Diagnosed type 2 diabetes and elevated blood glucose are more strongly associated with muscle mass than BMI in Vanuatu (South Pacific)

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Introduction and Health Relevance

Populations undergoing rapid economic change often face shifts in disease burdens, such as rising rates of obesity and chronic diseases.

Type 2 Diabetes (T2D) seems to accompany economic change. Many factors influence diabetes risk, including diet, visceral adiposity, and physical activity.

Vanuatu, an archipelago in the South Pacific (Fig. 1), is currently undergoing rapid but variable modernization, which has led to an increase in chronic health conditions such as T2D (1,2).

Variation across islands in infrastructure and market integration allow us to sample a wide range of physical activity levels and diets:
- Efate (urbanized island, location of the capital city)
- Aneityum (largely rural island with some tourism)

Previous research has found higher BMIs on Efate than Aneityum and other rural islands (1).

BMI and waist circumference are convenient anthropometric measures that are generally associated with T2D risk and are commonly used in screening and T2D prevention programs (3). However:

- They are imperfect measures of adiposity.
- Associations between BMI and T2D vary across populations: South Asian populations experience T2D earlier and at lower BMIs than other populations (4,5).
- BMI varies with muscle mass as well as adiposity.

We explored BMI, waist circumference, and muscle mass as predictors of T2D in Vanuatu, where rural populations remain highly physically active.

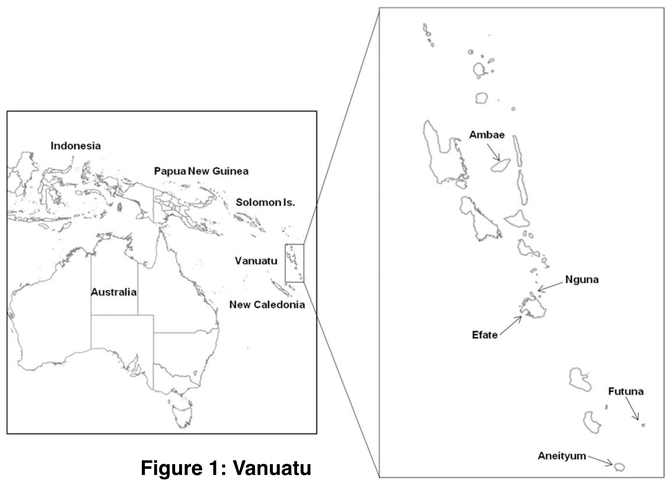


Figure 1: Vanuatu

Methods

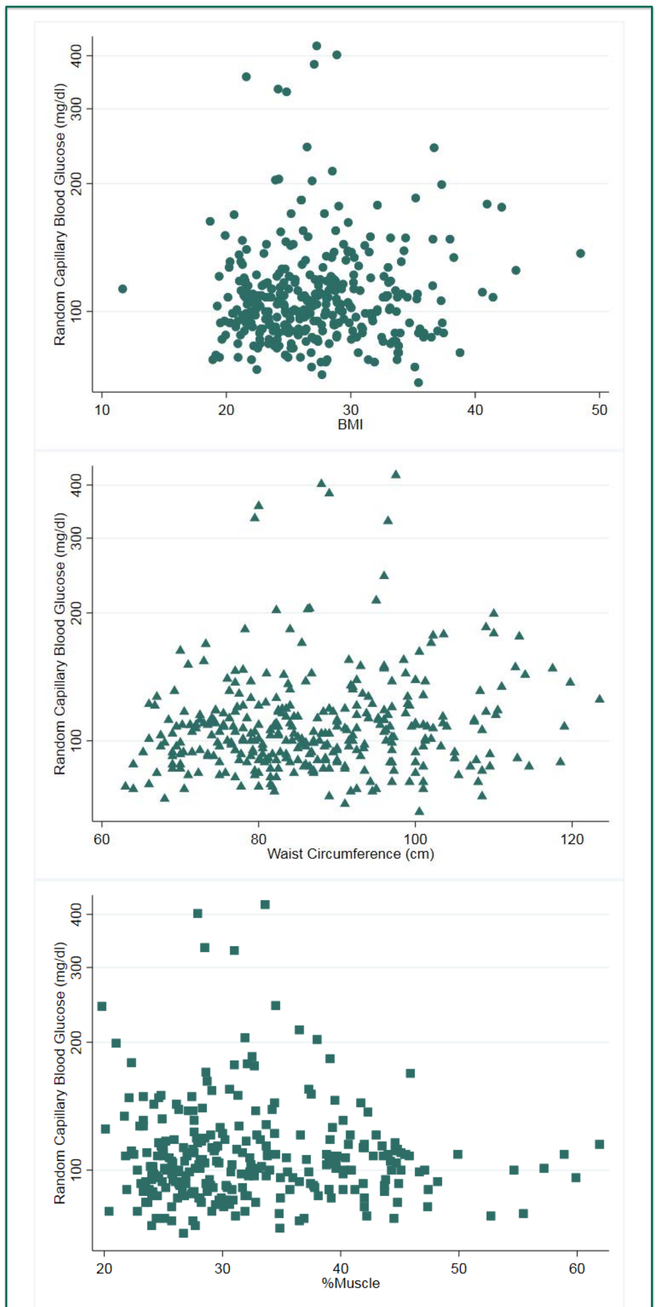
386 adults participated:
- 213 adults from Efate
- 155 adults from Aneityum

Anthropometry included height, weight, waist circumference, and skin folds measurements, and estimations of % body fat and % muscle mass via leg-to-leg bioimpedance.

Random capillary blood glucose (RCBG) was measured with a point-of-care test.

T2D was considered present if either:
- RCBG exceeded 140 mg/dL
- The participant reported a clinical diagnosis of T2D

Generalized linear and logistic regression models were estimated with STATA (version 15.0).



Figures 2-4: Crude Associations

Findings

Scatterplots (Fig. 2-4) suggest RCBG declines with % muscle. Controlling for age and sex, % muscle was inversely associated with RCBG (p = 0.089), but no association between either BMI (p = 0.837) or waist circumference (p = 0.462) and RCBG was apparent.

Muscle mass percent was more consistently associated with T2D than either BMI or waist circumference (Table 1). Models of % muscle and BMI or waist together led to similar conclusions: % muscle was the more consistent predictor (Table 2 and Fig. 5-6).

The average marginal effect of % muscle from Model 3 was -0.016 (p = 0.005): **each 1% increase in muscle was associated with a 1.6% decrease in probability of T2D**.

Table 1. Logistic regression models of type 2 diabetes

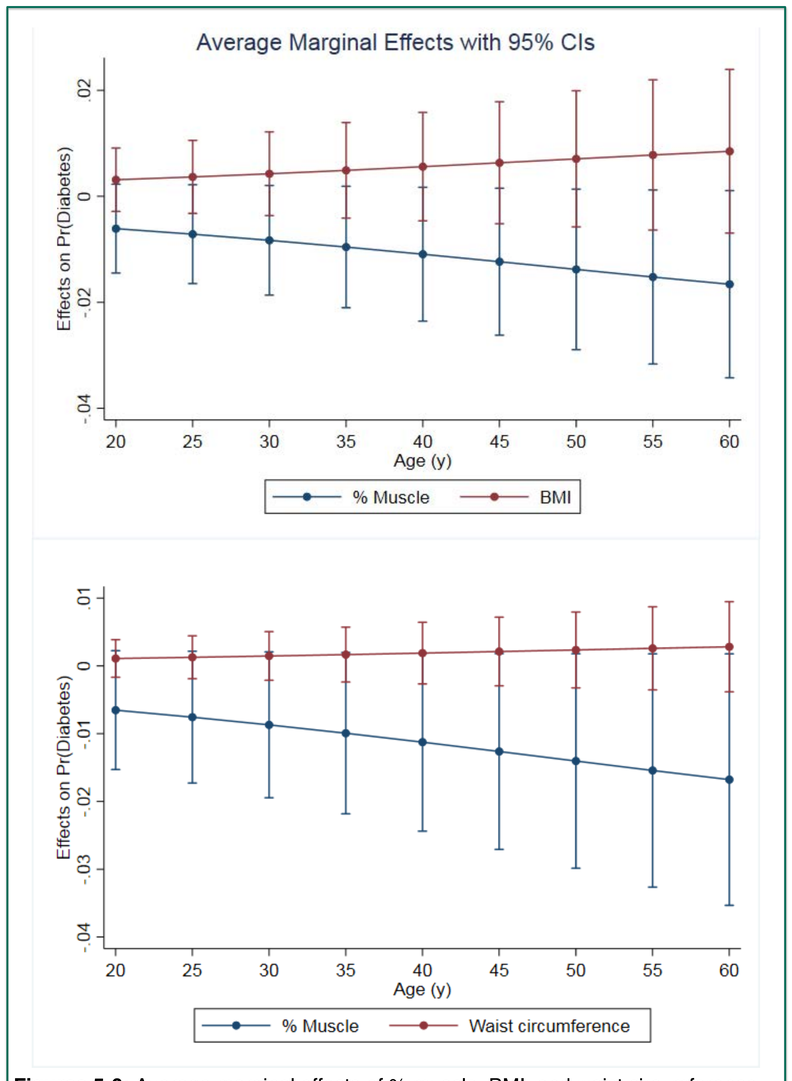
	Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI
Age	1.05	1.03, 1.07	1.04	1.02, 1.06	1.04	1.02, 1.06
Female sex	1.03	.55, 1.10	1.06	.57, 1.97	.249	.08, .78
BMI	**1.04**	**.98, 1.10**				
Waist cm			**1.02**	**1.00, 1.05**		
% Muscle					**.883**	**.81, .97**

Conclusion and Significance

In Vanuatu, T2D was more consistently associated with muscle mass than BMI or waist circumference.

Lower muscle mass may be an important component of T2D risk—or identifying those with higher T2D risk—in populations undergoing rapid economic change.

Future research should consider muscle mass, in addition to adiposity and BMI, to understand complex relationships between diet, physical activity, and T2D risk.



Figures 5-6: Average marginal effects of % muscle, BMI, and waist circumference

Table 2. Logistic regression models of type 2 diabetes

	Model 1		Model 2	
	OR	95% CI	OR	95% CI
Age	1.04	1.02, 1.06	1.04	1.01, 1.06
Female sex	0.33	0.09, 0.16	0.33	.09, 1.16
BMI	1.04	.96, 1.14		
Waist cm			1.02	0.98, 1.05
% Muscle	**0.91**	**0.82, 1.01**	**0.91**	**0.82, 1.01**

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