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Screen Time Associated to Unhealthy Diets in Low-Income Children

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Abstract The aim of this study was to examine the relationship between screen time (TV viewing and video game playing), dietary intake and overweight/obesity prevalence in low-income, primarily Hispanic young children. Data were obtained via a 2011 phone survey from caregivers of children enrolled in the Women, Infants and Children (WIC) program in Los Angeles, USA. WIC staff measured the child's height and weight in the clinics. The final sample included 2278 low-income children (2-4 y) in the WIC program in Los Angeles County (LAC). Screen time was [significant ($p \leq 0.01$)] inversely related to vegetable intake and positively related to flavored milk, 100% juice, sugar sweetened beverages (SSB), and sweets. The odds of participants eating 1-4+ servings of fast food per week was 9-fold times higher in the children who reported 3+ hrs/day of screen time compared to those who reported <1 hr/day (OR=9.83, 95% CI 4.74 to 20.37; $p<0.001$). Screen time was not associated to obesity and/or overweight prevalence. These findings suggest screen time is associated to unhealthy dietary patterns, particularly increased sugar consumption, in low-income young children and should be taken into consideration for future interventions.

Keywords: *television, food intake, children, low-income population, obesity*

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1. Introduction

Childhood obesity [body mass index (BMI) ≥ 95% by age and gender] [1] is a major health problem in the United States and has tripled over the past three decades [2]. Today, one in three children in America are either overweight or obese. Hispanic communities are at an even higher risk, where nearly 40% of the children are overweight or obese; 16.7% of Hispanic children (2-5 y) are considered obese in the United States.

The growth of technology has risen exponentially, leading to the increase in screen time. Past research has shown that screen time was associated with the risk of obesity. Studies have also shown that reducing TV viewing reduced overweight in children and adolescents. In a longitudinal study by Jago et al., TV viewing was a significant predictor of BMI in children (3-4 y) who were followed for three years [3]. In a cross-sectional study by Dennison et al., TV viewing was positively associated with the risk of being overweight, and a TV in the child's bedroom was an even stronger marker of increased risk for preschoolers (1-5 y) [4].

Few studies have examined the link between screen time and dietary intake in 2-4 year old children. A cross-sectional study by Taveras et al. found that TV and video viewing were correlated with fast food consumption among primarily Caucasian preschool children (2-5.9 y) [5]. Data analyzing screen time with dietary intake and obesity in the same population is limited [6,7,8], and to date, no study has examined this question among low-income Hispanic children (2-4 y) in the United States. Thus, there is a need to examine how TV viewing is linked to dietary intake and obesity, particularly in a high-risk population.

A previous study looked at the link between dietary intake and obesity using the same dataset as our current study [9]. Results found that SSB intake (servings/day) was positively related to obesity prevalence, with children who consumed 2+ SSB servings per day having a 28% increase in obesity prevalence compared to those who consumed no SSB per day. No other dietary variables assessed in this analyses (including 100% juice, plain and flavored milk, fruit, vegetable, sweets or fast food) were linked to overweight or obesity status. However, the relationship of screen time to dietary intake or prevalence of overweight/obesity status was not explored.

Therefore, the overall goal of this study was to examine the relationship of screen time with dietary intake (including fast food, beverage, and fruit and vegetable intake) and overweight/obesity prevalence. We hypothesized that higher screen time would be linked to higher amounts of fast food, SSB intake, and sweets, and decreased fruit and vegetable intake. We also hypothesized that higher levels of screen time would be positively correlated with overweight/obesity prevalence, independent of dietary intake. This analysis will inform potential interventions targeting screen time in young, minority populations.

2. Materials and Methods

2.1. Data Collection

This was a cross-sectional analysis of data obtained from the LAC WIC Program 2011 Child Food and Beverage Intake Questionnaire (CFBIQ), a triennial survey first administered in 2005. The survey was designed to assess health indicators and health-related behaviors, and home and community indicators of support for families with young children. The CFBIQ was updated for the 2008 and 2011 surveys to include additional emerging questions such as screen time, which includes TV viewing and video or computer game playing. Other studies have been published using this questionnaire [9,10,11], but no other study has examined the screen time data. The survey questions were first created in English and then translated to Spanish to maintain consistency in the two versions. The English and Spanish versions of the survey were each piloted with WIC participants to check the clarity of the questions. Validation of the dietary questions in the CFBIQ was tested in a sample of 70 mothers with young children (2-4 y) from WIC against three 24-hour recalls with intra-class correlations (ICC) ranging from 0.04 for vegetables, 0.46 for sweetened drinks, 0.11 for regular sodas and 0.31 for sweets [12]. Field Research Corporation conducted the interviews using computer-assisted telephone interviewing. All study participants were mailed a consent form prior to their phone call and verbal consent was obtained at the beginning of the interview. Each interview averaged 20-25 minutes in length. Mothers were the respondents about their child's behaviors, which included screen time and dietary intake information. Interviewers were trained in interviewing techniques, refusal conversion, and confidentiality procedures. No more than eight attempts were made to reach the eligible participants from each telephone listing dialed. Participants who completed an interview were mailed a $10 gift card. Approval from the Independent Review Consulting Institutional Review Board was obtained for all protocols prior to commencement of the study and a data sharing agreement was signed by parties from the Public Health Foundation Enterprises (PHFE) WIC Program and the Department of Nutritional Sciences from the University of Texas at Austin for approval of secondary analyses.

2.2. Participants

Figure 1 illustrates the flow of participants through the study. The initial sample for the 2011 WIC survey was a random selection from the entire population of participants receiving WIC services in LAC during January 2011. Eligibility for participation in the survey included individuals who were able to complete the English or Spanish version of the survey and reported enrollment or had a child in the household enrolled in the WIC program. If more than one child in the household enrolled in the WIC program, data were collected only regarding the child with the most recent birthday. Further, exclusion criteria are shown in Figure 1. The final sample includes 2278 caregivers with children (2-4 years).

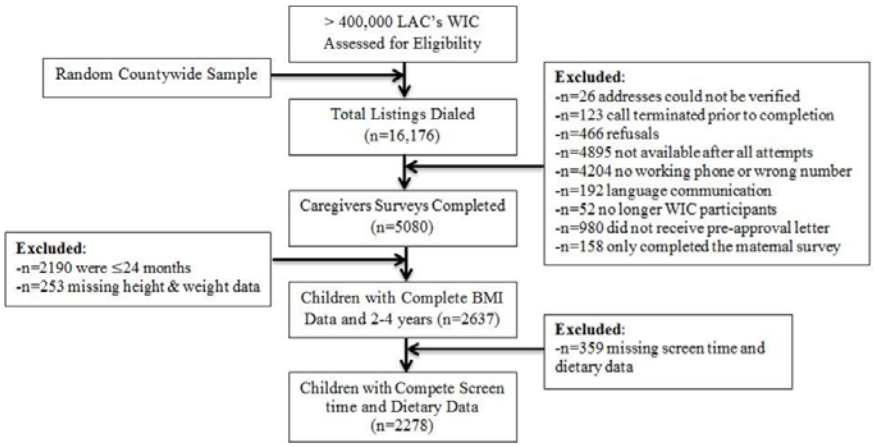

Figure 1. Flow of participants through the study

2.3. Anthropometrics

To overcome the barriers of accurately assessing a child's height and weight in a survey administered by phone, survey records were linked to the child's height and weight measured in the WIC clinics every 6 months, with anthropometric data required for delivery of WIC services. In California, WIC administrative data are stored in an Integrated Statewide Information System (ISIS). Data stored includes heights and weights for all WIC participants, and ISIS generates risk codes for overweight (BMI ≥85%) and obese (BMI ≥95%) children. In this analysis, ISIS risk categories of overweight and obese are used, which are based on the height and weight measurements taken by the WIC staff. A study on the accuracy of height and weight measurements taken by both PHFE WIC staff and research staff on 287 PHFE WIC children (2-5 y) was recently conducted, which found high correlations between WIC and research study measurements for height, weight, and BMI (0.97, 0.99 and 0.92, respectively) [13].

2.4. Survey Variables Used

Although the complete phone survey included 127 questions, this analysis will focus on the survey questions pertaining to TV viewing and video game playing, and dietary intake. Dietary intake variables included consumption of fast foods, a variety of beverages (i.e. milk, flavored milks, sodas, 100% juice, fruit drinks, and other sweetened drinks), fruit and vegetables, and sweets.

The sum of sodas, fruit drinks, and other sweetened drinks servings for each participant was created into the SSB variable. The questions are listed in detail in Table 1.

Table 1. Relevant Survey Questions

On an average day, how many hours does NAME watch television? Only include time when (he) (she) is sitting and watching TV?
On an average day, how many hours does NAME play video or computer games?
How often does NAME currently eat any food including meals and snacks from a fast food restaurant, like McDonald's, Taco Bell, Burger King, KFC, or another similar place?
On an average day, about how many servings of fruits does NAME eat?
On an average day, about how many servings of vegetables does NAME eat?
On an average day, how many times does NAME drink milk?
On an average day, how many times does NAME drink chocolate milk or sweetened milk?
On an average day, how many times does NAME drink 100% fruit juice?
On an average day, how many other fruit juice drinks that are not 100% juice, such as Sunny Delight, Capri Sun, or lemonade does NAME drink? Please count a 12-ounce can, bottle or glass as one drink.
On an average day, about how many sweetened drinks such as Gatorade, Kool Aid, or Red Bull does NAME drink? Please count a 12-ounce can, bottle or glass as one drink.
On an average day, about how many regular sodas such as Coke or Mountain Dew, does NAME drink? Do not include diet sodas or sugar-free drinks. Please count a 12-ounce can, bottle or glass as one drink.
On an average day, how many times does NAME eat sweets or sweetened foods, such as sweetened cereals, fruit bars, pop-tarts, donuts, cookies and candies?

2.5. Statistical Analyses

Data were analyzed using SPSS version 21.0 software. All dietary variables were coded and checked for normality via box plots and histograms, and outliers were removed. Spearman correlations were performed to assess the relationships with screen time and dietary intake, and screen time and overweight and obesity prevalence. ANCOVAs were used to assess the difference in dietary variables (continuous) between screen time categories with Bonferroni adjustments. Multinomial logistic regression with never eating fast food category and 0-<1 hrs/d of screen time as the reference categories was employed to assess the odds of fast food consumption (categorical) between screen time categories. A priori covariates included age (in months), birth weight (in grams), ethnicity, and sex of the child. Given multiple dietary variables were tested, a correction for multiple comparisons (eight dietary variables) was applied for these models, and a p-value of p=0.006 was considered statically significant.

3. Results

The sample characteristics, weight status, and behavioral variables (including screen time and dietary intake) of the final population sample are shown in Table 2. Not all participants completed every dietary variable, therefore, sample sizes varied slightly for each (Table 2). Over 80% of the participants were Hispanic and over one-third of the participants were classified as either overweight or obese. Average child screen time was close to two hours/day.

Table 2. Participant Characteristics for WIC Children (2-4 years)[a]

Category	Variables	Mean	SD	n	Percent
Characteristics	Sex (male)			1193	52.4%
	Age (months)	40.8	9.6		
	Birth Weight (lbs)	7.6	1.0		
Child's Ethnicity	Non-Hispanic White			73	3.2%
	African American			122	5.4%
	Asian Pacific Islander			41	1.8%
	Native American			10	0.4%
	Hispanic			1905	83.6%
	Other			127	5.6%
Weight Status	Overweight or obese			765	33.6%
	Obese			422	18.5%
Behavioral Variables	Screen time (hrs/d)	1.7	1.2		
	TV viewing (hrs/d)	1.6	1.0		
	Video game playing (hrs/d)	0.2	0.4		
	Fast food (1+ serv/wk)			1086	47.7%
	Fruit (serv/d)[b]	3.1	1.3		
	Vegetable (serv/d)[c]	2.2	1.2		
	Milk (serv/d)[d]	2.6	1.3		
	Flavored milk (serv/d)[e]	0.5	0.8		
	100% juice (serv/d)[f]	1.9	1.2		
	SSB (serv/d)[g]	1.2	1.5		
	Sweets (serv/d)[h]	1.0	0.8		

SD, Standard Deviation
[a] Data presented as sample size and percent or mean and SD;
[b] Sample size n=2218; [c] n=2245; [d] n=2274; [e] n=2234; [f] n=2259; [g] n=1965; [h] n=2209

Table 3. TV Viewing, Video Game Playing, and Screen Time Relationships to Dietary Variables and Weight Status of WIC Children (2-4 years)[a]

	TV Viewing	Video Gaming	Screen Time
Dietary Variables			
Fast food (1+ serv/wk)[b]	0.13**	0.07*	0.14**
Fruit (serv/d)[c]	-0.04	-0.02	-0.03
Vegetable (serv/d)[d]	-0.08**	-0.01	-0.08**
Milk (serv/d)[e]	-0.01	-0.01	-0.01
Flavored milk (serv/d)[f]	0.09**	0.07*	0.09**
100% juice (serv/d)[g]	0.12**	0.03	0.11**
SSB (serv/d)[h]	0.15**	0.03	0.15**
Sweets (serv/d)[i]	0.18**	0.07*	0.17**
Weight Variables			
Obese [j]	0.01	-0.005	0.02
Overweight [k]	0.01	-0.001	0.003
Overweight and obese [l]	0.02	0.000	0.02

[a] Spearman correlations were run to assess the relations between screen time, dietary intake and overweight/obese status. Data are presented as r-value.
[b] Sample size n=2278; [c] n=2218; [d] n=2245; [e] n=2274; [f] n=2234; [g] n=2259; [h] n=1965; [i] n=2209; [j] n=422; [k] n=343; [l] n=765.
* p<0.01, ** p<0.001

Spearman correlations are shown in Table 3. TV viewing and screen time was significantly inversely correlated with vegetable intake, and positively related to fast food, flavored milk, 100% juice, SSB, and sweets. Video gaming was significantly positively related to fast food, flavored milk, and sweets. Overweight and obesity status, both separately and combined, were not significantly correlated with TV time, video game time, or total screen time combined.

ANCOVA with Bonferroni adjustment were employed. Vegetable intake (servings/day) decreased significantly with higher levels of screen time (p=0.003) with intake being 9% and 11% lower (p=0.015 and p=0.005) at 2-<3 hrs/d and 3+ hrs/d respectively when compared to 1-<2 hrs/d. Flavored milk intake increased significantly with higher levels of screen time (p=0.013) with intake being 30% higher at 3+ hrs/d when compared to a screen time of 0-<1 hrs/d (p=0.014). Juice intake (100%) increased significantly with higher levels of screen time (p<0.001) with intake being 18% and 15% higher (both p<0.001) at 3+ hrs/d when compared to intake at 0-<1 hrs/d and 1-<2 hrs/d, respectively. SSB intake increased significantly (p<0.001) with intake being 28% higher at 2-<3 hrs/d when compared to a screen time of 0-<1 hrs/d (p=0.004), and 39% and 27% higher at 3+ hrs/d when compared to a screen time of 0-<1 hrs/d and 1-<2 hrs/d, respectively (both p<0.001). Sweets intake was also significantly higher (p<0.001) with intake being 22% and 13% higher at 2-<3 hrs/d when compared to a screen time of 0-<1 hrs/d and 1-<2 hrs/d, respectively (p<0.001 and p=0.031), and 34%, 25%, and 15% higher at 3+ hrs/d when compared to a screen time of 0-<1 hrs/d, 1-<2 hrs/d, and 2-<3 hrs/d (p<0.001, p<0.001, and p=0.002), respectively. There was a trend in decreased fruit consumption with higher levels of screen time. Figure 2 further illustrates significant findings.

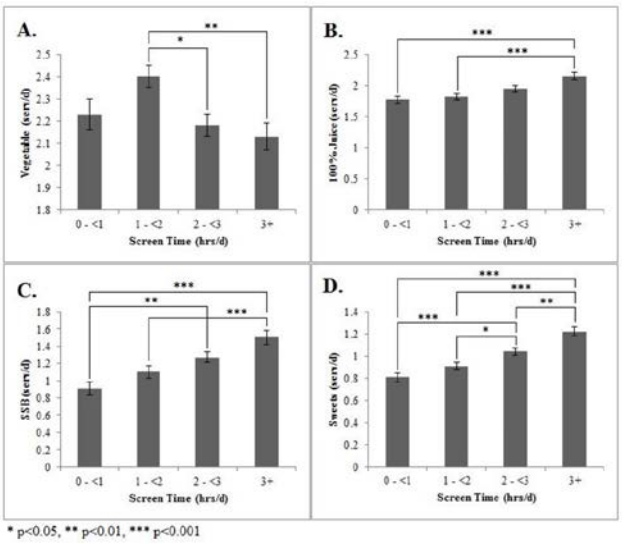

Figure 2. Significant interactions between screen time and dietary variables of WIC children (2-4 years). Data presented as mean ± standard error (SE)

Unadjusted and adjusted odds ratios (OR) of how screen time predicts high fast food consumption (1-4+ times per week) are shown in Table 4. Compared to participants who reported low screen time (0-<1 hrs/d), the odds of high fast food consumption (1-4+ times/week) increased in those who reported 1-<2 hrs/d of screen time (adjusted odds ratio (AOR)=4.7, 95% CI 2.8, 8.1; p<0.001), 2-<3 hrs/d of screen time (AOR=7.9, 95% CI 4.3, 14.7; p<0.001), and 3+ hrs/d of screen time (AOR=9.8, 95% CI 4.7, 20.4; p<0.001).

Table 4. Odds Ratios for Screen Time on Predicting High Fast Food Consumption (1-4+ times/week) of WIC Children (2-4 years)[a]

	Screen Time (hrs/day)				p-value
	0-<1	1-<2	2-<3	3+	
Model 1[b] Unadjusted	Referent	1.4 (0.6-3.0)	2.2 (1.0-4.7)	9.9 (5.0-20.0)	<0.001
Model 2[c] Adjusted	Referent	4.7 (2.8-8.1)	7.9 (4.3-14.7)	9.8 (4.7-20.4)	<0.001

[a]Multinomial regression was employed. Sample size n=2278; [b]Data are OR (95% CI); [c]Model 2 adjusted for age (months), birth weight (g), ethnicity, and sex.

4. Discussion

Studies have shown that TV viewing and video game playing increases the risk of obesity, but few have examined the relationship between screen time and dietary intake. According to our knowledge, no other study has examined these variables together in a young (2-4 years), primarily Hispanic population. Our results indicate that screen time is linked to unhealthy dietary intake in Hispanic low-income children. Vegetable intake was inversely related to screen time, and flavored milk, 100% juice, SSB, and sweets were positively related to screen time. Children who watched 3+ hrs/d of screen time were nine times more likely to eat fast food frequently (1-4+ times/week).

Several variables on dietary intake were significantly associated to screen time. In this analysis, unhealthy dietary intake was considered as food and beverages that have been associated to increased obesity prevalence. Even though 100% juice and flavored milk are sometimes not viewed as unhealthy dietary factors in society, some studies have shown increase intake is related to increased obesity prevalence and caloric intake [14,15]. These significant findings could be the result of several possible mechanisms. Past research has shown that some children eat mindlessly while watching TV. This may result in lack of attention to hunger cues and overeating. In Francis et al., preschoolers (3-5 y) who reportedly watched more hours of TV per day and who had a higher frequency of meals eaten in front of the TV at home, ate more lunch (in grams) in the TV condition in comparison to the no TV group [16]. Snacking on energy-dense foods is also a notable action seen co-occurring with TV viewing. Preparing fruits and vegetables also takes time, so parents may be more prone to give their child prepackaged, processed snacks while they watch TV or play video games. Future studies in this population should account for other factors shown to influence the relationship between dietary intake and screen time.

The average time spent watching TV was much greater than time spent playing video games (about 1.6 and 0.2 hrs/d, respectively). Also, as seen in the Spearman correlations, TV viewing was significantly associated to more dietary variables than video game playing (6 vs. 3 dietary variables). Therefore, in the screen time variable, TV viewing had a bigger impact than video gaming on the intake of dietary variables. In a longitudinal study by

Francis et al. with 434 children (5-13 years of age), TV viewing was a better predictor of future sedentary behaviors (comparing participants' ages at 5 y and 13 y) than video gaming in children [17]. A possible explanation for higher TV viewing over video game playing could simply be the young age range (2-4 y) of our participants. However, the increased marketing of video gaming towards families and buying power of younger populations might change video gaming data for children in the future [18].

The current screen time recommendation from the American Academy of Pediatrics (AAP) for children and teens is no more than one or two hours per day of high-quality content, and for infants and children under two, screen time should be avoided altogether [19]. The average amount of screen time in our population was leaning towards the maximum AAP standards (about 1.7 hrs/d).

Contrary to our hypothesis, overweight and/or obesity were not significantly associated to screen time. Again, a possible explanation may be related to the young age of our population. Regardless, our results, along with other studies [20], have shown that higher levels of screen time is associated with unhealthy dietary factors, which may lead to obesity later on in life. Eating a poor diet, with either too much or not enough various nutrients, also has negative effects on health regardless of overweight or obese status. In the short term, poor nutrition may contribute to tiredness and stress, and in the long term, it may even contribute to the risk of developing illnesses such as obesity, type 2 diabetes, osteoporosis, hypertension, and heart disease [21]. Thus, more studies are warranted to understand how dietary intake in young children can affect obesity levels later in childhood, adolescence and adulthood.

The analysis between dietary intake and obesity was not conducted in this study. However, previous findings using the same dataset found that high SSB intake was linked to increased obesity prevalence. Other dietary variables, such as 100% juice, plain and flavored milk, fruit, vegetable, sweets or fast food were not linked to overweight or obesity status in this study [9]. Given that screen time was linked to higher amounts of SSB intake in this study, and previous works (including that from this cohort) support the positive link between SSB and obesity, it is possible that chronic high screen time could mediate this relationship and be linked to obesity/overweight prevalence as the children age.

This link between higher levels of screen time and unhealthy dietary habits is likely to get stronger and more pronounced as the growth of technology continues to accelerate. Newer inventions, such as iPads, tablets and smartphones that can access the internet, are used on a daily basis by all age groups. Apps are starting to target younger populations, and are even being used in the educational settings. The Apple website links to real stories showing teachers and schools around the world using these products to reinvent learning; these example schools include elementary schools [22]. Thus, newer surveys targeting screen time should include questions regarding the use of several other screen devices than just television use.

There are some limitations of the current study. The beverage questions were based on a 12 fl oz serving size, which is larger than the standard serving size of 8 fl oz or 1 cup [23], and a rather large serving for children to consume in a sitting. This could have caused the mothers to overestimate the amount of beverages consumed. There may have been times when the children watched TV while not in the mother's care which may have led to an inaccurate report from the mother. Another limitation was that there were small differences in servings of dietary variables. However, one could argue that a small difference in dietary intake of a young population could have a meaningful impact. This population sample was low-income, and primarily Hispanic, therefore the findings may not be applicable to other population types. Height and weight were taken 6 months prior to survey data collection, which makes it more difficult to examine the impact of screen time on obesity prevalence. Finally, this was a cross-sectional analysis; therefore, causality of the results cannot be inferred.

5. Conclusion

Screen time was inversely related to vegetable intake and positively related to flavored milk, 100% juice, SSB, and sweets. The odds of high fast food consumption increased with higher amounts of screen time. These findings suggest that interventions targeting reductions in screen time may lead to healthier diets in young children; further, more research in this area is warranted in regards to other ethnicities, different income levels, and improved surveys to capture different types of screen time.

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Statement of Competing Interests

The authors have no competing interests.

List of Abbreviations

WIC: Women, Infants, and Children, LAC: Los Angeles County, SSB: Sugar sweetened beverage, CFBIQ: Child Food and Beverage Intake Questionnaire, PHFE: Public Health Foundation Enterprises, ISIS: Integrated Statewide Information System

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