ORIGINAL ARTICLE

Association of Self-reported Figural Scales With Body Mass Index Among Adults With Hypertension in a Resource-limited Setting

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ABSTRACT

Introduction: This study examined the performance of perceived body size in predicting measured body mass index (BMI) among adults with hypertension in Myanmar and to determine the perceived body size cutoffs for obesity. **Methods:** This cross-sectional study was conducted among 410 hypertensive patients attending public health centers in Myitkyina Township, Kachin State, Myanmar. Perceived body size was measured using the Stunkard's silhouettes and was compared to a measured BMI. The performance of perceived body size was analyzed by sex-specific receiver operating characteristic curves (ROC) and the optimal perceived body size cutoffs for overweight/obesity (BMI ≥25) were determined. **Results:** With good correlation coefficients between perceived body size and BMI (0.78 and 0.70 in men and women respectively), perceived body size had the high area under curve (AUC) for overweight/obesity (0.896 (95%CI=0.835-0.956) for men and 0.828 (0.761-0.895) for women). The optimal figural scales for identifying overweight/obese individuals with a correct detection rate were sixth in men and women. Linear regression analyses supported the fact that the self-reported silhouette rankings in detecting the social patterning of body size was similar with measured BMI. **Conclusion:** This study supports the idea that figural drawing scales are a potentially useful indicator to assess the overweight/obesity of adults in resource limit settings when self-reported and measured BMI are not available. Further studies are required to re-examine our findings and its effectiveness using a larger population.

Keywords: Figural scales, Body mass index, Hypertension, Myanmar

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INTRODUCTION

Hypertension is a global menace that affects more than a quarter of the global adult population (1). Almost two-third of people with hypertension live in low- and middle-income countries (LMICs)(2, 3). Globally, obesity is considered as one of the most prevalent risk factors for non-communicable diseases (NCDs) like hypertension (4, 5). Myanmar (also known as Burma) is a lower middle-income country in Southeast Asian region. Prevalence of hypertension is relatively high with an overall prevalence (of about 30%) and only 7% received treatment for high blood pressure (2.4% have been treated and controlled and 4.4% treated but not controlled) (6). Prevalence of overweight/obesity (body mass index (BMI) ≥25) is also in an increasing trend from 20.2% in 1999 to 35.1% in 2015 for adult females and from 12.4% to 25.2% in male adults (7). The Nurses' Health Study, a prospective cohort study among women aged 27-44 years, showed that 50% (95% CI=49-52%) of new cases of hypertension could hypothetically be attributed to a BMI ≥23.0 (8). Given the significant impact of obesity in the pathogenesis of hypertension (4), even a modest magnitude of weight loss contributed to improved control of blood pressure (9). Thus, people with comorbidity like hypertension need to have an increased awareness of being obese for behavioral modification because accurate weight knowledge is critical to managing health outcomes.

BMI, a measure of body fat based on measured height and weight, is most commonly considered as a cost-effective and reliable measure of weight status and has been recommended for individual use to guide recommendations for weight loss and weight control in clinical practice (10). However, measuring reliable height and weight to determine BMI still remains challenging especially in resource constrained settings like Myanmar, because they often require a considerable

survey time, specific measurement tools, such as weight and height scales, and staff who have appropriate expertise and training. In addition, it is obviously difficult to get the reliable data in the context of postal, phone, and web-based surveys. Self-reported anthropometric information instead of objectively measured information is also not feasible in resource-constraint settings, since several people with low education and income are less likely to know their weight and height (11). Figural scales, first developed and validated by Stunkard et al (12) represent a range of figural drawings from extremely lean to extremely obese. The figural scales are an easy-to-administer measure of body size and have been used in many studies when self-reported or measured weight and height were not available (11-13). The strong correlates of the Stunkard silhouettes with the BMI have been documented to be a valid, trustworthy, and effective instrument in classifying subjects as overweight/obese (13-16). In our opinion, the correlation of perceived body size with BMI among adults are empirically limited particularly in Southeast-Asian countries like Myanmar. This study investigated to what extent self-reported body silhouettes correlate with measured BMI and if the silhouettes can be used to reflect overweight/obesity in adult men and women with hypertension attending primary care clinics in the Myitkyina Township, Kachin State, Myanmar using population-based samples. Thus, this study may contribute to the Sustainable Development Goals of "ensuring healthy lives and promoting well-being of all at all ages (Goal 3)" by 2030 (17) whereby the population is reduced using NCDs with effective strategies aimed at hypertension control.

MATERIALS AND METHODS

Study design and participants

The cross-sectional survey was carried out from April to May, 2019 in Myitkyina Township, Kachin State, Myanmar. Major ethnics in this township is Kachin and the others are Burmese, Shan, and Chinese. The sample size was calculated using a confidence interval of 95%, an acceptance error of 5%, and with unknown prevalence of misperception rate from previous studies, having a prevalence of 50%, with total study population in the township (N=2,567). The estimated sample size with multiplying 1.5 design effects and after accounting for 10% non-response rate was 402. For a sampling technique, stratified according to geographical area (urban and rural areas), one health center in urban area and four health centers in rural areas were randomly chosen and then three catchment areas (wards for urban and villages for rural areas) of each health center within urban and rural areas were randomly selected. Of those aged 30 - 70 years old and with hypertensive diagnosis and treatment during the last 1 year, a total of 410 hypertensive patients using a simple random sampling technique were finally recruited. After the study objectives and assurance of the confidentiality of their identity were told, all participants were asked to complete informed consent before the study. Ethical approval for this study was obtained from Ethical Committees in Thailand (Mahidol University; 2019/070.0204) and Myanmar (University of Public Health, Yangon; UPH-IRB-2019/Research/20).

Variables measures

Anthropometric measurements

Anthropometric measurements were performed by a trained and certified health personnel. The participants were asked to weigh in bare feet and light clothes, noting and subtracting the weight of the clothes. Participants' weight was measured to the nearest 100 g, and height to the nearest 0.5 cm according to WHO guideline. Weight and height measures were used to calculate body mass index (BMI, kg/m2). Due to the small sample size, the categories of overweight and obese individuals were combined together and those with BMI of 25kg/m^2 or higher were defined as overweight/obese in the analyses.

Perceived body size

The Stunkard's silhouettes of adult male and female figures (18), which consist of silhouette drawings ranging from 1 (the leanest) to 9 (the largest), were shown to participants and asked to choose one figure that most accurately represented their current body size using the question, 'Which of these figures look most like your current body shape?'.

Statistical Analysis

All statistical analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC). Descriptive statistics were used to present mean and the 95% CI of anthropometric data and perceived body size. Spearman correlations were calculated between perceived body size and BMI. Due to small sample size, the categories of overweight and obesity were combined together and those with BMI of 25 kg/m^2 or higher were defined as overweight/obesity in the analyses. Sex-specific receiver operating characteristic (ROC) curves were computed to assess the ability of the figural silhouettes to identify subjects at risk as overweight/obesity (25 kg/m^2 or higher). The area under the curve (AUC), a measure of test accuracy, was used to compare the performance of silhouette rankings in predicting overweight/obesity with AUC of 0.7 or higher indicating acceptable/good discrimination. Negative and positive predictive values (NPV and PPV respectively) were calculated to assess the diagnostic value of the figural rankings given the different prevalence of overweight/obesity in men and women. The Youden index (J), a common summary measure of the ROC curve is calculated by the sum of sensitivity and specificity minus one (19) and ranges from 0 to 1. The perceived body size cutoff value for overweight/obesity that gave the greatest Youden index denoted the optimal cutoff for that overweight/obesity (20). We also performed linear regression models to assess the ability

of the figural drawings to detect the social patterning of figural drawings and overweight/obesity by sexes. Several socioeconomic variables, such as age, income, education and ethnicity were included in these models.

RESULTS

A total of 410 hypertensive patients were recruited. Table I presents the mean and its 95% CI of age, anthropometric data and perceived body size. The mean height and weight was higher in men (161.0 cm and 64.2kg, respectively) compared to women (151.8 cm and 57.3 kg). The mean BMI was similar between sexes (24.7 (95% CI=23.8-25.7) for men and 24.8 (24.2-25.4) for women). With regards to the selected silhouettes, the median corresponded to silhouette 5 in both men and women. The Spearman correlation coefficient (r) showed a good level but it was higher in men than in women (0.7878 for men and 0.7082 for women).

BMI values according to perceived body size by gender Frequency and percentage of subjects according to the self-selected silhouette and the sex-specific corresponding BMI values (mean and 95% CI) were presented in Table II. The modal silhouette was number 5 for both sexes, but a corresponding mean BMI was lower in men (23.4 (95% CI=22.3-24.4) than in women (25.1 (24.1-26.1)). The mean of BMI increased with increasing figural scale from scale 1 (extremely underweight) to scale 8 (obese), but dropped at scale 9 in both sexes.

Differential ability of ROC curves for figural Scales

Table III shows detailed estimates of sensitivity, specificity, positive and negative predictive values (PPV and NPV) and Youden index (J) for detecting overweight/obesity (BMI ≥25) for each possible silhouette cutoff by sex. The AUC values were high (0.8958 (95%CI=0.835-0.956) for men and 0.8281 (0.761-0.895) for women). The overall discriminatory power of silhouettes to detect overweight/obesity was greater in men than in women. The Youden index with sensitivity and specificity appeared to be optimal using the 6th figure as a cut-off for detecting overweight/obesity for both men and women. Using the 6th silhouette for both sexes, the prevalence of overweight/obesity was 41.7% for men and 34.1% for women. Figure 1 presents the ROC curve for identifying overweight/obesity with the cut-off point by sexes.

Social patterning of perceived body size and BMI

Table IV presents the ability of the self-reported figural drawings to detect the social patterning of figural drawings compared to the measured BMI. We found two outcome indicators which showed similar results in terms of magnitude, direction, and statistical significance for age, income and education in the linear regressions.

Table I. Mean and 95% Confidence intervals (CI) of anthropometric data and perceived body size of the subjects

	Men			Women		
	n	Mean	(95 % CI)	n	Mean	(95 % CI)
Age (years)	96	57.2	(54.8- 59.5)	314	54.8	(53.6- 56.0)
Anthropometric data						
Height	96	161.0	(159.5- 162.5)	314	151.8	(151.1- 152.4)
Weight	96	64.2	(61.5- 66.8)	314	57.3	(55.8- 58.7)
BMI	96	24.7	(23.8- 25.7)	314	24.8	(24.2- 25.4)
Perceived body size	96	5.1	(4.7- 5.5)	314	4.8	(4.6- 5.0)
(1:Leanest to 9: largest)		(median: 5)			(median: 5)	
Correlation coefficient between BMI and perceived body size	96	r=0.78479, p<0.0001		314	r=0.70822, p<0.0001	

Table II. Mean BMI and 95% confidence intervals of the subjects who selected each silhouette category

Body size silhouette number	Men				Women			
	n	%	BMI		n	%	BMI	
			Mean	(95 % CI)			Mean	(95 % CI)
1	5	5.2	19.2	(16.5- 21.9)	18	5.7	19.4	(16.9- 21.8)
2	6	6.3	18.8	(15.4- 22.2)	25	8.0	21.0	(18.3- 23.7)
3	10	10.4	21.8	(19.9- 23.7)	37	11.8	21.6	(20.4- 22.8)
4	10	10.4	21.8	(20.8- 22.9)	48	15.3	22.4	(21.7- 23.1)
5	25	26.0	23.4	(22.3- 24.4)	79	25.2	25.1	(24.1- 26.1)
6	12	12.5	26.8	(24.8- 28.9)	47	15.0	26.2	(25.6- 26.8)
7	23	24.0	28.8	(27.1- 30.5)	35	11.2	28.8	(27.3- 30.2)
8	3	3.1	34.2	(29.1- 39.3)	17	5.4	33.4	(30.9- 35.9)
9	2	2.1	29.1	(-23.7- 81.8)	8	2.6	31.6	(27.5- 35.8)

Table III. Discriminatory ability of each self-reported silhouette ranking in detecting overweight/obesity (BMI of 25 or higher) by sex

		Men					Women				
	Silhouette number	SE	SP	PPV	NPV	J	SE	SP	PPV	NPV	J
Overweight (25+)											
Cutoff=	1	100	0.0	38.5	100	0.000	100	0.0	43.0	100	0.000
	2	100	8.5	40.6	100	0.085	97.8	8.4	44.6	83.3	0.062
	3	100	18.6	43.5	100	0.186	96.3	21.2	48.0	88.4	0.175
	4	100	35.6	49.3	100	0.356	91.9	38.5	53.0	86.2	0.304
	5	100	52.5	56.9	100	0.525	87.4	62.0	63.4	86.7	0.494
	6	83.8	84.7	77.5	89.3	0.685	63.7	88.3	80.4	76.3	0.520
	7	62.2	91.5	82.1	79.4	0.537	39.3	96.1	88.3	67.7	0.353
	8	10.8	98.3	80.0	63.8	0.091	17.0	98.9	92.0	61.2	0.159
	9	2.7	98.3	50.0	61.7	0.010	5.2	99.4	87.5	58.2	0.046

Sensitivity (SE); Specticity (SP); Positive Predictive Value (PPV); Negative Predictive Value (NPV); Youden (J)

Figural scale with optimal sensitivity and specificity to detect overweight/obesity (BMI of 25 or higher) is 6 for both men and women (Youden=0.685 and 0.520, respectively)

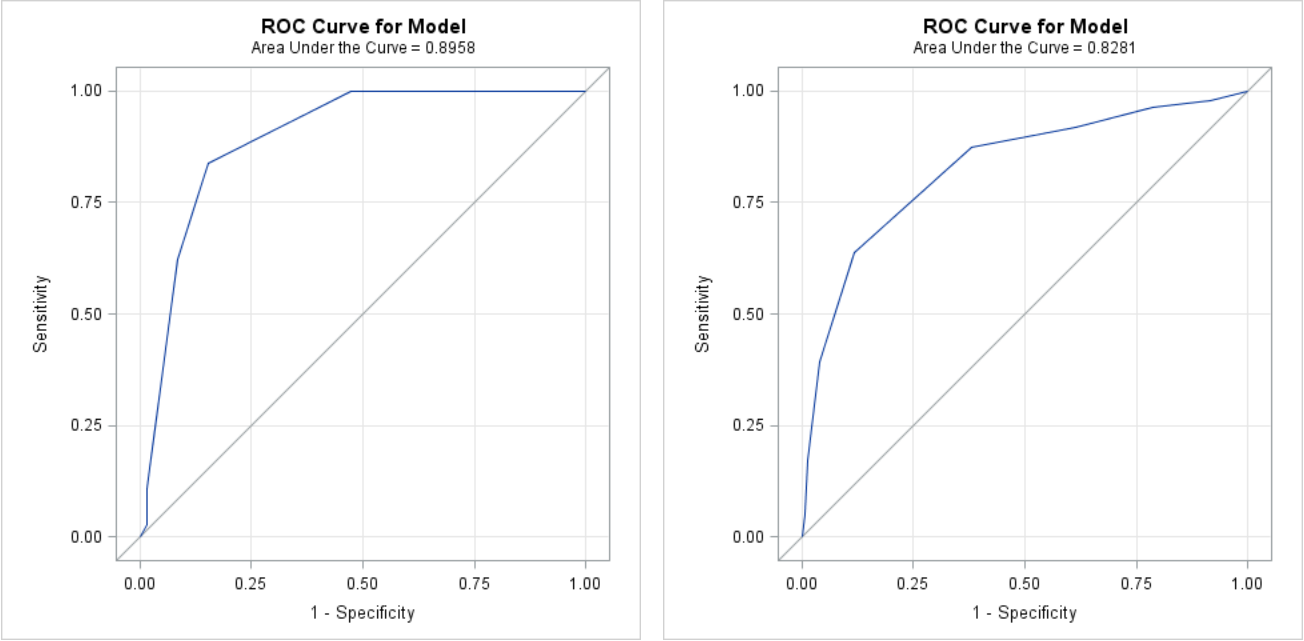

Figure 1: Receiver operating characteristic (ROC) curves to detect overweight/obesity (BMI ≥25) using the 9-body size instrument in men and women. Cut-off point of optimal sensitivity and specificity is 6 for both men and women with Youden index 0.685 and 0.520, respectively

Table IV. Linear regression models for BMI and self-reported silhouette ranking on education and income

	Men			Women		
	Parameter Estimate	s.e.	p-value	Parameter Estimate	s.e.	p-value
Measured BMI						
Age (61+ vs. 30-60 years)	-2.206	0.910	0.017	-0.297	0.634	0.639
Education (Secondary + vs. primary -)	2.038	0.966	0.038	2.556	0.634	<.0001
Income (high vs. low/middle tertiles)	1.522	1.050	0.151	0.659	0.665	0.323
Ethnicity (Kachin vs. others)	-0.539	0.986	0.586	-1.041	0.601	0.084
Perceived body size						
Age (61+ vs. 30-60 years)	-0.883	0.370	0.019	-0.146	0.228	0.522
Education (Secondary + vs. primary -)	0.878	0.392	0.028	0.863	0.228	0.000
Income (high vs. low/middle tertiles)	0.232	0.427	0.587	0.363	0.239	0.130
Ethnicity (Kachin vs. others)	-0.320	0.400	0.426	-0.396	0.216	0.068

Standard error (s.e.)

DISCUSSION

Studies on body weight perception were limited to specific populations, such as adolescents (21) or university students (22, 23). There are limited studies in the Southeast Asian region that examines body image perception using the Stunkard figural scales. Studies among university students in Malaysia revealed that around 10-11% and 27-28% of the overweight males and females perceived themselves as normal weight (22, 23). A greater proportion of females were reported to favor underweight (55.7%) or normal weight (42.3%), whereas 31% of the males picked an overweight/obesity figure as their optimal model (23). Despite being the most widespread measure of body size, there is little study on a figural silhouette as a simple self-reported survey measure for body size and adiposity and its association with measured body weight status in the adult population in the South-east Asian region. A clinic-based cross-sectional study among urban adult population in Malaysia showed that prevalence of overweight and obesity were 33.9% for each category, and their body weight misperception was high (58.8% and 91.9%, respectively)(24). However, this study measured the perceived body weight using a single question of "how do you describe your weight with 5 answer options from very underweight to very overweight (24).

Bulik et al.(25) determined the effectiveness of the figural stimuli to identify individuals as obese or thin. Some studies adopted the same cutoff points to define overweight or obesity from the Bulik's study (26), while others examined the optimal criterion for determining overweight or obesity(11, 13, 27). Despite the differences in body composition and the use of weight status references by races and gender, there is no study on the cut-off points of each silhouette in the Southeast Asian region. Our study is thus novel in the sense that it suggests cut-off points or intervals of BMI values for each silhouette. This study revealed perceived body size which is comparable to measured BMI. Our study showed good correlation coefficients between silhouette ratings and the measured BMI in both sexes (0.78 in men and 0.70 in women), similarly shown in other studies. Some studies also showed a good correlation coefficient, although the coefficient was higher in women (0.70 in men and 0.77 in women in Northern Europe(13) and 0.702 and 0.766, respectively in Mexico) (28), while a study in an African population in the Republic of Seychelles showed higher correlation and similar correlation between sexes (0.80 in men and 0.81 in women)(11). The ROC curve analyses in our study showed the ability of perceived body size to serve as a good proxy for overweight/obesity for both sexes. Using BMI of 25 or greater as the cut-off for overweight/obesity, the perceived silhouette rankings showed a high accuracy for detecting overweight/obesity amongst Myanmar adults with AUC values of 0.896 and 0.829 in men and women, respectively, although the AUC values were greater in men than in women. Other studies showed no significant difference between sexes (0.84 in men and 0.86 in women in Northern Europe (13) and 0.85 in men and 0.86 in women in Mexico) (28).

The modal and median scale in our study was 5th in both men and women, corresponding to a mean BMI of 23.4 kg/m2 in men and 25.1 kg/m2 in women. The silhouette which corresponds best with the overweight/obese individuals was the 6th silhouette in both sexes. The perceived body size seemed higher than the categorization of weight status in other studies. Stunkard et al (25) reported that the silhouette 5 indicate slightly overweight and the 6th and 7th silhouette moderately overweight, also the 8th and 9th silhouette indicates very overweight among 16,728 females and 11,366 males ranging in age from 18–100 at Virginia, the USA. Kaufer-Horwitz et al revealed similar findings that overweight ranged from silhouette 4 to 6 and obesity from silhouette 6 to 9, in both Mexican men and women (28). A sample of adults aged 38–66 years in Scandinavia showed the optimal criterion for identifying overweight/obesity is 5th for men and 4th for women (13). Lшnnebotn et al (16) reported that despite no significant gender differences, there is better discriminatory capability of the body silhouettes to identify obesity in women than in men. Our study also revealed that the ability to detect overweight/obesity was not clear among men, compared to women, probably due to small sample size of men (n=96). Thus, further study should be followed using a large population sample.

Linear regression models in our study showed the perceived body size is able to capture the social patterning of weight status. It may provide evidence on the usefulness of the Stunkard's silhouettes to detect overweight/obesity of adults for postal, online or mobile device-based survey when direct anthropometric measurements are not feasible, particularly in limited resource settings like Myanmar. Myanmar is experiencing nutrition transition. Our previous study using a nationally representative sample showed high prevalence of overweight or obese (BMI 23 or higher, 41.2%) women aged 18-49 years (29). With the high prevalence of overweight/obesity (BMI 25 or higher) (38.5% for men and 43.0% for women), the prevalence estimated by the perceived body size (Silhouette 6 to 9) is also high (41.7% in men and 34.1% in women). Westernization, even in LMICs like Myanmar, has led to changes in sociocultural norms of the ideal body type from plump to slender. Women were more likely to consider themselves to be heavier than men, while men were more likely to be considered as lighter (30-34). Meanwhile, although men are less socialized in discussing their body image concerns and are under less pressure to be physically attractive than women, due to the proliferation of media, in recent years, increasing attention to male musculature in visual media have an impact on men's body image (35, 36). Body image and

self-concept are related to body weight in men as with women.

With the upward surge of NCDs in LMICs, that are the direct complications of obesity, having correct self-perception about body shape as part of healthy weight management practices is very important in fighting the obesity epidemic in both sexes (37). With a high proportion of overweight or obesity among the study participants with hypertension, health-promotion strategies and policies aimed at accurate weight perception and behavioral modification are recommended for the management of obesity in order to effectively manage high blood pressure in the obese (4). Since accurate perception of one's actual weight is critical for individuals to be receptive to public health messages about weight loss goals and health behavior changes, the findings of our study may help health professionals to educate people about their ideal weight and prevention of weight gain using the figural scales which are important steps towards addressing the issue of NCDs.

This study has several limitations that must be acknowledged. The study participants may not be representative of the township, as we restricted our study sample to those registering in public health centers for hypertension in Myitkyina township, while those who registered in hospitals or other private clinics or those at risk who did not screen for diagnosis of hypertension may not be included. Thus, these results cannot be generalized for the entire township and also national population. Furthermore, as there were considerably smaller number in men than women, this could affect the findings particularly in men. Due to the small sample size, the categories of overweight and obesity were combined together and those with BMI 25 kg/m2 or higher were defined as overweight/obesity in the analyses. Thus, further studies are required using a large population in order to define the cutoffs for each overweight and obesity.

Nonetheless, the findings of our study are important for a number of reasons. To the best of our knowledge, this is the first study to examine silhouette body size as a simple self-reported survey measure for body size and adiposity among a population with hypertension in Southeast Asia, including Myanmar. In addition, since individual's weight assessment at home is not frequently performed in resource-poor settings, ease of the body size silhouettes use makes it an attractive alternative for providing health tips to identify risk of overweight or obesity to the public. Further study is required to determine appropriate cutoff points for overweight and obesity separately using a large population sample in Myanmar. In Myanmar, special efforts on weight loss may not be made, since under-nutrition in children under five years of age and communicable diseases like HIV/AIDS and tuberculosis still remains one of the public health priorities. Nevertheless, with a high prevalence of untreated and uncontrolled cases of hypertension and a growing number of overweight and obese people, future hypertension control interventions may actually be effective if given with an educational component to help individuals accurately self-assess and manage their weight.

CONCLUSION

This study reports that figural drawing scales are a potentially useful indicator for assessing weight status of adults in settings having limited resources when measured and self-reported BMI are not available. Further studies are required to re-examine our findings using a large population and its effectiveness to facilitate greater understanding of correct weight perception aimed at NCDs control in resource-limit settings, where overweight/obesity is high while awareness is low.

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