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Factor Analysis of Metabolic Syndrome Components in the Coronary Artery Risk Development in Young Adults (CARDIA) Study: Examination of Factors by Race-Sex Groups and Across Time

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Abstract

Purpose—This study tests hypotheses of one-, two-, three-, and four-factor models of metabolic syndrome (MetS) components and assesses the consistency and fit of the factor models ten years later using confirmatory factor analysis in a large biracial sample of men and women.

Methods—Using data from the baseline and year-10 exams of the Coronary Artery Risk Development in Young Adults Study, confirmatory factor analysis was performed overall and for race-sex specific groups for one-, two-, three-, and four-factor MetS models in 3,403 White and Black, men and women at baseline and 2,532, ten years later. Metabolic risk variables used in the factor analysis were insulin resistance (HOMA-IR), fasting glucose, triglycerides, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, systolic and diastolic blood pressure, waist circumference, waist-hip ratio, triceps skin-folds, and uric acid.

Results—Three- and four-factor models of MetS achieved excellent fits of the data, ranging from 0.92 to 0.96, for race-sex specific models and from the baseline to year-10 exams.

Conclusions—The results suggest that MetS factors are consistent across time and race-sex groups. When investigating the MetS, it is necessary to evaluate race-sex groups.

Keywords

Metabolic Syndrome; Factor Analysis; CARDIA

The co-occurrence of multiple metabolic and physiologic risk factors for two major diseases, cardiovascular disease and type-2 diabetes is referred to as metabolic syndrome (MetS) (1).

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The MetS definition and the usefulness of the MetS delineation for patients in a clinical setting have been debated in the literature (2). The World Health Organization, National Cholesterol Education Program (NCEP), and American Association of Clinical Endocrinologists have three different classification definitions for MetS (3–5). The syndrome involves the occurrence of abnormalities in glucose tolerance, lipid metabolism, obesity, hyperuricemia, and hypertension in an individual more frequently than by chance (1,6–8). The common occurrence of these risk factors previously suggested an interrelation or a dominant underlying common factor (1,7). One dominant underlying factor that had been suggested is insulin resistance; however, insulin resistance has been unable to be established as the basis of all the components of the syndrome. The MetS continues to be investigated by the use of factor analysis in order to determine the presence of underlying factors.

Factor analysis is a mathematical method that uses the covariance or correlation structure of a set of observed variables to define a smaller set of unobserved latent variables identified as factors (9–11). These factors that cannot be directly measured influence the observable variables that can be measured. Exploratory factor analysis and principal component analysis dominate the literature. There is debate as to which factor analysis is more appropriate exploratory or confirmatory. The use of exploratory factor analysis does not allow for hypothesis testing. Confirmatory factor analysis is used to test a hypothesis of the presence of certain latent variables, their relations and causal effects (12). Maximum likelihood statistics are computed assessing if the variance among the given variables are adequately explained by the model.

All but three of the previous exploratory factor analysis studies of the MetS found more than one factor; most have resulted in three or four factors (13–15). The factor names are often similar to a Body Weight/Fat Distribution Factor, a Blood Pressure Factor, a Lipid Factor, and an Insulin/Glucose Factor. Because there are differences in prevalence of some of the MetS risk variables by race and sex (16), it suggests that there are differences in the factor loadings by race and/or sex. The consistency of these identified factors across race-sex specific groups and time has not been investigated with the use of confirmatory factor analysis.

This paper presents a confirmatory factor analysis to evaluate the MetS factors by race-sex using data collected from a population cohort, the Coronary Artery Risk Development in Young Adults Study (CARDIA). This study allows hypotheses of one-, two-, three-, and four-factor models of MetS to be tested in a large biracial sample of men and women and to assess the consistency of the factor models ten years later.

RESEARCH DESIGN AND METHODS

Study population

The sample population is from an epidemiologic study of the natural history of coronary artery disease, the CARDIA study. In 1985 – 1986, 5,115 young Black and White men and women 18 to 30 years of age were recruited by population-based sampling and through membership of a prepaid health plan. The study population was approximately balanced within each of the four centers according to race, gender, high school education, and age, allowing adequate sample size for subgroup analysis. The analyses reported are from the baseline exam and the year-10 exam. Further details of the CARDIA Study's design, population recruitment methods, and additional methods have been published (17).

Data collection

Baseline and year-10 data were collected using the same standard protocols at each of the four sites. The clinic managers and phlebotomists completed a centralized training prior to the exam

cycle and the data collectors at each site were trained and certified on CARDIA data collection methods: physical exam, questionnaires, blood draw, and urine collection. Blood pressure was measured after a five minute rest, taking an average of second and third readings of the 1st and 5th phase Korotkoff sounds. Venipuncture was performed after a requested 12-hour fast. Patients were asked not to smoke or do heavy physical activity two hours prior to their clinic visit. Baseline serum insulin was measured using an immunoassay technique at the LINCO Research Center (18). Total cholesterol and triglycerides were determined using enzymatic procedures, and high density lipoprotein cholesterol (HDL-C) was measured after dextran sulfate-magnesium precipitation (18,19). Low density lipoprotein cholesterol (LDL-C) was calculated using the Friedewald equation (20). Serum uric acid was measured using the uricase method and a standard assay. Homeostasis model assessment (HOMA-IR) was used as a measure of insulin resistance and was calculated as [fasting glucose (mg/dL) × fasting insulin (mg/dL)]/22.5 (21). It has been shown that surrogate measures of insulin resistance provide adequate information to explore the intercorrelational structure of MetS (22).

Statistical analyses

Spearman correlations were calculated for the 14 metabolic risk variables. High correlations existed between HOMA-IR and fasting insulin (r = 0.91), total cholesterol and LDL-C (r = 0.96), and BMI and waist circumference (r = 0.83). Variables with high correlations pose problems for the ability of the model to converge. Therefore, fasting insulin, total cholesterol and body mass index (BMI) were not included in the factor analysis. HOMA-IR is considered the most accurate surrogate measure of insulin resistance (21) and waist circumference is used in the NCEP Adult Treatment Panel III definition of MetS (4). The metabolic risk variables included in the factor analysis models were fasting glucose, HOMA-IR, HDL-C, LDL-C, systolic blood pressure, diastolic blood pressure, triceps skin-folds, triglycerides, waist circumference, waist-hip ratio, and uric acid.

The study population met all the assumptions for factor analysis. In testing the normality assumption, three variables were found to have a high skewness, triglycerides, glucose, and HOMA-IR; these variables were transformed with a natural log function. Participants were excluded if they were pregnant (n=7), had missing fasting insulin values (n = 1,627), or had missing data for any of the other metabolic risk variables included in the factor analysis (n = 78). The individuals excluded were on average slightly younger, higher body mass, and had higher levels of glucose and insulin. The total sample for this analysis using the baseline data was 3,403. To compare the factor models on year-10 data, the sample size was 2,532; an additional 871 individuals were excluded for not having year-10 data for all of the 11 metabolic risk variables included in the factor analyses or were pregnant at the year-10 exam. Means and standard deviations of risk factors associated with the MetS were computed for age, fasting insulin, total cholesterol, BMI, and the 11 metabolic risk variables included in the factor analysis. The dichotomous variables used to define MetS risk-factors were categorized by cut points based on accepted classifications: American Diabetes Association, International Diabetes Federation, and American Heart Association and National Heart, Lung, and Blood Institute diagnosis of metabolic syndrome (23–25).

All 11 variables analyzed in the factor analysis were continuous. Continuous variables are considered the appropriate type of variable for factor analysis because of the assumption of interval-level measurement (9,21,27). The one-factor model included all 11 variables loading on one factor considered the MetS. The four-factor model was defined from reviewing the literature and on the basis of grouping the 11 different variables by the theoretical pathophysiologic processes. The four factors were defined as an Insulin Resistance Factor using HOMA-IR, fasting glucose, and uric acid; an Obesity Factor using triceps skin-folds, waist circumference, and waist-hip ratio; a Lipid Factor using triglycerides, LDL-C and HDL-

C; and a Blood Pressure Factor using systolic and diastolic blood pressure. For the three-factor model, systolic blood pressure was set to load on the Lipid Factor and diastolic blood pressure was removed from the analysis; only ten variables were analyzed. A two-factor model was evaluated loading all the variables from the Obesity, Lipids, and Insulin Resistance factors into one factor with the second factor comprised of systolic and diastolic blood pressure. In addition, the three- and four-factor models were further tested using the year-10 data overall and for each race-sex group.

The differences between each of the predicted interrelations and the actual observed interrelations from the baseline values are the fitted residuals. Four model fit indices were used to evaluate the models: Goodness-of-fit index (GFI), Comparative fit index (CFI), Root Mean Square Error of Approximation, and the Minimum Fit Function of Chi-Square. As findings yielded similar results, only the GFIs and CFIs are presented. GFI does not depend on sample size explicitly and measures how much better the model fits as compared with no model at all; CFI is based upon the non-central chi-square distribution. GFI and CFI > 0.90 are considered an excellent fit.

Statistical analyses packages used for the analyses include SAS© version 9.1, SAS Institute, Inc. Cary, NC for means, standard deviations, frequencies, correlations and LISREL© version 8.80, Scientific Software, International Lincolnwood, IL for the confirmatory factor analyses.

RESULTS

The sample at baseline consisted of 25.1 % (n = 855) White men, 28.3 % (n = 964) White women, 19.8 % (n = 675) Black men, and 26.7 % (n = 909) Black women. The mean age at baseline was 24.9 (standard deviation (SD) = 3.6) years (table 1); Blacks were slightly younger than Whites. As expected when a cohort gets older, the mean of the majority of the metabolic risk variables increased. The mean of eight of the 14 variables increased after ten years, and the overall mean of HDL-C decreased. Mean total cholesterol, waist-hip ratio, LDL-C, and systolic blood pressure did not change, and uric acid levels in the population decreased over the ten years after the baseline exam.

Dyslipidemia (an at risk level present in triglycerides, total cholesterol, LDL-C or HDL-C) was the most prevalent MetS risk factor overall (43.4 %) and in each race-sex group at baseline and at year-10 (table 2). Black women had a higher prevalence of at risk levels in the metabolic risk factors than any of the other race-sex groups, at baseline and year-10. Those risk factors included HOMA-IR, diabetes, obesity characterized by BMI or waist circumference, and HDL-C. Black men had a higher prevalence of hypertension and White men had a higher prevalence of high triglycerides. The only risk factor which decreased prevalence in the sample after ten years was high uric acid levels.

The model fit indices for the one-, two-, three-, and four-factor models are 0.82 and below when using the full sample at baseline (table 3). In the race-sex specific analyses, the fit increased as the MetS factor model increased in the number of factors evaluated, from one- to three-factor models, with minimal difference, ranging from 1–2% in fit between three- and four-factor models. The highest fit is achieved in the four-factor models with White women having the highest GFI or CFI > 0.95.

Findings using year-10 data were similar to those using baseline data for the same 2,532 participants (table 4). The GFI of the four-factor model using year-10 data was an 81 % fit overall (GFI = 0.81), which was the same model fit when baseline exam data were used. The variables within each factor often had higher loadings in year-10 than at baseline. The Insulin Resistance Factor was mostly defined by HOMA-IR (loadings = 0.93 – 1.00) and least defined by uric acid (loadings = 0.39 – 0.07). The Obesity Factor was mainly defined by waist

circumference (loadings = 1.00) with waist-hip ratio describing the least among Black women (loadings = 0.59 – 0.69) and triceps skin-fold the least among other race-sex groups (loadings = 0.61 –0.77). Triglycerides (loadings = 0.50 – 95) had the highest loading for the Lipid Factor, followed by HDL-C with an inverse loading (loading = − 0.41 – −0.61), and was least defined by LDL-C (loading = 0.38). The Blood Pressure Factor was mainly described by systolic blood pressure (loading = 0.89); however, at year-10 the diastolic blood pressure in White men had a higher loading.

The three-factor model show similar results with systolic loading on Lipid Factor with triglycerides, LDL-C and HDL-C. The loading of Triglycerides is decreased in the three-factor model with systolic in most race-sex groups having the lowest loading. In addition, the data was stratified by age to evaluate if there were differences by age separate from calendar time. The sample was divided into two age groups at baseline and at the year-10 exam. The fit statistics and factor loadings were very similar within each group ten years later (data not shown).

CONCLUSIONS

Confirmatory factor analysis of the MetS in the CARDIA population indicates that the MetS appears to have more than one underlying factor. In testing the *a priori* hypothesis of one-, two-, three-, and four-factor models, the goodness-of-fit for a one-factor model for the full sample was the least fit of all the models evaluated. Race-sex specific models consistently demonstrated a better fit than the overall sample models including all individuals without regard to race and sex suggesting the factors typically used to assess MetS do not capture entirely the race-sex differences with respect to the MetS. Also the fit of these models, and the factor loadings, were comparable to those of the same model ten years later, and that these fit statistics and factor loadings were comparable within age groups suggest that the factors underlying the MetS do not change in correlation significantly in early adulthood.

The implication that the MetS is unified by one underlying common factor is not well supported by this study's analyses or the literature. Of the limited studies that used confirmatory factor analysis, only one found an excellent fit of a one-factor model, Pladevall et al. (15). In the current analyses, support is seen for both the three- and four-factor models, which both achieve and excellent fit. The higher fit is obtained with the four-factor model; however, the authors acknowledge that the increase in fit from the three- to four- factor model is not more than 2% and that both the models achieve a fit greater than 90% in all the race-sex groups. A major difference between the studies that present a three-factor model or a four-factor model has been the inclusion or exclusion of a blood pressure factor. The authors are aware that using both systolic and diastolic blood pressure may more often result in a separate factor for blood pressure because of the higher correlation of the two measures with each other rather than with the other variables. However, investigating the factor loadings and the correlations of the factors in the four-factor model, support can be seen for a blood pressure factor instead of forcing systolic blood pressure to load on another variable with less of a correlation or pathophysiologic linkage. The present study's findings are consistent with Shah et al. and that blood pressure may contribute to the MetS independent of the other factors (28).

There are few studies in the literature that investigate differences between Black and White populations. The investigators in the Bogalusa Heart Study evaluated the MetS by race (White and Black) and three age groups, but not sex (29). The study identified, using an exploratory factor analysis method, two uncorrelated factors comprising the MetS that were independent of race and age. Factor One was triglycerides, HDL-C, glucose, and adiposity; the second factor was made of systolic blood pressure and diastolic blood pressure. Shen et al. investigated a four-factor model using confirmatory factor analysis in three ethnic groups: African,

Caucasian, and Cuban Americans. They found minor differences between the groups evaluating their model by race and by sex separately. Sample size limited the authors' ability to evaluate combinations of race-sex groups. The authors of the present study found similar findings to Shen et al. with the addition that the factor models are generally consistent across White/Black race-sex groups and race-sex specific models provide an increase in goodness-of-fit. This suggests that there is some underlying factor which accounts for some of the race-sex differences which is not captured by the 11 variables included in this study's models. Inflammatory markers and clotting factors are other variables hypothesized as playing a role in the MetS, but these measures were not available in the CARDIA cohort for analysis at baseline.

Our results suggest that the interrelation of the MetS risk variables is consistent as one ages early in life. The fit of the models were tested among the same cohort ten years later with minimal differences. This is somewhat different from the results of the Ramos et al study (30). The difference may reflect that their study only examined a two-factor model. The present study was limited in that the age distribution of the CARDIA samples was limited, only 18 – 30 at baseline and 28–40 at the 10- year follow-up; therefore, a large percent of the sample has not developed a number of the conditions that make up the MetS. This also limits the ability to see significant shifts in the risk and when individuals approach mid-life. However, the results suggest that the interrelation of the components of the MetS is still present. Also, the conditions hypothesized to make up MetS have individually been shown to be trackable; persons with elevated risk levels are more likely to develop MetS and other cardiovascular outcomes. The ample sample size in the CARDIA population which allows analyses of race-sex groups is a strength of the present study, as is the ability to investigate the MetS factors among the same population over time.

Our analysis of the MetS adds to the literature with the analysis of one-, two-, three-, and four-factor models in a study population with both Whites and Blacks and men and women. No prior studies have demonstrated the consistency of the factor models of the MetS over ten years or in race-sex groups in the same cohort. The authors conclude that MetS is not defined by a single factor comprised of the currently known metabolic risk variables, and that the fit of the model is maximized when race-sex groups are considered.

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ABBREVIATIONS

BMI	body mass index
CFI	comparative fit index
CARDIA	Coronary Artery Risk Development in Young Adults
HDL-C	high density lipoprotein cholesterol
HOMA-IR	homeostasis model assessment insulin resistance
GFI	goodness-of-fit index
LDL-C	low density lipoprotein cholesterol
MetS	metabolic syndrome
NCEP	National Cholesterol Education Program

SD standard deviation

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Table 1

Mean and standard deviation of metabolic syndrome risk variables of participants in the Coronary Artery Risk Development in Young Adults (CARDIA) Study at baseline and Year-10.

	Baseline (N = 3,403)	Baseline (N=2,532)	Year-10 (N=2,532)
	Mean ± SD	Mean ± SD	Mean ± SD
Age	24.9 ± 3.6	25.1 ± 3.6	35.1 ± 3.6
Fasting insulin (uU/mL)	11.5 ± 5.8	11.2 ± 5.3	13.1 ± 7.8
Total cholesterol (mg/dL)	177.0 ± 33.2	176.5 ± 32.2	177.8 ± 33.5
HOMA-IR $(mg/dL)^2$	42.6 ± 29.1	41.5 ± 26.4	53.2 ± 45.4
Fasting glucose (mg/dL)	82.1 ± 11.0	82.0 ± 11.8	87.6 ± 16.9
Uric acid (mg/dL)	5.2 ± 1.4	5.2 ± 1.4	4.8 ± 1.4
BMI	24.3 ± 4.7	24.1 ± 4.4	27.0 ± 5.8
Waist Circumference	77.4 ± 10.9	77.0 ± 10.4	85.0 ± 13.6
Waist-hip ratio	0.8 ± 0.1	0.8 ± 0.1	0.8 ± 0.1
Triceps skin-fold	16.9 ± 9.3	16.7 ± 8.9	19.8 ± 10.0
Triglycerides (mg/dL)	72.5 ± 48.4	70.3 ± 40.0	88.3 ± 56.8
LDL-C (mg/dL)	109.4 ± 30.6	109.2 ± 30.2	109.3 ± 13.9
HDL-C (mg/dL)	53.1 ± 12.8	53.2 ± 12.6	50.4 ± 13.9
Systolic blood pressure (mmHg)	110.4 ± 11.2	110.1 ± 10.7	109.6 ± 11.9
Diastolic blood pressure (mmHg)	68.6 ± 9.5	68.4 ± 9.4	72.3 ± 9.7

Abbreviations: HOMA-IR, Homeostasis model assessment insulin resistance [(fasting glucose × fasting insulin)/22.5]; BMI, body mass index; LDL-C, low density lipoprotein cholesterol; HDL-C, high density lipoprotein cholesterol; SD, Standard deviation

Table 2

Prevalence of Metabolic Syndrome Risk Factors and Diabetes Among 3,403 Participants in the Coronary Artery Risk Development in Young Adults (CARDIA) Study at the Baseline exam (1985 – 1986).

	Race-Sex Groups							
	White Men		White Women		Black Men		Black Women	
	Baseline	Year 10	Baseline	Year 10	Baseline	Year 10	Baseline	Year 10
Total Baseline N = 3,404; Year-10 N = 2,532	855 %	681 %	964 %	757 %	675 %	435 %	909 %	659 %
HOMA-IR top quartile	23.2	22.6	14.6	14.3	29.0	30.8	34.4	36.9
HOMA-IR top decile	6.6	8.5	5.5	4.6	11.7	13.6	16.9	15.2
Diabetic (Glucose ≥ 126mg/dL) *	0.7	2.1	0.9	5.4	0.9	2.1	1.8	8.8
Hypertensive (SBP or DBP ≥ 140/90 mmHg) *	3.7	4.0	1.7	2.1	5.3	12.6	4.7	12.0
Elevated BP (SBP or DBP ≥ 130/85 mmHg) *	12.4	12.2	3.2	4.2	14.2	21.8	6.7	18.4
Obese (BMI ≥ 30)	6.2	16.3	7.4	17.0	9.3	24.6	19.4	41.0
Obese waist (≥ 102 cm men; > 88cm women)	3.0	12.2	6.2	18.8	4.7	13.8	13.3	40.1
High triglycerides (≥ 150 mg/dL)	10.1	22.2	3.7	8.5	4.2	10.8	1.7	4.9
High cholesterol (≥ 200 mg/dL)	21.6	27.8	20.8	22.5	23.9	25.8	25.5	18.4
High LDL-C (≥ 160 mg/dL)	7.5	9.4	3.8	4.4	6.7	8.1	7.6	4.7
Low HDL-C (< 40 mg/dL men; < 50mg/dl women)	22.1	40.1	31.6	36.6	12.4	25.5	32.0	41.0
High uric acid (> 7 men; > 6 women)	23.0	11.8	7.5	2.5	20.4	16.1	7.6	4.9
Dyslipidemia†	39.4	57.0	46.9	50.7	33.9	46.4	50.4	54.0

Abbreviations: HOMA-IR, Homeostasis model assessment insulin resistance [(fasting glucose × fasting insulin)/22.5]; SBP, systolic blood pressure; DBP, diastolic blood pressure; BP, blood pressure; BMI, body mass index; LDL-C, low density lipoprotein cholesterol; HDL-C, high density lipoprotein cholesterol

*Also includes individuals with normal levels but reported taking medication for the condition

†At risk level present in triglycerides, total cholesterol, low density lipoprotein cholesterol, or high density lipoprotein cholesterol

Table 3

Model fit indices for factor analyses models of the metabolic syndrome for 3,403 participants in the Coronary Artery Risk Development in Young Adults (CARDIA) study, by number of Factors, overall and by race-sex groups (1985–1986)

	All	Race-Sex Groups			
		White Men	White Women	Black Men	Black Women
Chi-Square					
N Factors					
1	5767.2	921.8	1064.8	692.9	923.8
2	4731.5	692.4	598.7	527.0	641.1
3	4236.4	272.1	245.0	224.6	365.4
4	4074.7	250.6	237.4	229.1	346.8
Goodness-of-fit					
N Factors					
1	0.78	0.85	0.85	0.85	0.85
2	0.81	0.88	0.90	0.89	0.89
3	0.79	0.94	0.95	0.94	0.93
4	0.82	0.95	0.96	0.95	0.94
Comparative fit index					
N Factors					
1	0.62	0.78	0.74	0.77	0.76
2	0.69	0.83	0.86	0.83	0.84
3	0.68	0.93	0.94	0.93	0.90
4	0.73	0.95	0.95	0.94	0.92

Table 4

Factor Loadings for a Four-Factor Model of the Metabolic Syndrome Defined by 11 Metabolic Risk Variables Among 2,532 Participants in the Coronary Artery Risk Development in Young Adults Study (CARDIA) at Baseline and the Year-10 Exam, Overall and by Race-Sex.

	All		Race-Sex Groups							
			White Men		White Women		Black Men		Black Women	
	Baseline	Year-10	Baseline	Year-10	Baseline	Year-10	Baseline	Year-10	Baseline	Year-10
N	2532		681		757		435		659	
χ^2 d.f.=38	3052.9	3038.8	186.0	235.2	170.3	296.2	132.2	132.3	296.1	320.7
Goodness-of-fit	0.81	0.81	0.95	0.94	0.96	0.94	0.95	0.95	0.93	0.92
Factor 1: Insulin resistance										
HOMA-IR	0.51	0.85	1.00	0.93	0.93	0.99	0.99	0.96	0.94	0.97
Fasting glucose	0.42	0.64	0.41	0.58	0.58	0.67	0.62	0.67	0.55	0.60
Uric acid	0.51	0.43	0.07	0.39	0.19	0.31	0.28	0.29	0.22	0.31
Factor 2: Obesity										
BMI	1.00	1.00	1.00	1.00	1.00	1.03	0.99	1.00	1.00	1.00
Waist:Hip	0.71	0.74	0.74	0.77	0.70	0.71	0.61	0.76	0.59	0.69
Triceps skin-fold	0.37	0.43	0.66	0.65	0.75	0.75	0.69	0.73	0.79	0.75
Factor 3: Lipids										
Triglycerides	0.65	0.71	0.80	0.95	0.67	0.67	0.63	0.65	0.50	0.63
LDL-C	0.37	0.39	0.40	0.27	0.34	0.44	0.47	0.43	0.32	0.29
HDL-C	−0.59	−0.65	−0.59	−0.61	−0.54	−0.61	−0.41	−0.59	−0.56	−0.52
Factor 4: Blood pressure										
Systolic	0.94	0.89	0.78	0.74	1.00	0.89	1.00	0.95	0.78	0.89
Diastolic	0.59	0.85	0.68	0.94	0.63	0.79	0.47	0.76	0.67	0.87

Abbreviations: HOMA-IR, Homeostasis model assessment insulin resistance [(fasting glucose × fasting insulin)/22.5]; BMI, body mass index; LDL-C, low density lipoprotein cholesterol; HDL-C, high density lipoprotein cholesterol

Table 5

Factor Loadings for a Three-Factor Model of the Metabolic Syndrome Defined by 10 Metabolic Risk Variables Among 2,532 Participants in the Coronary Artery Risk Development in Young Adults Study (CARDIA) at Baseline and the Year-10 Exam, Overall and by Race-Sex.

	All		Race-Sex Groups							
			White Men		White Women		Black Men		Black Women	
	Baseline	Year-10	Baseline	Year-10	Baseline	Year-10	Baseline	Year-10	Baseline	Year-10
χ^2 d.f.=32	3187.8	3172.1	197.3	259.4	171.4	321.9	124.8	145.3	307.3	325.6
Goodness-of-fit	0.79	0.79	0.95	0.93	0.96	0.92	0.95	0.94	0.92	0.92
Factor 1: Insulin resistance										
HOMA-IR	0.74	0.85	1.00	0.94	0.93	0.99	0.99	0.96	0.96	0.97
Fasting glucose	0.58	0.64	0.41	0.58	0.58	0.67	0.62	0.67	0.54	0.60
Uric acid	0.38	0.42	0.07	0.38	0.19	0.31	0.28	0.29	0.21	0.31
Factor 2: Obesity										
Waist Circumf.	1.00	1.00	0.99	1.00	1.00	1.00	0.99	1.00	1.00	1.00
Waist:Hip	0.71	0.74	0.74	0.77	0.70	0.73	0.61	0.76	0.59	0.69
Triceps skin-fold	0.37	0.43	0.66	0.65	0.75	0.78	0.69	0.73	0.79	0.75
Factor 3: Lipids										
Triglycerides	0.57	0.68	0.79	0.92	0.64	0.67	0.62	0.63	0.47	0.61
LDL-C	0.34	0.39	0.40	0.23	0.33	0.30	0.47	0.42	0.29	0.28
HDL-C	−0.55	−0.61	−0.59	−0.62	−0.53	−0.59	−0.40	−0.55	−0.50	−0.50
Systolic BP	0.38	0.36	0.15	0.23	0.29	0.43	0.27	0.27	0.26	0.29

Abbreviations: HOMA-IR, Homeostasis model assessment insulin resistance [(fasting glucose × fasting insulin)/22.5]; LDL-C, low density lipoprotein cholesterol; HDL-C, high density lipoprotein cholesterol; Systolic BP, systolic blood pressure