zip-code areas with higher income. This neighbourhood selection method was adopted from Glanz \textit{et al} \(^{[42]}\), 'to maximize the ability to contrast food outlet types between neighbourhoods with differing levels of income'. Communities within the highest range of income were excluded, considering the relatively small proportion of these residents. Therefore, to represent the high-income neighbourhood, the second and third most affluent zip-code areas were selected.

As shown in Fig. 1, the low-income neighbourhood consisted of two zip-code areas with median household incomes ranging from US$ 23,348 to US$ 25,369, which fell below the Texas (US$ 39,927) and US (US$ 41,994) median household incomes\(^{[55]}\). In contrast, the median household incomes of the two zip-code areas within the high-income neighbourhood ranged from US$ 54,591 to US$ 62,404, which were greater than the state and national median household incomes. Two categories of income – approximately a US$ 30,000 gap – separated the low- and high-income neighbourhoods. The remaining and unselected low-income zip-code area seen in the centre of Fig. 1 is a university setting with primarily student residents; therefore it was not considered for the neighbourhood sample selection. Each neighbourhood was independently located within the eastern or western section of the city, which minimized the potential overlap in residents' access to stores in the contrasting neighbourhood. The low-income neighbourhood had a larger population (with 63,195 residents) as compared with the high-income neighbourhood's 43,644 residents. However, despite the disparities between the low- and high-income neighbourhoods, some similarities were still accounted for to ensure a balanced design in order to conduct valid comparisons. For instance, the low- and high-income neighbourhoods were 100\% urban, residential communities and had similar land sizes (12.6 and 13.5 square miles, respectively).

\textbf{Definition and selection of stores}

A list of stores within the neighbourhood samples was collected from the city’s Consumer Health Services, printed Yellow Pages and online directories, and then

<table>
<thead>
<tr>
<th>Category</th>
<th>Income Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>≤ US$11,250</td>
</tr>
<tr>
<td>B</td>
<td>US$11,667 – US$26,152</td>
</tr>
<tr>
<td>C</td>
<td>US$26,202 – US$34,545</td>
</tr>
<tr>
<td>D</td>
<td>US$34,596 – US$44,375</td>
</tr>
<tr>
<td>E</td>
<td>US$44,476 – US$58,929</td>
</tr>
<tr>
<td>F</td>
<td>US$59,180 – US$83,950</td>
</tr>
<tr>
<td>G</td>
<td>≥ US$84,847</td>
</tr>
</tbody>
</table>

\textbf{Fig. 1 Categories of median household income per zip-code area, central Austin, Texas}
verified through on-site visitations in January 2008. Stores that were inaccessible to the general public (e.g. within worksites, schools or private facilities) were not included. Specialty stores (e.g. bakeries or liquor stores) were also excluded considering their limited range of products.

The stores selected for the study were classified into two main categories: convenience stores and grocery stores. Convenience stores were defined as food outlets having limited options and primarily stocking items intended for immediate consumption (e.g. potato chips, snack items, soft drinks). Grocery stores were defined as food outlets offering a full range of items from all food categories, above and beyond what convenience stores offer. A consistent distinguishing feature of grocery stores was the availability of fresh/raw products which require preparation and/or cooking (e.g. fruits, vegetables and raw meat). These definitions were obtained from a NEMS-S\(^{(42)}\) research/training specialist via email correspondence as their published work did not discuss how convenience stores and grocery stores were operationalized (E. Davis, personal communication, April 2008).

A total of eighty-five stores were found within the selected neighbourhoods (see Table 1). For data collection, all existing grocery stores in both neighbourhoods were selected, and a smaller random sample of convenience stores was selected out of seventy-two total convenience stores due to limited resources. From the originally selected forty-store sample, one low-income convenience store went out of business and one high-income convenience store withdrew from participation, leaving a total sample of thirty-eight stores. As shown on Table 1, the low-income neighbourhood sample had thirteen convenience and four grocery stores, while the high-income neighbourhood sample had twelve convenience and nine grocery stores. The obtained sample size within each neighbourhood meets the minimum size discussed by Glanz \textit{et al.}\(^{(42)}\) of at least fifteen stores per neighbourhood.

<table>
<thead>
<tr>
<th>Low-income neighbourhood</th>
<th>Convenience store</th>
<th>Grocery store</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-income neighbourhood</td>
<td>55</td>
<td>4</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>9</td>
<td>26</td>
</tr>
</tbody>
</table>

Table 1 Cross-tabulation of actual and sample ratios of store types within neighbourhood samples, central Austin, Texas

The purposes of Phase I of the study were to: (i) introduce the newly developed TxNEA-S tool to the raters; (ii) provide data collection training; (iii) conduct practice store assessments; and (iv) further refine the TxNEA-S tool according to rater feedback.

The raters were twenty-one senior undergraduate nutrition majors from the University of Texas at Austin. Rater training consisted of four 1 h classroom instruction sessions which included PowerPoint presentations, item-by-item discussions of tool content, and instructions regarding observation and data collection procedures. Classroom instructions were followed by 3 h of practice store assessments at randomly selected stores. After each training session, rater feedback was gathered to identify data collection experiences and recommendations for improvement. Training and fieldwork protocols were guided by the NEMS-S manual\(^{(55)}\).

Initial evaluations revealed that the original draft of the TxNEA-S tool was excessively lengthy and required an unfeasible amount of time to complete; therefore, the tool was revised and redesigned accordingly. For example, the measure to record item shelf-space was removed from the tool as raters found the task to be time-consuming and difficult to assess accurately. To reduce evaluation time, items of least importance were identified and removed, and the tool was formatted to require less writing. The tool was continually revised until raters believed that it was manageable and ready for pilot evaluation. Approximately ten revisions were made, which reduced the original 19-page tool to 12 pages, and decreased evaluation time from initially over 180 min to an average of 73 min for grocery stores and 19 min for convenience stores. This phase of the project lasted one academic semester.

**Phase II: pilot evaluation of the TxNEA-S tool**

The purpose of Phase II of the study was to pilot test the TxNEA-S tool for inter-rater and test–retest reliability, using the same raters from Phase I. The collected data would also be used for comparing the availability of healthy foods in grocery and convenience stores between low- and high-income neighbourhoods.

A subsample of the total sample size (see Table 1) was used for reliability testing due to limited resources. Grocery stores were prioritized in the selection of samples for reliability testing, considering that: (i) the same survey was used regardless of store type; and (ii) grocery stores have substantially more food options. Inter-rater reliability...
assessment was calculated using all thirteen grocery stores and six randomly selected convenience stores. Test–retest reliability was computed using a convenience sample of ten grocery stores. These subsamples satisfy the recommendation that subsample size for reliability testing be at least 10–20% of the total sample size(56).

To evaluate inter-rater reliability, two data collectors were randomly assigned to each store with instructions to simultaneously complete the TxNEA-S tool. To ensure independence between the two raters, they were instructed to begin assessments from opposite ends of the tool (one rater started on the first page of the tool, while the other started on the last page). Item-by-item agreement between the two raters was compared, and percentage agreement – the frequency of correctly matched responses divided by the total number of observations(57) was calculated using Microsoft® Office Excel 2007 (Microsoft Corp., Redmond, WA, USA). To examine test–retest reliability, one of the two raters was randomly selected and directed to re-evaluate the same store within four weeks of the initial observation date. Item-by-item agreement between initial and follow-up observations was compared, and percentage agreement was calculated using the Excel software.

Finally, a 2 × 2 ANOVA was used to examine mean comparisons of the availability of healthy foods between store types (grocery and convenience stores) and neighbourhood incomes (low and high), using the SPSS statistical software package version 16 (SPSS Inc., Chicago, IL, USA). Data from the total sample size (see Table 1) were used for this analysis, and the availability score was determined by the percentage value (out of the total 106 tool items) observed as present in the store during data collection.

Results

The cross-tabulation of all grocery and convenience stores within the neighbourhood samples revealed that the low-income neighbourhood had over three times as many convenience stores and less than half as many grocery stores, as compared with the high-income neighbourhood (see Table 1). According to Fisher’s Exact Probability Test, there was a statistically significant association between the frequency of store type and neighbourhood income ($P = 0.002$, two-tailed).

Table 2 shows the inter-rater and test–retest reliability results. Rates of inter-rater agreement on the availability measure ranged from moderate (79%) to very high (100%), with a mean of 95 (SD 6)% Test–retest reliability scores on availability yielded similarly strong findings, ranging from 80% to 100%, with a mean of 92 (SD 6)%.

Figure 2 shows a histogram of the mean comparisons of the availability of healthy foods between store type and neighbourhood income. It illustrates that neighbourhood income has a positive relationship with the availability of healthy foods in grocery stores; however, neighbourhood income appears to have no association with the availability of healthy foods in convenience stores. The 2 × 2 ANOVA of store type (grocery and convenience stores) and neighbourhood income (low- and high-income) on availability of healthy foods found a significant relationship with store type ($F(1,34) = 269.66$, $P < 0.001$, $\eta_p^2 = 0.888$) and a significant relationship with neighbourhood income ($F(1,34) = 5.39$, $P = 0.026$, $\eta_p^2 = 0.157$). A statistically

**Table 2 Inter-rater and test–retest reliability scores for the TxNEA-S tool, central Austin, Texas**

<table>
<thead>
<tr>
<th>Store type</th>
<th>Inter-rater</th>
<th>Test–retest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grocery*</td>
<td>0.95</td>
<td>0.97</td>
</tr>
<tr>
<td>Grocery*</td>
<td>1.00</td>
<td>0.88</td>
</tr>
<tr>
<td>Grocery*</td>
<td>0.93</td>
<td>0.99</td>
</tr>
<tr>
<td>Grocery*</td>
<td>0.90</td>
<td>0.91</td>
</tr>
<tr>
<td>Grocery†</td>
<td>0.88</td>
<td>0.92</td>
</tr>
<tr>
<td>Grocery†</td>
<td>0.86</td>
<td>0.92</td>
</tr>
<tr>
<td>Grocery†</td>
<td>0.79</td>
<td>0.88</td>
</tr>
<tr>
<td>Grocery†</td>
<td>0.88</td>
<td>0.91</td>
</tr>
<tr>
<td>Grocery†</td>
<td>0.99</td>
<td>0.80</td>
</tr>
<tr>
<td>Grocery†</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Convenience*</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Convenience*</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>Convenience*</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Convenience†</td>
<td>0.95</td>
<td></td>
</tr>
<tr>
<td>Convenience†</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>Convenience†</td>
<td>0.99</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.95</td>
<td>0.92</td>
</tr>
<tr>
<td>SD</td>
<td>0.06</td>
<td>0.06</td>
</tr>
</tbody>
</table>

**Fig. 2 Comparison of means and standard deviations of the availability of healthy foods between store type and neighbourhood income ($\square$, low-income neighbourhood; $\blacksquare$, high-income neighbourhood), central Austin, Texas. Note: % Availability of healthy foods score = (no. of healthy foods observed/106 total items) × 100**
significant interaction was also found for store type and
neighbourhood income ($F(1,34) = 5.26, P = 0.028, \eta^2_p = 0.134$).

A limitation to this analysis was that the assumptions of
homogeneity and normality were not satisfied due to one
unusual case: a small grocery store from the low-income
neighbourhood. Out of the four observed grocery stores
from the low-income neighbourhood, three were large
chain grocery stores but one was a smaller local grocery
store. Based on Glanz et al.\(^{(42)}\), small grocery stores have
one or two cash registers, while large grocery stores have
three or more. The small local grocery store had sub-
stantially less availability of healthy foods as compared with
the three larger stores, which pulled and skewed the group
mean. This store was not removed in the analysis because it:
(i) matched the operational definition of a grocery store; (ii)
was not considered an outlier as it falls within three standard
deviations; and (iii) was expected to appear in the sample
since small local grocery stores are known to exist, parti-
cularly in low-income neighbourhoods.

When this unusual case was removed from the data set,
all statistical test assumptions were satisfied but the $2 \times 2$
ANOVA produced somewhat dissimilar results. As expected,
a significant relationship was found with store type
($F(1,33) = 1525.70, P < 0.001, \eta^2_p = 0.979$). However, the
relationship with neighbourhood income was found to be
statistically non-significant ($F(1,33) = 0.218, P = 0.643,$
$\eta^2_p = 0.007$) and the interaction for store type and
neighbourhood income was also found to be statistically
non-significant ($F(1,33) = 0.166, P = 0.686, \eta^2_p = 0.005$).
Therefore, the prior reported statistically significant find-
ings should be interpreted with this limitation in mind.

**Discussion**

Research suggests that nutrition environments – grocery
and convenience stores, and the food products therein –
influence individual dietary consumption, weight status
and subsequent health outcomes\(^{(11,17–22)}\). A number of
nutrition environment instruments have been developed
to observe the availability of healthy foods in retail
stores\(^{(35,36,38,41–49)}\), but these measures lack a compre-
prehensive scope and the sensitivity required to effectively
assess food choices from specific subgroups of the US
population, such as Texas consumers whose dietary
preferences are strongly influenced by Latino and His-
panic cultures. Therefore, the NPAOP collaborated with
the researchers to develop the TxNEA-S tool, which was
designed to effectively examine the availability of healthy
foods in grocery and convenience stores in Texas.

In comparison to other instruments that produced low
to good reliability scores\(^{(36,41–45)}\) or were not tested for
reliability\(^{(35,38,46–49)}\), the TxNEA-S tool obtained moderate
to very high inter-rater and test–retest reliability scores.
The high inter-rater reliability scores indicate that the
availability measure has a sound design and that the rater
training protocol adequately prepares data collectors for
accurate store assessments. The high test–retest reliability
scores suggest limited change in the availability of the
observed healthy foods over a period of several weeks;
however, this finding may be inapplicable to convenience
stores as test–retest reliability was examined only in
grocery stores.

Neighbourhood income has a significant positive relation-
ship with the availability of healthy foods in grocery
stores, as data indicated that grocery stores from high-
ineighbourhoods have greater availability of healthy
foods than grocery stores from low-income neighbour-
hoods. However, neighbourhood income appears to have
no relationship with the availability of healthy foods in
convenience stores. This interaction between neighbour-
hood income and the availability of healthy foods from
grocery and convenience stores did not support the pro-
posed hypothesis that neighbourhood income would
instead have a direct relationship with store type and the
available healthy foods therein, as found by previous
research\(^{(42)}\). As shown in Fig. 2: (i) there is no difference in
the availability of healthy foods between convenience stores
regardless of neighbourhood income; (ii) grocery stores
from low-income neighbourhoods offer greater availability
of healthy foods than convenience stores from both low-
and high-income neighbourhoods; and (iii) grocery stores
from high-income neighbourhoods have greater availability
of healthy foods as compared with grocery stores from
low-income neighbourhoods as well as convenience stores
from both low- and high-income neighbourhoods.

Although these findings are challenging to interpret
because of the possible violations of the statistical
assumptions of homogeneity and normality due to the
influence of the unusual case (small local grocery store in
the low-income neighbourhood) which nullified some of
the initial significant findings, it is important to consider
that this may be the reality of nutrition environments
within low-income neighbourhoods. With increased
sample size, investigators may find – and have found\(^{(42)}\) –
higher frequencies of small grocery stores. It is recom-
manded that the sample size in each cell has at least ten
stores, as not only does this allow for conducting stronger
comparisons, it also maintains the robustness of the
ANOVA test even under situations when violations of
assumptions are experienced.

The cross-tabulation of the actual store frequencies
within the neighbourhood samples revealed a large dis-
parity in the convenience and grocery store ratios
between low- and high-income neighbourhoods (see
Table 1). The data show that the low-income neigh-
bourhood had 227% more stores than the high-income
neighbourhood. The low-income neighbourhood had
324% more convenience stores and 56% fewer grocery
stores, as compared with the high-income neighbour-
hood. These findings support previous research in that
Conclusions

The purpose of the current pilot study was to develop the TxNEA-S observational tool which measured the availability of healthy foods from grocery and convenience stores located in the State of Texas. With respect to the Texas native food culture, the TxNEA-S tool includes 106 healthy food items from categories recommended by the Dietary Guidelines for Americans, such as fruits, vegetables, dairy, proteins and grains. The tool has sound and reliable measures as indicated by high inter-rater and test-retest reliability scores, and the face validity of the tool was affirmed by the Texas Department of State Health Services.

References


14. Koplan JP, Liverman CT, Kraak VI et al.


12. Reardon S, Taylor E, Kuo E et al.

11. Texas nutrition environment assessment


Appendix

**List of healthy food items observed by the TxNEA-S tool**

<table>
<thead>
<tr>
<th>Fruits</th>
<th>Vegetables</th>
<th>Dairy</th>
<th>Proteins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh apples</td>
<td>Fresh tomatoes</td>
<td>Skimmed milk quart</td>
<td>Canned black beans</td>
</tr>
<tr>
<td>Fresh oranges</td>
<td>Fresh cucumbers</td>
<td>Skimmed milk half</td>
<td>Canned black-eyed peas</td>
</tr>
<tr>
<td>Fresh bananas</td>
<td>Fresh carrots</td>
<td>1 % milk quart</td>
<td>Canned chickpeas/garbanzo</td>
</tr>
<tr>
<td>Fresh cantaloupe</td>
<td>Fresh broccoli</td>
<td>1 % milk half</td>
<td>Canned kidney/red beans</td>
</tr>
<tr>
<td>Fresh grapes</td>
<td>Fresh lettuce</td>
<td>1 % milk gallon</td>
<td>Canned navy/white beans</td>
</tr>
<tr>
<td>Fresh honeydew melons</td>
<td>Fresh corn</td>
<td>Lactose-free quart</td>
<td>Canned baked beans</td>
</tr>
<tr>
<td>Fresh peaches</td>
<td>Fresh celery</td>
<td>Lactose-free half</td>
<td>Canned lima beans</td>
</tr>
<tr>
<td>Fresh pears</td>
<td>Fresh cabbage</td>
<td>Soya milk quart</td>
<td>Canned pinto beans</td>
</tr>
<tr>
<td>Fresh strawberries</td>
<td>Fresh cauliflower</td>
<td>Soya milk half</td>
<td>Canned refried pinto beans (fat-free)</td>
</tr>
<tr>
<td>Fresh watermelons</td>
<td>Fresh avocados</td>
<td>Soya milk gallon</td>
<td>Canned refried black beans (fat-free)</td>
</tr>
<tr>
<td>Fresh grapefruits</td>
<td>Fresh greens</td>
<td>Light flavoured yoghurt 6–8 oz</td>
<td></td>
</tr>
<tr>
<td>Fresh mangoes</td>
<td>Fresh onion</td>
<td>Light flavoured yoghurt 32 oz</td>
<td></td>
</tr>
<tr>
<td>Fresh papayas</td>
<td>Fresh squash</td>
<td>Light plain yoghurt 6–8 oz</td>
<td></td>
</tr>
<tr>
<td>Ready-to-eat cut-up fruits</td>
<td>Fresh courgette</td>
<td>Light plain yoghurt 32 oz</td>
<td></td>
</tr>
<tr>
<td>Canned light pears</td>
<td>Ready-to-eat lettuce</td>
<td>Light cottage cheese 16 oz</td>
<td>Wholegrain bread</td>
</tr>
<tr>
<td>Canned light mandarins</td>
<td>Ready-to-eat baby carrots</td>
<td>Light cottage cheese 24 oz</td>
<td>Wholegrain bagels</td>
</tr>
<tr>
<td>Canned light mixed fruits</td>
<td>Ready-to-eat cut-up vegetables</td>
<td>Fat-free American cheese</td>
<td>Wholegrain English muffin</td>
</tr>
<tr>
<td>Canned light peaches</td>
<td>Canned corn</td>
<td>Mozzarella</td>
<td>Wholegrain tortillas</td>
</tr>
<tr>
<td>Canned light pineapples</td>
<td>Canned green beans</td>
<td>Fat-free Cheddar cheese</td>
<td>Non-fat flour tortillas</td>
</tr>
<tr>
<td>Frozen strawberries</td>
<td>Canned tomatoes</td>
<td>Low-fat Mexican cheese</td>
<td>Wholegrain hamburger buns</td>
</tr>
<tr>
<td>Frozen peaches</td>
<td>Canned peas</td>
<td></td>
<td>Wholegrain hotdog buns</td>
</tr>
<tr>
<td>Frozen blueberries</td>
<td>Canned mixed vegetables</td>
<td></td>
<td>Wholegrain dinner rolls</td>
</tr>
<tr>
<td>Frozen mangoes</td>
<td>Frozen corn</td>
<td></td>
<td>Plain toasted oats</td>
</tr>
<tr>
<td>Frozen mixed berries</td>
<td>Frozen carrots</td>
<td></td>
<td>Bran flakes with raisins</td>
</tr>
<tr>
<td>Mixed fruits</td>
<td>Frozen broccoli</td>
<td></td>
<td>Plain bran flakes</td>
</tr>
<tr>
<td></td>
<td>Frozen green beans</td>
<td></td>
<td>Grape nuts</td>
</tr>
<tr>
<td></td>
<td>Frozen spinach</td>
<td></td>
<td>Plain shredded wheat</td>
</tr>
<tr>
<td></td>
<td>Frozen peas</td>
<td></td>
<td>Whole-wheat pasta</td>
</tr>
<tr>
<td></td>
<td>Frozen mixed vegetables</td>
<td></td>
<td>Brown rice</td>
</tr>
<tr>
<td></td>
<td>Bulk whole-wheat flour</td>
<td></td>
<td>Whole-wheat flour</td>
</tr>
<tr>
<td></td>
<td>Bulk whole-wheat pasta</td>
<td></td>
<td>Bulk brown rice</td>
</tr>
<tr>
<td></td>
<td>Bulk whole-wheat flour</td>
<td></td>
<td>Bulk whole-wheat flour</td>
</tr>
<tr>
<td></td>
<td>Rolled oats</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TxNEA-S, Texas Nutrition Environment Assessment of Retail Food Stores.