Hypertriglyceridemic Waist as a Screening Tool for CVD Risk in Indigenous Australian Women

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Research has demonstrated that the simultaneous determination of waist circumference and fasting plasma triglyceride (TG) concentrations can identify men characterized by a metabolic triad of unconventional risk variables: increased levels of fasting insulin, apolipoprotein (apo) B, and a predominance of small, dense, low density lipoprotein (LDL) particles. The aim of this study was to assess the efficacy of using ''hypertriglyceridemic waist'' to identify individuals at high risk of CVD in a sample of indigenous Australian women, for whom 2 of the 3 non-traditional risk factors were measured (apo B and insulin). Subjects (*N*=80) were divided into subgroups on the basis of waist girth and TG levels. The TG /HDL ratio increased in women with both elevated waist (above 95 cm) and TG levels (above 2.0 mmol/L), who were also characterized by lower HDL and elevated LDL concentrations. Although there was no trend toward an increase in apo B with increasing waist girth and TG levels, apo B concentration was highest among subgroups with elevated waist and TG levels. Fasting insulin levels were higher with increasing waist girth, but not with increasing TG levels. Utilizing hypertriglyceridemic waist as a marker of high plasma insulin and apo B can be an important factor in assessing cardiovascular risk in indigenous Australian women, despite an unexpected apo B distribution. (*Ethn Dis*. 2003; 13:80–84)

Key Words: Triglycerides, Apolipoprotein B, Insulin, Indigenous Australians

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Introduction

The metabolic triad of increased levels of fasting insulin, apolipoprotein (apo) B, and a predominance of small, dense, low-density lipoprotein (LDL) particles, is now emerging as a powerful risk factor for coronary heart disease (CHD) in men.[1] Due to the time and cost associated with the measurements of insulin, apo B, and LDL size, the simultaneous measurement of waist circumference and fasting plasma triglyceride (TG) concentrations has been promoted as an alternate, and much less expensive tool to identify men characterized by this triad.[2] Waist circumference, commonly used as an index of abdominal obesity, is positively associated with apo B and insulin levels in men, and has therefore been used to identify these potential risk factors.[2] Fasting TG concentration has been identified as a marker of LDL size, as TG levels correlate with LDL size measured by gradient gel electrophoresis.[3–5] More than 80% of men with both elevated waist girth (≥90 cm) and TG levels (≥2.0 mmol/L) also exhibited the metabolic triad; however, elevated waist circumference, alone, failed to adequately identify men at high risk.[2] It is not clear whether "hypertriglyceridemic waist" can identify subjects with a higher risk of cardiovascular disease (CVD) among other groups, including indigenous populations. As pointed out by Després et al,[6] cut-off values need to be clarified for different age range and ethnicity. Australian indigenous people have been characterized as having an unusually high prevalence of obesity, hyperinsulinemia, dyslipidemia, and non-insulin dependent diabetes, compared to non-indigenous populations.[7–11] Therefore, the aim of this study was to assess the efficacy of using "hypertriglyceridemic waist" to identify individuals at high risk of CVD in a sample of Australian indigenous women with a wide range of BMI (mean BMI=30.1 ± 7.9 kg/m^2, range 18.1–65.7 kg/m^2).

Methods

Subjects were indigenous Australian women (*N*=92) recruited from those attending Community Health Centers, or training as aboriginal health workers and residing in urban New South Wales, Australia. The definition of aboriginal was "persons identifying themselves as aboriginal and being accepted as such by an aboriginal community."[12] Among 92 subjects, 34 subjects were classified as non-obese (BMI<25 kg/m^2), were used to determine the 50th percentile values for apo B and insulin, and were regarded as cut-off points for apo B and insulin. Eighty of the 92 subjects (mean BMI=30.1 ± 7.9 kg/m^2) had both apo B and insulin measured, and formed the basis of the statistical analysis. The blood available was insufficient to measure apo B and insulin in the remaining 12 subjects. Height was measured with a portable stadiometer, and weight was measured with a digital scale, which was calibrated before each session. Body mass index (BMI=weight kg/height m^2) was calculated. Waist girth was measured, with the subjects standing, using a plastic tape measure at the least girth between the bottom of the rib cage and

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the iliac crest. Fasting venous blood samples were collected in EDTA tubes. Total cholesterol (TC), high-density lipoprotein (HDL) cholesterol, and triglycerides (TG) were determined on a Boehringer-Mannheim Reflotron analyser, and apo A-1 and B were calculated using a Turbitimer (Behring). Fasting insulin was determined by radioimmunoassay at a tertiary reference laboratory. An unpaired *t* test was used to investigate the association of waist girth with apo B and insulin. Pearson correlation coefficients were determined to test the relationship between waist girth, BMI, insulin, apo B, TG, TC, and HDL. A log transformation was used to normalize the skewed distribution of insulin and TG. Anthropometric and lipid profiles of subgroups were compared by ANOVA, and the post-hoc test was used when a significant group effect was determined. Results were expressed as mean ± standard deviation (SD). All statistical analyses were performed using Statview 5.0 (MacIntosh) and SPSS version 10.0 (SPSS Inc, Chicago, Ill.), and findings were considered statistically significant at $P<.05$. In addition, the risks were expressed as odds ratio (95% confidence interval) by logistic regression analysis. Confounding was assessed by entering the covariates in the regression models.

Table 1. Pearson correlation coefficients of anthropometric and biochemical parameters (*N*=75)

	Waist (cm)	BMI (kg/m²)	Insulin* (pmol/L)	Apo B (g/L)	TG* (mmol/L)	TC (mmol/L)	HDL (mmol/L)
Waist (cm)	1.0	0.90†	0.50†	0.15	0.54†	0.26‡	−0.38†
BMI (kg/m²)	0.90†	1.0	0.50†	0.28‡	0.43†	0.24‡	−0.32§
Insulin (pmol/L)*	0.50†	0.50†	1.0	−0.05	0.32§	0.04	−0.25‡
Apo B (g/L)	0.15	0.28‡	−0.05	1.0	0.29‡	0.42†	0.19
TG (mmol/L)*	0.54†	0.43†	0.32§	0.29‡	1.0	0.53†	−0.37†
TC (mmol/L)	0.26‡	0.24‡	0.04	0.42†	0.53†	1.0	−0.10
HDL (mmol/L)	−0.38†	−0.32§	−0.25‡	0.19	−0.37†	−0.10	1.0

* Log-transformed.
† $P<.001$.
‡ $P<.05$.
§ $P<.01$.

RESULTS

Figure 1A shows the relationship between plasma apo B concentrations and waist girth, stratified by waist girth ($N=91$), among subgroups of women; no significant differences in mean apo B concentrations were observed between subgroups, nor was there any trend toward an increase in apo B with increasing waist girth. Fasting plasma insulin increased with increasing waist girth (Figure 1B) and a positive association existed between insulin (log-transformed) and waist girth ($N=81$, $r=0.47$, $P<.0001$). Using the 50th percentile values from non-obese subjects ($N=30$), cut points for apo B and insulin were determined as 1.04 g/L and 57.0 pmol/L, respectively. The 80 subjects for whom both apo B and insulin measurements were available were divided into 6 groups, according to waist girth and TG levels. A value of 85 cm was chosen as the cut point for waist girth, as a rapid increase in insulin was observed between women with a mean waist girth of 80.9 cm, and women with a mean waist girth of 88.8 cm (Figure 1B). Hypertriglyceridemia was defined as TG levels greater than 2.0 mmol/L. Figure 2 shows the percentage of subjects with insulin>57.0 pmol/L, and apo B>1.04 g/L, in 4 subgroups of

Table 2. Plasma insulin and apo B levels among Australian indigenous women stratified by waist girth (cm) and TG levels (mean ± SD)

	Group 1 TG<2.0 Waist<85	Group 2 TG<2.0 85≤Waist<95	Group 3 TG<2.0 Waist≥95	Group 4 TG≥2.0 Waist≥95
No. of subjects	21	19	21	14
Age (years)	34.8±10.9	39.2±11.8	40.4±12.6	42.8±10.7
BMI (kg/m²)	22.7±2.8	28.0±3.5*	36.4±5.8*†	36.4±9.3*†
Waist (cm)	76.1±6.6	88.3±2.4*	108.9±12.3*†	110.9±20.5*†
TG (mmol/L)	1.01±0.3	1.31±0.3*	1.32±0.4*	2.55±0.6*†‡
TC (mmol/L)	4.64±1.0	5.43±1.0*	4.76±1.0†	6.01±0.8*‡
LDL (mmol/L)	2.96±1.0	3.73±1.1*	3.22±1.0	4.46±0.7*†‡
HDL (mmol/L)	1.30±0.4	1.21±0.3	1.00±0.3*†	0.91±0.3*†
TC/HDL	3.72±1.6	4.78±1.5	5.30±2.5	7.08±1.9*†
Insulin (pmol/L)	64.0±43.4	128.1±107.8*	156.8±52.7*	120.9±63.2*
Apo B (g/L)	1.21±0.5	1.25±0.3	1.03±0.2	1.46±0.5

* Significantly different from Group 1.
† Significantly different from Group 2.
‡ Significantly different from Group 3.

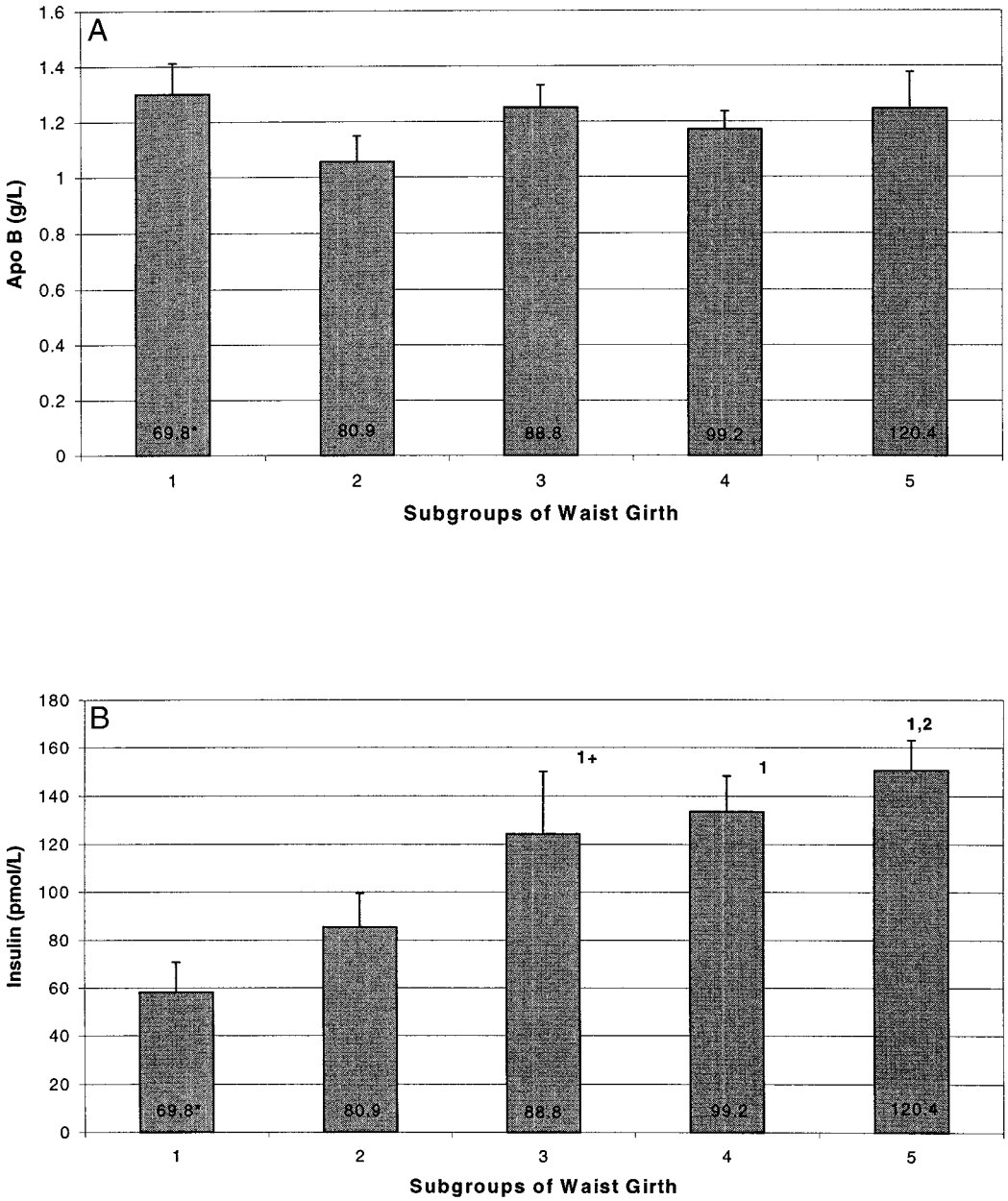
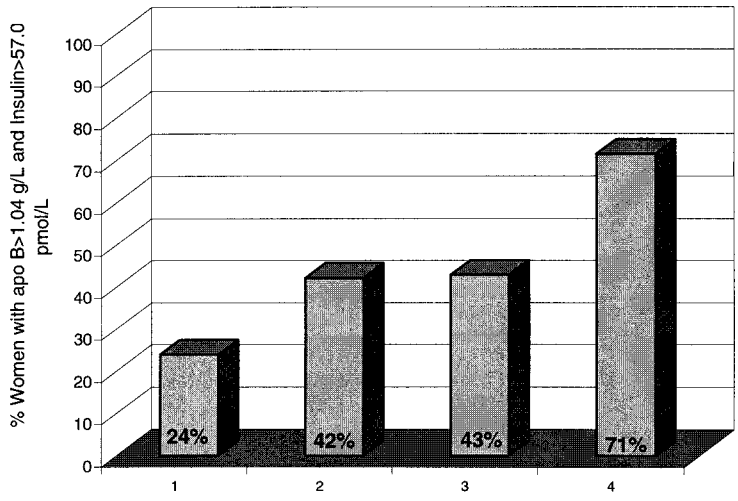


Fig 1A. Mean apo B concentrations among subgroups of Australian *Number within each bar shows mean waist girth for each subgroup. Fig 1B. Mean insulin concentrations among subgroups of Australian indigenous women stratified by waist girth (*N*=81). *Number within each bar shows mean waist girth for each subgroup. +Number above each bar indicates significant difference (*P*<.05).

waist girth and TG levels. Two groups were excluded from the analysis due to the small number in each group: 3 women with small waist girth (<85 cm) and elevated TG levels (≥2.0 mmol/L), and 2 women with intermediate waist girth (between 85 and 95 cm) and elevated TG levels (≥2.0 mmol/L). Therefore, 75 subjects were included in the statistical analysis for Figure 2, and Tables 1 and 2. Seventy-one percent of women with both elevated waist girth (above 95 cm) and TG levels (above 2.0 mmol/L) had at-risk levels of apo B and insulin (Figure 2). These women had an 8-fold greater chance of having apo B>1.04 g/L, and insulin>57.0 pmol/L, compared to those in Group 1. These associations are reflected in their intercorrelations (Table 1). The risks reported in Figure 2 did not vary by age, and increased after adjusting for HDL (data not shown). As BMI and waist girth are highly correlated, we did not adjust for



	TG<2.0 Waist<85	TG<2.0 85≤Waist<95	TG<2.0 Waist≥95	TG≥2.0 Waist≥95
Odds Ratio	**1.0**	**3.3**	**3.4**	**8.0**
95% CI		**(0.79-14.2)**	**(0.79-15.0)**	**(1.7-37.1)**
				***P*=.008**

Fig 2. Percentage of and risks for women with insulin >57.0 pmol/L and apo B>1.04 g/L among subgroups of women based on waist girth and TG level

BMI in this analysis. Using the 4 previously described subgroups, the TC/HDL ratio was found to be elevated in women with both elevated waist girth and TG levels (Group 4 in Table 2); these subjects were also characterized by lower HDL levels, elevated LDL concentrations, and higher BMI. Although no trend was observed toward an increase in apo B with increasing waist girth and TG levels, apo B concentration was highest among subgroups with elevated waist girth and TG levels. Fasting insulin levels were higher with increasing waist girth, but not with increasing TG levels.

DISCUSSION

The present study has established that the simultaneous determination of waist girth and TG levels can be used as a screening tool for CVD risk in indigenous Australian women. We found no association between apo B and waist girth in this sample of women; however, Lemieux et al[2] observed a positive association between these factors in Caucasian men, with apo B levels progressively increasing with increased waist girth.[2] Up to 100 cm, apo B concentration was very sensitive to expanding waist girth but above this measure there was little correlation observed.

In the current study, women with the smallest waist circumference had the highest mean apo B levels (1.30 g/L, see Figure 1A), which may indicate a difference in apo B distribution between Caucasian men and indigenous Australian women. Apo B levels observed here are higher than those previously reported in Australian Caucasian women.[13] Compared to men in the Lemieux study,[2] fewer women had intermediate waist girth or elevated TG levels.

In the total sample of Australian indigenous women in this study, 38% had a BMI>30, which is identical to that found for a sample of indigenous Australian women from an urbanized area in the adjacent state of Victoria.[14] However, our BMI figure is slightly higher than that observed in a sample of indigenous Australian women from remote communities in the Northern Territory.[15] In this sample from a remote community, 31% of females aged 35–44 years were classified as obese, a finding similar to that reported in the national representative data of indigenous sample.[16] The higher prevalence of obesity in our sample might be due to the much smaller proportion (2%) of underweight people defined as BMI<18.5 kg/m^2, compared to the other indigenous groups, as well as to the possible effect of urbanization and Westernization on the prevalence of obesity, as previously described.[17] The indigenous women in this study were living either in rural towns in NSW, or in the western suburbs of Sydney. Hypertriglyceridemic waist was associated with elevated levels of multiple cardiovascular risk factors, including TG, TC, LDL, and TC/HDL ratio; however, elevated waist girth alone failed to identify subjects at higher risk. A limitation of this study is that LDL particle diameter, suggested to be one of the metabolic triad, was not determined. In our sample of 92 indigenous Australian women, 56 (61%) were smokers, which could have been a potential confounding factor.

In summary, hypertriglyceridemic

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waist can be used as a marker of high plasma insulin and apo B in cardiovascular risk assessment in indigenous Australian women, despite an unexpected apo B distribution. Both waist girth and plasma triglyceride levels are simple clinical measurements that can be determined with minimal training, and in remote locations. The findings of this study are of potential clinical significance in cardiovascular risk detection and management in rural and remote indigenous populations.

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Acquisition of funding: Acklin, Newman, Caterson, Brock, Bermingham

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