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Sex differences in cardiometabolic risk factors among Hispanic/ Latino Youth

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Abstract

Objective—To determine the prevalence of obesity and cardiometabolic risk in US Hispanic/ Latino youth and examine whether there are disparities by sex in cardiometabolic risk factors.

Study design—SOL Youth is a population-based cross-sectional study of 1466 Hispanic/Latino youth (8-16 years old) who were recruited from four urban US communities (Bronx, NY; Chicago, IL, Miami, FL, and San Diego, CA) in 2012-2014. The majority of children were US-born (78%) and from low-income and immigrant families. Cardiometabolic risk factors were defined using national age- and sex-specific guidelines.

Results—The prevalence of obesity was 26.5%. The prevalence of class II-III obesity, diabetes and dyslipidemia was high (9.7%, 16.5%, and 23.3%, respectively). The prevalence of cardiometabolic risk factors increased with severity of obesity in both, boys and girls. Boys had a higher prevalence of diabetes and of elevated blood pressure than girls (20.9% vs. 11.8% and 8.5%

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vs. 3.3%). In multivariable analyses, younger boys were more likely to have obesity class II-III than girls (OR = 3.59; 95% CI 1.44, 8.97). Boys were more likely to have prediabetes than girls (OR = 2.02; 95% CI 1.35, 3.02), and the association was stronger at older ages.

Conclusions—The prevalence of cardiometabolic risk factors was high in this sample of Hispanic youth. Boys had a more adverse cardiometabolic profile compared with girls that may put them at higher risk of diabetes and cardiovascular disease later in life. Reasons for this disparity and the long-term clinical implications remain to be elucidated.

Hispanic/Latino youth are a fast growing segment of the United States (US) population, and make up 22% of all children under the age of 18 in the US.(1) Data from NHANES indicate that Hispanic youth have high rates of obesity (2, 3), but less is known about the burden of cardiometabolic risk factors in Hispanic/Latino children. Obesity and diabetes are leading cardiovascular risk factors among Hispanic/Latino adults, raising concerns about whether an increased risk of these conditions is also manifested at younger ages. Furthermore, although studies in adults indicate that women are at higher risk of obesity than men, among Hispanic/Latino youth these sex differences appear to be reversed, with boys more likely to be obese than girls (3, 4). However, adult men were found to have a higher prevalence of diabetes and cardiovascular risk factors than women (5, 6). Recent studies also indicate that there are sex differences in cardiometabolic risk profiles, with boys being more likely to have impaired fasting glucose than girls, but girls being more insulin resistant (7).

It is now well accepted that the process leading to atherosclerosis and other chronic conditions starts during childhood (8-11). Therefore, describing the magnitude of these risk factors in youth is important for prioritizing prevention and public health efforts. This study expands the literature on the health status of Hispanic/Latino youth by reporting on the prevalence of obesity and cardiometabolic risk factors in a community-based sample of Hispanic/Latino youth living in four major US urban areas. Because previous reports suggest that there is a higher burden of cardiometabolic risk in Hispanic young men compared with women, this study examined sex differences in the prevalence of obesity and cardiometabolic risk factors.

METHODS

HCHS/SOL is a population-based cohort study of 16,415 Hispanic/Latino adults (ages 18-74 years) who were selected using a two-stage probability sampling design from four US communities (Chicago, IL; Miami, FL; Bronx, NY; San Diego, CA). SOL Youth is an ancillary study to HCHS/SOL that enrolled a subset of the offspring of HCHS/SOL participants from the same four field centers. Between 2012 and 2014, 6,741 households were screened via a phone call using a standardized script; the screening identified 1,777 eligible children between the ages of 8-16 years, of whom 1,466 were enrolled, achieving a participation rate of 82%. Of these 1,466 children, 156 were excluded because they did not have values for one or more cardiometabolic factors or key covariates, leaving a final analytical sample of 1,310 for the current study. Details about the methodology and protocols of HCHS/SOL and SOL Youth are published elsewhere (12, 13). The study was conducted with approval from the institutional review boards of each of the institutions involved in the study. Written informed consent and assent were obtained from parent/caregivers and their children, respectively.

Height (cm) was measured with a wall stadiometer (SECA 222, Germany) and weight (kg) was obtained with a digital scale (Tanita Body Composition Analyzer, TBF 300, Japan). CDC guidelines were used to classify children into categories of underweight/normal weight (BMI <85th percentile), overweight (BMI 85th to <95th percentile), or obese (BMI ≥95th percentile) (14). Obese children were further classified by the severity of obesity using recommended pediatric thresholds (4, 15). Class I obesity was defined as ≥95% of the 95th percentile to <120% of the 95th percentile, class II obesity as ≥120% of the 95th percentile to <140% of the 95th percentile or BMI ≥35 to <40 kg/m2, and class III obesity (≥140% of the 95th percentile OR BMI≥40 kg/m2). Class II and III were combined to achieve adequate sample size for analyses. Seated blood pressure was measured after 5 minutes of rest using an OMRON HEM −907XL sphygmomanometer. Three consecutive measures were obtained and the average of the last two measures was used in the analyses. Age-, sex-, and height-specific systolic and diastolic blood pressure (SBP and DBP) percentiles were derived according to established guidelines (16). Elevated blood pressure was defined as having systolic or diastolic blood pressure ≥90th percentile.

Fasting plasma glucose was measured using a hexokinase enzymatic method (Roche Diagnostics). Hemoglobin A1c (HbA1c) was measured from whole blood using a Tosoh G7 Automated HPLC Analyzer (Tosoh Bioscience Inc, South San Francisco, CA 94080). Pre-diabetes/diabetes was defined as having fasting glucose ≥100 mg/dL or HbA1c ≥5.7%, according to the American Diabetes Association guidelines (17).

Blood for lipid assays were obtained under fasting conditions. Total serum cholesterol (TC) was measured using a cholesterol oxidase enzymatic method (Roche Diagnostics, Indianapolis, IN 46250), serum triglycerides using a glycerol blanking enzymatic method (Roche Diagnostics, Indianapolis, IN 46250), and high-density lipoprotein cholesterol (HDL-c) with a direct magnesium/dextran sulfate method. Low-density lipoprotein cholesterol (LDL-c) was calculated using the Friedewald equation. Non-HDL cholesterol was calculated as the difference between total cholesterol (TC) and HDL-c. Cutoffs values for each lipid were chosen based on the Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents (18). In addition, a TG/HDL-c ratio ≥ 2.2 was used because this cutoff has been related to higher cardiometabolic risk in youth (19). Lastly, dyslipidemia was defined as having total cholesterol ≥200 mg/dL, LDL-c ≥130 mg/dL; triglycerides ≥100 mg/dL for 8-9 year-old and ≥130 mg/dL for 10-16 year-old; or HDL-c <40 mg/dL.

An index of overall cardiometabolic risk was calculated by summing the presence of the following eight risk factors: obesity (BMI ≥95th percentile); SBP or DBP ≥90th percentile; fasting glucose ≥100 mg/dL; HbA1c ≥5.7%; total cholesterol ≥200 mg/dL; LDL-c ≥130 mg/dL; triglycerides ≥100 mg/dL for 8-9 year-old and ≥130 mg/dL for 10-16 year-old; or HDL-c <40 mg/dL. We then categorized participants as having 0, 1-2, or ≥3 cardiovascular disease risk (CVD) risk factors.

The pubertal development scale (PDS) consists of 5 questions for boys concerning changes in body hair, voice, skin, growth spurt, and facial hair, and for girls questions about body hair, breast change, skin change, growth spurt, and menarche (20, 21).

Children and their parents/caregivers reported their Hispanic/Latino background (Central American, Cuban, Dominican, Mexican, Puerto Rican, South American, and other/mixed), place of birth, date of birth and sex. Parents/caregivers reported their household income and their educational attainment.

Statistical analyses

We calculated the weighted proportion of participants who had cardiometabolic risk factors overall and by sex. Test for linear trend was assessed using logistic regression with the binary variable for the CVD risk factor as the dependent variable, and weight category as the independent variable. Multivariable logistic regression was used to assess the association of sex (boys versus girls) with the presence of cardiometabolic risk factors. Multinomial logistical regression was used for outcomes that were not binary (weight category and CVD risk factors). Models adjusted for age, nativity, household income, parental education, and field center. Model 2 adjusted for all variables included in Model 1, plus percentile BMI in analyses that did not include obesity as the outcome variable. Analyses were presented for the overall sample; stratified by age group and by weight category. Sensitivity analysis included adjusting the multivariable models for Tanner stage of development in the subset of participants who had this variable available (N=898). All analyses were conducted with Stata version 14.0 (StataCorp, College Station, Texas, USA) and accounted for the complex survey sampling design (by including stratification and cluster variables) and sampling weights.

RESULTS

The sample included 380 children living in the Bronx, 304 in Chicago, 245 in Miami, and 381 in San Diego. About half of the children in the target population were boys (51.4%) and a little over half (52.7%) were between the ages of 8-12 years. The majority of children were born within the 50 US states (78%) and were of immigrant parents (86% born outside the 50 US States); 49% of children were of Mexican background. The majority of children came from low income households; 53% of them reported a household income of ≤$20,000 and 38% of their parents reported less than a high school education. Characteristics of the study target population are presented in Table I.

Prevalence of obesity and cardiometabolic risk factors

The overall prevalence of overweight and obesity was 19.9% and 26.5%, respectively. The prevalence of overweight did not vary significantly by sex, but boys had a slightly higher prevalence of obesity than girls (28.4% vs. 24.6%) (Table II). The overall prevalence of obesity class II/III was 9.7% (CI: 7.1%, 12.1%), with boys having a slightly higher prevalence than girls (10.2%, CI: 7.6, 13.6; and 9.2%, CI: 6.5-12.8, respectively). Overall, the prevalence rates of prediabetes and dyslipidemia were high (16.5%, and 19.9%, respectively) (Table II). Boys had a higher prevalence of pre-diabetes compared with girls

(20.9% vs. 11.8%, respectively). Boys had almost three times the prevalence of elevated blood pressure, compared with girls, but the confidence intervals overlapped. The prevalence of dyslipidemia and individual lipid factors were similar in both sexes. About a one-half of the target population did not have any cardiovascular risk factors (Table II), with more girls being free of cardiovascular disease risk factors.

Obesity and cardiovascular disease risk factors

As expected, there was an increasing linear trend in number of cardiovascular disease risk factors across categories of weight, for both boys and girls (Figure). Notably, the prevalence of pre-diabetes among children with obesity class II/III was high (26%, CI: 18.1, 35.7), particularly among boys (31.4%, CI: 20.3, 45.2). Furthermore, more than 50% of boys and girls with class II/III obesity had dyslipidemia.

Sex differences in obesity and cardiovascular disease risk factors

Overall, the odds of obesity were similar in boys and girls (OR=1.25; 95% CI 0.87, 1.80). However, among children 8-10 years old, there was a higher odds of obesity in boys compared with girls (OR=2.14; 95% CI 1.14, 4.02) that was not observed in other age groups. Furthermore, boys 8-10 were almost four times more likely to have class II/III obesity, compared with girls (Table III). Boys had twice the odds of having pre-diabetes compared with girls (OR=2.02; 95% CI 1.35, 3.02), and this association was stronger at older ages. Boys aged 13-14 had higher odds of dyslipidemia than girls, but this association was not present in other age groups. When looking at individual lipid factors, there were no sex differences, except for high TG/HDL ration among 13-14 year old boys. Regarding blood pressure, boys were almost three times more likely than girls to have elevated blood pressure, but due to the low prevalence we could not estimate whether this association was consistent across all age groups. This disparity was not statistically significant when examining systolic or diastolic blood pressure separately. Furthermore, the presence of elevated number of cardiovascular disease risk factors (≥ 3) was similar in boys and girls and consistent across age groups. However, boys were more likely than girls to have a moderate number of cardiovascular disease risk factors (1-2), and this association was stronger among 13-14 year old boys.

Tanner stage was derived, using the Pubertal Development Scale, in 69% of the sample (N = 898). Of these, 13.6% had a Tanner Stage I-II, 39.6% had a Tanner Stage III-IV, and 46.8% reached Tanner Stage V. A comparison between those with Tanner stage and those without showed that these groups were similar in sex and BMI percentile, but those missing pubertal development stage were younger than those with that information (mean age 10.9 vs. 12.3, respectively. The associations above remained after adjustment for reported pubertal development (Table V; available at www.jpeds.com). We also examined whether disparities in cardiometabolic risk factors by sex were consistent across weight categories (Table IV). Interestingly, higher odds of pre-diabetes and moderate number of cardiovascular disease risk factors (1-2) in boys were only observed among the normal weight category.

DISCUSSION

In this community-based study of Hispanic/Latino youth we observed significant sex differences in the prevalence of cardiometabolic risk factors. Younger boys were more likely to be obese than girls, but this disparity was not evident at older ages. Younger boys were more likely to have more severe levels of obesity (obesity class II/III) than girls. Notably, the study found a high prevalence of prediabetes/diabetes, with boys almost twice as likely to have pre-diabetes/diabetes compared with girls, a difference even more pronounced at older ages.

The high prevalence of severe obesity (class II/III) in this sample is also noteworthy, as it approximates rates of severe obesity in young adults (23). Consistent with prior research, the prevalence of cardiometabolic risk factors was higher in obese youth than in normal weight youth (4, 24). Furthermore, there was a strong impact of class II/III obesity on pre-diabetes and dyslipidemia. The prevalence of pre-diabetes among youth with class II/III obesity approximated rates reported for young adults (25) and dyslipidemia was found on more than 50% of class II/III obese youth. Taken together, these results highlight the need for screening and lifestyle modification interventions to promote cardiovascular health in Hispanic/Latino youth as recommended by the Integrated Guidelines for Cardiovascular Health (18). A strong focus on weight reduction and control is necessary to prevent the developing of cardiovascular disease later in life.

Sex disparities in cardiometabolic risk factors have been described by others (7, 24, 26, 27) although few studies include Hispanic/Latino children in adequate numbers to examine results by sex. A prospective study of cardiometabolic risk factors during adolescence showed an increased risk in males that was independent of adiposity (27). Another study, based on NHANES data suggested that the impact of obesity on cardiometabolic risk factors was stronger in boys compared with girls (4). A large study of Hispanic/Latino youth in California found that boys were more likely to have impaired fasting glucose, but girls were more insulin resistant (7). It's interesting to note that the adverse cardiometabolic profile in boys was observed among boys in the normal weight range and not among those with overweight or obesity. The reasons behind this cardiometabolic disadvantage observed in boys are poorly understood. Hormonal differences have been postulated as possible explanations (4, 27), as have behavioral factors such as differences in physical activity and sedentary behavior, however, no definitive conclusions have been reached (28, 29). Differences in body distribution of excess adiposity could be another explanation, as there are studies that suggest that visceral adiposity is a stronger influence on cardiometabolic abnormalities (30, 31).

The interpretation of results of this study requires caution due to some important limitations. First, the study sample is not representative of the overall Hispanic/Latino youth population in the US, but only of the communities from which the study enrolled; although these four urban communities are among the 15 metropolitan areas with the largest concentration of Hispanic/Latinos (32). The sample size does not allow us to test differences by Hispanic/Latino national background. However, the prevalence of cardiometabolic risk factors in youth of Mexican background and youth of other backgrounds, were similar (Table VI;

available at www.jpeds.com). In adults, the HCHS/SOL study has reported important differences in cardiovascular disease risk factors (33), including diabetes, by Hispanic national background, with adults of Puerto Rican and Mexican backgrounds showing higher burden of CVD than adults from South American background. Another limitation is that oral glucose tolerance test was not available in this study, resulting in an incomplete characterization of pre-diabetes status that cannot distinguish between impairment of insulin secretion or reductions in β-cell function. Prior studies of pre-diabetes in youth suggest that impairment in insulin secretion plays a greater role than insulin resistance in the progression to type 2 diabetes, and having a combined phenotype of impaired glucose and impaired glucose tolerance confers an even greater risk for type 2 diabetes (34, 35). Another limitation is our measure of pubertal status, which was based on self-report and not available in all subjects. Nevertheless, in a sensitivity analysis, our associations were confirmed. Moreover, youth with pubertal assessment were not significantly different than those missing it on key demographic variables. Finally, conducting many subgroup analyses could increase the false positive rates, but sex and age comparisons were hypothesized a priori when designing the study.

Future studies need to address the longitudinal patterns of cardiometabolic risk factors to guide the identification of those most at risk of progression to type 2 diabetes and subclinical cardiovascular disease.

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REFERENCES

1. Fry, R.; Passel, JS. Hispanic Children: a majority are U.S.-born offspring of immigrants. Pew Hispanic Center; Washington DC: 2009.
2. Ogden CL, Carroll MD, Fryar CD, Flegal KM. Prevalence of Obesity Among Adults and Youth: United States, 2011-2014. NCHS data brief. 2015; (219):1–8.
3. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011-2012. Jama. 2014; 311(8):806–14. [PubMed: 24570244]
4. Skinner AC, Perrin EM, Moss LA, Skelton JA. Cardiometabolic Risks and Severity of Obesity in Children and Young Adults. The New England journal of medicine. 2015; 373(14):1307–17. [PubMed: 26422721]
5. Price JF, Fowkes FG. Risk factors and the sex differential in coronary artery disease. Epidemiology. 1997; 8(5):584–91. [PubMed: 9270963]
6. Daviglus ML, Talavera GA, Aviles-Santa ML, Allison M, Cai J, Criqui MH, et al. Prevalence of major cardiovascular risk factors and cardiovascular diseases among Hispanic/Latino individuals of diverse backgrounds in the United States. Jama. 2012; 308(17):1775–84. [PubMed: 23117778]

7. Tester J, Sharma S, Jasik CB, Mietus-Snyder M, Tinajero-Deck L. Gender differences in prediabetes and insulin resistance among 1356 obese children in Northern California. Diabetes & metabolic syndrome. 2013; 7(3):161–5. [PubMed: 23953182]
8. Freedman DS, Patel DA, Srinivasan SR, Chen W, Tang R, Bond MG, et al. The contribution of childhood obesity to adult carotid intima-media thickness: the Bogalusa Heart Study. International journal of obesity. 2008; 32(5):749–56. [PubMed: 18227845]
9. Saydah S, Bullard KM, Imperatore G, Geiss L, Gregg EW. Cardiometabolic risk factors among US adolescents and young adults and risk of early mortality. Pediatrics. 2013; 131(3):e679–86. [PubMed: 23420920]
10. The NS, Richardson AS, Gordon-Larsen P. Timing and duration of obesity in relation to diabetes: findings from an ethnically diverse, nationally representative sample. Diabetes care. 2013; 36(4): 865–72. [PubMed: 23223352]
11. Attard SM, Herring AH, Howard AG, Gordon-Larsen P. Longitudinal trajectories of BMI and cardiovascular disease risk: the national longitudinal study of adolescent health. Obesity. 2013; 21(11):2180–8. [PubMed: 24136924]
12. Sorlie PD, Avilés-Santa LM, Wassertheil-Smoller S, Kaplan RC, Daviglus ML, Giachello AL, et al. Design and Implementation of the Hispanic Community Health Study/Study of Latinos. Annals of epidemiology. 2010; 20(8):629–41. [PubMed: 20609343]
13. Isasi CR, Carnethon MR, Ayala GX, Arredondo E, Bangdiwala SI, Daviglus ML, et al. The Hispanic Community Children's Health Study/Study of Latino Youth (SOL Youth): design, objectives, and procedures. Annals of epidemiology. 2014; 24(1):29–35. [PubMed: 24120345]
14. Kuczmarski RJ, Ogden CL, Guo SS, Grummer-Strawn LM, Flegal KM, Mei Z, et al. 2000 CDC Growth Charts for the United States: methods and development. Vital Health Stat. 2002; 11(246): 1–190.
15. Kelly AS, Barlow SE, Rao G, Inge TH, Hayman LL, Steinberger J, et al. Severe obesity in children and adolescents: identification, associated health risks, and treatment approaches: a scientific statement from the American Heart Association. Circulation. 2013; 128(15):1689–712. [PubMed: 24016455]
16. NHLBI/NHBPEP. The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents. Pediatrics. 2004; 114(2 (Suppl 4th Report)):555–76. [PubMed: 15286277]
17. Association AD. 2. Classification and Diagnosis of Diabetes. Diabetes care. 2015; 38(Supplement 1):S8–S16.
18. Expert Panel on Integrated Guidelines for Cardiovascular H; Risk Reduction in C; Adolescents, National Heart L, Blood I. Expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents: summary report. Pediatrics. 2011; 128(Suppl 5):S213–56. [PubMed: 22084329]
19. Manco M, Grugni G, Di Pietro M, Balsamo A, Di Candia S, Morino GS, et al. Triglycerides-to-HDL cholesterol ratio as screening tool for impaired glucose tolerance in obese children and adolescents. Acta diabetologica. 2015
20. Petersen A, Crocket L, Richards M, Boxer A. A self-reported measure of pubertal status: reliability, validity, and initial norms. Journal of Youth and Adolescence. 1988; 17:117–33. Journal of Youth and Adolescence. [PubMed: 24277579]
21. Schmitz KE, Hovell MF, Nichols JF, Irvin V, Keating KK, Simon GM, et al. A Validation Study of Early Adolescents' Pubertal Self-Assessments. The Journal of Early Adolescence. 2004; 24(4): 357–84.
22. Magge SN, Prasad D, Koren D, Gallagher PR, Mohler ER 3rd, Stettler N, et al. Prediabetic obese adolescents have a more atherogenic lipoprotein profile compared with normoglycemic obese peers. The Journal of pediatrics. 2012; 161(5):881–6. [PubMed: 22622051]
23. Kaplan RC, Aviles-Santa ML, Parrinello CM, Hanna DB, Jung M, Castaneda SF, et al. Body mass index, sex, and cardiovascular disease risk factors among Hispanic/Latino adults: Hispanic community health study/study of Latinos. Journal of the American Heart Association. 2014; 3(4)
24. May AL, Kuklina EV, Yoon PW. Prevalence of cardiovascular disease risk factors among US adolescents, 1999-2008. Pediatrics. 2012; 129(6):1035–41. [PubMed: 22614778]

25. Hispanic Community Health Study Data Book. A report to the Communities. NIH. Natioal Heart, Lung and Blood Institute; Sep. 2013 2013. Report No

26. Li C, Ford ES, Zhao G, Mokdad AH. Prevalence of pre-diabetes and its association with clustering of cardiometabolic risk factors and hyperinsulinemia among U.S. adolescents: National Health and Nutrition Examination Survey 2005-2006. Diabetes care. 2009; 32(2):342–7. [PubMed: 18957533]

27. Moran A, Jacobs DR Jr. Steinberger J, Steffen LM, Pankow JS, Hong CP, et al. Changes in insulin resistance and cardiovascular risk during adolescence: establishment of differential risk in males and females. Circulation. 2008; 117(18):2361–8. [PubMed: 18427135]

28. Prentice-Dunn H, Prentice-Dunn S. Physical activity, sedentary behavior, and childhood obesity: a review of cross-sectional studies. Psychology, health & medicine. 2012; 17(3):255–73.

29. Govindan M, Gurm R, Mohan S, Kline-Rogers E, Corriveau N, Goldberg C, et al. Gender differences in physiologic markers and health behaviors associated with childhood obesity. Pediatrics. 2013; 132(3):468–74. [PubMed: 23940242]

30. Lawlor DA, Benfield L, Logue J, Tilling K, Howe LD, Fraser A, et al. Association between general and central adiposity in childhood, and change in these, with cardiovascular risk factors in adolescence: prospective cohort study. Bmj. 2010; 341:c6224. [PubMed: 21109577]

31. Ali O, Cerjak D, Kent JW Jr. James R, Blangero J, Zhang Y. Obesity, central adiposity and cardiometabolic risk factors in children and adolescents: a family-based study. Pediatric obesity. 2014; 9(3):e58–62. [PubMed: 24677702]

32. Hispanic Population in Select U.S. Metropolitan Areas. 2011.

33. Daviglus ML, Pirzada A, Talavera GA. Cardiovascular Disease Risk Factors in the Hispanic/Latino Population: Lessons From the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). Prog Cardiovasc Dis. 2014

34. Bacha F, Lee S, Gungor N, Arslanian SA. From pre-diabetes to type 2 diabetes in obese youth: pathophysiological characteristics along the spectrum of glucose dysregulation. Diabetes care. 2010; 33(10):2225–31. [PubMed: 20592052]

35. Cali AM, Bonadonna RC, Trombetta M, Weiss R, Caprio S. Metabolic abnormalities underlying the different prediabetic phenotypes in obese adolescents. The Journal of clinical endocrinology and metabolism. 2008; 93(5):1767–73. [PubMed: 18303080]

36. Seo DC, Sa J. A meta-analysis of obesity interventions among U.S. minority children. The Journal of adolescent health : official publication of the Society for Adolescent Medicine. 2010; 46(4): 309–23. [PubMed: 20307819]

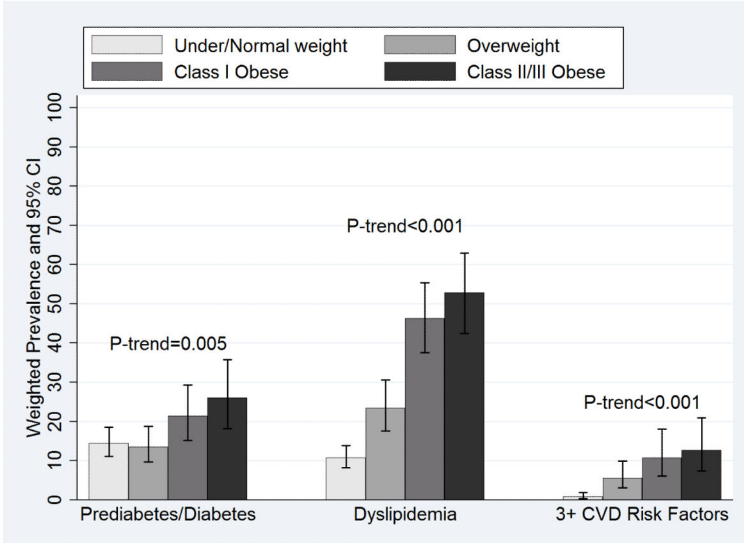
37. Rieder J, Khan UI, Heo M, Mossavar-Rahmani Y, Blank AE, Strauss T, et al. Evaluation of a community-based weight management program for predominantly severely obese, difficult-to-reach, inner-city minority adolescents. Childhood obesity. 2013; 9(4):292–304. [PubMed: 23865528]

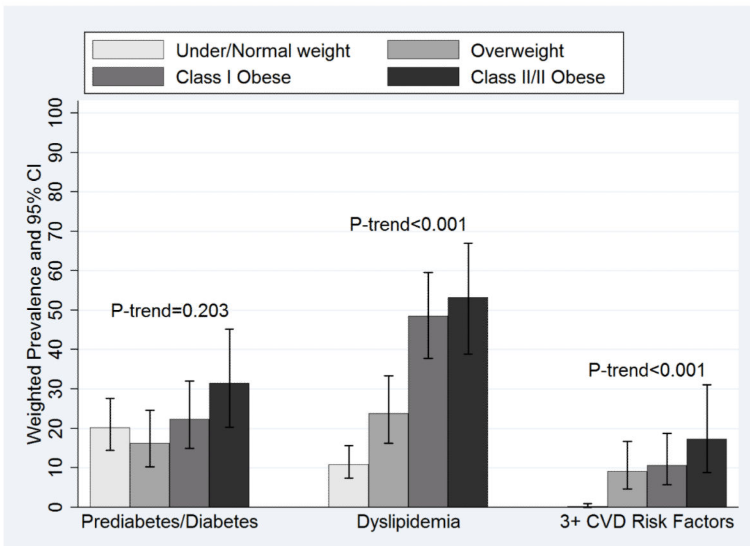
38. Haemer MA, Grow HM, Fernandez C, Lukasiewicz GJ, Rhodes ET, Shaffer LA, et al. Addressing prediabetes in childhood obesity treatment programs: support from research and current practice. Childhood obesity. 2014; 10(4):292–303. [PubMed: 25055134]

39. Ligthart S, van Herpt TT, Leening MJ, Kavousi M, Hofman A, Stricker BH, et al. Lifetime risk of developing impaired glucose metabolism and eventual progression from prediabetes to type 2 diabetes: a prospective cohort study. The lancet Diabetes & endocrinology. 2015

40. Diabetes Prevention Program Research G. Knowler WC, Fowler SE, Hamman RF, Christophi CA, Hoffman HJ, et al. 10-year follow-up of diabetes incidence and weight loss in the Diabetes Prevention Program Outcomes Study. Lancet. 2009; 374(9702):1677–86. [PubMed: 19878986]

41. Goran MI, Lane C, Toledo-Corral C, Weigensberg MJ. Persistence of pre-diabetes in overweight and obese Hispanic children: association with progressive insulin resistance, poor beta-cell function, and increasing visceral fat. Diabetes. 2008; 57(11):3007–12. [PubMed: 18678615]


Under/Normal weight
Overweight
Class I Obese
Class II/III Obese
Weighted Prevalence and 95% CI
0
10
20
30
40
50
60
70
80
90
100
P-trend=0.005
P-trend<0.001
P-trend<0.001
Prediabetes/Diabetes
Dyslipidemia
3+ CVD Risk Factors


Under/Normal weight
Overweight
Class I Obese
Class II/II Obese
Weighted Prevalence and 95% CI
0
10
20
30
40
50
60
70
80
90
100
P-trend=0.203
P-trend<0.001
P-trend<0.001
Prediabetes/Diabetes
Dyslipidemia
3+ CVD Risk Factors

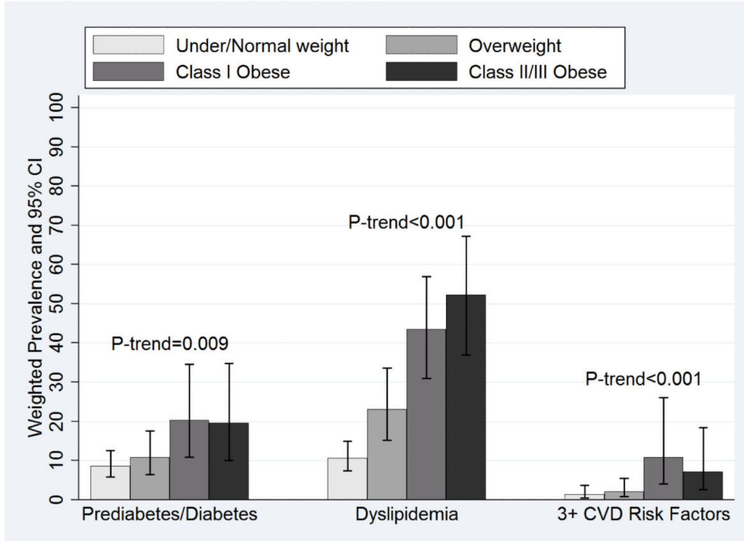


Figure.

Cardiometabolic risk by weight category in the Study of Latino Youth (SOL Youth). **A, A,** All, B, boys only, C, girls only.

Table 1

Distribution of study population characteristics. The Study of Latino Youth (SOL Youth)

	Unweighted n (Weighted %)
Field Center	
Bronx	380 (36.6)
Chicago	304 (14.2)
Miami	245 (14.0)
San Diego	381 (35.2)
Age group	
8-10 years old	417 (30.9)
11-12 years old	314 (21.8)
13-14 years old	339 (22.6)
15-16 years old	240 (24.8)
Male	653 (51.4)
US-born (within 50 US states)	1014 (78.2)
Hispanic/Latino background	
Mexican	586 (48.9)
Dominican	148 (13.5)
Central American	100 (6.3)
Puerto Rican	119 (10.5)
Cuban	95 (5.7)
South American	60 (4.2)
Mixed	113 (9.1)
Other	22 (1.9)
US-born parents (within 50 US states)	174 (13.9)
Parental educational attainment	
< High school	502 (38.0)
High school	372 (29.5)
>High school	436 (32.5)
Household income	
≤$20,000	695 (53.0)
$21,000-$40,000	423 (31.7)
>$40,000	192 (15.3)

Table 2

Prevalence of cardiometabolic risk factors by sex (N = 1310). The Study of Latino Youth (SOL Youth)

	Overall (N=1,310)	Boys (N=653)	Girls (N=657)
	Weighted % (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)
Normal weight (BMI <85th percentile)	53.6 (49.9, 57.3)	52.0 (46.3, 57.7)	55.3 (50.1, 60.3)
Overweight (BMI 85-94th percentile)	19.9 (17.1, 23.0)	19.6 (15.5, 24.5)	20.1 (16.5, 24.3)
Obesity (BMI ≥95th percentile)	26.5 (23.5, 29.7)	28.4 (24.1, 33.1)	24.6 (20.3, 29.4)
Obesity Class I (≥95th percentile to <120% of the 95th percentile)	16.8 (14.4, 19.5)	18.1 (14.7, 22.1)	15.4 (12.0, 19.6)
Obesity Class II (≥120% to <140% of the 95th percentile, or BMI≥35 and BMI<40)	8.0 (6.2, 10.3)	8.8 (6.4, 12.0)	7.2 (4.7, 10.7)
Obesity Class III (≥140% of the 95th percentile or BMI≥40)	1.7 (1.1, 2.6)	1.4 (0.7, 2.8)	2.0 (1.2, 3.4)
Prediabetes/Diabetes	16.5 (14.0, 19.3)	20.9 (16.9, 25.6)	11.8 (9.1, 15.2)
Dyslipidemia	23.3 (20.3, 26.6)	24.6 (20.4, 29.3)	22.0 (17.9, 26.8)
High TC (≥200mg/dl)	6.0 (4.6, 7.7)	6.2 (4.5, 8.6)	5.7 (3.7, 8.6)
High LDL (≥130mg/dl)	4.3 (3.1, 5.7)	4.0 (2.7, 6.0)	4.5 (2.9, 6.9)
High TG (≥130 mg/dL for 10-19 y and ≥100 mg/dL for 8-9 y)	12.2 (9.9, 14.9)	12.8 (9.7, 16.8)	11.5 (8.5, 15.4)
Low HDL (<40mg/dl)	11.1 (9.2, 13.4)	11.6 (9.0, 14.9)	10.5 (7.9, 14.0)
High TG/HDL ratio (≥2.2)	20.3 (17.4, 23.5)	21.8 (17.7, 26.4)	18.7 (15.0, 23.2)
High non-HDL (≥145 mg/dL)	7.4 (5.7, 9.5)	7.3 (5.4, 9.9)	7.5 (5.0, 10.9)
Elevated blood pressure	5.9 (4.4, 8.0)	8.5 (5.9, 12.0)	3.3 (1.7, 6.3)
High SBP (SBP ≥90th percentile)	4.1 (2.8, 6.0)	5.8 (3.7, 8.8)	2.4 (1.1, 5.4)
High DBP (DBP ≥90th percentile)	2.4 (1.5, 4.0)	3.4 (1.8, 6.1)	1.4 (0.6, 3.4)
CVD risk factors			
0	52.9 (49.5, 56.4)	47.8 (42.5, 53.2)	58.3 (53.2, 63.3)
1-2	36.8 (33.6, 40.1)	41.5 (36.3, 46.8)	31.9 (27.8, 36.2)
≥3	10.3 (8.4, 12.6)	10.7 (8.3, 13.7)	9.8 (7.0, 13.6)

Prediabetes/Diabetes is defined as fasting glucose ≥100 mg/dL or HbA1c ≥5.7%. *Dyslipidemia* is defined as having total cholesterol ≥200 mg/dL, LDL-c ≥130 mg/dL, triglycerides ≥100 mg/dL for 8-9 year-olds and ≥130 mg/dL for 10-16 year-olds, or HDL-c <40 mg/dL. *Elevated blood pressure* is defined as SBP or DBP ≥90th percentile. *CVD risk factors* may range from 0-9 and are defined as the following: obesity; SBP or DBP ≥90th percentile; fasting glucose ≥100 mg/dL; HbA1c ≥5.7%; total cholesterol ≥200 mg/dL; LDL-c ≥130 mg/dL; triglycerides ≥100 mg/dL for 8-9 year-olds and ≥130 mg/dL for 10-16 year-olds; HDL-c <40 mg/dL.

Table 3

Adjusted Odds Ratios for cardiometabolic risk factors in boys versus girls, overall and by age groups. The Study of Latino Youth (SOL Youth)

	All ages (N=1,310)	8-10 years (N=417)	11-12 years (N=314)	13-14 years (N=339)	15-16 years (N=240)
	Odds ratio (95% CI)	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**
Obese Class II and III (vs. normal weight) [1]	1.22 (0.74, 2.03)	3.59 (1.44, 8.97)	1.06 (0.44, 2.57)	0.94 (0.30, 2.91)	0.60 (0.17, 2.09)
Obese Class I (vs. normal weight) [1]	1.27 (0.84, 1.93)	1.81 (0.89, 3.69)	1.17 (0.50, 2.72)	1.54 (0.69, 3.44)	0.80 (0.31, 2.05)
Overweight (vs. normal weight) [1]	1.07 (0.71, 1.61)	1.19 (0.62, 2.27)	0.77 (0.36, 1.67)	1.29 (0.65, 2.53)	1.24 (0.50, 3.09)
Pre-diabetes/ Diabetes [2]	2.02 (1.35, 3.02)	1.61 (0.79, 3.26)	2.01 (1.01, 3.99)	2.70 (1.21, 6.01)	2.33 (0.98, 5.52)
Dyslipidemia [2]	1.14 (0.80, 1.61)	0.96 (0.53, 1.76)	0.74 (0.40, 1.37)	2.01 (1.07, 3.77)	1.34 (0.64, 2.80)
High total cholesterol [2]	1.08 (0.60, 1.93)	0.59 (0.20, 1.71)	1.60 (0.62, 4.09)	2.52 (0.66, 9.62)	0.92 (0.22, 3.79)
High LDL [2]	0.88 (0.48, 1.60)	0.56 (0.21, 1.51)	2.04 (0.37, 11.24)	1.06 (0.31, 3.70)	0.56 (0.11, 2.76)
High triglycerides [2]	1.09 (0.69, 1.72)	0.80 (0.39, 1.64)	0.64 (0.24, 1.74)	1.69 (0.72, 3.95)	1.16 (0.45, 2.96)
Low HDL [2]	1.07 (0.71, 1.61)	1.27 (0.52, 3.11)	0.43 (0.20, 0.93)	1.84 (0.88, 3.84)	2.28 (0.78, 6.67)
High TG/HDL ratio [2]	1.17 (0.80, 1.71)	0.67 (0.35, 1.27)	0.62 (0.33, 1.14)	2.61 (1.43, 4.73)	1.44 (0.65, 3.21)
High non-HDL [2]	0.92 (0.54, 1.57)	0.45 (0.17, 1.21)	1.38 (0.46, 4.12)	2.09 (0.72, 6.05)	0.43 (0.11, 1.61)
Elevated blood pressure [2¥]	2.68 (1.17, 6.16)	-	-	-	-
Elevated SBP [2¥]	2.41 (0.89, 6.56)	-	-	-	-

	All ages (N=1,310)	8-10 years (N=417)	11-12 years (N=314)	13-14 years (N=339)	15-16 years (N=240)
	Odds ratio (95% CI)	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**
Elevated DBP [2¥]	2.35 (0.78, 7.08)	-	-	-	-
CVD risk factors (≥3 vs. 0) [1]	1.14 (0.82, 2.26)	1.64 (0.70, 3.85)	0.97 (0.37, 2.53)	1.75 (0.66, 4.67)	1.10 (0.37, 3.27)
CVD risk factors (1-2 vs. 0) [1]	1.63 (1.18, 2.25)	1.70 (1.05, 2.76)	1.47 (0.78, 2.75)	2.46 (1.35, 4.49)	1.47 (0.71, 3.07)

[1] is adjusted for age, nativity, household income, parental education, and field center

[2] is additionally adjusted for age- sex- specific BMI percentile

Prediabetes/Diabetes is defined as fasting glucose ≥100 mg/dL or HbA1c ≥5.7%. *Dyslipidemia* is defined as having total cholesterol ≥200 mg/dL, LDL-c ≥130 mg/dL, triglycerides ≥100 mg/dL for 8-9 year-olds and ≥130 mg/dL for 10-16 year-olds, or HDL-c <40 mg/dL. *Elevated blood pressure* is defined as SBP or DBP ≥90th percentile. *CVD risk factors* may range from 0-9 and are defined as the following: obesity; SBP or DBP ≥90th percentile; fasting glucose ≥100 mg/dL; HbA1c ≥5.7%; total cholesterol ≥200 mg/dL; LDL-c ≥130 mg/dL; triglycerides ≥100 mg/dL for 8-9 year-olds and ≥130 mg/dL for 10-16 year-olds; HDL-c <40 mg/dL.

[¥] Because of low numbers stratified analyses by age group could not be estimated.

Table 4

Adjusted Odds Ratios for cardiometabolic risk factors in boys versus girls by weight categories. The Study of Latino Youth (SOL Youth)

	Normal weight (N=666)	**Overweight (N=276)**	**Class I Obesity (N=236)**	**Class II/III Obesity (N=132)**
	Odds ratio (95% CI)	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**
Pre-diabetes/Diabetes	2.93 (1.65, 5.20)	1.73 (0.77, 3.93)	0.98 (0.42, 2.72)	2.17 (0.74, 6.42)
Dyslipidemia	1.10 (0.62, 1.94)	1.13 (0.54, 2.33)	1.09 (0.57, 2.09)	1.20 (0.47, 3.09)
High total cholesterol	0.64 (0.27, 1.54)	3.34 (0.96, 11.57)	0.65 (0.18, 2.30)	5.59 (0.49, 64.05)
High LDL	0.16 (0.05, 0.54)	3.04 (0.80, 11.52)	0.94 (0.30, 2.95)	6.01 (0.51, 71.34)
High triglycerides	1.37 (0.52, 3.62)	0.70 (0.26, 1.89)	1.02 (0.48, 2.17)	1.34 (0.48, 3.68)
Low HDL	1.14 (0.50, 2.58)	1.28 (0.57, 2.86)	1.22 (0.59, 2.49)	0.66 (0.26, 1.69)
High TG/HDL ratio	1.00 (0.51, 1.99)	0.90 (0.43, 1.89)	1.64 (0.83, 3.23)	0.89 (0.32, 2.48)
High non-HDL	0.21 (0.07, 0.63)	2.83 (0.88, 9.04)	0.56 (0.22, 1.44)	2.39 (0.59, 9.62)
CVD risk factors (≥3 vs. 0)	0.15 (0.02, 1.09)	7.19 (1.57, 32.91)	1.23 (0.34, 4.52)	3.98 (0.71, 22.29)
CVD risk factors (1-2 vs. 0)	2.26 (1.39, 3.67)	1.05 (0.55, 1.99)	1.97 (0.97, 4.02)	1.25 (0.47, 3.32)

All models are adjusted for age, nativity, household income, parental education, and field center

Prediabetes/Diabetes is defined as fasting glucose ≥100 mg/dL or HbA1c ≥5.7%. *Dyslipidemia* is defined as having total cholesterol ≥200 mg/dL, LDL-c ≥130 mg/dL, triglycerides ≥100 mg/dL for 8-9 year-olds and ≥130 mg/dL for 10-16 year-olds, or HDL-c <40 mg/dL. *CVD risk factors* may range from 0-8 and are defined as the following: SBP or DBP ≥90th percentile; fasting glucose ≥100 mg/dL; HbA1c ≥5.7%; total cholesterol ≥200 mg/dL; LDL-c ≥130 mg/dL; triglycerides ≥100 mg/dL for 8-9 year-olds and ≥130 mg/dL for 10-16 year-olds; HDL-c <40 mg/dL.

Table 5

Adjusted Odds Ratios for cardiometabolic risk factors in boys versus girls, adjusted for pubertal development (N=898)

	All ages (N=898) Unadjusted for Tanner Stage	All ages (N=898)	8-10 years (N=216)	11-12 years (N=215)	13-14 years (N=267)	15-16 years (N=200)
	Odds ratio (95% CI)	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**	**Odds ratio (95% CI)**
Obese Class II and III (vs. normal weight) [1¥]	1.23 (0.67, 2.24)	1.38 (0.73, 2.60)	4.00 (0.91, 17.50)	0.82 (0.27, 2.45)	2.11 (0.66, 6.73)	-
Obese Class I (vs. normal weight) [1¥]	1.03 (0.61, 1.74)	1.11 (0.65, 1.88)	0.74 (0.24, 2.26)	0.78 (0.31, 2.01)	2.29 (0.92, 5.73)	-
Overweight (vs. normal weight) [1]	1.13 (0.72, 1.77)	1.29 (0.83, 2.00)	1.16 (0.49, 2.76)	1.66 (0.69, 3.99)	1.44 (0.68, 3.07)	1.72 (0.65, 4.59)
Pre-diabetes/ Diabetes [2]	2.16 (1.38, 3.39)	2.28 (1.43, 3.63)	1.48 (0.61, 3.61)	2.18 (1.02, 4.66)	2.63 (1.10, 6.25)	4.67 (1.49, 14.70)
Dyslipidemia [2]	1.41 (0.90, 2.20)	1.29 (0.83, 2.02)	1.18 (0.53, 2.65)	0.39 (0.17, 0.91)	2.09 (0.96, 4.56)	2.90 (0.82, 10.24)
High total cholesterol [2]	1.26 (0.62, 2.53)	1.22 (0.59, 2.51)	0.60 (0.14, 2.59)	1.63 (0.51, 5.17)	10.00 (1.99, 50.26)	0.67 (0.18, 2.49)
High LDL [2]	0.92 (0.45, 1.88)	0.83 (0.41, 1.68)	0.99 (0.27, 3.68)	1.48 (0.37, 5.93)	1.38 (0.37, 5.07)	0.35 (0.12, 1.07)
High triglycerides	1.29 (0.70, 2.38)	1.19 (0.64, 2.21)	0.62 (0.21, 1.82)	0.39 (0.11, 1.39)	1.44 (0.47, 4.47)	3.64 (0.67, 19.90)
Low HDL [2]	1.13 (0.69, 1.85)	1.02 (0.62, 1.68)	1.69 (0.53, 5.43)	0.20 (0.08, 0.51)	1.50 (0.62, 3.66)	3.47 (0.91, 13.33)
High TG/HDL ratio [2]	1.39 (0.86, 2.23)	1.23 (0.76, 1.99)	0.56 (0.21, 1.48)	0.21 (0.08, 0.61)	2.98 (1.48, 6.03)	2.64 (0.66, 10.57)
High non-HDL [2]	0.98 (0.49, 1.96)	0.98 (0.48, 1.97)	0.62 (0.17, 2.25)	1.05 (0.26, 4.25)	3.73 (1.02, 13.65)	0.21 (0.04, 1.12)
Elevated blood pressure [2¥]	3.63 (1.45, 9.06)	4.10 (1.63, 10.33)	-	-	-	-
CVD risk factors (≥3 vs. 0) [1]	1.18 (0.66, 2.11)	1.23 (0.69, 2.16)	1.07 (0.36, 3.16)	0.41 (0.12, 1.38)	2.07 (0.73, 5.88)	3.89 (0.94, 16.12)
CVD risk (1-2 vs. 0) [1]	1.82 (1.24, 2.67)	1.95 (1.32, 2.88)	0.96 (0.46, 2.02)	1.36 (0.65, 2.85)	3.76 (1.89, 7.49)	3.49 (1.45, 8.40)

[1] is adjusted for age, nativity, household income, parental education, field center, and Tanner stage; odds ratios obtained using multinomial logistic regression

[2]is additionally adjusted for age- sex- specific BMI percentile; odds ratios obtained using logistic regression

Prediabetes/Diabetes is defined as fasting glucose ≥100 mg/dL or HbA1c ≥5.7%. *Dyslipidemia* is defined as having total cholesterol ≥200 mg/dL, LDL-c ≥130 mg/dL, triglycerides ≥100 mg/dL for 8-9 year-olds and ≥130 mg/dL for 10-16 year-olds, or HDL-c <40 mg/dL. *Elevated blood pressure* is defined as SBP or DBP ≥90th percentile. *CVD risk factors* may range from 0-9 and are defined as the following: obesity; SBP or DBP ≥90th percentile; fasting glucose ≥100 mg/dL; HbA1c ≥5.7%; total cholesterol ≥200 mg/dL; LDL-c ≥130 mg/dL; triglycerides ≥100 mg/dL for 8-9 year-olds and ≥130 mg/dL for 10-16 year-olds; HDL-c <40 mg/dL.

[¥]Because of low numbers stratified analyses by age group could not be estimated.

Table 6

Prevalence of cardiometabolic risk factors stratified by Mexican background

	Overall (N=1,310)	Mexican background (N=586)	Non-Mexican background (N=724)
	Weighted % (95% CI)	Weighted % (95% CI)	Weighted % (95% CI)
Normal weight (BMI <85th percentile)	53.6 (49.9, 57.3)	54.4 (48.8, 59.8)	52.9 (48.2, 57.6)
Overweight (BMI 85-94th percentile)	19.9 (17.1, 23.0)	19.1 (15.5, 23.3)	20.6 (17.1, 24.5)
Obesity (BMI ≥95th percentile)	26.5 (23.5, 29.7)	26.6 (22.3, 31.3)	26.5 (22.5, 30.9)
Obesity Class I (≥95th percentile to <120% of the 95th percentile)	16.8 (14.4, 19.5)	17.7 (14.2, 21.8)	16.1 (12.9, 19.8)
Obesity Class II (≥120% to <140% of the 95th percentile, or BMI≥35 and BMI<40)	8.0 (6.2, 10.3)	7.3 (4.7, 11.2)	8.6 (6.4, 11.5)
Obesity Class III (≥140% of the 95th percentile or BMI≥40)	1.7 (1.1, 2.6)	1.5 (0.8, 2.9)	1.8 (1.0, 3.3)
Prediabetes/Diabetes	16.5 (14.0, 19.3)	15.8 (12.4, 20.0)	17.1 (13.7, 21.2)
Dyslipidemia	23.3 (20.3, 26.6)	24.0 (19.5, 29.2)	22.7 (19.0, 26.9)
High TC (≥200mg/dl)	6.0 (4.6, 7.7)	5.3 (3.5, 8.2)	6.5 (4.7, 8.8)
High LDL (≥130mg/dl)	4.3 (3.1, 5.7)	2.9 (1.6, 5.2)	5.4 (3.8, 7.6)
High TG (≥100 mg/dL for 8-9 year-olds and ≥130 mg/dL for 10-16 year-olds)	12.2 (9.9, 14.9)	14.0 (10.5, 18.3)	10.6 (7.9, 14.1)
Low HDL (<40mg/dl)	11.1 (9.2, 13.4)	11.7 (8.7, 15.5)	10.6 (8.2, 13.6)
High TG/HDL ratio (≥2.2)	20.3 (17.4, 23.5)	22.4 (18.3, 27.2)	18.4 (14.7, 22.8)
High non-HDL (≥ 145 mg/dL)	7.4 (5.7, 9.5)	7.1 (4.9, 10.3)	7.6 (5.5, 10.5)
Elevated blood pressure	5.9 (4.4, 8.0)	6.7 (4.2, 10.5)	5.3 (3.5, 7.9)
High SBP (SBP ≥90th percentile)	4.1 (2.8, 6.0)	4.6 (2.6, 8.0)	3.8 (2.3, 6.2)
High DBP (DBP ≥90th percentile)	2.4 (1.5, 4.0)	2.6 (1.2, 5.6)	2.2 (1.1, 4.2)
CVD risk factors (omitting HOMA-IR)			
0	52.9 (49.5, 56.4)	53.0 (48.3, 57.7)	52.8 (48.0, 57.6)
1-2	36.8 (33.6, 40.1)	36.8 (32.1, 41.8)	36.8 (32.5, 41.3)
≥3	10.3 (8.4, 12.6)	10.2 (7.3, 13.9)	10.4 (7.9, 13.5)

Prediabetes/Diabetes is defined as fasting glucose ≥100 mg/dL or HbA1c ≥5.7%. *Dyslipidemia* is defined as having total cholesterol ≥200 mg/dL, LDL-c ≥130 mg/dL, triglycerides ≥100 mg/dL for 8-9 year-olds and ≥130 mg/dL for 10-16 year-olds, or HDL-c <40 mg/dL. *Elevated blood pressure* is defined as SBP or DBP ≥90th percentile. *CVD risk factors* may range from 0-9 and are defined as the following: obesity; SBP or DBP ≥90th percentile; fasting glucose ≥100 mg/dL; HbA1c ≥5.7%; total cholesterol ≥200 mg/dL; LDL-c ≥130 mg/dL; triglycerides ≥100 mg/dL for 8-9 year-olds and ≥130 mg/dL for 10-16 year-olds; HDL-c <40 mg/dL.