Screen Exposure and BMI Status in 2-11 Year Old Children

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ABBREVIATIONS

CHICA: Child Health Improvement through Computer Automation;

TV: television;

BMI: Body Mass Index;

PSF: Pre-Screener Form;

PWS: Physician Worksheet

AAP: American Academy of Pediatrics

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ABSTRACT

Objective: Measure the relationship between screen exposure and obesity in a large, urban sample of children and whether the relationship is moderated by sociodemographics.

Methods: We asked parents of 11,141 children visiting general pediatrics clinics if the child had a television (TV) in the bedroom and/or watched more than 2 hours of TV/computer daily. We measured children's height and weight, then used logistic regression to determine whether screen exposure indicators predicted obesity (BMI $\geq 85^{th}$ percentile) and interacted with race/ethnicity, sex, age, and health care payer.

Results: Having a TV in the bedroom predicted obesity risk (p=0.01); however, watching TV/computer for more than 2 hours a day did *not* (p=0.54). There were no interactions.

Conclusions: Asking whether a child has a TV in the bedroom may be more important than asking about duration of screen exposure to predict risk for obesity.

INTRODUCTION

Despite recent trends suggesting that pediatric obesity rates have steadied globally,[1] pediatric obesity is still an alarming public health problem. Discrepancies exist in obesity rates among children of various racial and ethnic groups, with Hispanic and Latino children considered to be at highest risk for pediatric obesity and at an earlier age than other ethnicities.[2-8] Research has also suggested that children from low-income households are at increased risk for pediatric obesity.[9,10]

In addition to sociodemographic risk factors, television (TV) and other screen exposure has typically been linked to an increased risk for pediatric obesity[11-14]; however, see Laurson et al., 2008, for an exception,[15] as well as research by Lanningham-Foster et al., 2006,[16] which demonstrated that active screen exposure, such as through fitness video games, can be linked to decreased obesity risk. Various mechanisms for this relationship have been posited. For example, the correlation between screen exposure and pediatric obesity may be mediated by lack of physical activity, increased consumption of unhealthy foods while watching TV, exposure to advertising of unhealthy foods, and/or poor sleep patterns.[17-21] Another theory is that elevated screen exposure is a proxy for general household "chaos," which is related to a myriad of health-risk behaviors besides lack of physical activity and poor nutrition, including reduced cognitive and social engagement among household members.[22]

Given the increased risk for obesity in minority and low-income children reported in previous research, it follows that screen exposure, another factor related to obesity, could exacerbate this risk among more vulnerable populations, such as minority and low-income children.[23] Specifically, this study was designed to test whether screen exposure predicts pediatric obesity risk in 2-11 year old children, and if so, whether sociodemographic characteristics moderate the relationship between screen exposure and risk for pediatric obesity. We aimed to test three primary hypotheses:

1) Screen exposure leads to increased risk for pediatric obesity (i.e., BMI percentile at or above 85).
2) Screen exposure leads to greater risk for pediatric obesity in Hispanic and Latino children and Black children compared to White children.
3) Screen exposure is associated with greater risk for pediatric obesity in low-income children (i.e., children with a public health care payer source) compared to higher income children (i.e., children with private insurance).

To do so, we utilized data from the *C*hild *H*ealth *I*mprovement through *C*omputer *A*utomation system (CHICA). CHICA is a clinical decision support system implemented in four pediatric clinics in Indianapolis, IN. We extracted data contained in CHICA pertaining to screen exposure, height, weight, age, and other sociodemographic variables of interest, operationalized below. To our knowledge, this is the first study explicitly designed to systematically test whether screen exposure differentially impacts children's risk for pediatric obesity as a function of sociodemographics.

METHODS

The CHICA System

The CHICA system was developed in 2002 and implemented in 2004. Since then it has been continuously utilized by a variety of pediatric health care providers. CHICA currently operates in four pediatric outpatient clinic sites affiliated with the county hospital system in Indianapolis, IN. To date, data from over 36,700 unique pediatric patients spanning over 185,000 clinical encounters have been captured by CHICA. Research using the CHICA system has primarily focused on preventive care reminders and preventive care prioritization.[24]

Data are stored by the CHICA system via two primary routes. One is the 20-item pre-screener form (PSF) that is given to families to complete in the clinic waiting room. The PSF includes questions about a variety of topics pertaining to the child's health. These questions are generated algorithmically by the computer using several factors, such as the child's age, patient demographic data and information from previous clinical encounters. Response options on the PSF are in binary "yes" or "no" format. The PSF also captures patients' height and weight as recorded by a nurse or medical assistant at the patient's visit. Figure 1 includes an example of a PSF with the specific screen exposure questions circled.

<Insert Figure 1 about here>

We relied on two PSF questions as measures of screen exposure (see Figure 1). Since January 2011, these questions have been asked of parents of children ranging in age from 2 through and including11 years old. Both questions are adapted from recommendations by the American Academy of Pediatrics (AAP), specifically limiting all screen time to no more than 1-2 hours a day; no TV/DVD player in bedroom; and that these topics both be asked about by pediatricians at every well visit.[25-28] The specific CHICA system questions are based on other questions used in previous research to demonstrate an association between screen exposure and obesity risk.[23] One question focuses on duration of daily screen exposure: "Does <child's first name> usually watch TV or computer more than 2 hours a day?" The second question is, "Does <child's first name> have a TV in his[her] bedroom?" These two questions served as separate measures of screen exposure in our sample and were answered by parents via the PSF.

We also abstracted the child's height and weight measured by the nurse or medical assistant in the clinic during the same visit that the parent responded to the screen exposure question noted above. Relying on the Centers for Disease Control and Prevention's percentile charts,[29] CHICA automatically calculates each child's body mass index (BMI) percentile as a function of height, weight, and age and records that percentile in the child's record. This BMI percentile value served as the primary dependent variable in all of our analyses.

We also extracted sociodemographic information for each child, including age, sex, race/ethnicity, as well as health care payer source as a proxy for income status with public health care payer sources reflecting lower income status and private insurance reflecting higher income status. Age is calculated based on the child's birth date, and child sex is reported by the parent to the clinic's front desk staff. The front desk staff also collects from the parent the child's race/ethnicity data via a single question as part of the county hospital's routine demographic data collection. Response options are Black, Hispanic, White, Asian or Pacific Islander, Alaskan Native or Native American, or other group. A small number of patients in these clinics self-identify as Asian or Pacific Islander, Alaskan Native or Native American, other group, or give no race or ethnicity. Because these patients form a small and heterogeneous subgroup (approximately 4% of our total study sample with an N=501, with 40 percent of these being other/unknown), they were excluded from analysis. This slightly reduces the generalizability of our results, but strengthens internal validity. Health care payer source, also recorded and confirmed by clinic front desk staff, was coded into three separate categories, including Commercial/Private; Public (Medicaid/Medicare); and Self Pay or No Insurance. Both race/ethnicity and health care payer data are forwarded from the clinic's registration system to the CHICA system through an HL7 ADT message.[30]

In order to be eligible for inclusion in our sample, a child had to have a simultaneously recorded screen exposure response and a clinically-measured height and weight (from which the CHICA system could calculate the BMI percentile) in his or her CHICA record. A child also had to be identified as Black, Hispanic, or White by his/her parent. If a child had multiple responses to the same screen exposure questions in his or her file, we extracted the response from the most recent clinic visit and its co-occurring BMI percentile, and we extracted the child's age at the time those data were recorded.

The Indiana University Institutional Review Board approved this study before data extraction commenced.

Statistical Analyses

Using logistic regression, we built two models to separately examine the impact on obesity status of having a TV in the bedroom and the role of screen exposure for more than 2 hours a day. One model examined whether the child had a TV in the bedroom ("TV in Bedroom"). The second model examined whether the child watched more than 2 hours of TV or computer daily ("Screen 2 Hours"). In both models, BMI percentile served as the dependent variable and was stratified as follows due to our primary interest in risk for pediatric obesity: BMI percentile $<85^{th}$ (considered not overweight or obese) or BMI percentile $\geq 85^{th}$ (considered overweight or obese). We dichotomized BMI this way because health risks are not linearly associated with BMI. We were interested in the association between screen exposure indicators and an unhealthy elevation of weight to overweight or obese levels. The choice of the 85^{th} percentile, as opposed to the 95^{th}, was made to maximize statistical power and result in a more sensitive outcome measure. Similar studies have used the 85^{th} percentile as a cut-off.[23]

In each model, we also controlled for the child's demographic variables, including age, sex, race and ethnicity, and health care payer source. Age was coded as 2 – <5 years; 5 – <8 years; and 8 – 11 years. Sex was coded as male and female. Race/ethnicity was coded as Black, Hispanic, or White. Health care payer source was coded as: Commercial/Private; Public (Medicaid/Medicare); or Self Pay/No Insurance. Our model was built using SAS 9.3 software (SAS Institute Inc., Cary, NC). We used a 0.05 or less cutoff to identify statistically significant p-values.

RESULTS

Between January 2011 and May 2012, a total of 11,141 unique children whose parents identified them as Black, Hispanic, or White had a response to one or both of the screen exposure indicators, as well as a simultaneously recorded height and weight in their records (from which CHICA system could calculate the BMI percentile). There were 7,650 unique children with "TV in Bedroom" responses in their records, and 7,637 unique children had "Screen 2 Hours a Day" responses. Some children had responses to both screen exposure indicators, and these children are included among both of the logistic regression models. Table 1 reflects the demographic variables of the samples included in each analysis, broken out by response to the screen exposure variables included in this study. In all analyses, children for whom there was a simultaneous screen exposure response and BMI percentile value on file were predominantly male, Black, 2 – <5 years of age, and received Medicaid.

<Insert Table 1 about here>

Across both of our models, age, sex, and race/ethnicity were statistically significantly related to risk for obesity. Compared to children 2 – <5 years of age, children 5 – <8 and children 8 – 11 years of age were more likely to have a BMI at or greater than the 85th percentile.

Males were more likely than females to have a BMI percentile at or greater than 85. Hispanic children were statistically significantly more likely than White children to have a BMI percentile greater than 85; the difference in risk for obesity between White and Black children did not attain statistical significance. There was no main effect of health care payer. See Tables 2a and 2b.

<Insert Tables 2a, b about here>

Children with TV in their bedrooms were significantly more likely to have a BMI percentile greater than or equal to 85 compared to children without a TV in their bedroom (*Wald* χ^2 = 6.22, *OR* = 1.13, *p* = 0.01). Contrary to our hypotheses, there were no interactions involving the "TV in the Bedroom" variable and sociodemographic characteristics to predict obesity risk. See Table 2a.

Children who watched more than 2 hours of TV or computer a day were *not* significantly more likely to have a BMI percentile greater than or equal to 85 compared to children not watching more than 2 hours of TV or computer a day (*Wald* χ^2 = 0.38, *OR* = 1.03, *p* = 0.54, *ns*). See Table 2b. Because there was no main effect of watching TV or computer for more than 2 hours a day, interactions were not tested.

DISCUSSION

Using data from a large cohort of patients from a group of general pediatric clinics, we found that having a TV in the bedroom was significantly related to an increased risk for BMI percentile over 85. However, we did not find that same association for watching more than 2 hours of TV or computer a day. Further, we did not find any interactions between having a TV in the bedroom and sociodemographic characteristics in terms of predicting BMI percentile status in our dataset. It appears that all children, regardless of demographic characteristics, are equally affected by having TVs in their bedrooms as a risk factor for overweight and obesity.

We found that, compared to females, males were more likely to have a BMI percentile over 85. We also found that older children, compared to younger children, were significantly more likely to have a BMI percentile over 85. In line with others' findings, we found that Hispanic children, compared to White children were more likely to have a BMI percentile over 85.[6,9,31] However, contrary to published findings elsewhere, we did not find that Black children were at a statistically significantly increased risk for a BMI percentile over 85, compared to White children. In other analyses, Black children have typically been at increased risk for elevated BMI compared to White children.[31]

This study relied entirely on data collected in routine clinical care. Secondary analysis of data collected through routine use of a clinical decision support system allowed us to rapidly collect large amounts of data in a population representative of our patients and consistent with data that could be routinely collected in a busy pediatric practice. On the other hand, data are limited in the depth, and to some extent, the quality that can be achieved in routine practice. So our findings reinforce previous epidemiological work in childhood obesity but also inform the application of these findings to clinical practice.

The finding that screen exposure is related to elevated BMI percentile only when measured as a TV in the bedroom is striking. However, this finding echoes recent work suggesting that a TV in the child's bedroom might more strongly predict pediatric obesity compared to screen time.[13] Asking families whether a child experiences greater than 2 hours of screen time each day is a recommended screening item to assess excessive television exposure.[25] However, we found that it was unrelated to BMI percentile values indicating obesity. This calls into question the sensitivity of asking whether a child watches more than 2 hours of a TV or computer each day as a screen for obesity risk. Indeed, this one, compound question fails to tease out TV versus computer time and does not distinguish screen time on weekends or weekdays. Nor does it precisely quantify hours of screen time or the type of screen exposure (educational, active video games, etc.). Nonetheless, this reflects the recommendations of the AAP. Clearly, if a single screening question is to be used in clinical practice, asking about a TV in the room has a stronger association with excessive weight gain. It also represents a single, modifiable risk factor. Moreover, it is notable that the risk for elevated BMI percentile associated with a TV in the bedroom holds for children as young as 2 years of age.

It is important to note that we relied on parents' reports of screen exposure in their children without direct observation. Although social desirability is a concern when eliciting self-reports of behaviors known to be detrimental to a child's health and development, so many parents in the CHICA clinics report their children's ("undesirable") screen exposure that we believe underreporting due to social desirability is unlikely. Moreover, short of direct observation, parent report is our best measure of screen exposure.

We also do not know for certain the nature of the screen exposure. Some screen exposure, such as through active videogames,[16] can be beneficial to a child's health. The CHICA system questions do not specifically inquire about content or types of specific activities involving screen exposure. Further, given that our sample relies on data from the CHICA system, implemented in four urban clinics that predominantly serve low-income, minority families, caution should be exercised concerning sample generalizability. Lastly, the CHICA system relies on optical character recognition when the PSF forms are scanned and data entered into the CHICA system. Scanning error rates were once approximately 9%.[32] However, as a result of CHICA system improvements and updates over time, we have reduced those error rates to approximately 1%, which has been the case for the duration that the screen exposure questions have been asked on the PSF.

We would suggest that clinicians focus on regularly asking whether a child has a TV in his/her bedroom. Given that a TV in a child's bedroom puts them at increased risk for a BMI percentile at or above 85, regardless of demographic characteristics, it is important that this screening item be asked of all children regardless of sex, race, or socioeconomic stratum. We would also suggest that clinicians consider asking about other types and durations of screen time, including electronic devices besides TVs and computers.

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Figure 1. Example of CHICA pre-screener form (PSF) completed by parents of pediatric patients.

Table 1. Sociodemographics and BMI status by screen exposure variable.

		TV in Bedroom			Screen 2 Hours		
		N	**N Yes**	**% Yes**	**N**	**N Yes**	**% Yes**
	Total	7650	2585	33.79%	7637	3928	51.43%
Sex	*Males*	3962	1279	32.28%	3964	1949	49.17%
	Females	3688	1306	35.41%	3673	1979	53.88%
Age	*2 – <5 years*	2953	1088	36.84%	2961	1655	55.89%
	5 – <8 years	2238	761	34.00%	2228	1203	53.99%
	8 – 11 years	2459	736	29.93%	2448	1070	43.71%
Race/ Ethnicity	*Black*	4162	1027	24.68%	4149	1676	40.40%
	White	681	272	39.94%	671	380	56.63%
	Hispanic	2807	1286	45.81%	2817	1872	66.45%
Health Care Payer	*Private/Commercial*	311	137	44.05%	305	140	45.90%
	Public (Medicaid/Medicare)	6850	2261	33.01%	6845	3556	51.95%
	Self Pay or No Insurance	489	187	38.24%	487	232	47.64%
BMI Status	*BMI <85th Percentile*	4541	1549	34.11%	4524	2301	50.86%
	BMI ≥85th Percentile	3109	1036	33.32%	3113	1627	52.26%

Table 2a. “TV in Bedroom” logistic regression model to predict pediatric obesity (BMI percentile at or above 85).

		Wald χ^2	***p***	**Odds Ratio Estimates: Effect**	**Point Estimate**	**95% Wald Confidence Limits**	
Main Effects	*TV in Bedroom*	6.22	0.0126	TV in Bedroom: Yes vs No	1.132	1.027	1.248
	Age	150.03	<0.0001	8-11 Years vs 2-<5 Years	1.966	1.764	2.191
				5-<8 Years vs 2-<5 Years	1.437	1.286	1.606
	Sex	4.41	0.0358	Female vs Male	0.908	0.831	0.994
	Race/ Ethnicity	172.04	<0.0001	Hispanic vs White	1.812	1.527	2.151
				Black vs White	0.950	0.804	1.123
	Health Care Payer	2.91	0.2339	Self Pay/No Insurance vs Commercial/ Private	0.854	0.639	1.141
				Public (Medicaid/ Medicare) vs Commercial/ Private	1.003	0.795	1.264

		Wald χ^2	***p***
Interactions	Age x TV in Bedroom	3.222	0.2
	Sex x TV in Bedroom	0.866	0.3521
	Race/Ethnicity x TV in Bedroom	4.05	0.132

Table 2b. “Screen 2 Hours” logistic regression model to predict pediatric obesity (BMI percentile at or above 85).

		Wald χ^2	***p***	**Odds Ratio Estimates**			
				Effect	**Point Estimate**	**95% Wald Confidence Limits**	
Main Effects	*Screen 2 Hours*	0.38	0.5375	Screen Over 2hrs: Yes vs No	1.030	0.938	1.130
	Age	150.17	<0.0001	8 - 11 Years vs 2-<5 Years	1.968	1.766	2.194
				5-<8 Years vs 2-<5 Years	1.411	1.262	1.577
	Sex	6.8	0.0091	Female vs Male	0.888	0.811	0.971
	Race/ Ethnicity	158.82	<0.0001	Hispanic vs White	1.803	1.518	2.142
				Black vs White	0.969	0.819	1.146
	Health Care Payer	4.2	0.1224	Self Pay/No Insurance vs Commercial/ Private	0.813	0.608	1.087
				Public (Medicaid/ Medicare) vs Commercial/ Private	0.986	0.782	1.244

3630166667 **CHICA Pre-Screening**

MRN: #99-2
Name: Patient, Ima Great
Age: 10 yo DOB: Aug 15 2002
Date: Nov 8 2012

Height: ☐☐☐ . ☐ in.
Uncooperative / Unable to Screen: ☐ Vision ☐ Hearing ☐ BP
Weight: ☐☐☐ . ☐☐ kg. * Vision Left: 20/ ☐☐☐
HC: ☐☐☐ . ☐ cm. * Vision Right: 20/ ☐☐☐
Pulse Ox: ☐☐☐ %
BP: ☐☐☐ / ☐☐☐ Vision Corrected? ☐
Temp: ☐☐☐ . ☐ deg. F
* Left Ear @ 25db: P ☐ F ☐
Pulse: ☐☐☐ /min RR: ☐☐☐
* Right Ear @ 25db: P ☐ F ☐

☐ Sick Visit
☐ Patient left without treatment
☐ Patient refused to complete form
☐ Two IDs checked

Box For Nursing Use Only - Box For Nursing Use Only - Box For Nursing Use Only - Box For Nursing Use Only

Parents: Thank you for answering these questions about your child. The answers will help your doctor provide better quality of care. If your child is age 11 or older, he/she should answer the questions privately. Answers are confidential, but if you prefer not to answer that is allowed. You may want to talk about these questions with your doctor.

Please fill in the circles completely with a pencil or pen.

Y N

Ⓨ Ⓝ Is Ima allergic to any medicines?

Ⓨ Ⓝ Does Ima take prescription or over-the-counter medicine, herbal medicine or vitamins, or use an inhaler or medicated creams or lotions?

Ⓨ Ⓝ Are you confident filling out medical forms by yourself?

Ⓨ Ⓝ Does Ima have sickle cell disease?

Ⓨ Ⓝ Has your partner kicked, hit, or slapped you?

Ⓨ Ⓝ Does Ima OFTEN have difficulty remaining seated when asked to do so, that is causing problems at home or school?

Ⓨ Ⓝ Does Ima always wear a helmet when riding her bike or tricycle?

Ⓨ Ⓝ Does Ima have a TV in her room?

Ⓨ Ⓝ Does anyone in Ima's home smoke?

Ⓨ Ⓝ Has your partner or another adult threatened or hurt your children?

Y N

Ⓨ Ⓝ Is Ima having pain today?

Ⓨ Ⓝ Do you sometimes need to have someone help you when you read material from your doctor or pharmacy?

Ⓨ Ⓝ Do you have at least 10 children's books in your home?

Ⓨ Ⓝ Do you feel safe in your home?

Ⓨ Ⓝ Does Ima OFTEN make careless mistakes or not pay close attention to details, that is causing problems at home or school?

Ⓨ Ⓝ Does Ima OFTEN have a hard time paying attention to tasks or play, that is causing problems at home or school?

Ⓨ Ⓝ Do you have a working smoke detector in your home or apartment?

Ⓨ Ⓝ Does Ima usually watch TV or computer more than 2 hours a day?

Ⓨ Ⓝ Does Ima ever swim or play around any water (lake, stream, pool, or ocean) without adult supervision?

Ⓨ Ⓝ Does Ima have asthma or wheezing, cough or breathing problems that won't go away or keep coming back?

Preguntas en español al otro lado.