Published in final edited form as:

Ann Epidemiol. 2017 April ; 27(4): 260–268.e2. doi:10.1016/j.annepidem.2017.03.001.

Association of Cardiovascular Risk Factors between Hispanic/Latino Parents and Youth: The Hispanic Community Health Study/Study of Latino Youth

Mercedes R. Carnethon¹, Guadalupe X. Ayala², Shrikant I Bangdiwala³, Virginia Bishop¹, Martha L. Daviglus⁴, Alan M. Delamater⁵, Linda C. Gallo², Krista Perreira³, Elizabeth Pulgaron⁵, Samantha Reina⁵, Gregory A. Talavera², Linda H. Van Horn¹, and Carmen R. Isasi⁶

¹Department of Preventive Medicine, Feinberg School of Medicine, Northwestern University

²College of Health and Human Services, San Diego State University and the Institute for Behavioral and Community Health

³Department of Biostatistics, University of North Carolina at Chapel Hill

⁴Institute for Minority Health Research, University of Illinois at Chicago

⁵Department of Pediatrics, University of Miami Miller School of Medicine

⁶Department of Epidemiology and Population Health, Albert Einstein College of Medicine

Abstract

Purpose—Hispanic/Latinos have a high burden of CVD risk factors which may begin at young ages. We tested the association of CVD risk factors between Hispanic/Latino parents and their children.

Methods—We conducted a cross-sectional study in the Hispanic Community Health Study/Study of Latinos Youth study. Girls (n=674) and boys (n=667) ages 8-16 years old (mean age 12.1 years) and their parents (n=942) had their CVD risk factors measured.

Results—CVD risk factors in parents were significantly positively associated with those same risk factors among youth. Following adjustment for demographic characteristics, diet and physical activity, obese parents were significantly more likely to have youth who were overweight (OR=2.39, 95% confidence interval [CI]: 1.20, 4.76) or obese (OR=6.16, 95% CI: 3.23, 11.77) vs. normal weight. Dyslipidemia among parents was associated with 1.98 higher odds of dyslipidemia among youth (95% CI: 1.37, 2.87). Neither hypertension nor diabetes was associated with a higher odds of high blood pressure or hyperglycemia (prediabetes or diabetes) in youth. Findings were consistent by sex and in younger (age <12) s vs. older (≥ 12 years) youth.

Conclusions—Hispanic/Latino youth share patterns of obesity and CVD risk factors with their parents, which portends high risk for adult CVD.

The prevalence of cardiovascular disease (CVD) risk factors including obesity and diabetes is high among Hispanic/Latino adults and exceeds that of non-Hispanic whites [1-3]. Given the decades-long process by which CVD develops, risk factors (i.e., obesity, dyslipidemia, high blood pressure and hyperglycemia) often emerge during childhood and adolescence. Prior studies report positive correlations for measures of adiposity, lipids, glucose and blood pressure between parents and youth [4-10]. Familial clustering of CVD risk factors is thought to originate from shared health behaviors, environmental exposures and genetic influences. Latino households often include multiple generations under a single roof, and a strong emphasis on family loyalty (familismo) and shared values and behaviors [11]. Whether these shared behaviors contribute to strong correlations between measured clinical CVD risk factors in Latino families is not known [12].

To address whether associations between parent and youth CVD risk factors are driven by the correlation between health risk behaviors, research is needed that includes statistical adjustment for a comprehensive set of measured health behaviors. Our objective is to determine whether CVD risk factors that are readily assessed in clinical practice are positively correlated between Hispanic/Latino youth and parents who share the same household. We hypothesized that these associations would be partially, but not completely, accounted for by the household socioeconomic environment and by the physical activity and diet behaviors. Describing these relationships is important to justify CVD prevention strategies that target behaviors and involve the entire household.

Methods

Study Population and Design

HCHS/SOL is a population-based cohort study of 16,415 adults aged 18-74 years old who self-identified as Mexican, Puerto Rican, Dominican, South/Central American, Cuban, or other Hispanic/Latino descent [13]. Cohort selection criteria and design are published [14]. In brief, participants were recruited from four US cities (Chicago, IL; Miami, FL; Bronx, NY and San Diego, CA) between 2008 and 2011. SOL Youth is a cross-sectional ancillary study of 1,466 youth ages 8-16 years old who were living in the household of HCHS/SOL participants [15]. Youth were recruited between 2012 and 2014 if they met the following criteria: lived with the HCHS/SOL participant at least 5 days a week and 9 months out of the year; had no known serious physical or cognitive comorbidity; and, were not currently pregnant or had given birth within 6 months. Biological relationships were not required. All eligible children in the household were invited to attend. Details of the sampling, recruitment and theoretical foundations for HCHS/SOL [16, 17] and SOL-Youth are published [18, 19]. The research was approved by the Institutional Review Boards of each of the participating institutions; a combination of written consent and assent was obtained. Participant safety was monitored by an Observational Studies Monitoring Board at the National Heart, Lung, and Blood Institute.

In the present analysis, we excluded caregivers who were not biological parents., which included (grandparents (n=31), step parents or adoptive parents (n=29), older siblings or other adult relatives (n=12) or an undefined relationship (n=7). Our final analysis sample is 942 parents and 1341 children.

Measurements

Data were collected from fasting (12 hours) participants using standardized protocols across field centers [13, 15].

Youth Measurements—Body weight and height were measured; body mass index (BMI) was calculated². The Centers for Disease Control and Prevention growth charts for children and adolescents were used to classify weight status using the following age and sex-specific percentiles of BMI: underweight (<5th percentile); normal or healthy weight (5th to <85th percentile); overweight (85th to <95th percentile) and obese (≥95th percentile) [20]. Waist circumference was measured in duplicate and averaged. Body fat percentage was measured via bio-electric impedance (Tanita Corporation, Japan).

Following 5-minutes of rest, blood pressure was measured 3 times using an automated sphygmomanometer (Omron Corporation, Japan); the second and third readings were averaged. Blood pressure was classified as normal, prehypertensive, and hypertensive, respectively, based on the following age-, height- and sex-standardized systolic and diastolic blood pressure percentiles: <90th percentile, 90-94th percentile and ≥95th percentile, respectively [21]. High blood pressure was defined as presence of either prehypertension or hypertension.

All blood samples were processed at a central laboratory (Fairview Laboratories, University of Minnesota). Plasma glucose was determined using a hexokinase enzymatic method (Roche Diagnostics). Hemoglobin A1c (HbA1c) was measured in whole blood (Tosoh Bioscience). Participants were classified as having prediabetes if their fasting glucose was 100-125 mg/dL or if HbA1c was 5.7-6.4%; diabetes was determined if fasting glucose ≥126 mg/dL or HbA1c ≥6.5% [22]. Hyperglycemia was determined if youth had prediabetes or diabetes.

Serum total cholesterol was assayed using a cholesterol oxidase enzymatic method and high density lipoprotein cholesterol (HDL-C) was determined using a direct magnesium/dextran sulfate method. Triglycerides were measured in serum using a glycerol blanking enzymatic method (Roche Diagnostics, Indianapolis, IN). Low density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald equation [23]. Youth were classified as having dyslipidemia if they met any of the following criteria for adverse levels of lipids: total cholesterol ≥200 mg/dL; LDL-C ≥130 mg/dL; triglycerides ≥150 mg/dL; or HDL-C <40 mg/dL [24, 25].

We created a summary measure of CVD risk factor burden consistent with that used in prior reports of adult HCHS/SOL participants [1]. Youth received a value of 1 if they had adverse levels of any of the following risk factors for CVD: obesity, high blood pressure (prehypertension and hypertension), hyperglycemia or dyslipidemia. We categorized participants as having 0, 1-2, or ≥3 risk factors.

Trained personnel interviewed youth and their parents to determine sociodemographic characteristics, dietary history, physical activity, medical history, medication use and pubertal status (i.e., Tanner staging) [26]. Because of a substantial amount of missing

responses to questions on the pubertal development scale, we were only able to determine Tanner stages on 983 participants. Self-reported physical activity among youth was assessed using a 68-item questionnaire querying the amount of time per day children spent engaging in moderate to vigorous activities [27] in the past month; responses were summed to calculate the number of times per month. Youth completed two interviewer-administered 24-hour diet recalls. The Healthy Eating Index 2010 is a measure of overall diet quality based on the reporting of 12 dietary components that reflect diet quality [28]. Scores ranged from 0-100 with a higher score indicating greater consistency of the diet with the 2010 Dietary Guidelines for Americans.

Parent Measurements—A small set of non-fasting measures was collected from the HCHS/SOL parent at the time of the SOL Youth examination, while the remainder were captured during the HCHS/SOL baseline examination conducted in 2008-2011 using standard protocols [13]. We included data on education level and income category from the HCHS/SOL caregiver who accompanied the child to the examination (n=1,018). Parent physical activity was assessed using an adapted scale from the Global Physical Activity Questionnaire (GPAQ) [29]. Diet quality was determined by calculating the alternative Healthy Eating Index based on two 24-hour dietary recalls. Height, weight, body composition and blood pressure were measured on parents who accompanied the child to the SOL Youth examination. Lipids, glucose and hemoglobin A1c were determined at the baseline HCHS/SOL examination. Weight status was determined using standard BMI cutpoints: underweight (BMI<18.5 kg/m²); normal weight (BMI 18.5-24.9 kg/m²); overweight (BMI 25-29.9 kg/m²); and obese (BMI ≥30 kg/m²). Hypertension was determined as SBP ≥140 mmHg, DBP ≥90 mmHg or reported using antihypertensive medications. Diabetes was determined as fasting glucose ≥126, HbA1c ≥6.5%, OGTT 2-hour glucose ≥200 mg/dL, or use of oral hypoglycemic agents or insulin. CVD risk factor score was created as the sum of the number of the following categorically elevated risk factors: hypercholesterolemia (total serum cholesterol ≥240 mg/dL or use of lipid lowering medication), hypertension, obesity, diabetes or cigarette smoking [1]. Parents were categorized as having 0, 1-2 or ≥3 risk factors.

Statistical Methods

All descriptive measures (means, proportions) and effect estimates (beta coefficients, odds ratios) were weighted to adjust for sampling probability and nonresponse [13, 14]. Weighting was carried out using generalized estimating equations with compound symmetric working covariance or multilevel models with a random intercept per household. To describe sociodemographic and clinical characteristics of youth and parents, we reported means for continuous variables, the number and weighted proportion for categorical variables, and 95% confidence intervals (CI). Next, we standardized (mean=0, standard deviation=1) continuously measured CVD risk factors among parents and modeled the association of adult CVD risk factors (independent variable) on the corresponding CVD risk factor among youth (dependent variable) using multivariable linear regression modeling that accounted for clustering within families. The standardized beta coefficients and 95% confidence intervals (CI) for youth CVD risk factors can be interpreted as the difference in youth values per SD higher measure of the same risk factor among parents.

Next, we modeled the probability of youth having a categorically elevated CVD risk factor (i.e., dyslipidemia, high blood pressure, hyperglycemia) by elevations in those same risk factors in parents using binary logistic regression to generate odds ratios (OR) and 95% CIs. We modeled the odds of youth having 1-2 or 3 risk factors (vs. 0 risk factors) according to whether parents had those same categorical elevations using multinomial logistic regression analyses. We used the same strategy to model the odds of youth being overweight or obese as compared with normal weight, based on their parent's weight status. Across analyses, we employed a similar strategy for statistical adjustment. Model 1 is adjusted for age (youth and parent), field center, parent's sex, income and education level and youth's ancestry. Model 2 is additionally adjusted for youth BMI percentile and parent BMI, youth and parent diet quality and self-reported physical activity. BMI percentile was not included in multinomial models of weight status.

We carried out a series of sensitivity analyses to evaluate whether our findings were robust. We tested whether the findings were consistent across dyads of the same sex and different sexes by stratifying by sex of the parent. To account for the influence of puberty on obesity and CVD risk, we stratified youth by age <12 years and ≥12 years and adjusted for Tanner staging in the subset of 983 youth (67% of the sample) who completed that instrument.

All statistical tests were 2-sided at a significance level of 0.05. No adjustments were made for multiple comparisons. All analyses were carried out using SAS version 9.4 (SAS Institute, Cary, NC) with survey weighting commands.

Results

A roughly equal number of girls (n=674) and boys (n=667) completed the examination (Table 1). On average, 1.4 youth were examined per family (range= 1 to 5). Mothers (n=810) were more likely to have accompanied their children to the examination than fathers (n=132). On average, youth were aged 12.1 years, mothers were 40.2 years old and fathers were 44.2 years old (Table 2).

Boys had higher blood pressure, fasting glucose and less favorable lipids than girls (Table 1). Dyslipidemia was prevalent, affecting 23.1% of boys and 20.1% of girls (21.6% overall). Youth were more likely to have low HDL-C (13.4%) than high total cholesterol (5.9%), LDL (4.3%) or triglycerides (7.6%). In the calculation of the CVD risk factor score, dyslipidemia and obesity were the most common components in boys and girls; however, a notable proportion of boys (20.8%) had prediabetes or diabetes. Among parents, BMI was similar by sex, but body fat percent was significantly higher among females. However, blood pressure, fasting glucose and hemoglobin A1c, and lipids were all significantly less favorable among men (Table 2).

With the exception of fasting glucose and diastolic blood pressure, CVD risk factors in youth were positively associated with those same risk factors in their parents (Table 3). Following additional adjustment for diet and physical activity and BMI, the correlations between adult and youth body fat and hemoglobin A1c were attenuated to non-significance. In models stratified by child's sex, there was no association of blood pressure and

triglycerides between girls and their parents. Among boys, there were no associations between adult and youth SBP, fasting glucose or HbA1c. When we stratified by sex of the parent, the findings were the same between mothers and their children of either sex; however, in the smaller sample of fathers (n=132) and their children the only statistically significant relationships were observed for diastolic blood pressure, fasting glucose, hemoglobin A1c and lipids (Supplemental Tables 1 and 2).

Figure 1 displays the weighted prevalence of youth weight status and number of CVD risk factors by adult weight category (Panels A-C) or CVD risk factor number (Panels D-F). Weight status is positively associated between parents and youth, with nearly three-quarters (72%) of normal weight parents having normal weight children. Similarly, 63% of parents who had no CVD risk factors had children without risk factors. Multivariable adjusted odds ratios of the binary risk factors are presented in Figure 2. In a fully adjusted model, the odds of having dyslipidemia remained two times higher (OR=1.98, 95% CI: 1.37 to 2.87) among youth whose parents had dyslipidemia in the full sample and in boys (OR=2.03, 95% CI: 1.26 to 3.26) and girls (OR=2.53, 95% CI: 1.42 to 4.52). Neither diabetes nor hypertension among parents was associated with hyperglycemia or high blood pressure in youth of either sex.

Following statistical adjustment, overweight and obese parents were 2-5 times more likely to have an obese child or adolescent (Table 4). The strongest associations were between obese parents and their children and adolescents. However, overweight parents were also twice as likely to have an obese child—an observation that was driven by the statistically significant relationship between overweight parents and girls (there was no association between overweight in parents and obesity in boys. Findings persisted with adjustment for youth diet and physical activity. As compared with parents who had 0 risk factors, parents with 1-2 risk factors were significantly more likely to have youth with 1-2 risk factors or 3 risk factors in models adjusted for demographic characteristics. Statistical adjustment for youth BMI percentile (Model 2) and diet and physical activity (Model 3) attenuated some associations; however, parents with risk factors were statistically more likely to have youth with 3 risk factors, though the absolute numbers were low leading to unstable estimates as reflected by wide confidence intervals. Again, in supplemental analysis that stratified by sex of the parents the findings were similar for mothers and their children (Supplemental Table 3) but estimates were unstable due to small numbers for fathers and their children and most were not statistically significant (Supplemental Table 4).

Sensitivity Analyses

Findings were similar when we stratified by age <12 vs. 12 years, adjusted for Tanner staging (data not shown).

Discussion

In our large, contemporary sample of Hispanic/Latino youth, the burden of overweight, obesity and CVD risk factors was high and patterned after those same risk factors among their parents. Our findings remained consistent following statistical adjustment for demographic characteristics and health behaviors that are directly relevant to risk factor

burden. These findings describe for the first time the implications for future clinical CVD in this large and growing subset of the US population.

Previous studies report an association of risk factors between parents and their children or adolescents in samples from the US, China, Australia, Germany and Sweden [6, 30]. Our findings build upon that literature by reporting an association that remains statistically significant following adjustment for two health behaviors—diet and physical activity, that contribute directly to the development of obesity and subsequent cardiovascular risk. One prior study in the US reported a stronger association of BMI between US Hispanic children and their parents as compared with black and white dyads [6]. We provide support for that observation in our sample of Hispanic/Latinos, though we cannot compare the strength of the association with other race/ethnic groups. We additionally report that these findings are also present for other measures of adiposity, namely waist circumference and body fat percentage, though the association attenuates to non-significance for body fat following adjustment for health behaviors. With that one exception, few estimates changed with additional statistical adjustment for health behaviors, which makes a strong argument for shared genes and environment as a logical future path of exploration [31].

The relatively high prevalence of dyslipidemia in youth (21.4%) and the significant correlation between adult and youth dyslipidemia was notable. Autosomal dominant familial hypercholesterolemia is an unlikely explanation since the prevalence of familial hypercholesterolemia is relatively low, affecting 1 in 200 to 500 individuals (no known estimates are available in Hispanics/Latinos) [32]. Further, the lipid component affected in familial hypercholesterolemia is LDL-C, whereas in our sample, youth were most likely to be classified as having dyslipidemia because of low HDL-C.

Two departures from the current literature were the absence of association for glucose and blood pressure between parents and youth. Diabetes is a significant problem in the HCHS/SOL cohort [33] and in other nationally representative samples of Hispanic/Latinos [34] while rates of hypertension are comparable between Hispanic/Latinos and non-Hispanic whites [35]. It is possible that the youth in our sample, who fell largely in the normal range for blood pressure and glucose levels, were not yet showing signs of the emergence of clinical disease. Glucose dysregulation was also not correlated between parents and youth in two small studies [10, 36]. By contrast, some [10, 37], but not all [30], prior studies report an association between parent and youth blood pressure.

Our findings should be interpreted in light of some limitations. Because our study was restricted to a single race/ethnicity—self-identified Hispanics/Latinos, we were unable to directly compare the magnitude and presence of associations with those in other race/ethnic groups in the US. However, Hispanic/Latino youth are relatively understudied despite the high rates of obesity in this sample and the high risk for future CVD. Given the contribution of pubertal status to CVD risk, in particular insulin resistance, accounting for pubertal development is essential. In response, we adjusted for Tanner stage in the subset on whom we had measures, and carried out sensitivity analyses stratifying our sample by the age (<12 years) [38] and each strategy yielded similar results. Diet and physical activity behaviors are self-reported in our sample and it is possible that inaccurate responses could result in

residual confounding by these important health behaviors. Because only one caregiver was measured, we do not have a full characterization of risk factor levels among parents in the household and in most cases our measures are in mothers. Despite our large sample size, only 132 fathers accompanied their children to the examinations. However, even with this small proportion of fathers, ours the largest study among Hispanics to capture male caregivers and their children. Our definitions of CVD risk factors did not match between youth and parents because we did not collect smoking behaviors among all youth. However, we chose to retain smoking in the adult score to maintain comparability with other reports of CVD risk factors in the HCHS/SOL study and with definitions related to “ideal” cardiovascular health. Finally, the majority of the CVD risk factors in parents (e.g., lipids, glucose and smoking status) were measured 3-5 years before those same measures were captured in children. If CVD risk factors among parents followed trends observed in other race/ethnic groups and worsened with aging, then associations that we observed with youth risk factors may have been artificially weakened.

Hispanic/Latino youth share patterns of obesity and CVD risk factors with their parents that are not attributable solely to shared health behaviors given that our statistically significant findings persisted following adjustment for obesity-related health behaviors of diet and physical activity. Based on longitudinal studies, we know that when obesity and risk factors are present in youth, it portends an elevated lifelong risk for CVD. An important implication of our findings is that while children and adolescents are routinely examined by healthcare professionals, their relatively young (mean age 40 years) parents are not. As pediatricians identify CVD risk factors in children and adolescents, it highlights an opportunity to encourage screening of parents who are also likely to have CVD risk factors but may not be aware because they are not captured in current screening guidelines. In summary, our study provides additional evidence that cardiovascular prevention efforts, including risk factor screening, should be broadened to include all household members in order to have the greatest potential to reduce the future burden of disease.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

The SOL Youth Study was supported by Grant Number R01HL102130 from the National Heart, Lung, And Blood Institute. The children in SOL Youth were drawn from the study of adults: The Hispanic Community Health Study/Study of Latinos, which was supported by contracts from the National Heart, Lung, and Blood Institute (NHLBI) to the University of North Carolina (N01-HC65233), University of Miami (N01-HC65234), Albert Einstein College of Medicine (N01-HC65235), Northwestern University (N01-HC65236), and San Diego State University (N01-HC65237). The following Institutes/Centers/Offices contribute to the HCHS/SOL through a transfer of funds to the NHLBI: National Center on Minority Health and Health Disparities, the National Institute of Deafness and Other Communications Disorders, the National Institute of Dental and Craniofacial Research, the National Institute of Diabetes and Digestive and Kidney Diseases, the National Institute of Neurological Disorders and Stroke, and the Office of Dietary Supplements. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Heart, Lung, And Blood Institute or the National Institutes of Health.

References

1. Daviglus ML, Talavera GA, Avilés-Santa M, et al. Prevalence of major cardiovascular risk factors and cardiovascular diseases among hispanic/latino individuals of diverse backgrounds in the united states. *JAMA*. 2012; 308:1775–84. [PubMed: 23117778]
2. Menke A, Casagrande S, Geiss L, Cowie CC. PRevalence of and trends in diabetes among adults in the united states, 1988-2012. *JAMA*. 2015; 314:1021–9. [PubMed: 26348752]
3. Ogden CL, Carroll MD, Kit BK, Flegal KM. PRevalence of childhood and adult obesity in the united states, 2011-2012. *JAMA*. 2014; 311:806–14. [PubMed: 24570244]
4. Chen W, Srinivasan SR, Elkasabany A, Berenson GS. The association of cardiovascular risk factor clustering related to insulin resistance syndrome (Syndrome X) between young parents and their offspring: the Bogalusa Heart Study. *Atherosclerosis*. 1999; 145:197–205. [PubMed: 10428311]
5. Chen W, Srinivasan SR, Bao W, Berenson GS. The Magnitude of Familial Associations of Cardiovascular Risk Factor Variables between Parents and Offspring Are Influenced by Age: The Bogalusa Heart Study. *Annals of Epidemiology*. 2001; 11:522–8. [PubMed: 11709270]
6. Jago R, Baranowski T, Watson K, Baranowski JC, Nicklas T, Zakeri IF. Relationships Between Maternal and Child Cardiovascular Risk Factors: Ethnic Differences and Lack of Influence of Physical Activity. *Arch Pediatr Adolesc Med*. 2004; 158:1125–31. [PubMed: 15583096]
7. Wang Z, Patterson CM, Hills AP. Association between overweight or obesity and household income and parental body mass index in Australian youth: analysis of the Australian National Nutrition Survey, 1995. *Asia Pacific journal of clinical nutrition*. 2002; 11:200–5. [PubMed: 12230233]
8. Bralic I, Vrdoljak J, Kovacic V. Associations between parental and child overweight and obesity. *Collegium antropologicum*. 2005; 29:481–6. [PubMed: 16417148]
9. Jago R, Harrell JS, McMurray RG, Edelstein S, El Ghormli L, Bassin S. Prevalence of Abnormal Lipid and Blood Pressure Values Among an Ethnically Diverse Population of Eighth-Grade Adolescents and Screening Implications. *Pediatrics*. 2006; 117:2065–73. [PubMed: 16740849]
10. Reis EC, Kip KE, Marroquin OC, Kiesau M, Hipps L Jr, Peters RE, et al. Screening children to identify families at increased risk for cardiovascular disease. *Pediatrics*. 2006; 118:e1789–97. [PubMed: 17142500]
11. Landale, N., Oropesa, R., Bradatan, C. *Hispanics and the Future of America*. Washington DC: National Academies Press; 2006.
12. Drenowatz C, Erkelenz N, Wartha O, Brandstetter S, Steinacker JM. on behalf of the U-ICESG. Parental Characteristics Have a Larger Effect on Children's Health Behaviour than Their Body Weight. *Obesity Facts*. 2014; 7:388–98. [PubMed: 25434370]
13. Sorlie PD, Aviles-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. *Ann Epidemiol*. 2010; 20:629–41. [PubMed: 20609343]
14. Lavange LM, Kalsbeek WD, Sorlie PD, Aviles-Santa LM, Kaplan RC, Barnhart J, et al. Sample design and cohort selection in the Hispanic Community Health Study/Study of Latinos. *Ann Epidemiol*. 2010; 20:642–9. [PubMed: 20609344]
15. 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. *Ann Epidemiol*. 2014; 24:29–35. [PubMed: 24120345]
16. 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; 20:629–41. [PubMed: 20609343]
17. LaVange LM, Kalsbeek WD, Sorlie PD, Avilés-Santa LM, Kaplan RC, Barnhart J, et al. Sample Design and Cohort Selection in the Hispanic Community Health Study/Study of Latinos. *Annals of Epidemiology*. 2010; 20:642–9. [PubMed: 20609344]
18. 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; 24:29–35. [PubMed: 24120345]

19. Ayala GX, Carnethon M, Arredondo E, Delamater AM, Perreira K, Van Horn L, et al. Theoretical foundations of the Study of Latino (SOL) Youth: implications for obesity and cardiometabolic risk. *Annals of Epidemiology*. 2014; 24:36–43. [PubMed: 24246265]
20. Barlow SE. the Expert C. Expert Committee Recommendations Regarding the Prevention, Assessment, and Treatment of Child and Adolescent Overweight and Obesity: Summary Report. *Pediatrics*. 2007; 120:S164–92. [PubMed: 18055651]
21. National High Blood Pressure Education Program Working Group on High Blood Pressure in C, Adolescents. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. *Pediatrics*. 2004; 114:555–76. [PubMed: 15286277]
22. American Diabetes A. (2) Classification and diagnosis of diabetes. *Diabetes Care*. 2015; 38 Suppl:S8–S16.
23. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clinical Chemistry*. 1972; 18:499–502. [PubMed: 4337382]
24. Cook S, Weitzman M, Auinger P, Nguyen M, Dietz WH. Prevalence of a metabolic syndrome phenotype in adolescents: findings from the third National Health and Nutrition Examination Survey, 1988-1994. *Arch Pediatr Adolesc Med*. 2003; 157:821–7. [PubMed: 12912790]
25. Kit BK, Kuklina E, Carroll MD, Ostchega Y, Freedman DS, Ogden CL. PRevalence of and trends in dyslipidemia and blood pressure among us children and adolescents, 1999-2012. *JAMA Pediatrics*. 2015; 169:272–9. [PubMed: 25599372]
26. Petersen A, Crockett L, Richards M, Boxer A. A self-report measure of pubertal status: Reliability, validity, and initial norms. *Journal of Youth and Adolescence*. 1988; 17:117–33. [PubMed: 24277579]
27. Ridley K, Ainsworth BE, Olds TS. Development of a compendium of energy expenditures for youth. *Int J Behav Nutr Phys Act*. 2008; 5:45. [PubMed: 18782458]
28. Guenther PM, Casavale KO, Reedy J, Kirkpatrick SI, Hiza HA, Kuczynski KJ, et al. Update of the Healthy Eating Index: HEI-2010. *J Acad Nutr Diet*. 2013; 113:569–80. [PubMed: 23415502]
29. Arredondo EM, Sotres-Alvarez D, Stoutenberg M, Davis SM, Crespo NC, Carnethon MR, et al. Physical Activity Levels in U.S. Latino/Hispanic Adults: Results From the Hispanic Community Health Study/Study of Latinos. *American journal of preventive medicine*. 2016; 50:500–8. [PubMed: 26597505]
30. Khanolkar AR, Byberg L, Koupil I. Parental influences on cardiovascular risk factors in Swedish children aged 5-14 years. *Eur J Public Health*. 2012; 22:840–7. [PubMed: 22167477]
31. DeMenna J, Puppala S, Chittoor G, Schneider J, Kim JY, Shaibi GQ, et al. Association of common genetic variants with diabetes and metabolic syndrome related traits in the Arizona Insulin Resistance registry: a focus on Mexican American families in the Southwest. *Human heredity*. 2014; 78:47–58. [PubMed: 25060389]
32. de Ferranti SD. Familial hypercholesterolemia in children and adolescents: A clinical perspective. *Journal of Clinical Lipidology*. 2015; 9:S11–S9. [PubMed: 26343208]
33. Schneiderman N, Llabre M, Cowie CC, Barnhart J, Carnethon M, Gallo LC, et al. Prevalence of diabetes among Hispanics/Latinos from diverse backgrounds: the Hispanic Community Health Study/Study of Latinos (HCHS/SOL). *Diabetes Care*. 2014; 37:2233–9. [PubMed: 25061138]
34. Menke A, Casagrande S, Geiss L, Cowie CC. Prevalence of and Trends in Diabetes Among Adults in the United States, 1988-2012. *Jama*. 2015; 314:1021–9. [PubMed: 26348752]
35. Egan BM, Zhao Y, Axon R. US trends in prevalence, awareness, treatment, and control of hypertension, 1988-2008. *JAMA*. 2010; 303:2043–50. [PubMed: 20501926]
36. Goran MI, Coronges K, Bergman RN, Cruz ML, Gower BA. Influence of family history of type 2 diabetes on insulin sensitivity in prepubertal children. *The Journal of clinical endocrinology and metabolism*. 2003; 88:192–5. [PubMed: 12519851]
37. Halvorsen T, Moran A, Jacobs DR Jr, Steffen LM, Sinaiko AR, Zhou X, et al. Relation of Cardiometabolic Risk Factors between Parents and Children. *J Pediatr*. 2015; 167:1049–56 e2. [PubMed: 26307644]

38. Sun SS, Schubert CM, Chumlea WC, Roche AF, Kulin HE, Lee PA, et al. National estimates of the timing of sexual maturation and racial differences among US children. *Pediatrics*. 2002; 110:911–9. [PubMed: 12415029]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Figure 1. Youth Weight Status and Cardiovascular Risk Factor Number by Adult Weight Status and CVD Risk Factor Count

Figure 2. Odds Ratios of the association between adult dyslipidemia (A), diabetes (B) and Hypertension (C) with youth dyslipidemia, prediabetes or diabetes and high blood pressure

Table 1

Sociodemographic and Clinical Characteristics of Youth

	All (n = 1341)			Girls (n= 674)			Boys (n= 667)			P Value**
	No.	Mean or % (95% CI)	No.	Mean or % (95% CI)	No.	Mean or % (95% CI)	Mean or % (95% CI)	No.	Mean or % (95% CI)	
Age, years		12.1 (12.0, 12.3)		12.1 (11.9, 12.3)		12.1 (11.9, 12.4)				.82
Age Group, %										.90
8-12 years old	756	53.4 (50.2, 56.7)	370	54.0 (49.0, 59.0)	386	52.9 (48.0, 57.8)				
13-14 years old	348	22.4 (19.8, 25.1)	179	22.6 (18.7, 26.6)	169	22.3 (18.5, 26.0)				
15-16 years old	237	24.1 (20.9, 27.4)	125	23.4 (18.9, 27.9)	112	24.9 (20.1, 29.7)				
Tanner Stage [†]										<.001
I	37	4.2 (2.7, 5.8)	9	2.3 (0.5, 4.2)	28	6.0 (3.6, 8.4)				
II	83	9.2 (6.5, 11.9)	34	8.2 (5.0, 11.3)	49	10.1 (6.3, 13.9)				
III	171	17.2 (14.3, 20.0)	63	13.2 (9.3, 17.1)	108	20.9 (16.3, 25.4)				
IV	208	23.2 (19.6, 26.7)	98	19.9 (15.7, 24.1)	110	26.2 (20.8, 31.6)				
V	394	46.3 (41.9, 50.6)	236	56.4 (50.3, 62.4)	158	36.8 (31.3, 42.4)				
Field Center, %										.97
Bronx, NY	367	35.1 (30.7, 39.5)	187	35.5 (30.4, 40.5)	180	34.7 (28.9, 40.6)				
Chicago, IL	346	16.4 (13.5, 19.2)	191	16.7 (13.3, 20.1)	155	16.0 (12.4, 19.7)				
Miami, FL	249	13.6 (10.9, 16.3)	114	13.2 (9.9, 16.5)	135	14.0 (10.7, 17.3)				
San Diego, CA	379	34.9 (29.8, 40.0)	182	34.6 (28.7, 40.6)	197	35.2 (28.9, 41.5)				
Hispanic/Latino Ancestry, %										.84
Central American	108	6.5 (4.8, 8.1)	67	7.9 (5.5, 10.2)	44	5.2 (3.2, 7.1)				
Cuban	94	5.4 (3.9, 6.9)	44	5.4 (3.2, 7.5)	50	5.4 (3.7, 7.2)				
Dominican	136	12.3 (9.4, 15.3)	70	12.8 (9.0, 16.5)	66	11.9 (8.1, 15.7)				
Mexican	615	49.8 (44.9, 54.7)	319	48.6 (42.7, 54.6)	296	50.9 (44.9, 57.0)				
Puerto Rican	108	9.6 (7.1, 12.2)	52	9.4 (6.3, 12.5)	56	9.9 (6.8, 12.9)				
South American	68	4.4 (2.9, 5.9)	30	4.0 (2.3, 5.7)	38	4.8 (2.6, 6.9)				
Mixed	122	10.0 (7.4, 12.6)	62	10.1 (6.7, 13.5)	60	9.9 (6.8, 13.1)				
Other	24	1.9 (1.0, 2.9)	11	1.9 (0.5, 3.2)	13	2.0 (0.6, 3.4)				
US Born, %	1070	81.6 (78.5, 84.6)	545	82.3 (78.6, 86.1)	525	80.8 (76.7, 84.9)				.55
Healthy Eating Index, score		53.8 (52.8, 54.9)		54.0 (52.7, 55.4)		53.7 (52.2, 55.1)				.68

	All (n = 1341)			Girls (n= 674)			Boys (n= 667)			P Value**
	No.	Mean or % (95% CI)	No.	Mean or % (95% CI)	No.	Mean or % (95% CI)	No.	Mean or % (95% CI)		
Moderate to vigorous physical activity, minutes/month		247.1 (235.1, 259.2)		235.8 (222.0, 251.5)		258.0 (241.5, 274.4)		.04		
BMI, kg/m2		22.3 (21.9, 22.7)		22.5 (21.9, 23.2)		22.1 (21.5, 22.6)		.28		
BMI Percentile		72.5 (70.4, 74.7)		72.6 (69.7, 75.4)		72.5 (69.4, 75.6)		.96		
Weight categories, % ‡								.89		
Underweight	34	2.9 (1.7, 4.1)	18	3.1 (1.4, 4.7)	16	2.8 (1.2, 4.3)				
Normal weight	655	50.7 (46.9, 54.5)	345	51.6 (46.5, 56.6)	310	49.8 (44.1, 55.5)				
Overweight	274	19.7 (17.0, 22.5)	142	20.2 (16.4, 24.0)	132	19.3 (15.0, 23.7)				
Obese	245	17.1 (14.4, 19.8)	111	15.7 (12.1, 19.4)	134	18.4 (14.5, 22.3)				
Severely obese	133	9.6 (7.4, 11.7)	58	9.4 (6.3, 12.5)	75	9.7 (6.8, 12.5)				
Waist circumference, cm		77.1 (76.0, 78.1)		77.2 (75.9, 78.5)		76.9 (75.4, 78.5)		.77		
Body fat percent,		26.2 (25.4, 27.0)		29.6 (28.6, 30.6)		22.9 (21.7, 24.0)		<.001		
Systolic blood pressure, mmHg		104.5 (103.7, 105.3)		101.1 (100.2, 102.0)		107.8 (106.6, 108.9)		<.001		
Diastolic blood pressure, mmHg		60.2 (59.5, 60.8)		59.5 (58.8, 60.3)		60.8 (59.9, 61.7)		.02		
SBP Percentile		44.6 (42.7, 46.6)		37.7 (35.1, 40.3)		51.2 (48.5, 53.9)		<.001		
DBP Percentile		42.9 (41.0, 44.7)		40.6 (38.3, 42.8)		45.1 (42.6, 47.5)		<.001		
Prehypertension or Hypertension,%	74	6.3 (4.5, 8.2)	25	3.9 (1.7, 6.0)	49	8.7 (5.6, 11.8)		.01		
Hypertension, %	33	2.7 (1.5, 3.9)	10	1.3 (0.2, 2.3)	23	4.0 (1.9, 6.2)		.02		
Fasting glucose, mg/dL		92.0 (91.3, 92.8)		89.7 (89.1, 90.4)		94.2 (92.9, 95.4)		<.001		
Hemoglobin A1c,		5.26 (5.23, 5.29)		5.23 (5.21, 5.27)		5.28 (5.24, 5.32)		.06		
Prediabetes or diabetes, %	218	16.5 (13.9, 19.2)	83	11.7 (8.6, 14.7)	135	21.2 (16.8, 25.5)		<.001		
Diabetes, %	3	0.43 (0.00, 0.91)	0		3	0.83 (0.00, 1.78)		NA		
Total cholesterol, mg/dL		154.7 (152.7, 156.8)		156.2 (153.5, 159.0)		153.5 (150.6, 156.5)		.160		
HDL cholesterol, mg/dL		52.10 (51.2, 52.9)		51.9 (50.8, 53.0)		52.2 (50.9, 53.6)		.74		
LDL cholesterol, mg/dL		86.9 (85.1, 88.7)		88.2 (85.7, 90.6)		85.7 (83.4, 88.0)		.12		
Triglycerides, mg/dL		80.3 (76.4, 84.2)		82.5 (76.1, 88.9)		78.2 (73.2, 83.2)		.31		
Dyslipidemia,%	299	21.4 (18.6, 24.2)	131	19.6 (15.6, 23.6)	168	23.2 (18.7, 27.6)		.26		
CVD Risk Factor Count [§] , %								.011		
0	697	53.9 (50.3, 57.5)	392	59.6 (54.6, 64.6)	305	48.5 (43.1, 53.9)				
1-2	584	41.8 (38.2, 45.5)	260	36.8 (31.8, 41.7)	324	46.7 (41.2, 52.1)				
3+	60	4.3 (3.09, 5.5)	22	3.6 (1.6, 5.6)	38	4.8 (3.0, 6.7)				

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

* Survey weighted mean and 95% confidence interval unless otherwise noted

[†] Available in 893 participants

[‡] Weight categories according to age and sex adjusted CDC cutpoints for youth (underweight = BMI percentile < 5th; normal weight=5-85th percentile; overweight =85th-95th percentile; obese 95th percentile)

CVD risk factor count: Dysglycemia (prediabetes or diabetes), elevated blood pressure (prehypertension or hypertension), dyslipidemia (total cholesterol ≥200, triglycerides ≥150, HDL 40 or LDL 130, or obesity (BMI percentile ≥95th percentile)

SI Units: To convert cholesterol to mmol/L, multiply values by 0.0259. To convert glucose to mmol/L multiply by 0.0555

Table 2
Sociodemographic and Clinical Characteristics of Parents

Characteristics	All (n=942)		Mothers (n=810)		Fathers (n=132)		P value**
	No.	Mean or % (95% CI)	No.	Mean or % (95% CI)	No.	Mean or % (95% CI)	
Age, years	941	40.7 (40.2, 41.2)	810	40.2 (39.7, 40.8)	131	44.2 (42.5, 45.9)	<.001
Field Center, %							.009
Bronx, NY	256	35.5 (31.5, 39.4)	233	37.3 (32.8, 41.7)	23	21.5 (12.4, 30.6)	
Chicago, IL	229	15.5 (13.1, 17.8)	188	14.3 (11.7, 17.0)	41	24.1 (16.7, 31.6)	
Miami, FL	184	14.7 (12.2, 17.2)	157	14.3 (11.6, 17.0)	27	17.8 (11.1, 24.5)	
San Diego, CA	273	34.4 (29.9, 38.9)	232	34.1 (29.2, 39.0)	41	36.6 (26.6, 46.5)	
Hispanic/Latino Ancestry, %							
Central American	106	13.9 (10.7, 17.2)	95	14.6 (10.9, 18.2)	11	9.0 (2.2, 15.9)	
Cuban	100	8.6 (6.6, 10.6)	90	8.7 (6.6, 10.7)	10	8.2 (2.9, 13.6)	
Dominican	79	6.3 (4.5, 8.2)	60	5.6 (3.7, 7.4)	19	12.4 (6.0, 18.8)	
Mexican	458	50.8 (46.4, 55.3)	388	50.2 (45.5, 55.0)	70	55.7 (5.5, 65.8)	
Puerto Rican	100	12.0 (9.3, 14.8)	91	12.8 (9.8, 15.8)	9	6.1 (1.9, 10.2)	
South American	70	6.1 (4.3, 7.8)	62	6.1 (4.3, 7.9)	8	5.8 (1.6, 9.9)	
Mixed	19	2.0 (1.1, 3.0)	16	1.9 (0.9, 2.9)	3	2.9 (0.0, 6.3)	
Other	3	0.2 (0.0, 0.4)	3	0.2 (0.0, 0.4)	0	-	.130
US Born, %							
Yes	760	78.5 (75.0, 81.9)	646	77.7 (74.0, 81.4)	114	84.5 (76.4, 92.5)	
No	178	21.5 (18.1, 25.0)	161	22.3, (18.6, 26.0)	17	15.5 (7.5, 23.6)	
Education, %							.058
< HS	350	37.6 (33.5, 41.6)	312	39.1 (34.6, 43.5)	38	25.9 (16.7, 35.0)	
HS Equivalent	261	28.3 (24.5, 32.0)	219	27.4 (23.3, 31.4)	42	35.4 (25.3, 45.5)	
>= HS	329	34.1 (30.1, 38.2)	278	33.5 (29.3, 37.8)	51	38.7 (28.7, 48.7)	
Household Income, %							<.001
\$20K	473	50.8 (46.3, 55.3)	439	54.6 (49.8, 59.4)	34	21.3 (13.4, 29.2)	
\$21K-\$40K	305	32.8 (29.0, 36.5)	247	30.9 (26.7, 35.0)	58	47.5 (37.1, 58.0)	
>\$40K	137	16.4 (13.2, 19.7)	101	14.5 (11.1, 17.9)	36	31.2 (21.5, 41.0)	

Characteristics	All (n=942)			Mothers (n=810)			Fathers (n=132)			P value**
	No.	Mean or % (95% CI)	No.	Mean or % (95% CI)	No.	Mean or % (95% CI)	No.	Mean or % (95% CI)		
BMI, kg/m2	907	30.8 (30.2, 31.4)	777	30.8 (30.2, 31.5)	130	30.5 (29.4, 31.7)			.986	
Weight categories †, %										
Underweight	6	0.6 (0.1, 1.1)	4	0.3 (0.0, 0.7)	2	2.4 (0.0, 5.8)			.286	
Normal weight	140	16.0 (12.6, 19.5)	125	16.8 (13.0, 20.5)	15	10.4 (4.5, 16.3)				
Overweight	335	37.9 (33.6, 42.2)	277	37.7 (33.0, 42.4)	58	39.5 (29.4, 49.7)				
Obese	426	45.5 (41.5, 49.5)	371	45.2 (40.9, 49.5)	55	47.7 (36.9, 58.5)				
Waist circumference, cm	908	98.9 (97.6, 100.2)	778	98.6 (97.1, 100.0)	130	101.2 (98.3, 104.2)			.067	
Body fat percent	901	37.6 (36.9, 38.2)	773	38.6 (37.9, 39.3)	128	29.7 (28.0, 31.5)			<.001	
Systolic blood pressure, mmHg	908	112.6 (111.5, 113.6)	783	111.3 (110.2, 112.5)	125	122.3 (119.5, 125.0)			<.001	
Diastolic blood pressure, mmHg	907	70.5 (69.8, 71.3)	782	70.1 (69.2, 70.9)	125	74.5 (72.5, 76.5)			<.001	
Hypertension, %	107	10.2 (7.8, 12.5)	82	9.5 (7.0, 12.1)	25	15.3 (9.0, 21.6)			.097	
Fasting glucose, mg/dL	907	98.2 (95.6, 100.7)	782	96.8 (94.2, 99.5)	125	108.8 (101.9, 115.7)			<.001	
Hemoglobin A1c	903	5.6 (5.5, 5.7)	778	5.6 (5.5, 5.7)	125	5.9 (5.7, 6.2)			.011	
Glycemic status, %									.027	
Normal	483	55.2 (51.1, 59.2)	432	56.7 (52.4, 61.1)	51	42.6 (32.0, 53.2)				
Prediabetes	313	33.6 (29.6, 37.5)	265	33.0 (28.8, 37.1)	48	38.5 (28.0, 49.1)				
Diabetes	113	11.3 (8.4, 14.1)	87	10.3 (7.3, 13.4)	26	18.9 (11.4, 26.4)				
Total cholesterol, mg/dL	907	191.8 (188.9, 194.8)	782	189.8 (186.6, 192.9)	125	208.1 (200.5, 215.7)			<.001	
HDL cholesterol, mg/dL	907	51.4 (50.2, 52.6)	782	52.3 (51.0, 53.6)	125	44.2 (42.5, 45.9)			<.001	
LDL cholesterol, mg/dL	900	117.0 (114.5, 119.5)	778	114.8 (112.2, 117.4)	122	134.8 (128.1, 141.5)			<.001	
Triglycerides, mg/dL	907	117.5 (111.3, 123.7)	782	113.5 (106.8, 120.3)	125	149.0 (131.9, 166.0)			<.001	
Dyslipidemia, %	267	27.9 (24.2, 31.6)	203	24.5 (20.6, 28.5)	64	54.8 (42.3, 65.3)			<.001	
CVD Risk Factor Count									<.001	
0	296	34.0 (29.8, 38.2)	266	35.9 (31.4, 40.5)	30	18.8 (11.5, 26.2)				
1-2	552	56.6 (52.3, 60.9)	476	56.0 (51.4, 60.6)	76	61.3 (51.2, 71.3)				
3+	92	9.4 (7.1, 11.7)	66	8.1 (5.6, 10.5)	26	19.8 (11.6, 28.1)				
Alternative Healthy Eating Index ‡ Score	903	47.5 (46.9, 48.2)	778	47.1 (46.4, 47.8)	125	51.1 (49.7, 52.4)			<.001	
Physical activity §	908	98.6 (86.8, 110.3)	783	93.0 (81.1, 105.0)	125	142.9 (106.6, 179.1)			.006	

SI Units: To convert cholesterol to mmol/L, multiply values by 0.0259. To convert glucose to mmol/L multiply by 0.0555

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

* Weighted Mean and 95% confidence interval unless otherwise noted

[†] Weight categories according to the World Health Organization cutpoints for parents (underweight = BMI<18.5 kg/m²; normal weight = BMI 18.5-24.9 kg/m²; overweight = BMI 25.0-29.9 kg/m²; obese = BMI>30 kg/m²)

[‡] Alternative Healthy Eating Index 2010.

[§] Total physical activity (min/day)

Dyslipidemia: High LDL, low HDL or High TGs

Table 3
Difference in youth cardiovascular risk factor level per standard deviation difference in parent risk factor level

Parent measure	Model 1		Model 2	
	β^* (95% CI)	P	β (95% CI)	P
<i>All (n=1466)</i>				
BMI [‡] (per 7.0 kg/m ²)	7.0 (5.2, 8.9)	<.001	7.0 (5.1, 8.9)	<.001
Waist (per 15.1 cm)	3.7 (2.8, 4.6)	<.001	1.6 (0.7, 2.6)	.001
Body Fat Percent (per 8.1%)	3.1 (2.4, 3.9)	<.001	0.7 (-0.2, 1.7)	.135
SBP (per 15.3 mmHg)	3.6 (1.3, 5.9)	.002	3.1 (0.7, 5.6)	.012
DBP [‡] (per 10.3 mmHg)	2.1 (0.4, 3.9)	.017	1.7 (-0.1, 3.5)	.063
Fasting Glucose (per 34.8 mg/dL)	0.5 (-0.3, 1.3)	.242	0.4 (-0.4, 1.2)	.319
Hemoglobin A1c (per 1.2%)	0.1 (0.02, 0.1)	.003	0.04 (0.01, 0.1)	.020
Total cholesterol (per 36.7 mg/dL)	7.2 (4.7, 9.8)	<.001	6.7 (4.1, 9.4)	<.001
HDL-C (per 12.6 mg/dL)	3.2 (2.5, 4.1)	<.001	3.1 (2.3, 3.8)	<.001
LDL-C (per 30.9 mg/dL)	6.7 (5.0, 8.5)	<.001	6.0 (4.2, 7.9)	<.001
Triglycerides (per 86.6 mg/dL)	9.6 (3.5, 15.9)	.002	9.8 (4.0, 15.5)	<.001
<i>Girls (n= 738)</i>				
BMI [†] (per 7.0 kg/m ²)	5.8 (3.3, 8.2)	<.001	5.7 (3.4, 8.2)	<.001
Waist (per 15.1 cm)	3.4 (2.2, 4.6)	<.001	2.3 (0.7, 3.9)	.005
Body Fat Percent (per 8.1%)	2.8 (2.0, 3.7)	<.001	2.2 (1.4, 3.0)	<.001
SBP [‡] (per 15.3 mmHg)	2.7 (-0.3, 5.8)	.079	2.8 (-0.4, 6.0)	.082
DBP [‡] (per 10.3 mmHg)	1.2 (-1.1, 3.4)	.302	1.5 (-0.8, 3.9)	.200
Fasting Glucose (per 34.8 mg/dL)	0.2 (-0.7, 1.2)	.632	0.2 (-0.8, 1.2)	.739
Hemoglobin A1c (per 1.2%)	0.1 (0.04, 0.1)	<.001	0.1 (0.03, 0.1)	.001
Total cholesterol (per 36.7 mg/dL)	7.9 (4.6, 11.2)	<.001	7.0 (3.3, 10.7)	<.001
HDL-C (per 12.6 mg/dL)	2.7 (1.5, 3.9)	<.001	2.9 (1.8, 3.9)	<.001
LDL-C (per 30.9 mg/dL)	7.5 (5.2, 9.9)	<.001	6.6 (3.9, 9.3)	<.001
Triglycerides (per 86.6 mg/dL)	8.7 (3.0, 13.8)	.002	8.3 (2.5, 14.1)	.005
<i>Boys (n= 728)</i>				
BMI [‡] (per 7.0 kg/m ²)	8.9 (5.9, 12.0)	<.001	9.2 (6.1, 12.3)	<.001
Waist (per 15.1 cm)	4.1 (2.9, 5.5)	<.001	1.2 (-0.1, 2.4)	.079
Body Fat Percent (per 8.1%)	3.5 (2.3, 4.7)	<.001	-0.2 (-1.7, 1.5)	.894
SBP [‡] (per 15.3 mmHg)	4.8 (2.1, 7.5)	<.001	3.3 (0.2, 6.4)	.035
DBP [‡] (per 10.3 mmHg)	3.5 (1.4, 5.7)	.001	2.0 (-0.5, 4.5)	.116
Fasting Glucose (per 34.8 mg/dL)	0.99 (-0.6, 2.8)	.219	1.0 (-0.8, 2.9)	.275
Hemoglobin A1c (per 1.2%)	0.03 (-0.02, 0.1)	.228	0.03 (-0.03, 0.08)	.333
Total cholesterol (per 36.7 mg/dL)	7.4 (4.4, 10.3)	<.001	7.4 (4.5, 10.3)	<.001
HDL-C (per 12.6 mg/dL)	3.8 (2.7, 4.9)	<.001	3.3 (2.0, 4.5)	<.001
LDL-C (per 30.9 mg/dL)	6.5 (4.4, 8.6)	<.001	6.0 (3.9, 8.2)	<.001

Parent measure	Model 1		Model 2	
	β^* (95% CI)	<i>P</i>	β (95% CI)	<i>P</i>
Triglycerides (per 86.6 mg/dL)	10.3 (1.8, 18.8)	.018	10.8 (3.2, 18.5)	.006

SI Units: To convert cholesterol to mmol/L, multiply values by 0.0259. To convert glucose to mmol/L multiply by 0.0555

Model 1: Adjusted for youth age, sex, ancestry, field center and adult's age, income, education and sex

Model 2: Model 1 + youth BMI percentile, youth physical activity level and diet score, parent physical activity level, diet score and BMI (except models for BMI)

* Beta coefficients represent the difference in the corresponding risk factor among youth with a SD change in the same measure among adults

[†] Measure for youth is BMI percentile determined by CDC cutpoints that account for age and sex.

[‡] Measure for youth is SBP and DBP percentiles based on age, sex, height adjustment

Table 4
Multinomial Logistic Regression Odds Ratios (95% Confidence Intervals) for Overweight, Obesity and Cardiovascular Disease Risk Factors among Youth by Parent Weight Status (A) or Risk Factor Status (B)

<i>A. Weight Status</i>									
	<u>All</u>			<u>Girls</u>		<u>Boys</u>			
	Overweight	Obese	1.0 (REF)	Overweight	Obese	Overweight	Obese	1.0 (REF)	Obese
Normal Weight	1.0 (REF)	1.0 (REF)	1.0 (REF)	1.0 (REF)	1.0 (REF)	1.0 (REF)	1.0 (REF)	1.0 (REF)	1.0 (REF)
Overweight									
Model 1	1.34 (0.71, 2.53)	2.37 (1.21, 4.62)	1.12 (0.48, 2.64)	2.96 (1.11, 7.92)	1.72 (0.72, 4.09)	1.92 (0.81, 4.58)			
Model 2	1.26 (0.66, 2.39)	2.39 (1.20, 4.76)	1.00 (0.42, 2.40)	2.90 (1.04, 8.07)	1.75 (0.72, 4.26)	2.18 (0.87, 5.44)			
Obese									
Model 1	2.57 (1.41, 4.67)	5.97 (3.20, 11.11)	2.33 (1.00, 5.46)	4.65 (1.85, 11.67)	3.11 (1.38, 6.98)	8.35 (3.62, 19.30)			
Model 2	2.65 (1.45, 4.84)	6.16 (3.23, 11.77)	2.24 (0.95, 5.29)	5.01 (1.89, 13.27)	3.42 (1.46, 7.98)	9.36 (3.88, 22.57)			
<i>B. Cardiovascular Risk Factor Count</i>									
	<u>All</u>			<u>Girls</u>		<u>Boys</u>			
	1-2 RF	3 RF	1.0 (REF)	1-2 RF	3 RF	1-2 RF	3 RF	1.0 (REF)	3 RF
0 RF	1.0 (REF)	1.0 (REF)	1.0 (REF)	1.0 (REF)	1.0 (REF)	1.0 (REF)	1.0 (REF)	1.0 (REF)	1.0 (REF)
1-2 RF									
Model 1	1.64 (1.18, 2.29)	2.09 (0.86, 5.10)	1.52 (0.93, 2.49)	3.83 (0.76, 19.46)	1.88 (1.17, 3.01)	1.79 (0.58, 5.47)			
Model 2	1.34 (0.94, 1.93)	0.76 (0.28, 2.03)	1.39 (0.82, 2.37)	2.32 (0.37, 14.54)	1.46 (0.86, 2.48)	0.43 (0.13, 1.47)			
3 RF									
Model 1	1.92 (1.12, 3.29)	7.77 (2.62, 23.04)	1.84 (0.71, 4.78)	16.36 (2.64, 11.32)	2.18 (0.95, 5.01)	7.49 (1.91, 29.38)			
Model 2	1.67 (0.91, 3.08)	3.63 (1.00, 13.19)	1.72 (0.71, 4.19)	26.69 (2.36, 302.21)	1.91 (0.58, 6.30)	2.40 (0.47, 12.13)			

[†]Model 1: Adjusted for youth age, sex, ancestry, field center and adult's age, income, education and sex

[‡]Model 2: Adjusted for Model 1 plus youth BMI percentile (for CVD RF models only), youth physical activity level and diet score, parent physical activity level, diet and BMI