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Do we need to think beyond BMI for estimating population level health risks?

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Body mass index (BMI) is an important tool used by clinicians, epidemiologists and public health officials for the categorisation of individuals based upon their relative weight. It has become the most commonly used measure of weight status due to its simplicity of calculation when collecting data for large population surveys (1). However BMI is a measure of weight and height and does not directly measure adiposity, limiting its use for measuring levels of obesity.

Waist circumference has been shown to be a more accurate measure of body fat and therefore would offer an alternative to BMI (2). However this does not mean that BMI should be discounted. It is important to understand how useful BMI is at estimating risk of health outcomes in comparison to waist circumference. This is important as self-reported data are easier to collect and inexpensive for large populations (more precise techniques for measuring obesity are not practical for large epidemiological studies or routine clinical usage). In this study, a comparison of BMI and waist circumference as measures of risk to multiple health outcomes is examined.

Individual level data were taken from the Yorkshire Health Study (2010-2012; n=18562, ages 16-85) (3). Logistic regression models using BMI and waist circumference separately (both standardised using z-scores to improve their comparability) as explanatory variables against a series of chronic health conditions, illnesses or disabilities (separate outcomes variables). Unadjusted and adjusted models were produced, controlling for the following confounders of poor health; age, sex, ethnicity, deprivation (measured using the Indices of Deprivation 2010), smoking status, alcohol intake (units per week) and physical exercise levels. Data were self-reported.

Table I presents the results from the analysis. BMI and waist circumference were statistically significant predictors of multiple health outcomes, independent of known confounders. An increase in value of either measure results in a larger risk of an individual having a chronic health condition. Diabetes had the highest risk across both measures, with Stroke and Cancer less related to body size after controlling for known confounders. The analysis was repeated stratifying by age group. For adults (25-64) and the elderly (65+), the results were similar. However, for young adults (16-24) the results were mostly insignificant due to the decreased prevalence of health conditions in the young.

Pearson's correlation coefficients were calculated for the unadjusted values of the odds ratios values for both BMI and waist circumference ($r=0.866$, $p<0.001$) and the adjusted odds ratios ($r=0.965$, $p<0.001$). The correlation values show closer agreement once known confounders were controlled for, with odds ratio values being similar. This would suggest that there is little difference in the measures once known confounders are controlled for.

The analysis has indicated that BMI remains a useful measure for estimating risk of health outcomes in a large and representative sample. There was little difference between the measures once known confounders were controlled for. Different measures may be better for assessing individuals, however BMI is still useful in a population setting and should not be discounted.

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Conflict of Interest

None declared.

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Tables

Table I: Results from unadjusted and adjusted logistic regression models explaining multiple health outcomes using separate models for body mass index and waist circumference (standardised using z-scores).

Outcome	BMI		Waist Circumference	
	Unadjusted	Adjusted	Unadjusted	Adjusted
Fatigue	1.422***	1.336***	1.507***	1.377***
Pain	1.533***	1.416***	1.587***	1.419***
Insomnia	1.251***	1.174***	1.232***	1.175***
Anxiety	1.196***	1.150***	1.154***	1.159***
Depression	1.362***	1.344***	1.339***	1.334***
Diabetes	1.841***	1.952***	2.238***	2.083***
Breathing Problems	1.274***	1.198***	1.415***	1.264***
High Blood Pressure	1.660***	1.710***	1.804***	1.657***
Heart Disease	1.350***	1.359***	1.691***	1.401***
Osteoarthritis	1.433***	1.431***	1.411***	1.337***
Stroke	1.163***	1.083	1.487***	1.156*
Cancer	1.083*	0.961	1.238***	1.011
Any Condition	1.599***	1.382***	1.658***	1.374***

* p<0.05, ** p<0.01, *** p<0.001

Note: Models adjusted for age, sex, ethnicity, deprivation, smoking, alcohol intake and physical exercise.