

Pictogram use was validated for estimating individual's body mass index

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Abstract

Objective: We designed this study to assess the validity and reliability of pictogram for estimating body mass index (BMI).

Study Design and Setting: Participants of Golestan cohort study during 2000–2004 were recruited in this study. Demographic and anthropometric information (weight, height, and BMI) were collected on all participants. A set of drawings (pictogram) ranging from very lean to obese were used to assess the individual's perception of their body size. Sensitivity and specificity of each pictogram score were calculated and cutoff points were determined using sensitivity/specificity plots. We used receiver operating characteristic curves to assess the validity of pictogram scores.

Results: Of the 15,437 subjects enrolled in the study, 6,574 (42.6%) were males and 8,863 (57.4%) were females. Their mean \pm standard deviation age was 52.58 ± 9.28 years. Pictogram scores 1, 2, and 3 were assigned to normal participants; pictogram score 4 was selected by overweight subjects, and finally, pictogram scores equal or higher than 5 were selected by obese ones (area under curve: 0.83–0.85).

Conclusion: According to our results, pictogram is a valid measure for discriminating obese or overweight from normal individuals, and for distinguishing obese from overweight or normal individuals. So it can be concluded that body image pictogram is valid for discriminating normal and obese individuals. © 2010 Elsevier Inc. All rights reserved.

Keywords: Body mass index; Pictogram; Estimation; Validity; Sensitivity; Specificity

1. Introduction

The incidence of obesity has been increasing rapidly since 1990. This has been occurred not only in developed [1] but also in developing countries [2,3], such as Iran [4]. Because obesity is a risk factor for most noncommunicable diseases (coronary artery diseases, cancers, etc.), a valid assessment of body mass index (BMI) is an important component of chronic diseases studies.

Usually, body weight and height are measured by precise instruments. However, in some situations, it is not possible to use these devices. For example, financial problems may be very important especially in developing countries. In other word, researchers may not have enough funds to buy appropriate instruments (regarding quality

and quantity) for measuring participant's weight and height.

An alternative way to estimate body weight and height is asking participants to report their body size, using pictorial representations ranging from very lean to severely overweight [5]. It may provide valid and reliable information to help community and individual-based programs track and measure body image perception data among individuals and populations. Historical cohort studies are good examples for application of pictogram. In these studies, we usually have sufficient information on current anthropometric measures of the participant. But we may not have necessary data about participant's condition in the past. This is a usual problem especially in developing countries, and pictogram may be useful in this situation. Several prospective cohort studies, including the Nurses' Health Study, used the pictograms developed by Stunkard et al. [6] to estimate BMI.

We designed this study to assess the validity and reliability of pictograms for estimating BMI among participants in a prospective study from Golestan in northeastern area of Iran.

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What is new?

Key finding:
We assessed the validity of pictogram for estimating body mass index.

What this adds to what was known:
Body image pictogram is valid for discriminating normal and obese individuals.

What is the implication, what should change now:
Pictogram can be used for estimating anthropometric measures in field studies.

2. Methods and procedures

Fifteen thousand four hundred thirty-seven participants of Golestan cohort study [7] were recruited during 2000–2004. After obtaining a written informed consent, demographic and anthropometric information were collected on all participants. Weight (kg) and height (m) were measured by trained interviewers and recorded with precision of one unit. The values for weight were rounded to the nearest 0.5 kg and height was rounded to the nearest 0.1 cm. Subjects were wearing light clothes. BMI was then calculated with the following formula: weight (kg) divided by height squared (m²).

We used a set of drawings (pictogram) ranging from very lean to obese, designed by Stunkard et al. [6], to assess the individual’s perception of their body size. Individuals were asked to select the drawing most similar to their perception of body image. The pictogram was scored between 1–7 and 1–9 in males and females, respectively (Fig. 1). Data were entered to computer and analyzed by SPSS v.13 (SPSS Inc., Chicago, IL, USA). As the main purpose of using pictograms is to determine and discriminate overweight (25 ≤ BMI < 30) and obese (BMI ≥ 30)

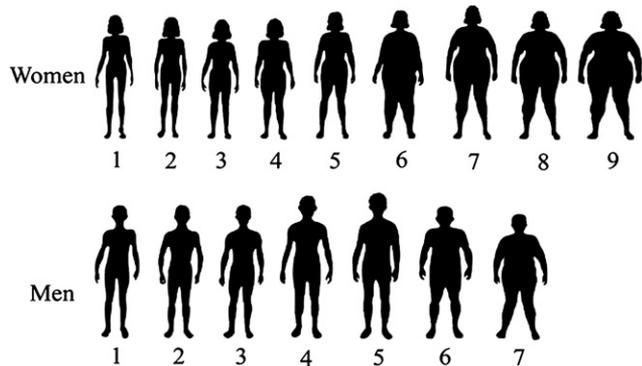


Fig. 1. Body image pictogram.

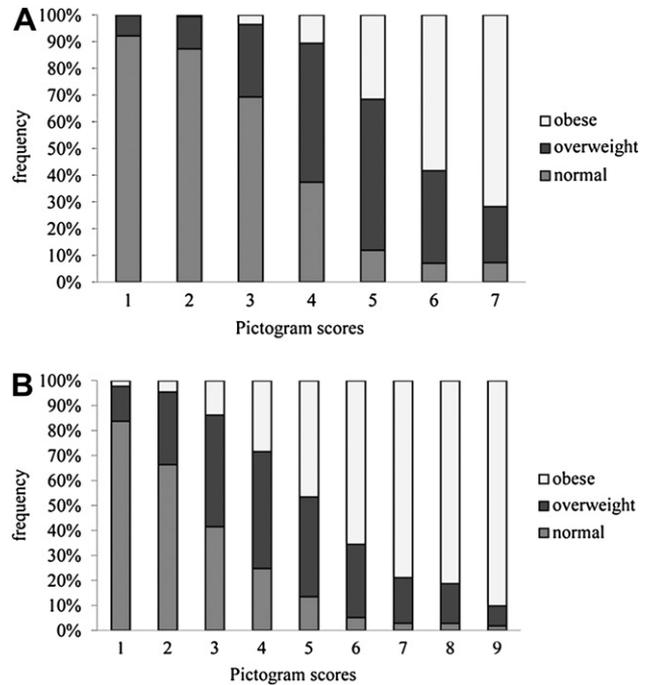


Fig. 2. Distribution of body mass index levels according to pictogram scores in males (A) and females (B).

individuals from normal ones (BMI < 25), we categorized BMI into these three groups (Fig. 2). Sensitivity and specificity of each pictogram score were calculated, and cutoff points were determined using sensitivity/specificity plots. At first, we calculated the sensitivity and specificity of each pictogram score for distinguishing overweight/obese subjects from normal ones. Secondly, we determined the sensitivity and specificity of each pictogram score for discriminating obese individuals from overweight/normal ones. We used receiver operating characteristic (ROC) curves to assess the validity of pictogram scores for estimating individuals’ BMI. P-value of less than 0.05 was considered as significant.

3. Results

Of the 15,437 subjects enrolled in the study, 6,574 (42.6%) were males and 8,863 (57.4%) were females. Their

Table 1
Mean and median of BMI according to pictogram score

Pictogram scores	Male		Female	
	Mean (SD)	Median	Mean (SD)	Median
1	20.2 (3.0)	19.8	21.7 (4.0)	21.5
2	21.7 (2.9)	21.4	23.7 (3.6)	23.6
3	23.6 (3.4)	23.4	26.0 (4.0)	25.8
4	26.1 (3.5)	26.1	27.8 (4.3)	27.5
5	28.6 (3.6)	28.4	29.7 (4.5)	29.7
6	30.9 (4.2)	30.5	32.2 (4.9)	31.9
7	32.9 (5.6)	32.4	34.1 (5.3)	33.9
8	—	—	35.0 (5.7)	35.0
9	—	—	36.8 (6.1)	36.1

Abbreviations: BMI, body mass index; SD, standard deviation.

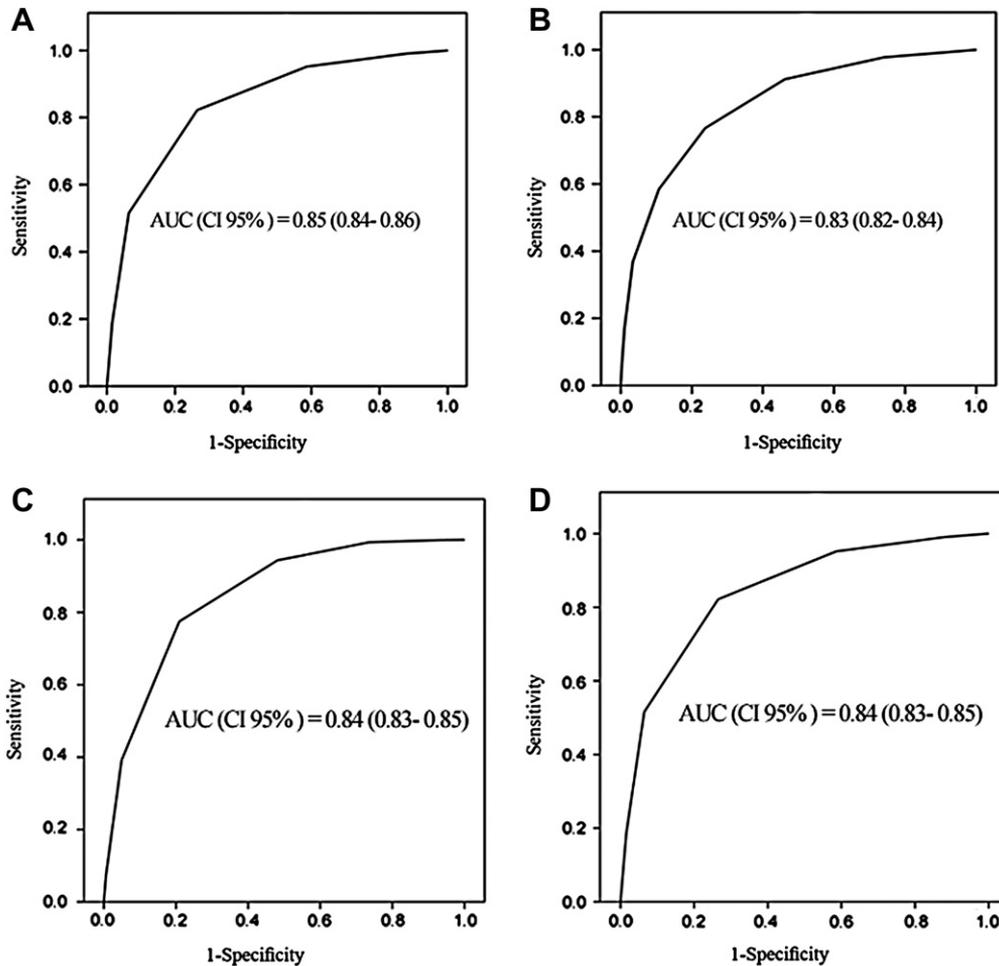


Fig. 3. Receiver operating characteristic curves of pictogram scores for discriminating obese males (A) and females (B) as well as obese/overweight males (C) and females (D). AUC, area under curve; CI, confidence interval.

mean ± standard deviation age was 52.58 ± 9.28 years. Table 1 shows the mean and median BMI for each pictogram score in males and females. Fig. 2 shows the distribution of BMI levels according to pictogram scores in males and females. The ROC curves of pictogram scores for discriminating obese individuals as well as obese/overweight ones are shown in Fig. 3. The range of area under curve in ROC curves was 0.83–0.85 (Fig. 3). We found that pictogram score 5 had the highest sensitivity and specificity for determining obese subjects both in males and females (Table 2). So it can be used as cutoff point for obesity in both sexes (Fig. 4A and B). Our results also showed that

pictogram score 4 can be used as cutoff point for distinguishing overweight/obese subjects both in males (Fig. 4C) and females (Fig. 4D), because it had the highest sensitivity and specificity for this purpose (Table 2).

4. Discussion

We found that pictogram scores 1, 2, and 3 were assigned to normal participants; pictogram score 4 was selected by overweight subjects, and finally, pictogram scores equal or higher than 5 were selected by obese ones.

Table 2
Sensitivity, specificity, and 95% CI for the best cutoff points of pictogram scores in discrimination of different BMI groups

Discrimination of BMI groups	Sex	Best cutoff points of pictogram scores	Sensitivity (95% CI)	Specificity (95% CI)
Obese from normal/overweight subjects	Males	5	77.4 (74.8–79.9)	79.1 (78.0–80.2)
	Females	5	77.4 (75.9–78.9)	74.9 (73.8–76.0)
Obese/overweight from normal subjects	Males	4	82.2 (80.9–83.5)	73.5 (71.9–75.0)
	Females	4	76.6 (75.6–77.7)	76.2 (74.6–77.8)

Abbreviations: BMI, body mass index; CI, confidence interval.

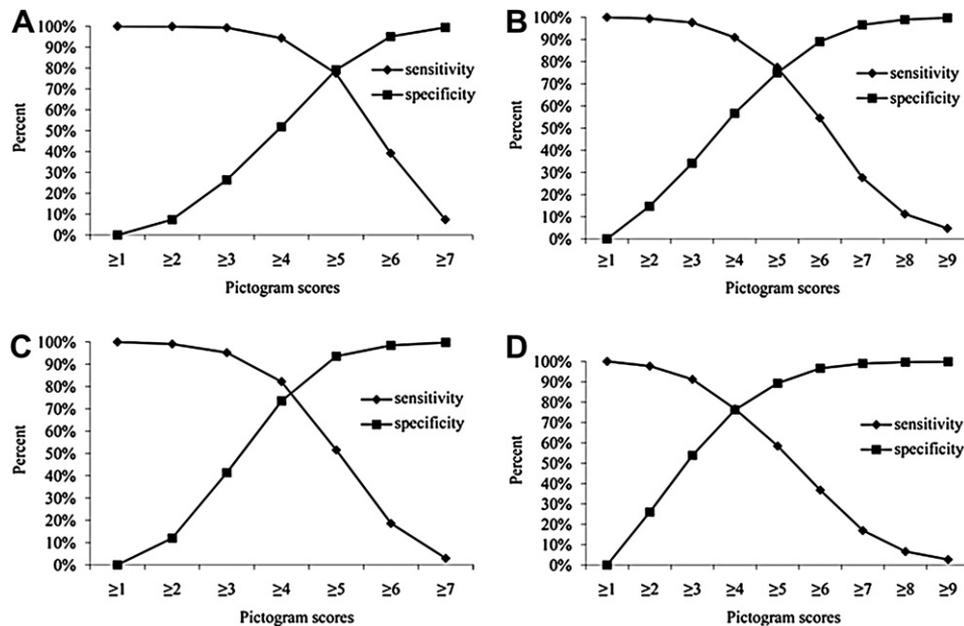


Fig. 4. Sensitivity/specificity plot of pictogram scores for discriminating obese from normal/overweight males (A) and females (B) as well as for distinguishing obese/overweight from normal males (C) and females (D).

Our findings showed that body image pictogram is a good semiquantitative instrument for estimating individuals' BMI, but it needs to be validated against actual measurements of BMI in at least a subset of the study population. This can be helpful specifically in field studies, in which there may be no possibility to measure the subject's anthropometric indices by precise instruments. Financial problems and historical cohort studies are two examples for application of pictogram in field studies, especially in developing countries. These findings were supported by the results from the study by Madrigal-Fritsch et al. [8]. Sánchez-Villegas et al. also suggested that perceived body images may be a good method for estimating body weight [9]. Some other studies found that body image assessment is a valid measure of individual's body size [10,11]. The results of a study from the United States provided discriminating measurements of community and population-based body image perceptions [12].

According to our results, pictogram is a valid measure for discriminating obese/overweight from normal individuals and for distinguishing obese from overweight/normal individuals. So it can be concluded that body image pictogram is valid for discriminating normal and obese individuals, but its validity for determining overweight subjects is less satisfactory. This is not surprising, because those in the middle category (overweight) can be misclassified in two directions (above and below), whereas those in the extreme categories (normal/underweight and obese) can be misclassified only in one direction. So this should be considered when using the pictogram. The validity of this instrument may be influenced by social context of study population (literacy, etc.) and race or ethnicity (size of body skeleton in different races), so these variables should be mentioned

for interpreting the results. We did not consider the above-mentioned variables, and this was the major limitation of the present project. So further studies are needed to identify the effects of these factors on pictogram scores.

In conclusion, we found that body image pictogram has good accuracy for anthropometric assessment in our population as well as other similar ones.

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