Media Screen time, Physical Activity and Nutritional Indicators as Risk Factors for Childhood and Adolescent Overweight and Obesity in Aguas Zarcas, Costa Rica

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ABSTRACT: Childhood obesity is an increasingly serious issue worldwide. There is substantial research that explores health problems, psychosocial issues and rising medical costs related to obesity, however, limited research has discovered the etiology and specific risk factors associated with the epidemic. This study sought to understand the prevalence and related risk factors of obesity in rural Aguas Zarcas, Costa Rica in Spring 2011. The sample included 1 025 school-aged children ages four to 18. Each child participating in the study completed a survey that addressed hypothesized risk factors (i.e. media screen time and physical activity). I also measured each subject's height, weight, and abdominal circumference to determine whether significant relationships existed between the proposed risk factors and the overall rate of obesity among school children. Results showed a positive relationship between screen time (time spent in front of a television, computer, or video game) and BMI/abdominal circumference and a negative relationship between physical activity and BMI/abdominal circumference. Time spent watching television on the weekend was positively correlated to BMI (p < 0,001) and physical activity throughout the week and weekend was negatively correlated with both BMI and abdominal circumference (p < 0,0001). Most children involved in the study fell within healthy height and weight classifications, while 12% were considered obese according to the Center for Disease Control's BMI standards. Obesity rates were especially high among males and females ages ten through 12. This research serves as a foundation for further exploration of obesity risk factors and prevalence, and can be used to inform policy and programming to prevent the impending rise of childhood obesity in Costa Rica.

Key words: obesity, risk factors, physical activity, media screen time, children, adolescents.

RESUMEN: La obesidad infantil es un problema cada vez más grave en todo el mundo. Hay investigación sustancial que explora los problemas de salud y psicosociales, y el aumento de los costos médicos relacionados con la obesidad, sin embargo, pocas investigaciones tratan la etiología y los factores de riesgo asociados específicamente con la epidemia. Aquí analizo la prevalencia y los factores de riesgo relacionados con la obesidad en la zona rural de Aguas Zarcas, Costa Rica, en el 2011. La muestra incluyó a 1 025 menores en edad escolar (4-18 años). Cada uno completó una encuesta que aborda los factores de riesgo hipotéticos (tiempo que pasan frente a una pantalla y actividad física). También medí la estatura de cada estudiante, el peso y la circunferencia abdominal, para determinar si hay relaciones entre los factores de riesgo y la tasa de obesidad. Hubo una relación positiva entre el tiempo ante pantalla (tiempo que pasan frente un televisor, la computadora o videojuegos) y el Índice de Masa Corporal IMC/circunferencia abdominal; y una relación negativa entre la actividad física y el IMC/circunferencia abdominal. El tiempo dedicado a ver la televisión en el fin de semana se correlacionó positivamente con el IMC (p <0,001) y la actividad física durante toda la semana y el fin de semana se correlacionó negativamente con IMC y circunferencia abdominal (p <0,0001). La mayoría de los menores que participaron en el estudio se encontraban en las clasificaciones de altura y peso saludables, mientras que el 12% fueron considerados obesos, según las normas de los EEUU. Las tasas de obesidad son especialmente altos entre niños de 10 a 12 años. Esta investigación sirve como una base para una mayor exploración de los factores de riesgo y prevalencia de obesidad, y se puede utilizar para la elaboración de políticas para evitar el inminente aumento de la obesidad infantil en Costa Rica.

Palabras clave: obesidad, factores de riesgo, la actividad física, el tiempo de pantalla, niños, adolescentes.

Obesity prevalence is rising and quickly becoming one of the most pressing medical and public health issues worldwide, especially among children. With higher obesity rates, medical professionals have discovered an increased prevalence of diabetes, heart disease and overall spending costs on weight-related medical issues.

Children and adolescents are currently heavier than ever, as classifications that once categorized children as "obese" have now been reduced to "overweight" to compensate for the rapidly changing weight trends around the world (Ogden & Carroll, 2010). Although obesity rates seem to be rising, many countries lack current data

to accurately recognize the severity of the epidemic. Obesity rates in the United States, which according to the Center for Disease Control is classified as having a BMI of 20kg/m^2 or higher, among children have more than tripled since 1970 (Harris, Kuramoto, Schulzer, & Retallack, 2009). Studies suggest that today over 12.5 million children and teenagers in the U.S. are classified as obese, however comparable statistics are unknown in most developing countries (Bell et al., 2011).

Obesity is especially detrimental to the development of children and teenagers, as it can affect their health both physically and psychologically throughout their entire lives. Overweight and obese children are more likely to suffer from a variety of medical conditions including: hypertension, high cholesterol, coronary heart disease, respiratory problems, and sleep apnea (Bell et al., 2001). Increasing rates of type II diabetes among children and teens, an illness that was very rare 20 years ago, has also been attributed to increased rates of overweight and obesity among young people today. Other concerns associated with overweight and obese children include stigmatization, low self-esteem, rejection from peer groups, low self-worth, depression, and in some cases a decrease in school/academic performance (Wang & Veugelers, 2008).

Mental and physical health issues that arise early in development are especially dangerous, as they can potentially become lifelong medical issues (de la Rosa, Squizzato & Masloski, 2007). One study found that childhood BMI is significantly and positively associated with an increased risk of coronary heart disease in adulthood (Baker, Olsen & Sorenson, 2007). When a child develops obesity starting at a young age, he or she is six to seven times more likely to also be obese during adulthood compared to healthy peers (Nuñez-Rivas, Monge-Rojas , León & Roseló, 2003). This data suggests that it is important to prevent obesity at a young age to not only help children lead healthier lives, but to also prevent lifelong chronic illnesses that are expensive to treat. Between 1997 and 1999 aggregate costs related to obesity issues amounted to $127 million in the U.S, close to a 400% increase in spending since 1980 (CDC, 2010). It is therefore important from both a medical and economic standpoint to address obesity in the U.S. and other countries at risk.

Risk Factors Associated with Childhood Obesity: As recognized in "The Identifying Determinants of Eating and Activity Project." the obesity epidemic among children is propelled by a variety of factors, from an individual's home environment to the type of school they attend (Lytle, 2009). The study provides a comprehensive overview of potential risk factors, but does not identify which are most influential at this time. However, several studies have identified that two of the most prominent risk factors today are increased media screen time and decreased physical activity among children (Gaya et al., 2009; Kourlaba, Kondaki, Liarigkovinos, & Manios, 2009). Researchers found that screen time is correlated with BMI status and negatively associated with physical activity, making it a major risk factor for obesity (Kourlaba et al., 2009). Epstein et al. (2011) similarly found that an increase in screen time leads to more sedentary behavior and less time spent on physical activity, also leading to higher levels of body fat. Finally, Tandon, Zhou, Lozano and Christaki (2011) found that despite pediatrician recommendations, most preschoolers are watching more than double the amount of recommended television. Given these findings, I was interested in revealing the average amount of time that school children in Aguas Zarcas spent in front of a media screen, as well as total physical activity and how these related nutritional indicators.

Although it is evident that many studies have been conducted on obesity in the U.S., there is little data on similar issues in developing countries, including Costa Rica. The most recent study in Costa Rica on childhood obesity was conducted in 2003 and focused on children from urban areas. Núñez-Rivas et al. (2003) discovered that 34,5% of study children were overweight and 26,2% were obese as classified as having a BMI over 85% and using skin folds. This study revealed shocking results, however contemporary research on obesity issues is necessary to better understand the severity of the problem today.

METHODOLOGY

Study Area: The study took place in the town of Aguas Zarcas in the province of Alajuela, Costa Rica. The town is situated 97km north of the capital, San Jose, and is 40km east of Ciudad Quesada, the largest local city. The total area of the town is 145 31km^2, with a projected population of 19 745 people in 2011 (INEC, 2011). Aguas Zarcas is considered a rural town and is primarily an agricultural and ranching area.

Study Population: The study included currently enrolled students at ten of the 30 public schools in the Aguas District 04. Students were eligible for the study if they were in kindergarten through 12th grade (ages four through 18) and consented to the research. Of the public schools in Aguas Zarcas District 04, there are 28 elementary schools ranging from kindergarten through

sixth grade and one high school ranging from seventh through 12th grade.

Procedure: Before initiating research, I presented my proposal to the regional director of schools at the Ministerio de Educación in Ciudad Quesada to obtain approval. After receiving authorization, I met with the superintendent of schools in Aguas Zarcas School District 04, who gave me detailed information on the schools in the area. I visited an average of two schools each day where I distributed surveys to entire classes and recorded the teacher's name, grade, number of students, and the date I planned to return. I then revisited each school to gather surveys and measure the height, weight and abdominal circumference of the students who returned a survey.

Surveys: The survey I distributed to students included questions about age, birth weight, amount of time the subject spends in front of a media screen in their home (watching television, using the computer, or playing video games), and the amount of physical activity they perform throughout the week, both at school and home. Children in kindergarten through third grade were given a survey and consent form to take home and complete with a parent or guardian. Students in fourth through 12th grade were given a survey to complete and consent form to sign on their own.

Anthropometric measurements: I measured the subject's weight with no shoes or excessive clothing using a digital bathroom scale. I measured the subject's height with no shoes, using a tape measure that was attached to the wall and a right triangle tool. I calculated the subject's abdominal circumference using the uppermost lateral border of the right and left ileum as landmarks. Weight was rounded to the nearest hundredth of a kilogram and height and abdominal circumference were rounded to the nearest millimeter. All measurements were taken three times to ensure reliability. I categorized participants as underweight, normal weight, overweight, or obese according to BMI and abdominal circumference classifications developed by the Center for Disease Control (CDC, 2011). I used percentiles from the World Health Organization database (WHO, 2007) to determine the mean range of BMI and abdominal circumference associated with each classification.

RESULTS

Participants: The study initially included 1 097 students enrolled in Aguas Zarcas District 04 public schools. Participants ranged from age four through 21, enrolled in kindergarten through twelfth grade. Due to exclusion criteria, 55 students were removed from the data because they completed surveys but were not present for measurements, 16 students were over the age of 18, and two students were pregnant. After exclusion, there were 1 025 students included in statistical analysis, 47% male and 53% female.

Return rate: For each school visited, I measured at least ten percent of the student population and had an overall survey return rate of 73%. The survey return rate for students in kindergarten through third grade was 54%, while the survey return rate for older students was 84%.

Excluded questions and data: I excluded three questions from the older student questionnaire that asked about time spent watching television, using the computer, or playing video games outside of one's own home, as they proved to be confusing and thus did not yield reliable answers. I combined questions 9 and 10 from both surveys, which asked about hours spent on the computer specifically for recreational purposes verses work, as students had difficulty differentiating between the two. I discarded a question about the amount of physical activity that children reported during school hours, as younger children had difficulty comprehending the question.

Anthropometric analysis: I summed frequencies and constructed histograms of BMI, abdominal circumference, and height of all participants for each age group (under 7, 7-9, 10-12, 13-14, and 15-18), gender, and for combined age groups. After running frequencies, I conducted a test of independence to determine if BMI and age are dependent on one another. I used a contingency table analysis on age groups by BMI levels (underweight, normal weight, overweight, and obese), and a chi-squared test. I then measured the relationship between BMI/abdominal circumference and hypothesized risk factors using regressions. Statistical tests followed Sokal and Rohlf (1995) and used Statgraphics 15.0 computer program.

Overall, 71% of observed students classified as having a normal weight, 4% classified as underweight, 13% classified as overweight, and 12% as obese. I found a dependency between the levels of BMI and age groups among boys (X^2=25,9; df=12; P=0,01) and girls (X^2=21,5, df=12; p< 0,05) and between abdominal circumference and age group with both boys (X^2=23,3, df=12; P<0,05) and girls (X^2=41,6, df=12; P < 0,001). Thus, both boys and girls between the ages of ten and 12 had the highest prevalence rate of obesity out of all age groups according to BMI. Results showed that within this age group, 19,1% of boys and 16,1% of girls classified as obese. I obtained somewhat similar results using abdominal circumference as a nutritional indicator, as I found that 62% of observed students classified as having a normal weight, 13% classified as underweight, 14% classified as overweight, and only 6% as obese. Although the distribution of classifications differ from those derived from BMI, both boys and girls between the ages of 10 and 12 also had the highest rates of obesity according to abdominal circumference. The results showed that 9,2% of boys and 10,1% of girls classified as obese in this age group according to abdominal circumference.

Furthermore, BMI and abdominal circumference were both positively related to the amount of television watched on Saturday and Sunday (Table 1). BMI and abdominal circumference were positively related to time spent in front of a computer throughout the week and weekend, time spent playing video games on Saturday, and time spent playing video games on Sunday was approaching a positive correlation to BMI and is positively related to abdominal circumference (Table 1). Finally, BMI was significantly and negatively related to physical activity for all days of the week and weekend (Table 1).

DISCUSSION

The observed study population had an overall obesity rate of 12% according to BMI, however many people use different classifications and criterion to define overweight and obesity which makes it difficult to directly compare these results to past studies. For example, Núñez-Rivas et al. (2003) discovered that 34.5% of children in Costa Rica were overweight and 26.2% were obese, however they classified obesity using different percentile limits and skin-fold tests as nutritional indicators. Amigo (2003), however, used similar BMI nutritional indicators as this study, but only had enough data to accurately report that children under age five yielded an obesity rate of 6%. These two studies demonstrate the difficulty associated with making comparisons between past and present studies concerning obesity in Costa Rica, where little research has been conducted on the topic. Despite these difficulties, there are many detailed statistics about the rising obesity epidemic in the United States that can be used to make general comparisons to my current findings. For example, Bell et al. (2001) discovered that childhood obesity in the U.S. has reached over 17% in 2001. This finding can be used to preliminarily conclude that obesity rates in Aguas Zarcas have not yet reached those in the U.S., however without proper precautions and programming, Costa Rica could easily follow in similar footsteps.

Rates of obesity in rural versus urban locations: This study only aimed to examine children in a rural location and therefore the findings cannot be generalized for all children in Costa Rica. Núñez-Rivas et al. (2003) found that within their study in Costa Rica there was a much

TABLE 1
Regressions between BMI and risk factors.

Risk Factors	F	DF	R^2 (%)	P
TV Sat	9,80	(1,1008)	0,86	< 0,01
TV Sun	10,21	(1,1006)	0,91	< 0,01
Comp. Mon-Fri	3,68	(1,506)	0,53	= 0,56
Comp. Sat	7,17	(1, 506)	1,20	< 0,01
Comp. Sun	10,05	(1, 506)	1,75	< 0,01
V.G Sat	3,80	(1. 330)	0,84	= 0,05
V.G. Sun	2,87	(1, 330)	0,56	= 0,09
P.A. Mon-Fri	26,85	(1, 1005)	2,50	< 0,0001
P.A. Sat	29,45	(1,1003)	2,67	< ,0001
P.A. Sun	41,48	(1, 1004)	3,87	< 0,0001

*TV = television, Comp= Computer, V.G. = Video Games, P.A. = Physical Activity.

greater prevalence of obesity among school children in urban rather than rural areas (35% verses 20%). They attributed this to rural school children often spending greater amounts of time walking to and from school and helping family members with agricultural work, which burns more calories than typical activities among urban school children (Núñez-Rivas et al., 2003). Furthermore, Kourlaba et al. (2011) found that children living in urban areas were also significantly more likely to watch excessive amounts of television than children living in rural areas, which could lead to an increase in BMI. Information regarding the differences between health conditions in rural versus urban locations lead me to believe that while I discovered that 12% of the rural study population is obese according to BMI classifications, this percentage could potentially be higher in urban areas of Costa Rica and should be taken into consideration for future studies.

Highest obesity rates found among children 10-12 years old: Among the five tested age groups, both boys and girls ages 10-12 classified as having the highest rates of obesity according to both BMI and abdominal circumference classifications. One explanation of these findings is that children at this age are often maturing physically but tend to gain weight before they have a growth spurt and normalize their BMI, as noted by the World Health Organization Growth Standards (WHO, 2007). However, it would be important to investigate this phenomenon to understand whether these subjects would then continue to maintain higher BMI levels as they develop, or drop back to normal BMI standards. A longitudinal study would help to reveal the reasoning behind these perplexing results. Additional data could potentially support the need for an intervention geared towards students age 10-12 to increase physical education classes in school or encourage physical activity at home as well as decrease screen time.

Differences between BMI and abdominal circumference: Although both BMI and abdominal circumference classifications identified ten to 12 year old students as having the highest prevalence of obesity, there were also some discrepancies between the two forms of measurement. According to BMI classifications over 71% of subjects had a normal weight, while only 62% of the sample had a normal weight according to abdominal circumference measurements. Furthermore, obesity rates according to BMI reached over 12%, whereas abdominal circumference measurements only identified 6% of the sample as obese. Obesity rates may appear to be much high according to BMI because the equation does not account for muscle mass weighing more than fat, and therefore classifies some people as overweight or obese when they actually have a healthy body weight (Barnett et al., 2010). These inconsistencies prove that there is not one completely accurate way to classify nutritional indicators. Instead, it is important to use several different types of measurements to ensure the validity of a study regarding obesity. I chose to primarily use BMI as a nutritional indicator in my results since it is a more widely used standard at this point and thus could make comparisons among studies more feasible.

Significant risk factors for obesity: Overall, this study proved that there is a significant, positive relationship between screen time and BMI/abdominal circumference. I specifically found that there is a positive correlation between BMI/abdominal circumference and time spent watching television on the weekend, time spent using the computer on weekdays and the weekend, and time spent playing videogames on the weekend. Many past studies have hypothesized that there could be a relationship between television viewing time and body mass index, however the phenomenon has not been widely studied. Many studies merely suggest that viewing more than one to two hours of quality programming a day is detrimental to the health of children and adolescents (Tandon et al., 2011). Epstein et al. (2011) on the other hand attribute an increase in television and computer time to higher rates of obesity because it is associated with a more sedentary lifestyle and lack of physical activity (Epstein et al., 2011). The researchers found that decreasing screen time proved to increase an individual's energy and minimize unnecessary eating habits, which ultimately lowered BMI rates (Epstein et al., 2011). Increasing energy intake could also lead to greater amounts of physical activity, which is also shown to help reduce BMI. My research provides support for these hypotheses, as I found that media screen time was associated with higher BMI rates and less physical activity.

Intervention strategies: After revealing both the prevalence and several risk factors associated with obesity in Aguas Zarcas, it is important to propose an intervention that combines both the reduction of screen time and increased activity among school children. Given that children and adolescents spend a significant amount of their waking hours in school, I believe that the classroom would be an appropriate place to initiate an intervention. In the case of Aguas Zarcas, the intervention could be most beneficial for children ages seven through 12, who proved to have the highest rates of obesity. Schools

have the unique opportunity of providing an environment where students can learn about the importance of physical activity, proper nutrition, and reducing unhealthy behaviors to help prevent the rise of obesity early in development.

Obstacles and future research: There were many aspects of this study that could be improved or changed if further research is to occur. Primarily, the schedule for schools was confusing and inconsistent, making it hard to track down the same group of students more than once. Other limitations included low return rates of surveys, especially among the younger students. I found that students were often confused by survey questions and thus did not always provide accurate responses. Thus, face-to-face interviews may be a more reliable form of data collection in the future. Finally, this study should be continued in other rural areas, but especially in more urban locations so that wider generalizations could be made about the overall prevalence of obesity in Costa Rica.

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