Five-Year Change in Visceral Adipose Tissue Quantity in a Minority Cohort: The Insulin Resistance Atherosclerosis Study (IRAS) Family Study

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OBJECTIVE — To describe the 5-year change in visceral adipose tissue (VAT) and subcutaneous adipose tissue (SAT) areas.

RESEARCH DESIGN AND METHODS — Absolute change in VAT and SAT measured by abdominal computed tomography scans has been obtained at a 5-year interval from African Americans (n = 389) and Hispanic Americans (n = 844), aged 20–69 years, in 10-year age-groups.

RESULTS — Mean 5-year increases in VAT areas in women were 18, 7, 4, 0.4, and −3 cm^2 for African Americans and 13, 7, 3, 1, and −15 cm^2 for Hispanics, across the 5 age decades (trend not significant). Mean 5-year increases in SAT areas in women were 88, 46, 19, 17, and 14 cm^2 for African Americans and 53, 20, 17, 12, and 1 cm^2 for Hispanics, across the 5 age decades ($P <$ 0.05 for both). Similar trends have been observed in men.

CONCLUSIONS — Accumulation of abdominal fat is greatest in young adulthood. These data may be useful in identifying subgroups at risk of type 2 diabetes.

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Longitudinal studies have shown a direct relationship between levels of visceral adipose tissue (VAT) and future risk of impaired glucose tolerance and type 2 diabetes, independent of total adiposity (1–4). The Diabetes Prevention Program showed that reductions in VAT and subcutaneous adipose tissue (SAT) led to decreased risk of type 2 diabetes (5). These studies suggest that central adiposity is an independent risk factor for type 2 diabetes. With IRAS (Insulin Resistance Atherosclerosis Study) Family Study data, we describe the natural progression of abdominal adiposity assessed by computed tomography over 5 years in African Americans and Hispanics.

RESEARCH DESIGN AND METHODS

— The IRAS Family Study was designed to explore genetic and epidemiological contributions to abdominal adiposity and glucose homeostasis traits among Hispanics and African Americans using a family-based design (6). Abdominal tissue area was measured at the L4/L5 vertebral region by computed tomography under a common protocol. Scans were read centrally at the Department of Radiology, University of Colorado Health Sciences Center. The methods have previously been described (7). This report is based on 389 African Americans and 844 Hispanics with good quality L4/L5 measures obtained at two time points (1999–2002 and 2005–2007).

Absolute change was calculated as the year 5 measure minus the baseline measure. Participants were grouped according to baseline age in 10-year increments (i.e., 20–29, 30–29, 40–49, 50–59, and 60–69 years). We used generalized estimating equations to accommodate correlated family data in our hypothesis testing, including testing for differences between means of two groups or testing for trends across age-groups. All subjects were nonpregnant at baseline. We did not exclude subjects reporting a recent pregnancy in this analysis given that our intent was to describe the progression of adiposity in a free-living cohort. SAS (version 9.1) was used for analyses.

RESULTS

— Overall, African American and Hispanic women were similar in age (43.7 ± 13.3 vs. 43.9 ± 14.1 years, respectively; P = not significant [NS]). African American women had similar baseline SAT areas (419 ± 185 vs. 391 ± 153 cm^2; P = NS) but had smaller VAT areas than Hispanic women (94 ± 58 vs. 107 ± 59 cm^2; $P < 0.01$). African American men were older (44.7 ± 14.6 vs. 41.4 ± 14.5 years; $P < 0.05$) and had similar baseline SAT measures (278 ± 152 vs. 270 ± 133 cm^2; P = NS) but smaller VAT areas than Hispanic men (108 ± 63 vs. 127 ± 62 cm^2; $P < 0.01$).

The youngest group presented with the lowest baseline VAT area, with African Americans having smaller VAT areas across all age-groups compared with Hispanics (supplementary Tables A1–A4, available in an online appendix at http://care.diabetesjournals.org/cgi/content/full/dc09-0336/DC1). The rate of increase in VAT area slowed with advancing age-group (Fig. 1*A*). The absolute changes from baseline were 18, 7, 4, 0.4, and −3 cm^2 for African American women; 12, 0.1, 3, −3, and −8 cm^2 for Hispanic

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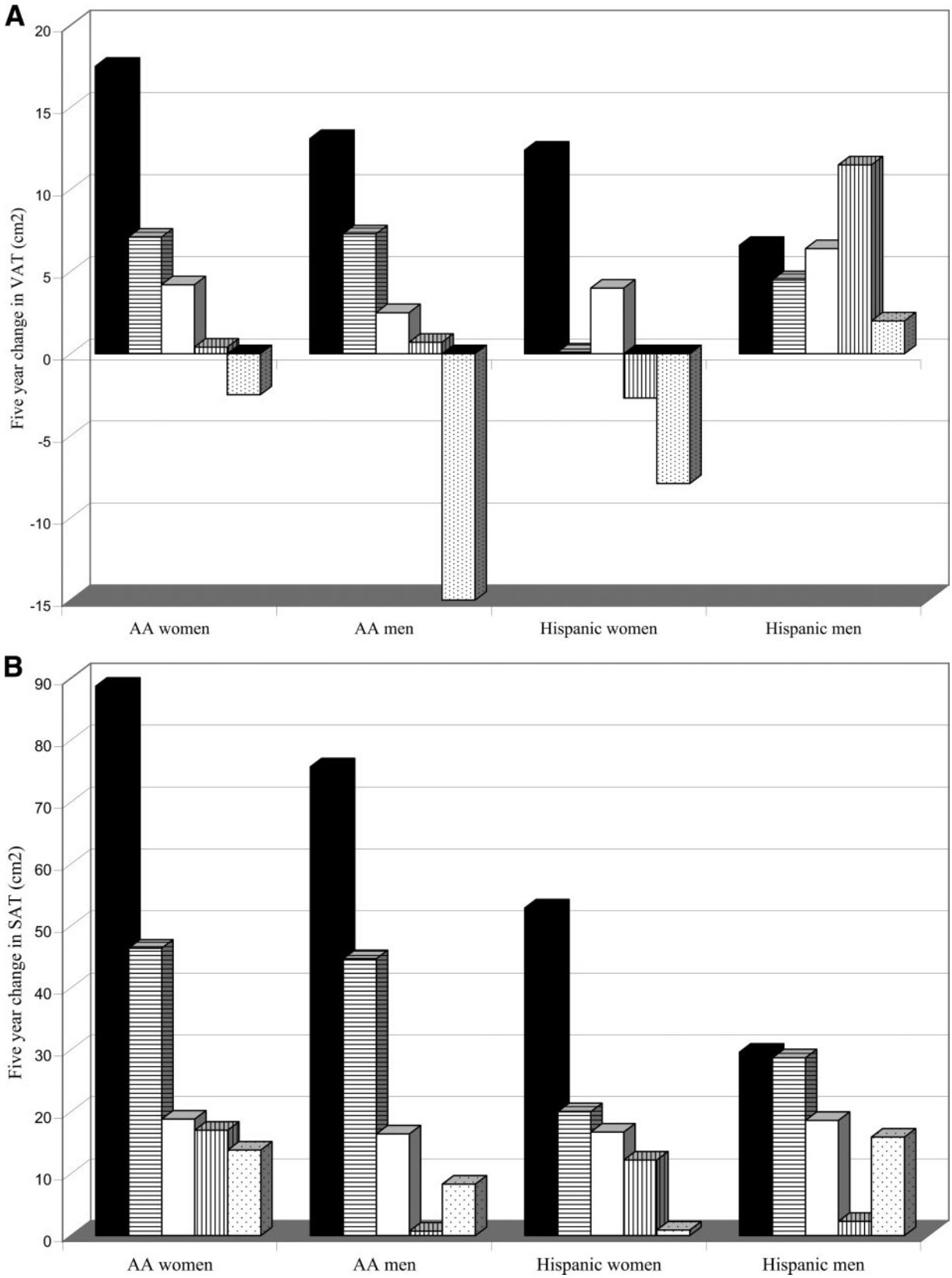

Figure 1—*Five-year change in VAT (*A*) and SAT (*B*) by baseline age categorized into ethnic groups.* ■*, 20–29 years;* ▤*, 30–39 years;* □*, 40–49 years;* ▥*, 50–59 years;* ▨*, 60–69 years.*

women; 13, 7, 3, 0.7, and −15 cm^2 for African American men; and 7, 5, 6, 12, and 2 cm^2 for Hispanic men. All trends except for the Hispanic men showed declines in fat accumulation over the age-groups; however, none of the trends were significant.

The youngest age-groups had the lowest baseline SAT area but had the largest increase from baseline (supplementary Tables A1–A4). African Americans had greater increases in SAT than Hispanics among the younger age-groups, despite the overall trend of decreasing accumulation across age (Fig. 1*B*). The absolute changes from baseline were 89, 46, 19, 17, and 14 cm^2 for African American women; 53, 20, 17, 12, and 0.9 cm^2 for Hispanic women; 76, 45, 16, 0.7, and 8 cm^2 for African American men; and 30, 29, 19, 2, and 16 cm^2 for Hispanic men. In general, there was a consistent decline in fat accumulation over the age-groups. Trends were significant in all groups ($P < 0.05$) except in African American men.

CONCLUSIONS — This epidemiological study is the first to quantify 5-year change in computed tomography–measured abdominal fat area in a large minority cohort. We observed *1*) large increases in VAT and SAT areas occurring in young adulthood that became attenuated with age and *2*) larger 5-year increases in abdominal adiposity in African Americans than in Hispanics, particularly among women.

The young adult age-group (20–29 years) had the largest 5-year increase in measured adiposity, regardless of race or sex. The 5-year increase in VAT area was 18 and 12 cm^2 among African American and Hispanic women, respectively, and 13 and 7 cm^2 among men. The 5-year increase in SAT area was 89 and 53 cm^2 among African American and Hispanic women, respectively, and 76 and 30 cm^2 among men. The absolute abdominal fat accumulation in the youngest age-groups may have clinical significance given that previous prospective studies have reported that VAT changes of this magnitude differentiate those who develop diabetes from those who do not (7,8). This pattern of excessive abdominal fat accumulation in young adults has not previously been reported using computed tomography–measured fat depots. These data are consistent, however, with data from several other studies that have used surrogate measures of central and abdominal adiposity such as BMI and waist circumference (9–11).

Another key finding of our study is that African American women have greater 5-year increases in VAT and SAT areas than their Hispanic counterparts (not consistently observed in men). This observation contrasts with previous comparative studies that show that African Americans, particularly women, have greater increases in total fat mass but smaller increases in VAT than do their counterparts over time (12–15).

In this first longitudinal report quantifying 5-year change in computed tomography–measured abdominal fat areas in a large minority cohort, we observed large increases in VAT and SAT areas occurring in young adulthood that became attenuated with age. African American women are at particularly high risk of fat accumulation. These levels of adipose tissue accumulation are consistent with the effect sizes associated with future risk of type 2 diabetes. Interventions to prevent accumulation of abdominal adipose tissue should be more focused on young adulthood, likely a high-risk period for the accumulation of abdominal fat. In addition, efforts should identify clinically feasible alternatives to computed tomography scans for identification of the high-risk groups and for monitoring the performance of clinical interventions.

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No potential conflicts of interest relevant to this article were reported.

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