# INVESTIGATION OF FACTORS CONTRIBUTING TO DIABETES RISK IN AMERICAN INDIAN/ALASKA NATIVE YOUTH

Kayleen Islam-Zwart, Ph.D. and Alvina Cawston, B.A.

*Abstract: This study investigated the relationship between family history, sedentary behaviors, and childhood risk for type 2 diabetes. Participants were 480 students attending schools on or near an American Indian reservation. Data were collected through survey and BMI measurement. Children who frequently watched television or played video games did not significantly differ in BMI compared to peers. However, children with a parental history of diabetes had significantly higher BMIs than children without.*

Type 2 diabetes is approaching epidemic rates of prevalence (Centers for Disease Control [CDC], 2002), especially among American Indians/Alaska Natives (AI/ANs). Furthermore, type 2 diabetes is afflicting AI/ANs at a continually younger age of onset. Several studies have been done to investigate the cause of diabetes (Hegele, Cao, Harris, Hanley, & Zinman, 1999; Martin, Warram, Krolewski, Bergman, Soeldner, & Kahn, 1992; Owen, Stride, Ellard, & Hattersley, 2003), but few have explored the reasons for the decreasing age of onset specific to the AI/AN population.

The increasing prevalence of type 2 diabetes among younger individuals has been attributed to lifestyle changes in diet and physical activity (Weir & Lipscombe, 2004). Modernization has resulted in a decrease in exercise and an increase in caloric and fat intake, which causes obesity – a risk factor for diabetes (Rosenbloom et al., 2000). Obesity is of particular concern given that AI/AN children have shown levels of obesity consistently higher than those of national averages and other ethnic groups (Baranowski et al., 2006; Caballero et al., 2003). Other risk factors for diabetes include family history: body mass index (BMI) greater than 25; a sedentary lifestyle; hypertension; dyslipidemia;

a history of gestational diabetes; polycystic ovary syndrome (Rao, Disraeli, & McGregor, 2004); belonging to a minority population such as AI/AN, African American, Hispanic American, or Asian/Pacific Islander (Rosenbloom et al.); and abdominal obesity (Weir & Lipscombe).

AI/AN youth show a number of poor health risk indictors (Harris, Gordon-Larsen, Chantala, & Udry, 2006) and type 2 diabetes specifically has had a dramatic impact on the AI/AN population. According to the CDC (2002), 14.9% of AI/ANs aged 20 years and older receiving care from the Indian Health Service (IHS) had diabetes, although the rate is likely even higher because of undetected cases. American Indians/Alaska Natives are 2.3 times more likely to develop diabetes than non-Hispanic Whites, and rates are increasing among the youth population. From 1988 to 1996, the prevalence of diabetes among youth aged 15-19 years increased 54% (Acton et al., 2002). Although not specific to AI/AN youth, a recent study found that the average time to insulin treatment did not differ by age, suggesting these individuals will have more years of life during which they can experience complications (Hillier & Pedula, 2003).

Although the etiology for the increase in diabetes and obesity among AI/ANs is unknown, studies have indicated possible explanations. Neel (1962) proposed the thrifty genotype phenomenon in AI/AN, which is hypothesized as an ability to release insulin quickly, so as to store energy in times of food abundance and utilize food energy storages efficiently during periods of famine (Neel, 1962; Neel, 1982; Neel, Weder, & Julius, 1998). Thus, because Western modernization has resulted in food abundance, food is continually stored in the body without being utilized for energy. Possibly related to this theory, AI/AN children are more likely to be overweight than any other ethnic group and to have increased central body fat (Goran et al., 1995). Blackett et al. (1996) also reported that obesity is associated with elevated lipid levels beginning at an early age in AI/AN children. Popkin (1994) asserted there is a nutrition transition pattern found in both low-income countries and AI/AN communities in the U.S. This nutrition transition is characterized by the adoption of a Western-type diet that is high in fat and low in fiber and linked with a sedentary lifestyle, which results in an increased prevalence of obesity and degenerative diseases (Popkin; Drewnowski & Popkin, 1997). Further studies have suggested that reductions in the economic cost of carbohydrates may contribute to higher incidences of AI/AN obesity (Richards & Patterson, 2006).

Research indicates that 50-90% of youth with type 2 diabetes have a BMI greater than 27 or $\geq$ 85% for age (Rosenbloom et al., 2000). Several studies in the general population have indicated a correlation between low levels of physical activity and obesity (Steinbeck, 2001; Kimm et al., 2002). Other findings indicate an interaction between television viewing and increased consumption of high-energy foods (Campbell et al., 2002), increased obesity (Crespo et al., 2001), and decreased energy expenditure (McMurray et al., 2000). Collectively, these studies support the notion that children who exhibit low levels of physical activity are at greater risk for type 2 diabetes. Similarly, Rosenbloom et al. (2000) assert that minority children have a genetic predisposition to insulin resistance and that the presence of environmental modulators could increase their risk. The purpose of the current study was to investigate this assertion among AI/AN youth. Specifically, it was predicted that AI/AN children who watched television or played video games for at least 2 hours per day, and/or who had a parent with type 2 diabetes, would have a higher BMI percentile rank than their peers.

## Method

### Participants

Participants were children in the third through twelfth grades attending schools located on or near an AI reservation in north central Washington state. (The decision to begin with third-grade students was based on the American Diabetes Associaton [2000] guidelines that suggest screening of children every two years beginning at 10 years of age.) Six school areas were screened over a one-year period. There were a total of 1404 students in the six schools, 796 of whom were known AI according to the Colville IHS unit. Specific data regarding ethnicity were not collected. For reasons of equity and to avoid stigmatization, non-Indian students were also offered the screening opportunity and their data were not excluded from analysis. Students who were diabetic, pregnant, acutely ill, or who had a chronic illness were excluded from analysis. Two comparisons were made in this study: 1) children who watched television or played video games for 2 or more hours per day ($n = 287$; 165 females and 122 males) and children who watched television or played video games for less than 2 hours per day ($n = 193$; 117 females and 76 males), and 2) children who had one or both parents

with diabetes (*n* = 78; 55 females and 23 males) and children with no parental diagnosis of diabetes (*n* = 402; 227 females and 175 males). The socioeconomic status of the reservation and surrounding areas was low to mid-range, with a median household income level of $29,830 in 1999, based on information from the U.S. Census Bureau regarding the tribe (2000). Average age was 12.08 years (*SD* = 2.71, range = 8-18). See Table 1 for additional demographic information.

**Table 1**
**Demographics by Group (N = 480)**

|  | No Parent with Diabetes/ ≥2 Hours of TV/Video | No Parent with Diabetes/ <2 Hours of TV/Video | Parent with Diabetes/ ≥2 Hours of TV/Video | Parent with Diabetes/ <2 Hours of TV/Video |
|---|---|---|---|---|
|  | n = 235 (male = 107, female = 128) | n = 167 (male = 68, female = 99) | n = 52 (male = 15, female = 37) | n = 26 (male = 8, female = 18) |
|  | Mean (*SD*) | Mean (*SD*) | Mean (*SD*) | Mean (*SD*) |
| Age | 12.04 (2.74) | 11.83 (2.70) | 11.98 (2.70) | 12.73 (2.53) |
| Height | 60.65 (5.31) | 60.39 (5.36) | 60.52 (5.54) | 61.80 (4.67) |
| Weight | 125.28 (47.89) | 119.38 (43.31) | 135.17 (49.32) | 157.00 (54.94) |
| BMI Percentile Rank | 75.86 (26.08) | 73.82 (25.13) | 81.80 (25.35) | 87.30 (18.34) |

## Apparatus

Parents completed a consent form that inquired briefly about medical and family history. Data pertaining to the children's number of hours spent watching television and playing video games and the presence of a parent with diabetes were also collected from the parental consent form. Specifically, there were questions on the consent that asked for a Yes or No response pertaining to the child (Have a mother or father with diabetes; Watch television or play video games at least 2 hours every day). The diabetes screen, performed by licensed nurses, measured each child's height in inches and weight in pounds to calculate the BMI using the standard formula and then converted the results into percentiles by age and gender, as specified on the SECA growth chart (CDC, 2001).

## Procedure

This study used archival data collected by the IHS Diabetes Program as part of an ongoing project investigating diabetes in youth and adolescents served by the Colville IHS unit (Marrero, Oliver, Kim, Robertson, & Lee, 2004). Participants for the screenings were recruited through a letter sent to parents one month prior to the screening. As part of the letter, parents were invited to attend a dinner and presentation at their child's school; the presentation included information about diabetes progression and the goal of primary prevention. Parents were given the opportunity to sign a consent form at the meeting or to send it to school with the child. One week and then one day prior to the screening, reminder letters were sent to parents. On the day of the screening, all children who had returned informed consents permitting participation were invited to the screening. Once there, an IHS employee read each child an assent form and obtained his/her signature. All children received packet containing a t-shirt, pencil, pedometer, and coloring book as compensation for their participation. Results of the screening were not given to the students that day, but were mailed to the parents. Students who did not participate in the screening were escorted to the cafeteria and provided an alternative activity according to each school's preferences. No information was collected from students electing not to participate. Study procedures were conducted in accordance with American Psychological Association ethical guidelines and were approved by the Portland Area IHS Institutional Review Board and the university's Institutional Review Board.

## Results

A 2 (2 hours or more per day spent watching television or playing video games vs. less than 2 hours) x 2 (parent with diabetes vs. no parent with diabetes) analysis of variance (ANOVA) was conducted to determine whether children who watched television or played video games for 2 hours per day or more and/or had a parent with diabetes would have higher BMI percentiles than children who did not. Findings indicated no significant difference in the BMI percentiles of children who watched 2 or more hours of television when compared to their peers, $F(1, 479) = 0.28$, $p = .60$. However, children with a parental history of diabetes did differ significantly in BMI percentile rank when compared to children who did not have a parent with diabetes, $F(1, 479) = 8.65$, $p = .00$, $\eta^2 = .018$. Specifically, children with one or both parents with diabetes

showed significantly higher BMI percentile rank ($M = 83.63$, $SD = 23.28$) than those without a parental history ($M = 75.01$, $SD = 25.68$). There was no significant interaction, $F(1, 479) = 1.30$, $p = .26$.

## Discussion

This study examined the relationship between parental diabetes status, sedentary behaviors, and childhood risk for type 2 diabetes. Rosenbloom et al. (2000) suggested that minority children have a genetic predisposition for insulin resistance. Thus, in the presence of environmental modulators, their risk for type 2 diabetes is increased, potentially resulting in earlier disease expression. In accordance with this assertion, it was predicted that children who watched television or played video games for 2 or more hours per day and/or had a parent with diabetes would have a higher BMI percentile rank than their peers. As anticipated, children with one or two parents who had diabetes had a significantly higher BMI percentile rank than those children without a parental history. In contrast to the expected finding, children who watched television or played video games for 2 or more hours did not have a higher BMI percentile rank than children who did not. Therefore, these results falter in support of Rosenbloom et al.'s contention that environmental modulators increase children's risk for type 2 diabetes.

Differential findings related to television watching may have resulted from the measurement used in the current study. Specifically, previous conceptions of environmental modulators may differ from the measurement used in the current study (amount of television viewing and video game playing). Alternatively, it may be that 2 hours is not an appropriate cutoff. In a longitudinal study in which television viewing hours were measured with specificity, television viewing was associated with obesity, poor cardio-respiratory fitness, increased cholesterol, and cigarette smoking in early adulthood (Hancox, Milne, & Poulton, 2004), which are all risk factors for diabetes. Future studies using a continuous measure of time spent watching television and playing video games would perhaps provide more definitive results. Another potential limitation for this study may be that additional activities were unknown. Thus, it is possible that hours of television watching or video game playing alone is not a good predictor of overall activity level. For example, a cross-sectional study indicated that the only risk factor for higher BMI in adolescents was an inadequate vigorous physical activity level (Patrick et al., 2004). Additionally, dietary information was not solicited in this study. Therefore, future studies might incorporate

sedentary lifestyle factors, dietary and environmental modulators, and physical movement to determine risk and health behaviors. Utilizing multiple measures would provide a more accurate account of activity level and other impacting factors.

In regards to parental diabetes status, there were also limitations. Specifically, the parental consent only inquired about having a parent with diabetes and did not ask for specifics regarding which parent, or whether both parents had diabetes. It is also possible that parents suffered from undiagnosed diabetes at the time of the screening and, thus, the classification was not accurate. Further studies should incorporate more specific questions about parental diabetes status and collect body weight, shape, and height information from parents as well as children. As more information becomes available about the most accurate indicators of risk, alternative measurements might be considered (Freedman et al., 2007). It is also necessary to look at shared environmental factors such as parents' and children's shared dietary habits.  It is possible that such factors contributed to the obesity and/or diabetes risk for children in this study.

Finally, parents were asked to report regarding their children's risk factors. Although it is likely that they would be knowledgeable about their own or a partner's diabetes status, the accuracy of their reporting of children's television watching and video game playing may be questionable. In the future, it would likely be more beneficial to question children, in addition to parents, to verify the accuracy of information. As study results do indicate some association between increased BMI in AI/AN youth and parental history of diabetes, further study in this area is warranted.

Kayleen Islam-Zwart, Ph.D.
Department of Psychology
Eastern Washington University
151E Martin Hall
Cheney, WA  99004
E-mail: kislamzwart@mail.ewu.edu
Phone: (509) 359-2380

## References

Acton, K. J., Burrows, N. R., Moore, K., Querec, L., Geiss, L. S., & Engelgau, M. M. (2002). Trends in diabetes prevalence among American Indian and Alaska Native children, adolescents, and young adults. *American Journal of Public Health, 92*, 1485-1491.

American Diabetes Association. (2000). Type 2 diabetes in children and adolescents. *Diabetes Care, 23*, 381-389.

Baranowski, T., Cooper, D.M., Harrell, J., Hirst, K., Kaufman, F.R., Goran, M., et al. (2006). Presence of diabetes risk factors in a large U.S. eighth-grade cohort. *Diabetes Care, 29,* 212-217.

Blackett, P.R., Taylor, T., Russell, D., Lu, M., Fesmire, J., & Lee, E.T. (1996). Lipoprotein changes in relation to body mass index in Native American adolescents. *Pediatric Research, 40*, 77-81.

Caballero, B., Himes, J.H., Lohman, T., Davis, S.M., Stevens, J., Evans, M., et al. (2003). Body composition and overweight prevalence in 1704 schoolchildren from 7 American Indian communities. *American Journal of Clinical Nutrition, 78*, 308-312.

Campbell, K., Crawford, D., Jackson, M., Worsley, A., Gibbons, K., & Birch, L. (2002). Family food environments of 5-6-year-old-children: Does socioeconomic status make a difference? *Asia Pacific Journal of Clinical Nutrition, 11,* S553-S561.

Centers for Disease Control. (2002). *National diabetes fact sheet.* Retrieved June 22, 2004, from http://www.cdc.gov/diabetes/pubs/factsheet.htm.

Centers for Disease Control. (2001). *National Center for Health Statistics Growth Charts.* Retrieved October 23, 2007, from http://www.cdc.gov/nchs/about/major/nhanes/growthcharts/background.htm.

Crespo, C., Smit, E., Troiano, R., Bartlett, S., Macera, C., & Andersen, R. (2001). Television watching, energy intake, and obesity in US children: Results from the Third National Health and Nutrition Examination Survey, 1988-1994. *Archives of Pediatrics & Adolescent Medicine, 155,* 360-365.

Drewnowski, A., & Popkin, B. (1997). The nutrition transition: new trends in the global diet. *Nutrition Reviews, 55,* 31-43.

Freedman, D.S., Kahn, H.S., Mei, Z., Grummer-Strawn, L.M., Dietz, W.H., Srinivasan, S.R., et al. (2007). Relation of body mass index and waist-to-height ratio to cardiovascular disease risk factors in children and adolescents: The Bogalusa Heart Study. *The American Journal of Clinical Nutrition, 86,* 33-40.

Goran, M., Kaskoun, M., Johnson, R., Martinez, C., Kelly, B., & Hood, Y. (1995). Energy expenditure and body fat distribution in Mohawk children. *Pediatrics, 95,* 89-95.

Hancox, R., Milne, B., & Poulton, R. (2004). Association between child and adolescent television viewing and adult health: A longitudinal birth cohort study. *Lancet, 364,* 257-263.

Harris, K.M., Gordon-Larsen, P., Chantala, K., & Udry, J.R. (2006). Longitudinal trends in race/ethnic disparities in leading health indicators from adolescence to young adulthood. *Archives of Pediatrics & Adolescent Medicine, 160,* 74-81.

Hillier, T., & Pedula, K. (2003). Complications in young adults with early-onset type 2 diabetes: Losing the relative protection of youth. *Diabetes Care, 26,* 2999-3005.

Kimm, S., Glynn, N., Kriska, A., Barton, B., Kronsberg, S, Daniels, S., et al. (2002). Decline in physical activity in black girls and white girls during adolescence. *New England Journal of Medicine, 347,* 709-715.

Marrero, A., Oliver, J., Kim, T., Robertson, D., & Lee, D. (2004). [Pre-diabetes and diabetes on the Colville reservation: A school based youth screening program]. Unpublished raw data.

McMurray, R., Harrell, J., Deng, S., Bradley, C., Cox, L., & Bangdiwala, S. (2000). The influence of physical activity, socioeconomic status, and ethnicity on the weight status of adolescents. *Obesity Research, 8,* 130-139.

Neel, J.V. (1962). Diabetes mellitus: A "thrifty genotype" rendered detrimental by "progress." *American Journal of Human Genetics, 14,* 353-362.

Neel, J.V. (1982). The thrifty genotype revisited. In *The genetics of diabetes mellitus* (Ed.), (pp. 49-60). New York: Academic.

Neel, J.V., Weder, A., & Julius, S. (1998). Type II diabetes, essential hypertension, and obesity as "syndromes of impaired genetic homeostasis": The "thrifty genotype" hypothesis enters the 21st century. *Perspectives in Biology and Medicine, 42*, 44-74.

Owen, K., Stride, A., Ellard, S., & Hattersley, A. (2003). Etiological investigation of diabetes in young adults presenting with apparent type 2 diabetes. *Diabetes Care, 26,* 2088-2094.

Patrick, K., Norman, G., Calfas, K., Sallis, J., Zabinski, M. S., Rupp, J., et al. (2004). Diet, physical activity, and sedentary behaviors as risk factors for overweight in adolescence. *Archives of Pediatrics & Adolescent Medicine, 158*, 385-390.

Popkin, B. (1994). The nutrition transition in low-income countries: An emerging crisis. *Nutrition Reviews, 52,* 285-298.

Rao, S., Disraeli, P., & McGregor, T. (2004). Impaired glucose tolerance and impaired fasting glucose. *American Family Physician, 69,* 1961-1968.

Richards, T.J., & Patterson, P.M. (2006). Native American obesity: An economic model of the "thrifty gene" theory. *American Journal of Agricultural Economics, 88,* 542-560.

Rosenbloom, A., Arslanian, S., Brink, S., Conschafter, K., Jones, K., Klingensmith, G., et al. (2000). Type 2 diabetes in children and adolescents. *Pediatrics, 105*, 671-680.

Steinbeck, K. (2001). The importance of physical activity in the prevention of overweight and obesity in childhood: A review and an opinion. *Obesity Reviews, 2,* 117-130.

Weir E., & Lipscombe, L. (2004). Metabolic syndrome: Waist not want not. *Canadian Medical Association Journal, 170,* 1390-1391.

## Authors' Notes

Dr. Islam-Zwart is affiliated with Eastern Washington University. Ms. Cawston was affiliated with Eastern Washington University at the time this work was conducted.  She is now affiliated with Oklahoma State University.