用身體組成作爲健康監督：廉價的技術

Using low-cost body composition technology for health surveillance

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Standards for skinfold thickness and abdominal/hip ratio have been published which facilitate the evaluation of body composition as an index of health risk and can be used to determine the degree to which lifestyle modification may be required. This study provides information on body composition including fat distribution in a Javanese population living in Jember, Indonesia. The sample consisted of 122 adults (71m, 51f), aged between 20 and 60 years, selected randomly from the Indonesian Government identification list. Data collected were compared with that obtained from the Melbourne Body Composition Study a representative sample of Australians living in Melbourne. Body fatness was assessed from the skinfold measurement at four sites: triceps, biceps, subscapular and supra iliac and converted using the Durnin and Womersley equation. Body fat distribution was assessed from the ratio of the smallest waist and the maximal gluteal circumference. The body composition profile of these two populations were also measured by the BIA method. The cross-sectional data showed that there are significant differences between the two populations in the degree of fatness and fat distribution. However, Melbourne Australians and Jember Indonesians were similar in biceps skinfold thickness of males and females, and in the subscapular skinfold thickness in females. The use of skinfold thickness of measuring body composition differences between populations is a valuable instrument, provided more than a single site is used. A low-cost technique like BIA provides additional information. A single skinfold thickness may still be valuable provided standards appropriate to the ethnic group are used. The difference in body composition profiles between the two populations suggests the evaluation of the association between fat mass and fat distribution and health risk should be based on standards appropriate to the ethnic group studied. This requires longitudinal studies of body composition, and health outcome specific to each population.

Introduction

Body composition is of interest in many metabolic and physiological studies. It provides information on energy stores, risk factors for pathological processes[1] and prognosis in a variety of acute and chronic illnesses[2,3]. Standards for skinfold thickness and abdominal/hip ratio have been published to facilitate the evaluation of body composition and can be used to determine the degree to which changes in lifestyle may be required. Body composition can be applied to large and different populations, with the advent of low-cost techniques such as anthropometry and bio-electrical impedance. Consequently, it has become easier to compare body composition between populations of different ethnicity, and evaluate body composition as a marker of lifestyle, morbidity between these groups.

The conversion equations for predicting body composition from skinfold thickness and bio-electrical impedance are based on reference groups of apparently healthy Caucasian populations. How relevant these equations are when applied to different ethnic groups has not been clearly answered.

In this cross-sectional study, we examined body composition including fat distribution, and some lifestyle markers in a group of Javanese living in Jember, Indonesia, using anthropometry and bio-electrical impedance.

Subjects

The sample consisted of 122 adults aged between 20 and 60 years, selected randomly from the Indonesian Government identification list. Of these, 71 were males and 51 were females.

Methods

Participants were invited to come to the clinic between 9.00 and 12.00 am where body weight was measured with a calibrated spring balance to the nearest 0.5 kg (Seca 760, Almere, The Netherlands), and body height was measured with a stadiometer (Harpenden, UK). Body composition was estimated using the skinfold measurement (Harpenden, UK) at four sites: triceps, biceps, subscapular and supra iliac and converted with the Durnin and Womersley equation[7]. Body fat distribution was estimated using the abdominal/hip ratio (AHR) and was measured at the smallest waist and the maximum gluteal circumference.

Single frequency bio-electrical impedance analysis (Holtain, Wales, UK) was measured and the manufacturer's formulas applied for conversion to body fat.

Data collected were compared with that obtained from the Melbourne Body Composition Study[5], a representative sample of Australians living in Melbourne.

Statistical analysis

All variables were tested for normality by the Kolmogorov Smirnov test before any statistical comparisons were made. Student's two-tailed t-test for non paired data was used to assess difference in variables between the two populations.

Results

In order to compare anthropometrical and impedance methods of measuring body composition, the Bland and Altman approach[6] was used to test the degree of agreement between the two methods (Table 1). The mean difference of %FM obtained by the two methods was -0.04% for Jember (95% CI -0.63% to +0.53%) and +0.38% for Melbourne (95% CI –0.04% to +0.73%). The mean values of %FM by anthropometry and BIA within genders for either population were not significantly different. Because there is a high level of agreement between these two methods, %FM was expressed as the mean values of %FM obtained from anthropometry and BIA.

Table 1. The degree of agreement between anthropometry (A) and BIA in estimating %FM.

Agreement	%FM	
	Jember (*n*=122)	Melbourne (*n*=736)
Mean difference between A and BIA	–0.04	0.38
SD of the difference	3.33	5.38
SEM of the difference	0.30	0.21
95% CI – upper limit	+0.55	+0.79
lower limit	–0.63	–0.04

Table 2 lists age and some physical characteristics of male and female subjects of both Javanese and Melbourne populations. The Javanese population differed in age, body weight and height, the Melbourne population being taller and heavier than the Javanese population, and the Melbourne females being older.

Table 2. Age and physical characteristics of the subjects (mean±sd).

Characteristic and sex (m,f)	Jember	Melbourne	*P*-value
n			
m	71	292	
f	51	287	
Age (yrs)			
m	40.2±8.7	40.4±11.3	ns
f	36.5±7.2	40.3±10.9	<0.01
Height (cm)			
m	163.6±5.5	174.1± 7.4	<0.001
f	152.6±5.2	160.7±14.9	<0.0001
Weight (kg)			
m	61.3±5.5	79.9±13.7	<0.0001
f	53.4±9.1	65.6±12.5	<0.0001
Arm span (cm)			
m	172.1±6.1	na	
f	159.6±6.2		
Sitting Height (cm)			
m	86.9±3.6	na	
f	81.1±2.3		

na, not available; ns, not significant

Data on armspan and sitting height was unavailable for the Melbourne population. Table, 3 and 4 list some body composition variables and lifestyle factors measured in both populations. BMI, %fat, triceps and supra-iliac skinfolds and AHR were significantly higher in the Melbourne population for both men and women, while biceps and supscapular skinfolds were not different between the two groups. Systolic and diastolic blood pressures were significantly higher in the Melbourne group, while Jember males smoked more and drank less alcohol than Melbourne males.

Table 3. Body composition profile of the two populations.

Body composition parameter	Jember	Melbourne	*P*-value
BMI (kg/m^2)			
m	22.6±4.4	26.4±3.9	<0.0001
f	22.3±4.8	25.1±5. 4	<0.0001
% Fat mass			
m	18.5±6.8	25.0±6.1	<0.0001
f	27.2±9.6	33.3±5.1	<0.0001
A/H ratio			
m	0.84±0.1	0.88±0.07	<00001
f	0.75±0.1	0.77±0.07	<0.005
Biceps SF (mm)			
m	5.3±2.7	6.3±4.1	ns
f	9.9±4.5	10.9±6.7	ns
Triceps SF (mm)			
m	10.3±5.9	12.6±6.4	<0.01
f	18.3±6.8	21.4±9.2	<0.01
Subscapular SF (mm)			
m	15.6±6.9	21.5±8.3	ns
f	20.4±7.9	17.7±9.4	ns
Supra iliac (mm)			
m	20.4±7.9	18.1±10.7	<0.0001
f	12. 1±6.4	15.4± 9.9	<0.001
Sum of SF (mm)			
m	44.1±18.1	53.7±22.7	<0.0001
f	58.1±24.2	65.6±28.4	<0.01

Table 4. Health risks characteristics of the subjects (mean±sd).

	Jember	Melbourne	*P*-value
Systolic BP (mmHg)			
m	112.9±26.0	134.3±17.7	<0.0001
f	114.5±26.9	124.0±16.5	<0.0001
Diastolic BP (mmHg)			
m	75.0±19.2	84.0±12.7	<0.0001
f	73.9±15.5	78.4±10.3	<0.001
Total cholesterol mmol/l			
m	na	5.2±1.2	
f		5.0±1.3	
HDL cholesterol mmol/l			
m	na	1.1±0.3	
f		1.5±0.4	
Regular smoker % total			
m	78.9	25.3	
f	0.0	23.9	
Regular drinker % total			
m	4.2	88.7	
f	5.9	79.6	

Discussion

Based on the Bland and Altman analysis, we found that the estimation of body composition using four skinfold thicknesses yielded a high degree of agreement with that obtained from the impedance technique. This may reflect common internal assumptions used in the derivation of the conversion formulae, but gives some confidence to our combining the measurements. When compared to the Australian population, the sum of four skinfold thicknesses of the Jember population was significantly lower, although the biceps and subscapular skinfold thicknesses of both populations were not significantly different. These findings suggest that the sum of four skinfold thicknesses can be used to detect the difference in

%FM of Javanese and Melbourne populations, while the use of a single skinfold such as biceps will not be able to detect differences.

In a cross-sectional study, such as this, it is not possible to investigate the effect of smoking habits on health outcome, both within a population where the majority of males were smokers (Jember), and between the populations.

Variations in body proportion as compared to the standard reference populations can be a factor that must be considered in interpreting body composition. The Javanese population had a shorter torso than limbs. This may also affect the estimation of %FM using BMI. BMI has been commonly used as an indicator of body fat, but estimation of %FM from BMI is not recommended for individuals with abnormal proportions of sitting height to total height ratio[4].

The use of skinfold thickness for measuring body composition differences between populations is a valuable instrument, provided more than a single site is used. A low cost technique like BIA provides additional information. A single skinfold thickness may still be valuable provided standards appropriate to the ethnic group are used. The difference in body composition profiles between the two populations suggests that evaluation of the association between fat mass and fat distribution and health risk should be based on standards appropriate to the ethnic group studied. This requires longitudinal studies of body composition, and health outcome specific to each population.

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