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Correlates of Physical Activity in Young American Indian Children: Lessons Learned from the Wisconsin Nutrition and Growth Study (WINGS)

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Abstract

Background—Obesity is a serious and growing health problem in American Indian (AI) children. Our study, the Wisconsin Nutrition and Growth Study (WINGS), is part of an ongoing community based participatory research partnership between university-based health investigators and 3 Wisconsin American Indian tribes. WINGS aimed to understand the prevalence and contributing factors to pediatric obesity in WI tribes and provide the foundation for intervention design.

Objective—This paper focuses on the associations among age, gender and 3 measures of weight status with proxy-reported physical activity and TV/screen time in 3–8 year old AI children in the WINGS study.

Design/Methods—In a cross-sectional design, 581 AI children (49.1% female, ages 3–8 yrs) participated in health screenings. Screenings included height, weight, waist circumference, percent body fat, and a parent survey on demographics and health, including questions on physical activity and TV/screen time.

Results—45% of children were overweight or obese. Boys were significantly more obese and had higher levels of body fat than girls. There were no differences in weight category across the age range of children examined. Boys participated in significantly more weekly sports than girls and sports participation was higher in younger vs. older children. BMI and waist circumference were not significantly correlated with TV/screen time or with the 3 activity measures (sports participation, outdoor play time or school based physical activity). Hours of outdoor play significantly predicted child body fat percent controlling for maternal BMI and child age and gender.

Conclusions—Young AI children in WI have high rates of overweight/obesity starting at a very early age, and outdoor play may play a significant role in mediating body fat. There is a need to develop obesity prevention interventions at early ages.

INTRODUCTION

American Indian (AI) people in the United States suffer the highest rates of diabetes, cardiovascular deaths, and obesity of any ethnic/racial minority.^{1,2,3,4} The prevalence of obesity is escalating in many American Indian (AI) communities, especially among children and adolescents.^{3,5} Wisconsin AI adults, adolescents, and children have particularly high rates of obesity and overweight.^{4,6} Among Wisconsin AI's, the age-adjusted mortality rate

for diabetes is three times higher than that of the general Wisconsin population.⁴ Data from the Indian Health Service indicates that among all AI's, those in the Bemidji area (Minnesota, Wisconsin, and Michigan) have the highest rates of cardiovascular disease (CVD) and the third highest rates of diabetes nationally.⁷

Physical activity (PA) is key in preventing^{8, 9, 10} and treating^{11, 12} obesity. In addition, it has important health effects beyond its tie to energy expenditure and obesity, most importantly in its relationship to cardiovascular disease, type 2 diabetes, and cancer.¹¹ Increased understanding of factors related to the development of pediatric obesity is vital because of its relevance to adult chronic diseases as well as the need for targeting effective primary prevention efforts.

The Wisconsin Nutrition and Growth Study (WINGS) was a participatory research project among three Wisconsin American Indian communities, the Great Lakes Inter-Tribal Council (a consortium of 11 WI Tribes), and academic researchers at the University of Wisconsin to examine the prevalence of obesity, obesity correlates, and associated risk factors for cardiovascular disease among children, ages 3 – 8.^{6,13,14} This ongoing partnership includes implementing principles of community based participatory research in all phases of the research process.¹³ Key community personnel, primarily in the health and education sectors, have played important roles in project promotion, subject recruitment, data collection and dissemination of results. They also have played an advisory role in the design of the research and data collection methods. Data produced in WINGS have provided a foundation for building intervention strategies, and the increased trust, mutual gain in knowledge, and real by-products of the participatory relationship have been essential in developing each step of intervention.

This paper examines the associations among age, gender and 3 measures of weight status with proxy-reported physical activity and TV/screen time in young AI children from the WINGS project in order to understand influences on the development of pediatric obesity and to aid in intervention design for this high risk population.

SUBJECTS AND METHODS

Three American Indian communities in northern Wisconsin participated in the study: the Bad River Band of Lake Superior Chippewa, the Lac du Flambeau Band of Lake Superior Chippewa, and the Menominee Tribe of Wisconsin. The study was approved by the Institutional Review Boards of the University of Wisconsin Medical School and the Indian Health Service, the Great Lakes Inter-Tribal Council, and by each Tribal Council.

WINGS Screenings

A total of 581 children (49.1% female) age 3 – 8 years old (mean = 5.9 years, sd = 1.5) participated in health screenings held at their schools or through tribal Head Start and WIC programs. Families responded to recruitment through letters sent home to parents (via schools and Head Start) or through on-site recruitment (WIC). At the on-reservation schools, participation averaged 60% of those solicited. There was no indication that the child participants were biased relative to health measures of interest. At one participating tribal school, tribal health staff regularly measure BMI's on all 1st and 2nd graders. We compared BMI's of 1st and 2nd graders from our sample at that site to those collected by tribal health staff: mean BMI for all children (n=124) = 18.3; screened (n=85) = 17.9; p = .45.

During health screenings, height, weight, waist circumference, and percent body fat, as well as a number of other physiological measures, were collected. Heights and weights were measured to the nearest 0.1 cm and 0.1 kg, respectively, using clinical grade equipment;

percent body fat was obtained with a Tanita (Chicago, IL) instrument. Details of this methodology have been reported elsewhere.¹³

Caregivers also completed a 66-question survey that sought information on childbirth and early development history, family demographics and health, parents' attitudes toward specific health issues, and information on their child's nutrition and physical activity habits. WINGS screenings were held during consecutive years and because all available children were recruited for each screening, this yielded a subsample (eighteen percent of children) that had surveys completed on more than one occasion. Test-retest reliability was computed on 80 surveys for children who were surveyed in 2 consecutive years. Average test-retest was $r = 0.88$. Results presented here are from children's first survey and screening.

The following questions from the survey are relevant to PA and were in the following format yes/no for first part of question followed by a choice of 1, 2, 3, 4 or 5 or more:

"Does this child participate in any organized sports or physical activities after school or on weekends? (such as t-ball, soccer, swimming, etc.) "If yes, how many times per week?"

"Does your child have gym at school?" "If yes, how many times per week?"

"Does this child play outside after school?" "If yes, approximately how many hours each day?"

with answers of less than 1 hour, 1–2, 3–4, 5–6, to more than 6 hours.

TV/screen time questions were:

"How many hours of television or videos does this child watch each day?"

"How many hours of video or computer games does this child watch each day? "

with answers of less than 1 hour, 1–2, 3–4, 5–6, to more than 6 hours.

The two responses to TV and screen time questions were added to form one measure for TV/screen time per day. Caregivers responded to these survey questions by circling the number of hours or times per week on a scale from 1–5 or more for each question. There was also a question that asked about mode of transportation and distance to school, but virtually no children walked or biked to school.

Data Return to Communities

During the WINGS study, efforts were continually made to return the data to the families and communities involved via individual results letters for each child, and community presentations to school boards, Tribal Health Boards, Tribal Councils, parent-teacher conference days, newsletters and newspaper articles. A number of meetings were held to discuss the results with community groups and with Tribal wellness teams to examine the data, to receive community input on the findings, and to determine the next steps.

Data Analysis

Results described below are based on data from 421 children. Lack of caregiver interviews or body fat measures were the most common reason for missing data. The final sample differed from the larger sample only in age (final sample mean = 6.4 years, $sd = 1.2$; $p < 0.001$). The final sample contained fewer young children because caregivers of children recruited through Head Start had less opportunity to complete surveys. Also, the device used for measurement of body fat did not always work with younger children. Data were analyzed using SPSS for Windows version 17 (SPSS, Inc., Chicago, IL). We performed

descriptive analyses, compared means via t-tests, proportions via z-tests, and used Pearson correlations and regression to examine the relationships between the physical measures taken at the time of screenings and the survey results.

RESULTS

Weight status

Overall, 54.1% of children were at a healthy weight, 0.7% were underweight, 20.0% were overweight, and 25.2% were obese based on child BMI's referenced by age and gender to parameters supplied from CDC.¹⁵ Proportionally more boys were obese vs. overweight relative to girls (Boys 28% obese, 15% overweight, Girls 22% obese, 25% overweight) ($Z = 2.065$, $p = 0.04$). There was no systematic change in pattern of the three weight categories across ages 3 through 8 years. Nineteen percent of children (18.2% boys, 18.8% girls, $p = ns$) exceeded the 90th percentile for waist circumference reported in an analysis of national data.¹⁶ Mean body fat for the sample was 21.5% ($sd = 8.8\%$), with significantly higher mean body fat in boys vs. girls (22.7% for boys, 20.3% for girls, $p = .007$). Note that at this age girls normally have approximately 1 – 2% greater body fat than boys, a value which increases with maturation. Thirty-four percent of children exceeded the 91st percentile for body fat based on international standards¹⁷, with more boys having significantly higher body fat than girls (43.0% boys and 24.2% of girls, $p < .001$).

Activity questions from caregiver surveys

Mothers were the most frequent respondents on surveys (74%), followed by grandmothers (10%) and fathers (9%).

Table 2 describes the reported PA and TV/screen time for children. Caregivers reported that children overall participated in organized sports 0.71 times per week ($sd = 1.3$). This number was highest among 7-year-olds (0.97, $sd = 1.4$, $p = ns$). Participation differed by gender: boys participated 0.86 ($sd = 1.4$) times per week while girls participated 0.57 ($sd = 1.2$) times per week ($p = 0.02$). Children 3 years and older participated in school related physical education classes on average 1.5 times per week. Participation was lower in older children, with 1.9 times per week for 3 and 4 year-olds vs. 0.7 times per week for 8 year-olds ($p = 0.01$). There were no gender differences.

Most caregivers (53%) responded that their children played outside approximately 1 – 2 hours daily; 21% indicated 3 – 4 hours per day. There were no significant differences in this pattern between genders or across ages.

Mean TV/screen time per day was 2.2 hr ($sd = 1.6$). Boys were reported to watch significantly more hrs of TV/screen time per day, boys 2.4 hrs/day vs. girls 2.0 hrs/day ($p = 0.04$). When looking at TV watching alone, most children (75%) watched two or fewer hours of television each day according to caregivers, and 10 children (approximately 2%) watched five or more hours per day on average. These numbers changed to 65% watching two or fewer hours and 11.2% watching five or more hours when other forms of screen time (video games/computer time) were included.

Associations between weight status and physical activity and TV/screen time

BMI and waist circumference were not significantly correlated with TV/screen time or with the 3 activity measures (sports participation, outdoor play time or school based physical activity). Hours of outdoor play significantly predicted child body fat percent when mother's BMI and child's age and gender were controlled for as predictors (adjusted $R^2 = 0.14$, $F = 12.7$, $p < 0.001$; Beta for hours of outdoor play = -0.12, $p = 0.031$). Reported TV/screen time

was weakly correlated with sports participation but was only significant for girls ($r = 0.20$, $p = 0.01$).

DISCUSSION

This study showed a high prevalence of obesity in AI children ages 3–8, from three tribes in Wisconsin, with rates of obesity significantly higher than national data. We found that this held for all three measures of weight status; BMI, percent body fat and waist circumference. In addition, boys had higher rates of obesity and percent body fat than girls. We found that parent-reported child outdoor play was a significant predictor of body fat after correcting for other relevant predictors (maternal BMI, child age and gender). Weekend play, participation in organized sports, school physical education class, and TV/screen time did not predict any weight measures. The majority of caregivers reported child PA amounts and TV/screen times that met national guidelines, and caregivers reported significantly more PA in boys but also more screen time. Boys participated in more sports than girls even at these very young ages, but their reported participation in exercise declined from ages 3 – 8.

Only a few studies have used questionnaires to assess PA in young AI children.^{18,19,20,21} All of these studies focused on elementary school children, primarily >age 8. Only one other study, like ours, asked caregivers to respond about their younger children, the Kahnawake Diabetes Prevention Program (KSDPP), which had 1st-3rd graders' parents fill out the questionnaires. In the KSDPP program with 7 year old Mohawk children, a cross-sectional analysis showed a significant relationship between skinfold thickness (adiposity) and summer sports involvement, and failure to achieve a minimum fitness standard on fitness testing.²² Additional correlates found only among girls included TV watching, lower reported PA, and involvement in community sports, with TV viewing the only consistent predictor of adiposity in girls longitudinally over 2 yrs. Parents in KSDPP reported that their children were active an average of 47 minutes/day²³, significantly less than our families reported in WINGS. Child TV watching in KSDPP was slightly lower than in WINGS, approximately 1.3 hrs per day.

Cleland et al. found a significantly lower prevalence of overweight among children ages 10–12 spending more time outdoors, but found no association between BMI and outdoor activity in younger children, which the authors attributed to the lower variability in early childhood BMI.²⁴ A 2007 systematic review of 9 studies examining correlates of PA/sedentary behavior in 4–12 year old children, found male gender, self-efficacy, parental support and parental physical activity (for boys only) to be positively associated with physical activity. No association with PA was found for age, ethnicity, BMI/skinfold thickness, single parent status or screen time.²⁵

We also did not see a significant relationship between BMI/waist circumference and PA, although we did see a relationship between outdoor PA and a more direct measure of adiposity, i.e. percent body fat. It is possible that due to different timings of the onset of the “adiposity rebound” BMI is less useful as a surrogate for adiposity in children of preschool and early primary school age. No other studies have examined waist circumference or percent body fat in young children with reported physical activity or TV/screen time. In addition, several studies have reported declines in PA with age similar to that seen in our study.^{26, 27, 28} which is difficult to explain and may be due to caregivers understanding less about school based programming or children participating in less outdoor play as they get older. Further research is needed to clarify the reasons for this trend.

As part of our ongoing participatory research program with our partner communities, we spent considerable time and effort in returning WINGS findings to the communities. As part

of these discussions, we collaboratively designed an intervention, Healthy Children, Strong Families (HCSF), using a participatory process with tribal wellness teams, university researchers, and the Great Lakes Inter-Tribal staff.^{13, 29} Because WINGS found evidence of high rates of overweight and obesity in children younger than age 5, the decision was made with the communities to focus on pre-school aged children. HCSF uses a randomized controlled design to test the effectiveness of a 2 year mentored home visiting and group support healthy lifestyles intervention for AI primary caregiver(s) and their children (ages 2–5 yrs) vs. providing educational material only. Two of the goals of HCSF are to decrease TV watching and to increase PA among children, and the aims of the program are directly related to many of the WINGS findings and parental suggestions.²⁹

Strengths of the WINGS study included the young age range 3–8 yrs, involvement of three different tribes, and the efforts made to bring the data back to the communities and families involved. Limitations include the small number of survey questions about PA, a focus on family barriers rather than on Head Start or school issues, and the cross-sectional design. Prior to HCSF intervention design, we addressed some of these issues by the use of caregiver focus groups, key informant interviews, and direct observations of environmental barriers to obesity prevention at tribal sites.³⁰

Our long-term research partnership with these communities continues to evolve, and we are gaining a clearer understanding of the challenges to PA, the best measurements of PA, and how to facilitate appropriate early healthy lifestyle interventions for these high-risk AI families and communities.

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Table 1

	Boys	Girls	Total	Significance ^a
Child characteristics				
Age, y				
3–4	21	22	43	NS
5–6	121	119	240	
7–8	72	66	138	
BMI ^b				
<85%	57%	53%	231 (55%)	.059
85%–95%	15%	25%	84 (20%)	
>95%	28%	22%	106 (25%)	
Percent body fat (SD)	22.7% (8.3)	20.3% (9.3)	21.6% (8.8)	.007
Waist circumference, cm (SD)	60.5 (9.5)	59.5 (9.0)	60.0 (9.3)	NS
Caregiver characteristics ^c				
Maternal BMI				
<25			88 (29%)	
25–30			102 (33%)	
>30			119 (39%)	
No response			112	
Paternal BMI				
<25			56 (21%)	
25–30			110 (42%)	
>30			98 (37%)	
No response			157	
Caregiver Completing Survey				
Mother			191 (74%)	
Other female relative			28 (11%)	
Father			23 (9%)	
Other			17 (6%)	
No response			162 (39%)	
Highest education in household				
Some high school or less			20 (9%)	
High school completed			72 (31%)	
Some college			101 (44%)	
College completed			33 (14%)	
Postbachelor			6 (3%)	
No response			189	

Abbreviations: BMI, body mass index; NS, nonsignificant.

^aSignificance for tests between boys and girls for weight measures.

^bPercent of children in each category based on Centers for Disease Control and Prevention growth charts.

^cPercentages listed are as (%) of respondents.

Table 2

	Age	Boys	Girls	Significance
Organized sports, times/wk				
	3–4	0.37 (0.41)	0.35 (0.30)	NS
	5–6	0.82 (0.26)	0.51 (0.21)	NS
	7–8	1.00 (0.33)	0.74 (0.31)	NS
	All	0.86 (0.18)	0.57 (0.15)	.02
Physical education classes, times/wk				
	3–4	1.92 (0.90)	1.34 (0.72)	NS
	5–6	1.41 (0.32)	1.59 (0.28)	NS
	7–8	1.64 (0.39)	1.05 (0.35)	NS
	All	1.54 (0.24)	1.40 (0.22)	.36
Daily outdoor play, h/d				
	3–4	2.00 (0.49)	2.22 (0.40)	NS
	5–6	1.63 (0.26)	1.57 (0.23)	NS
	7–8	1.62 (0.29)	1.48 (0.29)	NS
	All	1.66 (0.18)	1.61 (0.17)	.27
Daily screen time, h/d				
	3–4	1.60 (0.98)	2.22 (0.55)	NS
	5–6	2.58 (0.33)	1.91 (0.33)	NS
	7–8	2.17 (0.37)	2.11 (0.41)	NS
	All	2.40 (0.24)	2.00 (0.23)	.04

Abbreviation: NS, nonsignificant.

^aMeans (and 95% CI) on 4 categories of activity for boys and girls across age groupings. Significance tests are for gender comparisons. Differences across age groupings are all nonsignificant.