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RISK FACTORS FOR PRE-DIABETES AND DIABETES IN ADOLESCENCE AND THEIR VARIABILITY BY RACE AND ETHNICITY

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Abstract

Adolescent risk factors for pre-diabetes and diabetes in young adulthood were examined in three minority groups and compared to those in non-Hispanic Whites.

Retrospective cohort study with data on 8,337 adolescent respondents from Add Health (1994–2008). Participants included 5,131 non-Hispanic Whites, 1,651 non-Hispanic Blacks, 1,223 Hispanics, and 332 American Indians/Alaska Natives. Diabetes was defined as: hemoglobin A1C $\geq 6.5\%$, glucose > 125 mg/dl, self-reported diabetes, or self-reported diabetes medication use, in Wave 4 data. Pre-diabetes was defined as hemoglobin A1C $\geq 5.7\%$. Relative risk regression models were used to evaluate the association between risk factors and risk of diabetes and prediabetes, controlling for body mass index, sedentary and physical activity habits, fast food consumption, and parental education, parental diabetes status, and financial stability. 484 participants developed diabetes; 2,878 developed pre-diabetes between 1994 and 2008.

Prediabetes and diabetes were more prevalent in non-Hispanic Blacks (55% and 12%, respectively) than in American Indians/Alaska Natives (43% and 11%), Hispanics (37% and 6%), and non-Hispanic Whites (27% and 3%). In all races, higher body mass index and parental diabetes were associated with higher risk of pre-diabetes and diabetes, while female sex was associated with lower risk of pre-diabetes. Efforts to reduce the risk of pre-diabetes and diabetes in adolescents should emphasize parental diabetes and BMI in all races, independent of physical activity, sedentary behaviors, or fast food consumption. Future interventions might be interested in targeting households, rather than individuals, to prevent pre-diabetes and diabetes in adolescents and young adults.

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Keywords

adolescence; diabetes; race and ethnicity; diabetes prevention

INTRODUCTION

Diabetes is a risk factor for cardiovascular disease, kidney disease, stroke, amputations, blindness, and depression.^{1–4} In adolescence, diabetes complications develop at an accelerated pace,⁵ and the incidence of diabetes in racial and ethnic minority youth has increased in recent years.⁶ Current projections estimate that the prevalence of diabetes will quadruple among adolescents of all races in the next 30 years.⁷ Recent research indicates that American Indian and Alaska Native (AI/AN) adolescents have the highest prevalence of diabetes in the US, at 1.20 per 1,000, followed by non-Hispanic Blacks (1.06), Hispanics (0.79), Asians (0.34), and non-Hispanic Whites (0.17).⁷

Previous studies have explained disparities in diabetes as the result of genetic, metabolic, behavioral, and socioeconomic risk factors.^{8–11} However, recent studies suggest that diabetes risk factors might lead to differential outcomes depending on race and ethnicity.^{12–14} One study found that maternal diabetes (either gestational or type 2 diabetes mellitus) was more strongly associated with low glycemic control among Hispanics and non-Hispanic Blacks (NHBs) than among NHWs.¹² Another investigation developed a risk reduction score for diabetes based on dietary intake in the Nurses' Health Study (1980–2009), finding that minority respondents, achieved a larger reduction in absolute diabetes risk than did NHWs.¹³ If the impact of risk factors on prevalent diabetes truly varies by race and ethnicity, as this body of research suggests, it is a public health imperative to determine the associations between risk factors and diabetes outcomes in people of all backgrounds, especially youth.

Although no study to date has examined risk factors for pre-diabetes and diabetes in a multiracial sample of adolescents and young adults, the National Longitudinal Study of Adolescent to Adult Health (Add Health) offers data to fill this gap. Add Health assembled a nationally representative cohort of adolescents and followed them for four waves of data collection (1994–2008). The study cohort includes the largest sample of adolescent and young adult AI/ANs with longitudinal health data. The Add Health dataset enables an examination of the risk factors for diabetes in adolescence, as well as an estimate of the extent to which these factors vary by race. The objective of the present study was to measure the associations between known risk factors for pre-diabetes and diabetes among adolescents and the prevalence of these conditions among young adults in four racial and ethnic groups: NHWs, NHBs, AI/ANs, and Hispanics. Although Add Health also collected data on Asians and Native Hawaiians/Other Pacific Islanders, these data were aggregated in a single category ("Asian or Pacific Islander"), forestalling an extension of the analysis to additional races.

METHODS

Data

Add Health is a nationally representative survey conducted by the Carolina Population Center at the University of North Carolina-Chapel Hill. Details of Add Health have been previously published.¹⁵ Respondents were 11–20 years old (mean age: 16 years) at baseline in 1994 and were followed for additional waves of data collection in 1996, 2002, and 2008. In 2008 (Wave 4; mean follow-up time: 14 years; mean age: 30 years), respondents completed a questionnaire and a biomarker assessment that measured hemoglobin A1C and fasting glucose, enabling assessment of prevalent pre-diabetes and diabetes. Add Health retention rates over all waves ranged from 72% to 79%, similar to those in the National Health and Nutrition Examination Survey.¹⁶ Because the present study used anonymized survey data, it was exempt from ethical review by the authors' Institutional Review Board.

At baseline, Add Health administered separate questionnaires to 20,745 adolescents and 17,669 of their parents. Adolescent and parental questionnaires provided complementary information on risk factors for diabetes. For this study, analyses were limited to respondents who self-identified at baseline as NHW, NHB, AI/AN, or Hispanic; whose parents completed the parental questionnaire at baseline; and who participated in the biomarker assessment at Wave 4.

Exclusions and missing data

Of the original sample of 20,745 adolescents, only 10,684 had data from the parental questionnaire at baseline and participated in Waves 1, 2, and 4. From this subsample, 2,374 were excluded for the following reasons: 1) racial identification as "Asian or Pacific Islander" (N=540); 2) age 20 years or older at baseline (N=16); 3) prevalent diabetes at baseline (N=44); and 4) missing data for at least one variable of interest (N=1,747). We conducted a complete case analysis with a final sample of 8,337 respondents, including 5,131 NHWs, 1,651 NHBs, 332 AI/ANs, and 1,223 Hispanics.

Measures

Outcomes of interest were prevalent pre-diabetes and diabetes (either type 1 or 2) at Wave 4. Participants were defined as pre-diabetic if they had hemoglobin A1C $\geq 5.7\%$ or fasting glucose 100–125 mg/dl and did not meet any criteria for diabetes: hemoglobin A1C $\geq 6.5\%$, fasting glucose > 125 mg/dl, self-reported history of diabetes (yes/no), or self-reported diabetes medication use (yes/no). Previous research has confirmed the reliability of diabetes indicators in Add Health.¹⁷

The adolescent questionnaire at baseline (Wave 1) provided variables to measure respondents' BMI in kilograms/meters², measured with self-reported height and weight; weekly frequency of playing an active sport, such as baseball, softball, basketball, soccer, swimming, or football (not at all, 1 to 2 times, 3 to 4 times, and 5 or more times); hours of watching TV per week (less than 14, 14 to 27, and 28 or more); and weekly frequency of fast food consumption (none, 1 to 2 days per week, and 3 days per week or more). BMI was

transformed into a percentile based on age-(months) and sex- matched CDC referent values¹⁸ and measured in 5-percentile intervals.

The parental questionnaire at Wave 1 included self-reported diabetes status for both parents and for the adolescent respondent (yes/no) and two indicators to measure adolescents' socioeconomic status: a) parental education (less than a high school degree, high school graduate or more), and b) self-reported ability to pay monthly bills (yes/no).

If participants selected more than one race and ethnicity, they were assigned to a single racial/ethnic category in the following order of preference: AI/AN, Hispanic, NHB, and NHW. This approach, which is endorsed in the literature, maximizes the representation of racial and ethnic minorities.^{19,20}

Analyses

Sample characteristics were summarized by using means, standard deviations, and proportions by race and ethnicity. The statistical analysis of the data used relative risk regression models with a binomial distribution assumption, stratified by race and adjusted for age and sex, to model the association between adolescent risk factors at Wave 1 and prevalent pre-diabetes and diabetes at Wave 4. Relative risks (RR) and 95% confidence intervals (CI) are presented as results. All analyses were conducted with R, version 3.2.5.20. All data were analyzed in 2017.

RESULTS

Table 1 provides descriptive statistics for the study sample. At baseline, the average age was 15.7 years (standard deviation [SD] 1.6) and 52.9% were female. Relative to NHWs, Hispanics were older by an average of 0.35 years, and NHBs and AI/ANs had a higher proportion of female participants (by 3.8% and 4.9%, respectively). Among all races and ethnicities, NHWs reported the healthiest BMI and the highest frequency of physical activity. The average BMI among NHWs was 21.9 kg/m² (SD 4.2 kg/m²), while the average was higher by 1.2 kg/m² (95% CI 0.95, 1.34) among AI/ANs, NHBs, and Hispanics. Obesity was present in 17% of AI/ANs, 14% of NHBs, and 13% of Hispanics, but only 9% of NHWs. NHWs were the least likely to report not playing sports at all (24%) and the most likely to play sports at least five times per week (28%), while Hispanics were the most likely to report not playing sports (33%) and the least likely to play at least five times per week (22%). NHWs had the lowest frequency of weekly TV viewing, with 64% reporting 14 hours or fewer per week, while NHBs had the highest prevalence, with 25% reporting 28 hours or more per week. AI/ANs had the lowest frequency of fast food consumption, with 17% reporting no fast food consumption at all, compared to 16% of NHWs, 15% of NHBs, and 13% of Hispanics, while 39% of NHBs reported eating fast food at least three times per week, closely followed by Hispanics at 38%.

NHW parents also reported the best metabolic health, the highest prevalence of college degrees, and the lowest prevalence of financial instability. While 15% of AI/AN parents were diabetic, diabetes prevalence was 11% in NHB and Hispanic parents and only 6% in NHW parents. Among NHW parents, 38% had a college degree, compared to 31% of NHBs,

23% of AI/ANs, and 18% of Hispanics. Only 13% of NHW parents were financially unstable, compared to 27% of NHBs, 26% of Hispanics, and 21% of AI/ANs. These demographic and behavioral factors were broadly consistent with the prevalence of diabetes and pre-diabetes estimated for adolescents in each group. By Wave 4, 12% of NHBs, 11% of AI/ANs, 6% of Hispanics, and 3% of NHWs had developed diabetes, while most 55% of NHBs, 43% of AI/ANs, 38% of Hispanics, and 27% of NHWs were pre-diabetic (Table 1).

Table 2 provides estimates of the multivariate associations between risk factors and prevalent diabetes, adjusting for age and sex and stratifying by race. After adjusting for all other risk factors, a 5 percentile increase in BMI was associated with higher risk of diabetes in all races and ethnicities. In AI/ANs, a 5 percentile increase in BMI was associated with a RR of 1.09 (95% CI: 1.02–1.17). Similar results were observed in NHWs (RR: 1.12; 95% CI: 1.09–1.16), Hispanics (RR: 1.12; 95% CI: 1.06–1.18), and NHBs (RR: 1.06; 95% CI: 1.04–1.09). Notably, Hispanics with a diabetic parent had more than double the risk of prevalent diabetes (RR: 2.40; 95% CI: 1.50–3.86), while in NHWs, parental diabetes was associated with an increase of only 85% in diabetes risk (RR: 0.85; 95% CI: 1.22–2.80). In NHBs and AI/ANs, parental diabetes was associated with RR of 1.40 (95% CI: 0.99–1.97) and 1.53 (95% CI: 0.76–3.08), respectively, for diabetes. Having parents with at least a high school education was associated with lower risk of diabetes in NHWs (RR: 0.43; 95% CI: 0.28–0.67), AI/ANs (RR: 0.74; 95% CI: 0.35–1.57), and NHBs (RR: 0.82; 95% CI: 0.57–1.20), but not in Hispanics (RR: 1.05; 95% CI: 0.67–1.65). Note, however, that the association with NHWs was the only one that rose to statistical significance. No associations with prevalent diabetes were observed for physical activity, sedentary habits, or parental financial stability.

Table 3 provides estimates of the associations between adolescent risk factors and prevalent prediabetes, again adjusting for age and sex and stratifying by race. After adjusting for all other risk factors, a 5 percentile increase in BMI was associated with higher risk of pre-diabetes in all races and ethnicities: AI/ANs (RR: 1.04; 95% CI: 1.02–1.06), NHWs (RR: 1.03; 95% CI: 1.02–1.04), Hispanics (RR: 1.03; 95% CI: 1.02–1.05), and NHBs (RR: 1.01; 95% CI: 1.00–1.02). Female sex was associated with lower risk of pre-diabetes in all races and ethnicities, with the strongest association observed in NHWs (RR: 0.73; 95% CI: 0.66–0.80), followed by AI/ANs (RR: 0.74; 95% CI: 0.60–0.93), NHBs (RR: 0.77; 95% CI: 0.71–0.85) and Hispanics (RR: 0.79; 95% CI: 0.68–0.92). In NHBs, higher weekly frequency of playing sports was associated with lower risk of pre-diabetes (RR: 0.95; 95% CI: 0.91–0.99). In NHWs and AI/ANs, higher weekly frequency of TV watching was associated with higher risk of prevalent pre-diabetes. NHW respondents who watched TV 14–21 hours per week and those who watched at least 28 hours per week were respectively 12% (95% CI: 1.01–1.24) and 18% (95% CI: 1.04–1.35) more likely to develop prediabetes than those who watched TV 14 hours or fewer per week. In AI/ANs, watching TV 14–21 hours per week increased the risk of pre-diabetes by 13% (95% CI: 0.87, 1.46) and watching more than 28 hours increased the same risk by 36% (95% CI: 1.09, 1.70).

As with diabetes risk, having a diabetic parent was associated with a higher risk of pre-diabetes in all races: Hispanics (RR: 1.36; 95% CI: 1.14–1.61), AI/ANs (RR: 1.25; 95% CI: 1.01–1.25), NHWs (RR: 1.25; 95% CI: 1.07–1.46), and NHBs (RR: 1.16; 95% CI: 1.03–1.30). Having a parent with at least a high school diploma, on the other hand, was

significantly associated with a lower risk of pre-diabetes in NHWs, but not in other races (RR: 0.68; 95% CI: 0.58–0.80). Financial instability was associated with higher risk of pre-diabetes in Hispanics (RR: 1.18; 95% CI: 1.01–1.37). Finally, fast food consumption was not associated with prevalent pre-diabetes (Table 3).

DISCUSSION

This was the first study to examine the potential associations linking risk factors for diabetes with prevalent pre-diabetes and diabetes in NHW, NHB, AI/AN, and Hispanic adolescents. In all racial and ethnic groups, higher BMI in adolescence was significantly associated with higher risk of prevalent pre-diabetes and diabetes in early adulthood, independent of demographic or socioeconomic factors. Having a diabetic parent was another strong risk factor for pre-diabetes and diabetes, while female sex was protective against pre-diabetes in all groups. Analyses also addressed the extent to which associations with diabetes risk factors varied by race and ethnicity. The frequency of playing an active sport each week was associated with a lower risk of pre-diabetes in NHBs, but not in other groups. Among NHWs and AI/ANs, the number of hours spent watching TV per week increased the risk of pre-diabetes, and in NHWs alone, having parents with less than a high school education increased the risk of diabetes, as previous studies have shown.^{10,12} These results show the extent to which risk factors for diabetes and pre-diabetes vary across racial and ethnic groups.

What remains unclear is the extent to which risk factors for diabetes mediate each other. Parental diabetes might increase the relative risk of diabetes through a genetic pathway involving hereditary factors associated with disease susceptibility. Alternatively, a behavioral pathway might be involved, such that diabetic parents model unhealthy dietary and exercise-related behaviors that increase diabetes risk in their children.²⁶ Similarly, female sex might inhibit pre-diabetes through hormonal changes or cultural factors that remain unstudied.²⁷ Further research is needed to illuminate these questions.

Findings with wide confidence intervals, such as those for NHBs or AI/ANs, need to be reinvestigated with substantially larger samples. Larger samples and more high-quality data are also needed to inform population-specific interventions to prevent diabetes. Lifestyle interventions have been found to prevent or delay the onset of diabetes,^{28–32} but among AI/ANs, for example, such programs have primarily recruited adults.^{33–36} We are aware of only one intervention designed to address diabetes in AI/AN adolescents, and it is currently in progress.³⁷ A completed intervention study with some relevance to AI/ANs is Treatment Options for Type 2 Diabetes in Adolescent and Youth, whose sample was 5.9% AI/AN.³⁸ Unfortunately, that study did not stratify analyses by race,^{5,39} so the benefit of the intervention for AI/AN youth was unclear.

Limitations

This study is limited by the nature of the Add Health dataset. First, Add Health oversampled certain minority populations, such as highly educated NHBs, Puerto Ricans, and Cubans, but not others, such as AI/ANs. Thus, the limited AI/AN subsample likely does not represent the great diversity of AI/ANs across the US. Moreover, Add Health conflated Asians and Pacific

Islanders into a single category, preventing racially specific analyses of these very different populations. Second, the analysis only examined risk factors for pre-diabetes and diabetes with four waves of data, without distinguishing between type 1 and type 2, and without information about those who might have experienced a later onset. Third, because of attrition over the four waves of Add Health, the study sample might have under- or overestimated the prevalence and effect size of risk factors for diabetes. Notably, the Add Health research team examined missing data patterns between Waves 1 and 4, finding that BMI, physical activity, and sedentary habits did not predict missingness.⁴⁰ However, they did not examine missing data patterns for other variables assessed in the present research, such as parental diabetes status, education, and financial stability. Fourth, Add Health did not include variables (for example, Tanner stages⁴¹) to adjust for dietary intake or physical development. If physical development in adolescence varies by race, failure to adjust for this confounder might exaggerate racial differences. Fifth, Add Health did not collect participants' impaired glucose tolerance (IGT) or impaired fasting glucose (IFG) levels, which could have informed the analysis as well as the characterization of racial differences. Sixth, because of the small size of minority samples, we were unable to further stratify the results by glucose metabolism or to assess its potential mediating effect on pre-diabetes and diabetes risk.

Despite these limitations, our study has two important strengths. First, it analyzed the largest longitudinal sample of adolescent and young adult AI/ANs in the US and calculated population-based estimates of risk factors for diabetes in this age cohort. Second, it compared estimates of the associations between risk factors in adolescence and prevalent pre-diabetes and diabetes in later life in four different races.

CONCLUSIONS

This study contributes to the literature on diabetes, adolescent medicine, and health disparities by demonstrating an association between risk factors in adolescence and prevalent diabetes in early adulthood among four out of six racial and ethnic groups recognized by the US Census. Further research is needed to clarify the extent to which these findings can be generalizable, the causal pathways for specific risk factors, such as BMI, and whether they mediate other risk factors for diabetes, its onset, and its disparities by race and ethnicity. The present findings offer a powerful motivation to accelerate efforts to prevent diabetes in adolescence, especially in populations such as NHBs and AI/ANs, which experience a disproportionately high prevalence of diabetes in early adulthood.

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HIGHLIGHTS

- Examination of risk factors for pre-diabetes and diabetes in four races.
- BMI and parental diabetes increased the risk of diabetes in all races.
- Female sex decreased the risk of pre-diabetes in all races.
- Future interventions might target high-risk households to prevent diabetes.

Table 1.

Demographic characteristics of the study sample

	Non-Hispanic Whites		Non-Hispanic Blacks		American Indians/Alaska Natives		Hispanics	
	(N = 5,131)		(N = 1,651)		(N = 332)		(N = 1,223)	
Adolescent risk factors								
Age; mean (sd)	15.6	(1.6)	15.7	(1.6)	15.7	(1.5)	16.0	(1.5)
Female; n(%)	2669	(52.0)	922	(55.8)	189	(56.9)	632	(51.7)
Body mass index; mean (sd)	21.9	(4.2)	23.0	(4.8)	23.2	(5.0)	23.0	(4.7)
Overweight; n (%)	1095	(21.3)	487	(29.5)	106	(31.9)	354	(28.9)
Obese; n (%)	446	(8.7)	235	(14.2)	56	(16.9)	164	(13.4)
Weekly frequency of playing an active sport; n (%)								
Not at all	1206	(23.5)	507	(30.7)	92	(27.7)	401	(32.8)
1 or 2 times	1401	(27.3)	446	(27.0)	94	(28.3)	325	(26.6)
3 or 4 times	1082	(21.1)	261	(15.8)	63	(19.0)	232	(19.0)
5 or more times	1442	(28.1)	437	(26.5)	83	(25.0)	265	(21.7)
Weekly frequency of watching TV; n (%)								
14 hours	3259	(63.5)	809	(49.0)	203	(61.1)	668	(54.6)
14–27 hours	1276	(24.9)	437	(26.5)	70	(21.1)	339	(27.7)
28 hours	596	(11.6)	405	(24.5)	59	(17.8)	216	(17.7)
Weekly frequency of fast food consumption; n (%)								
None	819	(16.0)	239	(14.5)	57	(17.2)	163	(13.3)
1 to 2	2576	(50.2)	770	(46.6)	158	(47.6)	595	(48.7)
3 or more	1736	(33.8)	642	(38.9)	117	(35.2)	465	(38.0)
Parental risk factors								
Parental diabetes; n (%)	308	(6.0)	179	(10.8)	49	(14.8)	132	(10.8)
Parental education; n (%) ^f ^{a)}								
Less than high school degree	250	(4.9)	177	(10.7)	49	(14.8)	438	(35.8)
High school graduate	2942	(57.3)	957	(58.0)	207	(62.3)	561	(45.9)
College graduate	1939	(37.8)	517	(31.3)	76	(22.9)	224	(18.3)
Financial instability; n (%)	652	(12.7)	447	(27.1)	69	(20.8)	322	(26.3)
Outcome variables								
Diabetes; n (%)	176	(3.4)	196	(11.9)	36	(10.8)	76	(6.2)
Pre-diabetes; n (%)	1371	(26.7)	903	(54.7)	144	(43.4)	460	(37.6)

Source: National Longitudinal Study of Adolescent to Adult Health (Waves 1–4).

Parental education is defined as the maximum educational attainment of either the responding parent or the spouse, if present.

Table 2.

Associations between risk factors in adolescence and incident diabetes in young adulthood, by race/ethnicity

	Non-Hispanic Whites (N=5,131)		Non-Hispanic Blacks (N=1,651)		American Indians/ Alaska Natives (N=332)		Hispanics (N=1,223)	
	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
<i>Adolescent risk factors</i>								
Age	1.06	(0.96, 1.16)	1.08	(1.00, 1.18)	0.95	(0.78, 1.17)	1.16	(1.01, 1.35)
Female	1.28	(0.95, 1.74)	0.86	(0.64, 1.14)	1.24	(0.65, 2.37)	1.06	(0.67, 1.67)
Body mass index percentile ^(a)	1.12	(1.09, 1.16)	1.06	(1.04, 1.09)	1.09	(1.02, 1.17)	1.12	(1.06, 1.18)
Weekly frequency of playing an active sport	0.97	(0.85, 1.11)	0.96	(0.85, 1.09)	1.05	(0.78, 1.41)	0.94	(0.77, 1.15)
Weekly frequency of TV watching								
14 hours (ref)								
14 to 27 hours	1.46	(1.06, 2.02)	1.16	(0.85, 1.58)	1.14	(0.51, 2.54)	1.24	(0.75, 2.03)
28 hours	1.16	(0.75, 1.81)	1.14	(0.82, 1.57)	1.62	(0.80, 3.30)	1.38	(0.80, 2.37)
Weekly frequency of fast food consumption								
None (ref)								
1–2	0.97	(0.66, 1.41)	0.93	(0.66, 1.32)	0.60	(0.28, 1.27)	0.61	(0.35, 1.09)
3 or more	0.80	(0.52, 1.24)	0.63	(0.42, 0.93)	0.60	(0.27, 1.36)	0.74	(0.41, 1.33)
<i>Parental risk factors</i>								
Parental diabetes stat	1.85	(1.22, 2.80)	1.40	(0.99, 1.97)	1.53	(0.76, 3.08)	2.40	(1.50, 3.86)
Parental education: high school graduate or higher	0.43	(0.28, 0.67)	0.82	(0.57, 1.20)	0.74	(0.35, 1.57)	1.05	(0.67, 1.65)
Financial instability	0.83	(0.54, 1.28)	1.12	(0.84, 1.49)	0.95	(0.46, 1.97)	1.34	(0.84, 2.11)

Source: National Longitudinal Study of Adolescent to Adult Health (Waves 1–4).

^aBody mass index percentile is measured in 5-percentile intervals.

Table 3. Associations between risk factors in adolescence and prevalent pre-diabetes in young adulthood, by race/ethnicity

	Non-Hispanic Whites (N=5,131)		Non-Hispanic Blacks (N=1,651)		American Indians/ Alaska Natives (N=332)		Hispanics (N=1,223)	
<i>Adolescent risk factors</i>	RR	95% CI	RR	95% CI	RR	95% CI	RR	95% CI
Age	1.05	(1.02, 1.08)	1.01	(0.99, 1.04)	1.10	(1.05, 1.15)	1.04	(0.99, 1.09)
Female	0.73	(0.66, 0.80)	0.77	(0.71, 0.85)	0.74	(0.60, 0.93)	0.79	(0.68, 0.92)
Body mass index percentile ^a	1.03	(1.02, 1.04)	1.01	(1.00, 1.02)	1.04	(1.02, 1.06)	1.03	(1.02, 1.05)
Weekly frequency of playing an active sport	1.01	(0.97, 1.05)	0.95	(0.91, 0.99)	1.02	(0.93, 1.13)	0.94	(0.88, 1.00)
Weekly frequency of TV watching								
14 hours (ref)								
14 to 27 hours	1.12	(1.01, 1.24)	1.09	(0.98, 1.20)	1.13	(0.87, 1.46)	1.02	(0.87, 1.20)
28 hours	1.18	(1.04, 1.35)	1.07	(0.96, 1.19)	1.36	(1.09, 1.70)	1.06	(0.88, 1.27)
Weekly frequency of fast food consumption								
None (ref)								
1–2	0.99	(0.87, 1.12)	1.10	(0.97, 1.26)	1.25	(0.86, 1.80)	0.99	(0.80, 1.22)
3 or more	0.99	(0.87, 1.14)	1.02	(0.89, 1.17)	1.28	(0.90, 1.83)	1.08	(0.87, 1.34)
<i>Parental risk factors</i>								
Parental diabetes status	1.25	(1.07, 1.46)	1.16	(1.03, 1.30)	1.25	(1.01, 1.55)	1.36	(1.14, 1.61)
Parental education: high school graduate or higher	0.68	(0.58, 0.80)	0.92	(0.81, 1.04)	0.87	(0.72, 1.07)	1.04	(0.90, 1.21)
Financial instability	0.99	(0.87, 1.13)	1.05	(0.96, 1.15)	1.01	(0.80, 1.27)	1.18	(1.01, 1.37)

Source: National Longitudinal Study of Adolescent to Adult Health (Waves 1–4).

^aBody mass index percentile is measured in 5-percentile intervals.