Original Article

Assessment of risks of "lifestyle" diseases including cardiovascular disease and type 2 diabetes by anthropometry in remote Australian Aborigines

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Objective: To evaluate waist-to-height ratio (WTHR), waist girth and body mass index (BMI) as predictors of cardiovascular risk factors in Australian Aborigines. **Design**: Indices were examined as predictors of mean blood pressures (BP), blood lipids, glucose, insulin and as predictors of hypertension, decreased HDL-cholesterol, elevated glucose and type 2 diabetes. **Setting**: Aboriginal communities in remote north-west Australia. **Participants**: Four hundred and one adults. **Results**: More than 80% of participants had WTHR ≥0.5 or BMI >22 kg/m^2 and 78% had increased waist girth (>90 cm men; >80 cm women). Adverse BP, blood lipids, glucose and insulin were associated with classification above the cutpoint for each index. For fasting glucose ≥5.6 mmol/L, sensitivity was 91% with WTHR, 87% with waist girth and 88% with BMI; respective specificities were 29%, 29% and 44%. Area under receiver operating characteristic (AUROC) curves gave only "fair" accuracy for any discriminatory variable. With diabetes AUROC for BMI (0.59, 95% CI 0.53, 0.65) was significantly lower than with other indices (WTHR 0.74, 95% CI 0.69, 0.79; girth 0.72, 95% CI 0.67, 0.78) but did not differ significantly for fasting glucose, HDL-cholesterol or hypertension. AUROC did not differ significantly between men and women for any outcomes. **Conclusions**: The indices did not discriminate well for diabetes or cardiovascular risk factors in these Aborigines, but waist girth or WTHR appeared more useful than BMI. Appropriate cutpoints are needed. WTHR is simple, does not need sex-specific cutpoints and could be useful in developing public health strategies.

Key Words: overweight/obesity, diabetes, cardiovascular disease, anthropometry, BMI, Aborigines, indigenous

INTRODUCTION

Australian Aborigines (Aborigines) before European contact have been described as "slimly built, sinewy featherweights";[1] they apparently were not prone to chronic diseases such as hypertension, cardiovascular disease or diabetes.[2] This has changed dramatically, particularly over recent decades, and they now have very high rates of obesity, cardiovascular disease, type 2 diabetes mellitus and chronic renal disease. The rates of diabetes in Aborigines are at least double to four times those in other Australians[3] and in some Aboriginal communities the relative rates are very much higher.[4] There has also been a steep rise in rates of diagnosis of type 2 diabetes in Aboriginal children and adolescents recently. From 1990 – 2002, the diagnosis incidence rate ratio of childhood type 2 diabetes in Western Australia (Indigenous *vs.* non-Indigenous) was approximately 18:1.[5] The sharp increase in these chronic diseases may be related to rapid transition to "Western" diets and to more sedentary lifestyles.

When assessing remote Aboriginal people in relation to overweight, obesity and related disorders, it is desirable to have screening or detection procedures that are simple, readily reproducible, easy to interpret and can predict significant health risk requiring intervention. It has been suggested that waist-to-height ratio (WTHR) could be used as a simple, rapid screening method that may be better than body mass index (BMI). A simple WTHR boundary value of ≥0.5 indicates increased risk in adult and child males and females and in different ethnic groups.[6] It is particularly important to investigate such anthropometric indices in different ethnic groups as it is now clear that cutpoints

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associated with risk of lifestyle diseases differ with ethnicity.[7] We investigated WTHR, waist girth and BMI among Aborigines who took part in health assessments in remote parts of north-west Australia where obesity, diabetes and cardiovascular disease have collectively become a very serious public health problem.[8]

METHODS

The setting and the participants

The participants belong to culturally closely related Aboriginal groups who live in four very isolated, discreet communities in tropical north-west Australia. The locality is in tropical, monsoonal, lightly timbered savannah grasslands that are extremely sparsely populated. The Aborigines live on their ancestral homelands but traditional activities like hunting and food-gathering have declined recently and they are now dependent on store foods transported from hundreds or thousands of kilometres distant. The people are heavily dependent on government welfare and there are no local farming activities or industries. The communities' populations range from about 200 to 400 persons and they are approximately 150 to 200 kms (90 to 120 miles) from the nearest towns. They live in an area that is approximately that of England. Participants were 401 adults (173 men, 228 women) in whom waist girth was measured. They undertook health screening in an Aboriginal-driven program to minimise the impacts of nutrition-related "lifestyle" diseases.[8]

Collection of field data and blood samples for analysis

Informed and written permissions were obtained from each Aboriginal Community Council and from all individual participants. Each participant was free to withdraw from the program at any time. The procedures used conform to the National Health and Medical Research Council guidelines relating to work with Australian Aboriginal people. Personal and family histories were documented and clinical and anthropometric examinations carried out by trained clinical personnel. Body weight in light clothing was measured by trained clinical staff using checked electronic or standardised and calibrated spring balance scales (to 100 g). Waist circumference was measured to 0.1 cm using non-extensible tapes at the level of the umbilicus (Lufkin, Saginaw, Mi, USA). Blood pressure was measured after 5 minutes of sitting using a Dinamap® Procare 300 which meets Australian National Heart Foundation guidelines (http://www.heartfoundation.com.au/downloads/hypertension_management_guide_2004.pdf). Total cholesterol and glucose levels were measured on capillary whole blood using a Cholestech LDX analyser (Point of Care Diagnostics, Sydney, Australia). All results were available within 10 minutes. LDL-cholesterol was calculated using the Friedewald formula[9] after excluding samples with triglycerides >4.5 mmol/L.

Body mass index (BMI) was calculated as body mass (kg)/height (metres^2); waist-to-height ratio (WTHR) was as the ratio of waist circumference (metres) to standing height (metres). Hypertension was defined as a systolic blood pressure (BP) ≥140 mm Hg or a diastolic BP ≥90 mm Hg or having treatment for hypertension.[10] All participants were asked to come to the screening after fasting overnight and before breakfast; to encourage compliance, breakfast was provided for all of them after testing. Definitely fasting blood glucose samples were obtained from 119 adults (30%), 40 men (23%) and 79 women (35%). Because of doubts about fasting status of other participants, levels were considered as if they were random samples. Diabetes was defined by a clinically and biochemically documented past history, a confirmed fasting glucose level of >7 mmol/L, or symptoms suggestive of the diagnosis with a random glucose level of >11.1 mmol/L, or a plasma glucose of >11.1 mmol/L after a closely supervised fasting oral glucose tolerance test (OGTT). To document the presence of the metabolic syndrome we used the cutpoints of ≥5.6 mmol/L for fasting glucose and, for HDL-cholesterol levels, ≥1.03 mmol/L for men and ≥1.29 mmol/L for women in accordance with the International Diabetes Federation (IDF) criteria for the metabolic syndrome.[7]

Clinical, physical and laboratory findings were used to implement prompt and appropriate interventions, including therapeutic regimes and follow-up, as necessary.

Statistical methods

SPSS 12 (SPSS, Chicago, Ill) was used for analysis. Categorical variables are shown as number (%) and continuous variables as mean (SE) or geometric mean (95% confidence interval). Categorical data were examined in cross-tabulations with calculation of sensitivity and specificity of cutpoints; chi-square tests were used for significance. Means of classical risk factors were compared according to categories of anthropometric variables using Generalised Linear Models adjusted for age. Diabetes, and variables that contribute to definition of the metabolic syndrome (hypertension, fasting glucose and HDL-cholesterol) were examined as binary outcomes as defined above. These outcomes were also examined in Receiver Operating Characteristic (ROC) curves[11] in relation to waist circumference (WC), body mass index (BMI) and waist-to-height ratios (WTHR), with calculation of area under the curve (AUROC) assuming non-parametric distributions. A p value <0.05 was considered significant.

RESULTS

Prevalence of anthropometric indices above cutpoints

Table 1 shows the distribution of participants with WTHR ≥0.5, waist girth above the cutpoints of 90 cm for men and 80 cm for women as recommended for non-Caucasians[7] or BMI ≥22 rather than 25kg/m^2 generally used for anthropometric assessment.[12] More than 80% of adults had WTHR or BMI that exceeded the cutpoints, while 78% had waist girth greater than the IDF criteria.

The prevalence of participants with values exceeding cutpoints was similar whether waist girth, WTHR, or BMI was used. Among 330 adults with BMI ≥22 kg/m^2, 27 were classified in the lower risk category for waist girth and 19 had WTHR <0.5. Of the 326 adults with WTHR ≥0.5, 20 were classified in the lower group for waist girth and 15 in the lower category for BMI. Of the 312 classified in the higher category for waist girth, 6 had WTHR <0.5 and 9 had BMI <22 kg/m^2.

Table 1. Prevalence of participants with anthropometric indices above standard cutpoints.

	Waist to height ratio≥0.5	Waist girth[1]	BMI ≥ 22 kg/m ^{2}
Adults	326 (81.3%)	312 (77.8%)	330 (82.3%)
Men (N=173)	133 (76.9%)	120 (69.4%)	138 (79.8%)
Women (N=228)	193 (84.6%)*	192 (84.2%)***	192 (84.2%)

1: Classified according to the International Diabetes Federation criteria for non-Caucasians [7] with a cutpoint of 90 cm for men and 80 cm for women; * p<0.05; *** p<0.001 for difference between men and women.

Associations between anthropometric indices and risk factors

Table 2 shows blood pressure, blood lipids, glucose and insulin in relation to cutpoints for WTHR, waist girth and BMI. There were statistically significant differences between categories, with more adverse levels of risk factors associated with greater WTHR, greater waist girth and greater BMI for all variables, except for LDL-cholesterol which did not differ significantly between categories of WTHR or waist girth. Findings were similar with data analysed separately for men and women (data not shown).

Anthropometric indices as predictors of risk factors

Waist girth, WTHR and BMI group were examined in relation to prediction of type 2 diabetes and variables that contribute to the metabolic syndrome (hypertension, HDL-cholesterol, fasting glucose).[7]

With type 2 diabetes as the outcome, sensitivity was greater than 93.8% with WTHR, >90% for waist girth and 93.8% for BMI. However, specificity was low with values of 24-32%. With fasting glucose, sensitivity was close to 90% for all three anthropometric variables but again, specificity was low ranging from 24% for BMI to 29% for WTHR. The pattern was similar with hypertension and HDL-cholesterol as outcomes.

The area under a Receiver Operating Characteristics (ROC) curve is a convenient way of comparing classifiers.[11] An approximate guide for classifying the accuracy of a discriminatory test is where: 0.9 to 1.0 = excellent, 0.8 to 0.9 = good, 0.7 to 0.8 = fair, 0.6 to 0.7 = poor and 0.5 to 0.6 = fail. Using this guide, WTHR and waist girth provided fair discrimination but BMI failed for type 2 diabetes. For fasting glucose and hypertension, WTHR and waist girth provided poor discrimination while the AUROC with BMI failed. With HDL-cholesterol, discrimination was fair with WTHR and poor with waist girth and BMI. However, the only statistically significant difference in AUROC between the indices was seen with diabetes for which the value was significantly lower using BMI. There were no statistically significant differences in AUROC between men and women for any of the outcomes examined (Tables 3 and 4).

An example of ROC curves obtained using the three indices is shown in Figure 1 in relation to HDL-cholesterol. There was no clear indication of better sensitivity and specificity with choice of a different cutpoint. ROC curves were similar with other outcomes (data not shown).

DISCUSSION

Adverse values for BP, blood lipids, glucose and insulin in these Aborigines were associated with classification above the cutpoint for each index but WTHR, waist girth and BMI did not discriminate well in relation to hypertension, HDL-cholesterol, fasting glucose or diabetes. WTHR and waist girth showed similar results in classifying all variables but BMI was less satisfactory, with AUROC classified in the "fail" range for diabetes, fasting glucose and hypertension. The only significant difference in AUROC was in the classification related to BMI for diabetes compared to values with WTHR or waist girth. AUROC did not differ between men and women with any of the indices.

WTHR has the practical advantage of using the same cutpoint for men and women, unlike with waist girth, and requires a calculation that is simpler than for BMI.[6] WTHR also offers the potential for a simple index in health promotion being more easily understood than BMI. Results are critically affected by the choice of cutpoints used for both the anthropometric indices and the outcomes and these may not be appropriate for Aboriginal Australians. All anthropometric measurements are liable to observer errors and it is important to minimise these.[12]

Cutpoints are needed to identify lifestyle diseases risk with ethnicity. IDF guidelines specify different cutpoints according to ethnicity for components of the metabolic syndrome.[7] However, there is little information about anthropometric cutpoints appropriate to detect lifestyle diseases risk in Aborigines. It has been proposed that the BMI cut-off point for healthy body mass for indigenous people including Australian Aborigines should be 22kg/m ^{2} rather than 25kg/m ^{2}; this was the basis for our use this lower cutpoint.[13] We also used the cutpoints for waist measurement (90 cm, men; 80 cm, women) recommended by the IDF for non-Causcasians.[7] These values may be inappropriate for Australian Aborigines.

Although WTHR ≥0.5 is said to indicate increased risk for people of different ethnic groups,[6] only Caucasian and Asian populations were examined.[14,15] This may be relevant to Australian Aborigines because of their particular anthropometric characteristics with, for example, high limb-to-trunk ratios when compared to Caucasian Australians.[16] More data from Aborigines and other ethnic groups are needed to assess whether WTHR is more applicable to different ethnic groups than BMI or waist girth. As hip circumference was not measured in our survey, we were unable to examine waist-to-hip ratio as an indicator of risk.

The appropriateness of components of the metabolic syndrome used in our analyses is relevant. We used BP ≥140/90 mm Hg in defining hypertension[10] and the values for HDL-cholesterol recommended by the IDF.[7] Neither of these cutpoints is derived from Aboriginal data. Both variables are influenced by alcohol intake and hazardous consumption levels are more common among Aboriginals than other Australians.[17] A study of BP in Aborigines in remote north-west Australia showed a rate of

Table 2. Blood pressure, blood lipids, glucose and insulin related to cutpoints for waist-to-height ratio, waist girth and BMI in adults. Variables are shown as mean (SE) except for triglycerides and insulin which are shown as geometric mean and 95% confidence interval. Differences between categories were statistically significant for all variables except with reference to WTHR and waist girth for LDL-cholesterol.

	WTHR[1] <0.5	WTHR ≥0.5	WAIST <90cm men <80 cm women	WAIST ≥90cm men ≥80 cm women	BMI <22 kg/m^2	BMI ≥22 kg/m^2
SBP (mm Hg)	118(2) N=75	129 (1) * N=324	121(2) N=89	129 (1) * N=310	118 (3) N=71	129 (1) * N=328
DBP (mm Hg)	74(1) N=75	79(1) * N=324	75 (1) N=89	79 (1) * N=310	73 (1) N=71	79 (1)* N=338
Total cholesterol. (mmol/L)	4.5 (0.2) N=61	4.9 (0.1)* N=296	4.5(0.1) N=72	4.9 (0.1) * N=285	4.3 (0.1) N=62	4.9 (0.1) * N=295
HDL (mmol/L)	1.17 (0.04) N=61	1.01 (0.02) * N=289	1.15 (0.03) N=72	1.01 (0.02) * N=278	1.17 (0.03) N=62	1.01 (0.02) * N=288
LDL (mmol/L)	2.6 (0.1) N=59	2.7 (0.1) N=265	2.6 (0.1) N=67	2.8 (0.1) N=257	2.5 (0.1) N=61	2.8 (0.1)* N=263
Triglycerides (mmol/L)	1.3 (1.1,1.5) N=61	2.2 (2.0,2.3)* N=296	1.4(1.2, 1.7) N=72	2.2(2.0, 2.3)* N=285	1.2 (1.1,1.4) N=25	2.2 (2.0,2.3)* N=295
Fasting plasma glucose mmol/L	5.6 (0.4) N=48	7.8 (0.3)* N=200	5.9 (0.4) N=55	7.9 (0.3)* N=193	5.6 (0.3) N=45	7.7 (0.3)* N=203
Fasting insulin μU/L	7.9 (5.9, 10.8) N=43	20.2 (16.7, 24.5)* N=136	8.7 (6.4, 11.9) N=45	19.8 (16.3, 24.1)* N=134	8.2 (5.8, 11.6) N=37	19.0 (15.8, 22.8)* N=142

1: Waist-to-height ratio; * p<0.05 in Generalised Linear Models adjusted for age

Table 3. Sensitivity, specificity and area under the receiver operating characteristic curve (AUROC) related to waist-to-height ratio, waist girth and BMI. Cutpoints for waist girth and fasting blood glucose were defined according to the International Diabetes Federation criteria for non-Caucasians [7] and for BMI according to Daniel et al [13].

	Type 2 diabetes					Fasting blood glucose				
	N	Prevalence	Sensitivity	Specificity	AUROC	N	Prevalence	Sensitivity	Specificity	AUROC
WTHR										
Total	330	129 (39.1%)			0.74 (0.69, 0.79)	248	119 (48.0%)			0.72 (0.64, 0.79)
Men	144	55 (38.2%)			0.72 (0.63, 0.80)	111	83 (74.8%)			0.66 (0.56, 0.76)
Women	186	74 (39.8%)			0.76 (0.69, 0.83)	137	117 (85.4%)			0.65 (0.56, 0.74)
<0.5	65	8 (12.3%)	93.8%	28.3%		48	11 (22.9%)	90.8%	28.7%	
≥0.5	265	121 (45.7%)				200	108 (54.0%)			
WAIST										
Total	330	129 (39.1%)			0.72 (0.67, 0.78)	248	119 (48.0%)			0.72 (0.64, 0.80)
Men	144	55 (38.2%)			0.68 (0.59, 0.77)	111	76 (68.5%)			0.63 (0.52, 0.73)
Women	186	74 (39.8%)			0.75 (0.69, 0.82)	137	117 (85.4%)			0.65 (0.56, 0.74)
< cutpoint	75	10 (13.3%)	92.2%	32.3%		55	16 (29.1%)	86.6%	28.7%	
≥ cutpoint	255	119 (46.7%)				193	103 (53.4%)			
BMI										
Total	330	129 (39.1%)			0.59 (0.53, 0.65)	248	119 (48.0%)			0.58 (0.51, 0.65)
Men	144	55 (38.2%)			0.62 (0.52, 0.71)	111	89 (80.1%)			0.58 (0.47, 0.68)
Women	186	74 (39.8%)			0.67 (0.59, 0.74)	137	114 (83.2%)			0.58 (0.49, 0.68)
<22 kg/m^2	57	8 (14%)	93.8%	24.4%		45	14 (31.1%)	88.2%	24.0%	
≥22 kg/m^2	273	123 (44.3%)				203	105 (51.7%)			

Table 4. Sensitivity, specificity and area under the receiver operating characteristic curve (AUROC) related to waist-to-height ratio, waist girth and BMI. Cutpoints for waist girth were defined according to the International Diabetes Federation criteria for non-Caucasians[7] and for BMI according to Daniel et al [13]. Hypertension was defined as SBP>140 or DBP >90 or on treatment for hypertension. Low HDL-cholesterol was defined as <1.03 in men and <1.29 in women according to International Diabetes Federation cutpoints for the metabolic syndrome[7].

	Hypertension					HDL-cholesterol				
	N	Prevalence	Sensitivity	Specificity	AUROC	N	Prevalence	Sensitivity	Specificity	AUROC
WTHR										
Total	399	131 (32.8%)			0.61 (0.56,0.67)	350	245 (70.0%)			0.71 (0.64,0.77)
Men	172	74 (43.0%)			0.62 (0.54, 0.71)	152	87 (57.2%)			0.74 (0.66, 0.82)
Women	227	57 (25.1%)			0.68 (0.62, 0.76)	198	158 (79.8%)			0.63 (0.52, 0.74)
<0.5	75	10 (13.3%)	92.4%	24.2%		61	25 (41.0%)	90.0%	34.3%	
≥0.5	324	121 (37.3%)				289	220 (76.1%)			
WAIST										
Total	399	131 (32.8%)			0.63 (0.58, 0.69)	350	245 (70.0%)			0.69 (0.62, 0.75)
Men	172	74 (43.0%)			0.63 (0.54, 0.71)	152	87 (57.2%)			0.75 (0.67, 0.83)
Women	227	57 (25.1%)			0.65 (0.58, 0.73)	198	158 (79.8%)			0.62 (0.52, 0.73)
< cutpoint	89	14 (15.7%)	89.3%	28.0%		72	28 (38.9%)	88.6%	41.9%	
≥ cutpoint	310	117 (37.7%)				278	217 (78.1%)			
BMI										
Total	399	131 (32.8%)			0.57 (0.51, 0.63)	350	245 (70.0%)			0.66 (0.60, 0.73)
Men	172	74 (43.0%)			0.60 (0.51, 0.68)	152	87 (57.2%)			0.72 (0.64, 0.80)
Women	227	57 (25.1%)			0.60 (0.52, 0.68)	198	158 (79.8%)			0.59 (0.49, 0.70)
<22 kg/m^2	71	11 (15.5%)	91.6%	22.3%		62	28 (45.2%)	88.6%	32.3%	
≥22 kg/m^2	328	120 (36.6%)				288	217 (75.3%)			

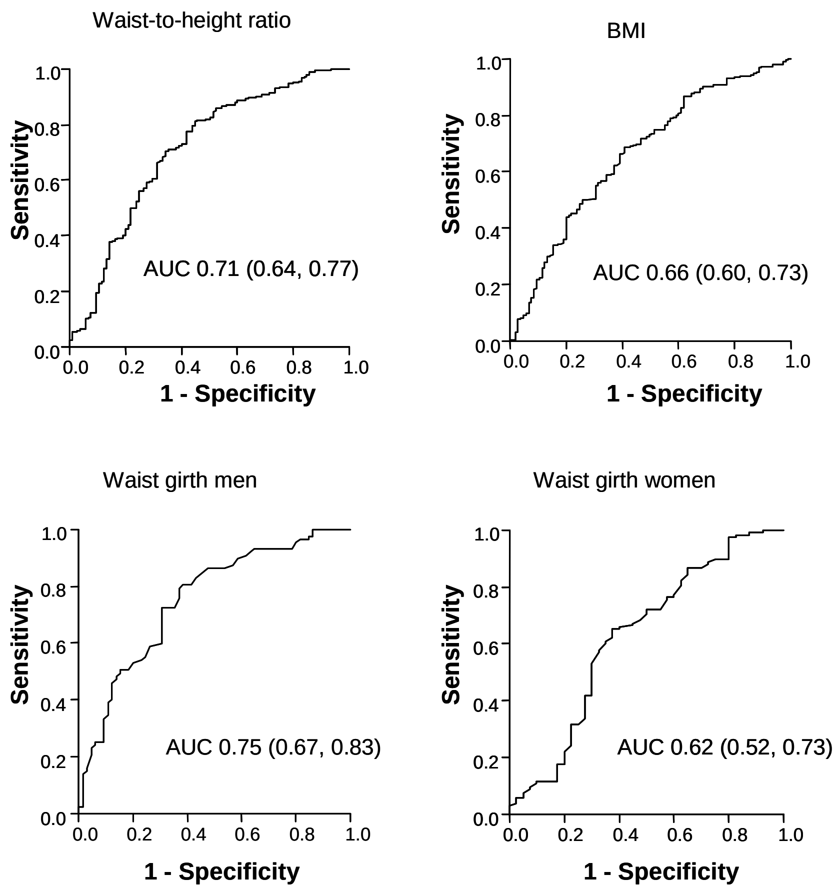

Figure 1. Receiver operating characteristics curves for HDL-cholesterol <1.03 mmol/L in men and 1.29 mmol/L in women as the grouping variable. Curves are shown for men and women combined for waist-to-height ratio and BMI (for which cutpoints were the same in men and women), and separately for men and women for waist girth for which cutpoints differed.

hypertension almost three times that of non-Aboriginal Australians and an association with alcohol intake.[18] Alcohol intake leads to higher HDL-cholesterol, at least within the range of moderate consumption.[19] Associations between HDL-cholesterol and alcohol intake at high levels in Australian Aborigines are not established. Perhaps alcohol influences cutpoints for these cardiovascular disease (CVD) risk factors independent of obesity, leading to inadequate discrimination using measures of obesity alone in this Aboriginal population. Individuals were asked to fast overnight for their blood glucose levels but compliance was only 30%. However, participants were also considered as if they had given random samples. On that basis 30/173 (17.3%) of men and 29/228 (12.7%) of women, that is 59/401 (14.7%) of the adults, had plasma glucose levels > 11.1 mmol/L. Closely supervised post-fasting oral glucose tolerance tests were also used to confirm the diagnosis of diabetes.

Overweight, obesity and their co-morbidities are hyperendemic and worsening in Aborigines.[3,5,8] It is important to be able to assess the prevalence of overweight/obesity in these people and their risk factors for the development of chronic diseases such as diabetes and CVD. This is needed for preventive health programs and for treatment and clinical follow-up. But many Aboriginal communities are very remote and have limited clinical staff and facilities. Simple, reliable methods to assess nutritional status. and related health risks are required.

BMI is used widely to indicate overweight/obesity but this method can be difficult for busy clinic staff with limited time and/or ability to utilise the method. This is common in isolated clinics or with rural health workers in remote areas such as in Aboriginal communities. Furthermore, there are doubts about the validity of BMI compared to other anthropometric measures when assessing overweight, obesity and related disease risks. This was found in a standardised case-control investigation of many well conducted, large-scale studies from more than 50 countries.[20,21] Studies in children and adolescents showed that waist circumference (WC) and WTHR are better predictors of cardiovascular risk than BMI.[22,23] WTHR, a simple relationship between WC at the level of the umbilicus (m) and body height (m), has appeal by removing the need to use height squared (m^2) in the calculation.[6]

The area under a Receiver Operating Characteristics (ROC) curve is convenient for comparing classifiers.[11] A random classifier has an area of 0.5 while an ideal one has an area of 1.0. The area under the curve is the percentage of randomly drawn pairs for which an abnormal test result comes. The ROC curves used in this investigation showed that WTHR and WC correlated better with diabetes than did BMI (Figure 1) but this difference was not statistically valid. This suggests that WC alone or when used to derive WTHR is at least as good as BMI to discriminate the risk of individuals or members of a group having diabetes; this is important for detecting the risk of related disorders including CVD. In 915 adult Aborigines from the Northern Territory the risk of diabetes increased according to WC, BMI, body mass, waist-to-hip ratio and hip circumference; in that report the area under the ROC curve was significantly greater for WC than for the other measurements.[24] Those observations and ours have very important practical implications. In clinics that are understaffed or have heavy work-loads or under field conditions where personnel have limited time or understanding of anthropometric assessment, even of the use of BMI, it is desirable to have simple, reliable, rapid methods to assess nutritional status. WC and/or WTHR have advantages over BMI to assess overweight or obesity among Aboriginal people under such conditions.

The same cutpoint of 0.5 for WTHR may also apply in children and adolescents.[6,22,23] This would help by avoiding the need to refer to sex- and age-specific BMI percentiles.[23] However, there are more problems in identifying children at risk of lifestyle diseases in relation to anthropometric indices than there are in adults. The International Obesity Task Force (IOTF) standards for categorising children by age- and sex-specific criteria for BMI are based on values extrapolated from the cutpoint of 25 kg/m^2 for overweight in adults.[25] None of the data used to derive these values included Australian Aboriginal children and adolescents; the use of BMI $\geq$ 25 kg/m^2 as the standard rather than lower value of 22 kg/m^2 may be inappropriate for this population.[13] A further problem is in recognising hazardous levels of cardiovascular risk factors in children. Age- and sex-specific standards for elevated BP in children and adolescents have been established[26] but these are based on data from Caucasian populations that may be inappropriate for Australian Aborigines. Although there were 204 children and adolescents included in our survey, these concerns, together with the low prevalence of WTHR ≥0.5 (15%) and BMI above IOTF cutpoints (12%) did not allow adequate assessment of these indices in this subgroup.

WTHR provided discrimination similar to the use of waist girth in our study while BMI appeared to be less useful. WTHR has the appeal of simplicity and not needing sex-specific cutpoints, as required with waist girth. Assessment of these indices in more Aborigines is needed to establish whether anthropometric cutpoints and risk factors are appropriate and whether our findings apply to other indigenous populations.

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AUTHOR DISCLOSURES

Michael Gracey, Valerie Burke, David D Martin, Robert J Johnston, Timothy Jones and Elizabeth A Davis, disclose no conflicts of interest other than those in the ACKNOWLEDGEMENTS.

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Original Article

Assessment of risks of "lifestyle" diseases including cardiovascular disease and type 2 diabetes by anthropometry in remote Australian Aborigines

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體位測量評估澳洲偏遠地區原住民的「生活型態」疾病包括心血管疾病以及第二型糖尿病之危險因子

目的：評估澳洲原住民的心血管疾病的預測因子：腰圍身高比(WTHR)、腰圍及身體質量指數(BMI)。**設計**：評估指標是否為平均血壓(BP)、血脂、血糖、胰島素及高血壓、低 HDL-膽固醇、高血糖以及第二型糖尿病的預測因子。**地點**：澳洲偏遠西北部原住民社區。**參與者**：401 名成年人。**結果**：超過 80%的參與者其 WTHR≥0.5 或是 BMI >22 kg/m^2，78%的人腰圍過大(男性>90 公分；女性>80 公分)。以上述的切點分類每個指標，這些指標與血壓、血脂、血糖及胰島素為負相關。對禁食血糖≥5.6 mmol/L 的敏感度 WTHR 為 91%、腰圍為 87%以及 BMI 為 88%；特異度分別為 29%、29%以及 44%。藉由接收器運作指標曲線下面積(AUROC)得知任一具辨別能力的變項的精確性只是「尚可」。BMI (0.59，95% CI 0.53，0.78)對糖尿病的 AUROC 比其他指標(WTHR 0.74，95% CI 0.69，0.79；腰圍 0.72， 95% CI 0.67，0.78)顯著的低，但是對禁食血糖、HDL-膽固醇或是高血壓則沒有顯著差異。男女性在任何結果的 AUROC 均沒有顯著差異。**結論**：這些指標對原住民的糖尿病或是心血管疾病危險因子沒有良好的區別能力，但是腰圍或 WTHR 較 BMI 有用。適當的切點是需要的。WTHR 簡單，不需要因性別用不同切點，對發展公共衛生政策可能有用。

關鍵字：過重/肥胖、糖尿病、心血管疾病、體位測量、BMI、原住民、土著。