OBSERVATIONS

Functional and Metabolic Imaging of the Cardiovascular System in Young Healthy South Asians and Caucasians Unveils Early Differences

South Asians, representing one-fifth of the world's population, have a higher risk of developing cardiovascular disease (CVD) than Caucasians (1). Moreover, CVD is more aggressive in this population (1). Traditional risk factors per se do not explain these between-ethnic group differences (1,2). Insulin resistance (IR) and type 2 diabetes are also highly prevalent in South Asians (3). Because the mortality risk of CVD associated with type 2 diabetes is higher in South Asians than in Caucasians (2,4), the excess CVD risk in South Asians might be due to inherent ethnicity-associated structural cardiac features and/or a higher cardiac susceptibility to metabolic disorders. Because it is unknown whether differences already exist in cardiac dimensions and function at a young age between these ethnicities, we studied these features in young South Asians and Caucasians and subjected both groups to a short-term high-fat, high-caloric (HFHC) diet to study cardiac response to metabolic stress.

Cardiac dimensions, cardiovascular function, and fat distribution were assessed with a 1.5-T magnetic resonance imaging/magnetic resonance spectroscopy scanner in young, healthy male South Asians and Caucasians (n = 12 for each ethnicity; mean age 22.1 ± 0.4 years; BMI 20.9 ± 0.4 vs. 22.2 ± 0.6 kg/m^2, respectively; P = 0.11) before and after a 5-day HFHC diet (~3,775 kcal/day of which ~54% was fat). Subjects were recruited through advertisements in newspapers. A mixed-effects model was applied to assess mean differences before and after the intervention within and between groups and to determine differences in diet effect. Groups and intervention were modeled as fixed effects, and the subject-specific deviations from the group mean were modeled as random effects. Of note, the small sample size might limit generalizability of the findings.

Fasting glucose and insulin levels were comparable at baseline but were significantly higher in South Asians after the HFHC diet. Oral glucose tolerance test data showed that South Asians had more IR at baseline. Furthermore, LDL

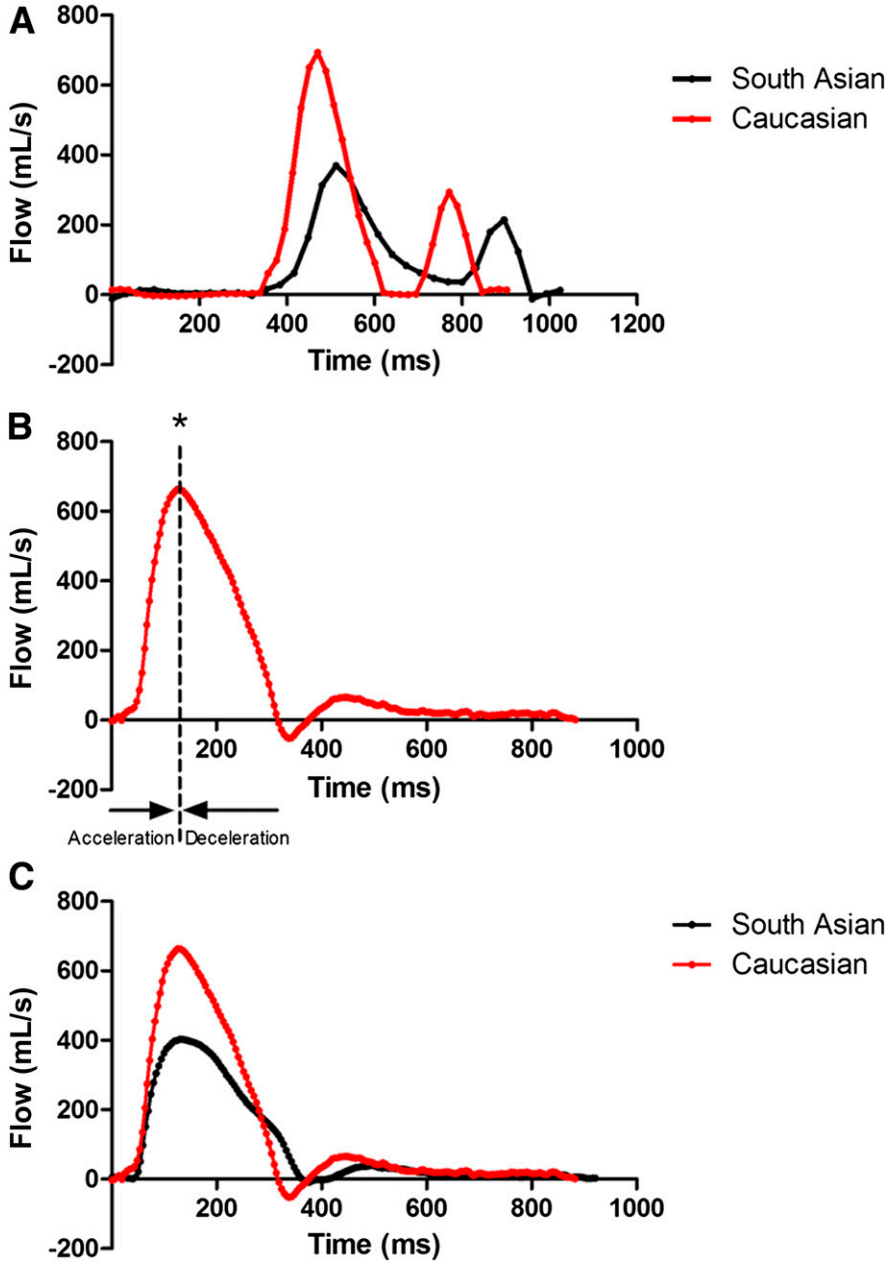

Figure 1—*Mitral valve and aortic flow curves.* A: *Example of the flow through the mitral valve, representing diastolic cardiac function. The black line represents a South Asian subject, the red line a Caucasian subject. E and A peak filling rate* (P < *0.001), E and A acceleration peak* (P = *0.004 and* P = *0.021, respectively), and E deceleration peak* (P = *0.005) were lower in South Asians, suggesting a prolonged cardiac relaxation compared with Caucasians.* B: *How aortic flow parameters are assessed. The * is the aortic peak flow rate. Acceleration duration is the time between the beginning of the flow curve and the peak flow rate. The deceleration duration is the time between the peak flow rate and the end of the deceleration period. The acceleration peak is the peak slope (dy/dx) of the acceleration phase, and the deceleration peak is the peak slope (dy/dx) of the deceleration phase.* C: *Example of flow velocity curve through the ascending aorta. The black line represents a typical curve of a South Asian subject, the red line of a Caucasian subject. South Asians had lower acceleration* (P = *0.004) and deceleration* (P < *0.001) peak flows over the aorta, suggesting somewhat prolonged cardiac contraction compared with Caucasians.*

cholesterol was higher in South Asians ($P = 0.03$). The higher IR in this group was not reflected in differences in waist fat distribution and hepatic or myocardial triglyceride (TG) content. After the HFHC diet, hepatic TG level was significantly increased in both groups ($P = 0.003$ for South Asians and $P < 0.001$ for Caucasians), indicating good dietary compliance. Waist fat distribution and myocardial TG levels were not affected by the diet.

At baseline, South Asians had lower left ventricular mass ($P < 0.001$) and end-diastolic volume ($P < 0.001$) than Caucasians, despite correction for body surface area. Gross parameters for systolic (EF) and diastolic cardiac function (E/A ratio and the estimated filling pressure E/Ea) were comparable between ethnicities and were not affected by the HFHC diet. However, more-sensitive parameters for cardiac function were significantly different, suggesting that cardiac relaxation and contraction are prolonged in South Asians compared with Caucasians (Fig. 1). The HFHC diet did not increase these differences. Finally, pulse wave velocity, a powerful independent predictor of cardiovascular events (5), was higher in South Asians than in Caucasians at baseline ($P = 0.022$), indicating increased arterial stiffness.

In conclusion, the young, lean South Asians recruited in this study had smaller cardiac dimensions, even when corrected for their smaller stature, and a different diastolic and systolic function profile than Caucasians. Moreover, pulse wave velocity was higher in the South Asian subjects. Reduced insulin sensitivity and increased LDL cholesterol might be causally related to the different cardiac function profiles in South Asians (6,7). Whether the observed differences in cardiovascular dimensions and function contribute to the higher incidence of CVD in South Asians remains to be determined. A 5-day HFHC diet did not increase the cardiovascular differences between the groups, despite distinct metabolic effects of the diet, which might suggest that these findings cannot be explained by a different metabolic response to short-term dietary fat consumption between these ethnicities at a young age. It is possible, however, that a longer high-fat diet duration is needed to induce changes.

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DOI: 10.2337/dc13-0287. Clinical trial reg. no. NTR 2473, www.trialregister.nl.

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Acknowledgments—Funding for this study was provided by the Netherlands Heart Foundation, The Hague, the Netherlands (Project UL 2009-4548).

Financial support was provided by Roba Metals B.V. IJsselstein (Utrecht, the Netherlands). No other potential conflicts of interest relevant to this article were reported.

L.D.v.S., L.E.H.B., J.T.J., A.d.R., H.P., A.E.M., I.M.J., J.W.A.S., and H.J.L. read and approved the final manuscript. L.D.v.S., L.E.H.B., J.T.J., A.E.M., I.M.J., J.W.A.S., and H.J.L. contributed to the analysis and interpretation of data. L.D.v.S., L.E.H.B., J.W.A.S., and H.J.L. drafted the manuscript. J.T.J., A.d.R., H.P., A.E.M., and I.M.J. revised the manuscript. J.T.J., A.d.R., H.P., A.E.M., I.M.J., J.W.A.S., and H.J.L. contributed to the study conception and design. L.D.v.S. and L.E.H.B. are the guarantors of this work and, as such, had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

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