

Research Article



Social and Health Risk Factor Levels of Preschool Children Living Along the Texas-Mexico Border

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- ABSTRACT -

BACKGROUND: Childhood obesity is a public health concern that disproportionately affects populations from low socioeconomic status (SES) and minority groups. Evaluation of social and health risk factors of preschool children living along the Texas-Mexico border provides feedback to design health interventions.

METHODS: South Texas Early Prevention Study-PreK (STEPS-PreK) is a cluster randomized trial designed to assess the effect of the Bienestar coordinated school health program on children's health outcomes. Family characteristics, dietary intake, fitness, and anthropometric data were collected from 1277 preschool students enrolled in 28 preschools.

RESULTS: The response rate was 67%. Overall, 57% of families lived in poverty. The mean age of students was 4.7 years, 95% were Hispanic, and 51% were male. The average serving of fruits and vegetables per day were 1 and 1/3, respectively. Of these, students consumed 39.7% of fruits and 18.9% of vegetables. Obesity prevalence for boys was 19.2% and for girls 16.8%. Nearly one-half reported some form of food insecurity.

CONCLUSIONS: Children living in low-income areas are affected by high levels of social and health risk factors. It is these families who should be targeted with early-age and culturally appropriate health programs.

Keywords: preschool; obesity; Hispanic health; poverty; food insecurity; Texas-Mexico border.

Citation: Treviño-Peña R, Wang X, Wang L, Romero Z, Alanis E, Li H. Social and health risk factor levels of preschool children living along the Texas-Mexico border. J Sch Health. 2021; 91: 87-93. DOI: 10.1111/josh.12979

Received on July 15, 2020 Accepted on October 23, 2020

Hidalgo County is in south Texas, located along the Texas-Mexico border. Compared to the state, Hidalgo County has higher rates of people living in poverty (17.5% vs 34%), uninsured (24.8% vs 38.2%), and unemployed (6.2% vs 10.3%).¹ These social and economic factors are a milieu for unhealthy outcomes.^{2,3}

Childhood obesity is a public health concern that disproportionately affects populations from low

socioeconomic status (SES) and minority groups.^{4,5} The prevalence of obesity is high among all children, but Hispanic children experience a disproportionate higher risk. In the 2013-2014 National Health and Nutrition Examination Survey (NHANES), the prevalence of obesity among Hispanic and all other US children of age 2 to 5 years were 15.6% and 8.9%, respectively.⁶ Childhood obesity carries a heavy burden. Children who are obese in their preschool

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This publication was supported by Award No. 6 CPIMP171151-03-01 from the Office of the Assistant Secretary for Health (OASH). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of OASH. We are also grateful to the Cigna Foundation for their support to implement the Bienestar *Eat to Live* Child Nutrition/School Food Service and Bienestar *MyFamily/MiFamilia* parent programs to relieve food insecurity.

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years are more likely to become obese in adulthood.⁷ Furthermore, children who are obese increase the likelihood of developing diabetes, hypertension, hyperlipidemia, asthma, sleep apnea, and other chronic diseases as adults.⁸

Food insecurity, like childhood obesity, is common among low SES and minority populations.⁹ Food insecurity means that at times during the year, household access to adequate food is limited due to lack of income. This condition puts children at risk for academic, emotional, and medical disabilities,^{10,11} and it is costly.¹² The relationship between food insecurity and childhood obesity, however, is inconclusive.

In this study, baseline data of the South Texas Early Prevention Study-PreK (STEPS-PreK) is presented. STEPS-PreK is a matched-pair cluster randomized trial designed to assess the effect of the Bienestar Coordinated School Health Program on preschool children's health outcomes. The baseline data presented consist of social, economic, and health measures of preschool children and their families living along the Texas-Mexico border.

METHODS

Participants

STEPS-PreK collected baseline data from preschool children in the fall of 2018 from 2 participating school districts in Hidalgo County. School demographics were similar, 99% Hispanic, 92% economically-disadvantaged, and 42% identified as English as a second language learners. Among the 2 school districts, there are 48 elementary schools (ES) with preschools. Based on a power analysis conducted for the cluster randomized trial, 28 ES were selected to participate. The preschool student enrollment in these 28 ES in 2018 to 2019 school year was 1907. For this report, only the cross-sectional data collected at baseline is presented.

Procedures

Household characteristics. Family Demographic and Household Health Characteristics questionnaires were sent to parents through 4 modes: online, faceto-face, school parent liaisons, and students. The questionnaires, English and Spanish, collected information on age, gender, race/ethnicity, educational attainment, household income, persons living per household, and family (1st and 2nd degree) history of hypertension and diabetes. The food insecurity item was obtained from the US Department of Agriculture (USDA), Expanded Food and Nutrition Education Program.¹³ This item asked the parent/guardian, "How often do you run out of food before the end of the month?" The response options were, "never, seldom, sometimes, most of the time, and almost always." *Dietary intake*. Student's dietary, fitness, and anthropometric measures were collected at the schools. Instead of total dietary intake, consumption of only 3 macronutrient groups was collected: fruits, vegetables, and whole grains. The 2015 to 2020 Dietary Guidelines for Americans acknowledge that findings and recommendations that have remained consistent over the last 38 years are: (1) the US diet is low in vegetables, fruits, and whole grains, and (2) eating more fruits, vegetables, and whole grains improves nutrition value.^{14,15}

Garcia-Dominic et al. reported the limitations of existing instruments to collect dietary intake in children.^{16,17} To counter these limitations, methods used in this study included direct observation of meals served at school (breakfast and lunch), complemented with photographs of meals before and after they were consumed. The direct observation method used in the present study is modeled after the validated Dietary Observation for Child Care system.^{18,19} School cafeteria production records, which included menus, recipes, and nutritional labels, were collected a week before data collection to verify the matching of actual food items served. Nutrition information was entered into the Nutrition Data System for Research software (NDSR; Version 4.04, 2019, University of Minnesota Nutrition Coordinating Center, Minneapolis) for analysis.

Specifically, the Visual Food Monitoring Form (VFMF) was used to record the amount of food served and consumed. Food consumed was measured in mean serving size and percent consumed of that served.¹⁸ VFMF has 3 subsections that collected data on: (1) amount served, (2) amount consumed, and (3) meal descriptions and comments. The dietary collection protocol included the following: (1) label the student's food trays as children were getting them and follow them to their sitting area, (2) photograph/record the amount of food served; and (3) photograph/record the amount consumed. The recording was in accordance with consumption measures as indicated on the VFMF form: all eaten, 3/4-eaten, 1/2-eaten, 1/4-eaten, or none eaten. The recorded measures were then entered into the NDSR nutrition software.

To complement the direct meal observation, photographs of meals were taken before and after consumption. Taking into consideration the large number of food observations to conduct within school's meals allotted mealtime, photographs added to the quality of dietary data collected through direct observation using VFMF. Selected macronutrients (fruits, vegetables, and whole grains) were collected for 3 consecutive school days during breakfast and lunch. Missing meals due to students' tardiness or absence were replaced by meal observations on separate makeup days.

PACER (Fitness) test. Fitness was measured using the Progressive Aerobic Cardiovascular Endurance Run (PACER) test.²⁰ This standardized fitness test is designed for students K-12. The PACER test is a multistage shuttle run designed to measure aerobic capacity. The objective of the PACER is to run as many laps as possible while keeping a specified pace. Children run back and forth across a 20-m space at a pace that gets faster each minute (there is also a 15-m PACER). For this preschool population, a modified 15-m PACER was utilized.²¹ A participant runs continuously until the pace can no longer be sustained for 2 successive laps. Once the participant discontinues the fitness test, the number of laps was recorded on the pre-printed PACER test scores sheet. The test was administered to 8-10 children at a time, depending upon space and data collector's availability. Children practiced 2 runs a day prior to the test. Physical education teachers are trained and experienced with the PACER test because the state of Texas mandates schools to report annual performance.

Anthropometric. For weight (wt.), a participating child was asked to remove excess clothing (sweatshirts, jackets) and shoes. When utilizing the scale (Tanita Corp. of America, Inc., Arlington Heights, IL), the child's feet were centered and next to one another. When the readout was stable, the wt. was recorded to the nearest 0.1 kg. For height (ht.), the child stepped onto the stadiometer (Detecto Corp., Webb City, MO) standing erect with the mid-axillary line perpendicular to the floor, wt. distributed evenly on both feet, and scapula and buttocks in contact with the vertical board. The headboard was placed firmly on top of the head with enough pressure to compress the hair to the scalp. Ht. was recorded to the nearest 0.1 cm.

Data Analysis

In this study, descriptive statistics were mainly used and where appropriate, mean with standard deviations and numbers with percentages were reported. If values for individual variables were missing, sample sizes, and percent were specified. Living in poverty status was calculated using self-reported household income and the 2019 US Census Bureau's poverty thresholds adjusted for household sizes.²² Height and weight were converted to BMI by dividing weight in kilograms with square of height in meters (kg/m²). The CDC's SAS program²³ was used to calculate the BMI *z*-scores and percentiles based on students' age and gender.

The 3-day collection of selected macronutrients were averaged individually and then aggregated to calculate study means and standard deviations of serving size intake. If a meal was missing, we averaged it by the true number of observations. The total amount served on the tray and the total amount consumed from that serving were calculated. Then the consumed over-served percent was computed for each student.

Table 1. Characteristics of Students and Caretakers Participating in the South Texas Early Prevention Study-PreK (STEPS-PreK)

Characteristic	Value
Students	
Response rate, N (%)	1277 (67.0)
Male, N (%)	645 (50.5)
Age in years, mean (SD)	4.7 (0.3)
Families	
Response rate, N (%)	924 (72.4)
Mother, N (%)	853 (93.3)
Father, N (%)	48 (5.3)
Other, N (%)	13 (1.4)
Hispanic, N (%)	838 (94.6)
Age in years, mean (SD)	32 (6.6)
Mother's education, N (%)	
< High school	248 (27.8%)
High school	218 (24.4%)
Some college/technical school	210 (23.5%)
College degree	217 (24.3%)
Father's education, N (%)	
< High school	272 (30.9%)
High school	299 (33.9%)
Some college/technical school	199 (22.6%)
College degree	111 (12.6%)
Annual household income, N (%)	
Under \$20,000	418 (48.0)
\$20,000 to \$34,999	133 (15.3)
\$35,000 to \$49,999	88 (10.1)
\$50,000 to \$74,999	98 (11.3)
\$75,000 to \$99,999	69 (7.9)
\$100,000 or more	65 (7.5)
Persons per household, mean (SD)	5 (1.5)
Living in poverty, N (%) [†]	483 (57.4)
You run out of food before the end of the month? Sometimes,	444 (48.8%)
most of the time & always, N (%)	
Family medical history (1st & 2nd degree families) N (%)	
Family history of hypertension	455 (51.2)
Family history of diabetes	459 (51.3)

Abbreviation: SD, standard deviation

[†]Based on 2019 US Census Bureau's poverty thresholds.

It is important to note that starchy food items such as mashed potato and French fries were not recorded as vegetables; fruit candies brought from home were not included as fruits; pickled cucumber was counted as vegetables, and lemon slices was recorded as fruits. Data were analyzed using R version 3.6.2 (R Core Team, 2019).

RESULTS

Of the total preschool students enrolled in the 28 participating ES, 1277 (67%) parent/guardians provided consent to participate in the study (*Table* 1). The mean age of the consented students was 4.7 years, 95% were Hispanic, and 51% were male. Of the 1277 consented students, 924 (72%) parent/guardians completed and returned the questionnaires; most were completed by mothers (93%). Overall, 52% of mothers and 65% of fathers who responded had a high school

Figure 1. Direct Observation of Students' Fruit and Vegetable Servings and Percent Consumed during School Breakfast and Lunch (3-day Average). Error Bars are for Standard Deviations



or less level of education, and 57% were living in poverty. Near half of parents/guardians reported that either sometimes, most of the time or always they ran out of food before the month was over. Over half of students had a first- or second-degree family history of hypertension and diabetes.

The average serving of fruits and vegetables per day were 1 and 1/3, respectively (*Figure* 1). Of the amount of fruits and vegetables served, students consumed, respectively, .32 and .06 portions of that serving size. The portions consumed made up 39.7% and 18.9% of total fruits and vegetables served, respectively.

The obesity prevalence for boys and girls was 19.2% and 16.8%, respectively (*Table 2*). The height and weight percentiles of children showed that they were shorter than 52% and heavier than 57% of US children their age. The number of laps finished in the fitness test was 15 for boys and 12 for girls.

DISCUSSION

Preschool children and families living along the Texas-Mexico border showed high levels of social and health risk factors. The families, mostly Hispanic, had low educational attainment, and more than half were living in poverty. Near one in 2 parents reported that, always, most of the time, or sometimes they did not have enough food to eat before the end of the month. And one in 2 reported a family history of hypertension and diabetes. Between both breakfast and lunch meals, children consumed on average less than half a serving of fruits and vegetables combined. These children had

Table 2. Physical Measures - Anthropometric and Pacer Fitness Test

Measure	Mean (SD)	Percentile [†] Mean (SD)
Overall		
Height (cm)	105.8 (5.0)	48.2 (28.3)
Weight (kg)	18.8 (3.9)	57.3 (29.7)
Body mass index (kg/m ²)	16.7 (2.3)	67.0 (28.1)
Obesity prevalence (≥95th percentile), N (%)	205 (18.0)	
PACER fitness test (laps),	13.3 (7.9)	
Girls		
Height (cm)	105.2 (5.1)	47.9 (27.8)
Weight (kg)	18.6 (4.1)	56.2 (29.6)
Body mass index (kg/m ²)	16.6 (2.5)	67.2 (27.2)
Obesity prevalence (≥ 95th percentile), N (%)	94 (16.8)	
PACER fitness test (laps)	11.9 (6.8)	
Boys		
Height (cm)	106.4 (4.9)	48.5 (28.8)
Weight (kg)	19.1 (3.7)	58.3 (29.8)
Body mass index (kg/m ²)	16.7 (2.2)	66.8 (28.8)
Obesity prevalence (≥ 95th percentile), N (%)	111 (19.2)	
PACER fitness test (lap)	14.6 (8.6)	

Abbreviation: SD, standard deviation.

[†]Centers for Disease Control and Prevention (2000; http://www.cdc.gov/ growthcharts/charts.htm) growth chart percentile (gender and age adjusted).

higher obesity prevalence than US children their age (18.0% vs 11.6%).²⁴

The number of laps finished in the PACER test were used in this study to assess fitness levels. Standards of what is considered healthy, or healthy fitness zone (HFZ), were developed for the PACER test. The HFZ represents minimal levels of fitness consistent with adequate health and reduced risk of disease.²⁰ Unfortunately, there are no HFZ for children younger than 10 years. The purpose of using the PACER test was to compare fitness levels between treatment groups using an objective measure.

Low SES and minority populations have higher risk factors for obesity than their counterparts. Data from the 2011 to 2014 NHANES showed that youth aged 2-19 years in the low- and middle-income groups had nearly twice as high obesity prevalence than youth in the high-income group (18.9%, 19.9%, and 10.9%, respectively).⁴ This same study also showed that the prevalence of obesity by \leq high school, some college, and \geq college degree was 21.6%, 18.3%, and 9.6%, respectively. Others have also found the higher prevalence of obesity among lower (vs higher) SES children populations.²⁵ Not only is obesity prevalence higher in low SES populations it is also higher in minority populations. The 2013 to 2016 NHANES showed that the obesity and severe obesity prevalence was significantly higher among Hispanic and non-Hispanic black than non-Hispanic white youth.²⁴

Nutritional findings were of concern. The USDA's nutrition standards for the National School Lunch and School Breakfast Programs recommends that children be served with 1 to 1/2 servings of fruits and 3/4 servings of vegetables over the 2 meals eaten at school in a day.²⁶ On average, children in the STEPS-PreK study were served with near one serving of fruits and 1/3 servings of vegetables for breakfast and lunch. Of these servings, children consumed 40% of the fruits and 20% of the vegetables. Another study with preschool Hispanic children the same age reported similar food intakes collected during school breakfast and lunch meals.¹⁸

Possible explanations for low servings and consumption of selected macronutrients are several. First, for this study, some macronutrients the schools considered fruits and vegetables were not included. Second, school's meal schedules are less than 20 minutes not giving children enough time to eat. Third, even when schools serve fresh fruits and vegetables, children throw most in the trash.

A study conducted in 6 elementary and middle schools with near 1000 students showed that children who had less than 20 minutes to eat consumed significantly less fruits and vegetables than those who had at least 25 minutes.²⁷ The third explanation given can be found in the trashcan. The lead author measured the kilograms of fruits and vegetables that 719 elementary school children threw in the trash during one lunch period. [unpublished data] Of 115.42 kg of fruits and vegetables the school cafeteria staff prepared, 77.48 kg (67%) were trashed and 37.96 (33%) were consumed. The schools do serve fruits and vegetables, but children throw most of them in the trash. It might be that these eating behaviors are learned at home at an earlier age.

The other concern was the high levels of selfreported food insecurity. Notably, these data were collected before COVID-19. We suspect this nutritional deficiency to have exacerbated during the pandemic.²⁸ Food insecurity has consistently been associated with adiposity markers in women;²⁹ and with medical, emotional, and learning disabilities in children.²⁹ However, results showing the relationship between food insecurity and adiposity markers in children have been mixed. Some studies have not shown a relationship³⁰ while others have.³¹ The reason for so much variability might be explained by the differences in study subjects, instruments used and research design. Some studies included only children from low income households³² and others included children from the general population.³⁰ Number of items in the instruments used ranged from 1 to 18 items.^{29,31} The research design were either cross-sectional or longitudinal. Three longitudinal studies, however, did show the impact of food insecurity on adiposity level of preschool children.^{31,33,34}

Limitations

Strength of the STEPS-PreK study was the large cohort of Hispanic preschool children living in a defined high-risk geographic area. It is these children who are more likely to develop chronic disease as they become adults, and it is these children who need early-age health screenings and evidencebased interventions. The present study had 3 notable limitations: it was cross-sectional, it was aimed only at a special population, and it used one-item question to measure food insecurity. With the cross-sectional method, causal inferences cannot be made solely with baseline data. Because STEPS-PreK study was aimed at high risk Hispanic children, findings in this study might not be generalized to other US children. Lastly, a oneitem questionnaire might not capture the essence of food insecurity. Two conditions consistently associated with food insecurity are low income and diabetes.³⁵⁻³⁷ In the STEPS-PreK study, these 2 conditions showed to be significantly higher in households with food insecurity (as measured with the one-item question) than in those without (data not shown).

Conclusions

Findings from the STEPS-PreK data clearly indicate the need to implement and evaluate early-age, culturally appropriate, health programs aimed at high risk families living along the Texas-Mexico border. A coordinated health program involving several components that delivers strong health messaging across home, school food service, health class, and PE environments might be more effective than targeting one environment alone. Instruments to evaluate health programs are just as important as the intervention itself. Because of the costly and harmful effects of food insecurity, and the high variability of methods to measure it, an instrument to detect this condition among children needs to be developed. The instrument should be simple enough to facilitate the collection in large, low literate, multi-lingual populations, and complex enough to detect risk. Once food insecurity instruments are standardized, longitudinal studies are needed to determine causal relationships between food insecurity and childhood obesity; and determine the role that gender plays in this relationship.

IMPLICATIONS FOR SCHOOL HEALTH

School districts face many challenges resulting from the COVID-19 pandemic. The most immediate concern is whether schools will be open for classes during the 2020 to 2021 school year, and if schools do open, how will classes be structured. A major public health concern that will be exacerbated by the pandemic and school closures is food insecurity. Among children, food insecurity has been associated with medical, behavioral, academic, and emotional problems.³⁸ The pandemic will directly affect food insecurity because of the high unemployment and low household income and indirectly because of school closures. Schools might be the only source of nutritious foods for many children.

In the STEPS-PreK study, near half of the participants self-reported that sometimes, most of the times, or always would run out of food before the end of the month. A parent should never have to worry, even if sometimes, about not having access to nutritious food for their children. Because some studies have shown a relationship between food insecurity and obesity, a solution to control childhood obesity might be methods to detect and treat food insecurity. A simple questionnaire can be sent home to parents to detect food insecurity. And, if the questionnaire screens positive, then a set of recommendations and referrals should be made available to these parents.

School staff do care and intervene if children's health is in jeopardy. When schools closed prematurely during the 2019 to 2020 school year due to COVID-19, the Child Nutrition department of both participating school districts opened their school food services to prepare meals for children. Parents were lining up outside the schools in their cars to pick up the meals. Special emphasis can be given to families with food insecurity. A second intervention is a referral system. Referrals can be made to the USDA's Supplemental Nutrition Assistance Program, the Commodity Supplemental Food Program, and the Food Aid Program. Other sources for referral are the local food banks and community-based organizations. Lastly, is state legislative action. In Texas, Senate Bill 725 allows schools to create food pantries on campus where they can store surplus food from the cafeteria to donate to non-profits. Before, this food was being trashed. Now it can be donated to families who screen positive for food insecurity.

It is imperative that schools, government, and the private sector prioritize strategies to guarantee availability of nutritionally adequate and safe foods to assure the health and well-being of children.

Human Subjects Approval Statement

The University of Texas Rio Grande Valley's Institutional Review Board and the school district board of directors approved the STEPS-PreK protocol.

Conflict of Interest

No competing financial interests exist.

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