Paradoxical relationships between anthropometric variables and phenotypic expression of the metabolic syndrome in non-diabetic Polynesians of New Caledonia

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In the multiethnic population of New Caledonia, the CALDIA Study showed that the prevalence of type 2 diabetes was much higher (15.3%) in Polynesians (mostly Wallisians) than in Melanesians or Europeans (8.4%) (1). Polynesians also exhibit high rates of obesity (2,3), known to be a risk factor for insulin resistance and type 2 diabetes (4,5). However, recent analyses of the CALDIA Study showed that despite high indices of abdominal obesity, Polynesians had low fasting plasma insulin levels and HOMA-estimated insulin resistance (HOMA-IR) (6). Since abdominal obesity is usually associated with impaired fasting glucose, dyslipidemia and/or hypertension, forming the metabolic syndrome (MetS) (7,8), we investigated whether these features were present in this group, in comparison with Melanesians and Europeans.

RESEARCH DESIGN AND METHODS
The CALDIA Study is a large population-based study of diabetes prevalence in New Caledonia. The protocol has been described in detail previously (1). A population-based sample of 9390 subjects, aged 30-59 years, resident in New Caledonia for more than ten years were visited at home for capillary blood glucose (CBG) measurement. Among them, 643 were known diabetics or had CBG value $\geq 6.1$ mmol/l when fasting or $\geq 7.8$ mmol/l when non fasting (positive screenees). A total of 588 of them (response rate: 91.5%), together with 517 negative screenees matched by ethnic group, gender, age and location, underwent a more detailed examination, including a two-hour oral glucose tolerance test (OGTT), anthropometric and biochemical measurements. Of these, we selected for the analysis 58 Europeans, 298 Melanesians and 63 Polynesians with no known or newly diagnosed diabetes (i.e., fasting plasma glucose (FPG) < 7 mmol/l and 2-hour plasma glucose < 11.1 mmol/l at the OGTT), no antihypertensive treatment and no missing data for variables of interest. We compared MetS parameters across the ethnic groups and studied the association between metabolic variables and waist circumference (WC). All statistical analyses were performed using SAS software.

RESULTS
Means of MetS parameters for each ethnic group are shown in figure 1. Despite having the highest means of WC, FPG, and a higher prevalence of glycemic abnormalities, Polynesians had lower triglycerides (TG) and systolic blood pressure (SBP) than Melanesians. Levels of TG, SBP and HOMA-IR were lower in Polynesians compared to Europeans after adjustment for age, sex and BMI but the differences were not statistically significant. Levels of HDL-cholesterol were similar between the three groups with or without adjustment.

In order to assess the contribution of abdominal obesity to the variability of MetS parameters, regression analyses were performed separately for each ethnic group, after adjustment for age and sex. In all ethnic groups, WC was positively associated with SBP. As expected, we also found a positive correlation between WC and TG in Europeans ($P<0.02$) and Melanesians ($P<0.0001$). Surprisingly, there was no such correlation in Polynesians. FPG was significantly associated with WC only in Melanesians ($P<0.0004$). HDL-cholesterol levels were not associated with WC whatever the group.

CONCLUSIONS
Polynesians did not exhibit the expected cluster of abnormalities usually observed in MetS, given their obesity indices. They displayed the lowest triglyceride levels, together with relatively low mean values for systolic blood pressure. Moreover, triglycerides and FPG levels were independent of waist circumference. This lack of association might however be a consequence of a lack of power and should be confirmed on larger samples.
Ours is another observation that the relation between obesity and the cluster of MetS abnormalities differs according to ethnicity (9,10), which raises discussions about the validity of MetS definitions (11). For example, Canadian or Greenland Inuits have rather low prevalence of dyslipidemia and hypertension despite high occurrence of abdominal obesity (12,13). Conversely, south Asian populations often exhibit the cluster of MetS abnormalities although they have low obesity rates compared to Caucasian populations; however they generally have an excess of visceral fat (14). One explanation for these discrepancies may be that amount of overall or visceral fat is poorly assessed by usual anthropometric indices (15). We had to rely on these because no direct estimation of fat mass or body composition was available in the CALDIA Study, and some studies have shown that Polynesians had higher percentage of lean mass, and higher bone mineral density compared to Caucasians (16-18). Moreover, it was observed that most Polynesians in the CALDIA Study were employed in heavy work, which may enhance their muscular mass.

The particular metabolic profile we observed in Polynesians may also be related to a low degree of insulin resistance, considered as the leading factor predisposing to MetS (19-21). In a previous paper, we have shown in accordance with Simmons et al. that Polynesians had low fasting insulin levels, and low HOMA-estimated insulin resistance (6). This may be due to their high physical activity or other environmental factors such as diet, or to genetic factors.

In conclusion, despite their large body mass, non diabetic Polynesians do not seem to display the expected profile of disorders described under conventional definitions of MetS. This suggests that either anthropometric indices do not properly reflect body fat mass, or pathogenetic mechanisms leading to the syndrome are not sufficiently understood. This may have implications for the diagnosis and characterization of MetS across populations, as well as for the assessment of its related disease risks.

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Figure 1.