ORIGINAL ARTICLE

Estimation of relative fat mass index as an indicator of obesity in reproductive age women at a tertiary care hospital

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Abstract:
Obesity is becoming a greater health concern worldwide. Body Mass Index (BMI) is used widely to classify and measure the obesity. Body Mass Index is a simple tool and can easily be used by clinician and patients but it is unable to differentiate between lean mass and fat mass. Relative Fat Mass (RFM) could be used in daily clinical practice for the evaluation of body composition in healthy or ill patients, as well as to monitor changes in FM%.
We conducted this study to validate the equation of Woolcott & Bergman to estimate FM% among reproductive age women from Pakistan as an alternative to Body Mass Index.
Objectives: To estimate FM% (relative fat mass) among reproductive age women by using Woolcott & Bergman equation and compare it with Body Mass Index.
Material and Methods: We conducted six months observational study on 300 non-pregnant women of reproductive age group (18-45 years) at Hamdard University Hospital. We calculated the Body Mass Index (weight (kg)/height (m2) and relative fat mass by using Woolcott & Bergman equation. SPSS version 23 was used to analyze data, frequencies and percentages are noted, chi-square test applied to see the relationship of relative fat mass with age groups, physical activity and Body Mass Index. P-Value <0.5 is considered significant.
Results: We included 300-women of reproductive age group and compare Body Mass Index categories with relative fat mass, we revealed that 63-women with excess fat and 60-women with high fat mass belong to overweight category, similarly 24 with excess fat and 48 with high fat mass belong to obese group. Unexpectedly, we found that 50-women with normal BMI had excess fat and 5 had high fat content.
Conclusion: Our study showed that a normal Body Mass Index women may also have excess or high fat contents and the relative fat mass is a better predictor of whole-body fat percentage as compare to Body Mass Index.

Keywords:Obesity, Body Mass Index (BMI), Relative Fat Mass (RFM)

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Introduction:
Obesity is becoming a greater public health issue worldwide. Obesity is a condition that substantially increases morbidity from hypertension, type-II diabetes, hyperlipidemia, coronary heart disease and other pathologies.[1-4]

Body mass index is the weight in kilograms divided by the square of height in meters and is strictly a measure of body size. The conventional World Health Organization (WHO) classification for body weight status is underweight (<18.5 kg/m2), normal weight (18.5–24.9 kg/m2), overweight (25–29.9 kg/m2), and obese (>30 kg/m2).[5]

BMI is globally used tool to classify and measure the obesity. Abnormal BMI is an independent predictor of mortality, and BMI is also used by some as part of the criteria for metabolic syndrome.[6] The main advantage of BMI is its simplicity to use both by clinicians and patients. However, the BMI is unable to differentiate between lean mass and fat mass and the distri-

bution of body fat. People with identical body mass index can vary widely in body fat percentage, which can lead to misclassification of body-fat defined obesity.[7]

Recently, Woolcott & Bergman had proposed a very simple equation described as relative fat mass (RFM). The relative fat mass index estimates body fat percentage based on the ratio of height and waist measurements. This fat mass index is considered a simple anthro-pometric procedure, easier to estimate than other body fat percentage methods and more accurate than the BMI.[8]

RFM could be used in daily clinical practice as a tool for the evaluation of body composition in healthy or ill patients, as well as to monitor changes in FM%.[9,10]

Relative fat mass was also found to be superior to BMI as a predictor of diabetes.[11] Only a few later studies were conducted using relative fat mass as an obesity indicator. In a small trial, relative fat mass was validated to estimate fat percentage among men and women. One study found relative fat mass to be a better predictor of severe liver disease and mortality than BMI.[12] The studies suggest relative fat mass may be used instead of waist circumference to define metabolic syndrome.[6,13]

A recent 2020 study has established gender specific cut-off points for obesity.

The relative fat mass equation is gender specific:

- RFM for adult males = 64 – 20 x (Height / Waist circumference)
- RFM for adult females = 76 – 20 x (Height / Waist circumference)

For a healthy body, women need a higher fat percentage than men because they need this fat for ovulation and uterine protection and also breast tissue consists mainly of fat. A person can look fit and even be a healthy weight for their height, but could still be carrying a high level of body fat and that could be a health risk.[8-10]

Fat is needed in diet for example, to make hormones, and for the absorption of fat-soluble vitamins A, D, E and K. So, it is important to keep healthy fats "Essential fat" in diet. While bad fats can increase the risk of certain diseases, good fats protect the brain and heart. In fact, healthy fats, such as omega 3s, are vital to the physical and emotional health. Healthy fat in diet can help improve mood, boost well-being, and even trim the waistline.

Avoid sugars and Trans- fats, get enough sleep, train regularly and reduce the stress level.[14] There is a lot of controversy over what amount of body fat is optimal for overall health. A research paper by Gallagher et al.[15] in the American Journal of Clinical Nutrition (2000) came to the conclusion that certain low body fat ranges are "underfat", which implies "unhealthy". According to this research paper, women who are between 20-40 years old with under 21% of body fat is "underfat" and 21-33% is considered "healthy" and more than 33% is considered overfat.

A Korean study[7] evaluated that RFM can be used to estimate body fat percentage and is a useful indicator of obesity. Based on the Korea National Health and Nutrition Examination Survey (KNHANES) 2008-2011, they analyzed 18,706 individuals (7,970 men, 10,643 women) aged ≥20 years and concluded that RFM has diagnostic accuracy for detecting excess body fat percentage, comparable to that of BMI. Using RFM with BMI could be beneficial in improving the diagnostic accuracy of obesity assessment in women.

We conducted this study to validate the equation of Woolcott & Bergman to estimate FM% among reproductive age women from Pakistan as an alternative to BMI. Our hospital is located in the center of the city and we received patients of all ethnicities mainly from Sindh and Balochistan. The RFM performance was compared to BMI and shown to be a better predictor of whole-body fat percentage in our study population.

Our objective was to estimate FM% (relative fat

Table 1: *Demographic characterstics*

Variables	Frequency (n=300)	Percentage
Physical Activity		
No activity	98	32.7
< 30 minutes	50	16.7
> 30 minutes	152	50.7
Age		
18-24 years	100	33.3
25-30 years	98	32.7
31-35 years	51	17.0
36-40 years	27	9.0
41-45 years	24	8.0
Occupation		
Housewife	105	35.0
Student	108	36.0
Working	87	29.0
Socio-economic class		
Lower class	129	43.0
Middle class	171	57.0
Body Mass Index		
Under weight	10	3.3
Normal weight	74	24.7
Over weight	138	46.0
Obese	78	26.0
Relative Fat Mass		
Riski low	11	3.7
Lean	9	3.0
Moderately lean	26	8.7
Excess fat	141	47.0
High	113	37.7

mass) among reproductive age women by using Woolcott & Bergman equation.

To compare relative fat mass to body mass index.

Materials and Methods:

We conducted 6 months prospective observational study from June 2019 to December 2019 at Hamdard University Hospital, Karachi Pakistan.We included 300 non-pregnant women of reproductive age group. Their demographic features were noted in a pre-designed proforma after their consent.

Their age (18-45 years), occupation, level of physical activity and socio-economic class were noted (middle class, lower class and high class according to their income, house and transport facilities), we measured their weight in kg and used a tape measure to record the height and waist circumference, the tape measure was placed at the top of the hip bone and wrapped around the body. Metric system was used and both measurements are input in the same unit system. We calculated the BMI(weight(kg)/ height(m2) and relative fat mass by using Woolcott & Bergman equation. We categorize BMI according to WHO BMI classification (under weight, normal weight, overweight and obese) and relative fat mass (risky low, lean, moderately lean, excess fat and high fat categories. Women with pregnancy and medical disorders were excluded from our study.

For data analysis, we used SPSS version 23. Frequencies and percentages are noted, chi-square test applied to see the relationship of relative fat mass with age groups, physical activity and BMI. P-Value <0.5 is considered significant.

Results:

We included 300 women of reproductive age group, 100(33%) women were 18-24 years old, 98(32.7%) were between 25-30 years. Table 1

Out of 300, 108(36%) were medical students, 105(35%) were house wife and 87(29%) were working women including nurses and paramedical staff.

171(57%) were belongs to middle class while 129(43%) were from low socio-economic group. 98(32.7%) of our study population not performed any physical activity and most of them were house wives, 50(16.7%) performed physical activity of < 30 min, while 152(50.7%) claimed of > 30 min physical activity.

Regarding BMI distribution, most of our study women were overweight 138(46%), 78(26%) were obese, while 74(24.7%) were normal weight and 10(3.3%) were underweight.

The pattern of relative fat mass in our study showed that 141(47%) women had excess fat mass percentage, 113(37.7%) had high fat mass

Table 2: *Relationship of RFM with socio-demographic details*

Variables						
	Riski Low	Lean	Moderately Lean	Excess Fat	High	P Value
Physical Activity						< 0.001
No activity	0	1	4	24	69	
< 30 minutes	2	0	5	26	17	
> 30 minutes	9	8	17	91	27	
Age						0.128
18-24 years	2	1	12	52	33	
25-30 years	4	3	9	47	35	
31-35 years	5	4	2	17	23	
36-40 years	0	1	1	12	13	
41-45 years	0	0	2	13	9	
Occupation						0.326
Housewife	6	4	5	47	43	
Student	2	2	13	57	34	
Working	3	3	8	37	36	
Socio-economic class						0.395
Lower class	6	3	14	64	42	
Middle class	5	6	12	77	71	
Body Mass Index						< 0.001
Under weight	8	4	6	4	0	
Normal weight	3	4	16	50	5	
Over weight	0	1	4	63	60	
Obese	0	0	0	24	48	

while, 26(8.7%) were moderately lean, 9(3%) were lean and 11(3.7%) were risky low category.

When we correlate these findings with relative fat mass percentage, we found some interesting and enthralling results. Out of 152 women who avowed that they perform physical activity of > 30 min, 91 had excess fat and 27 had high fat mass percentage. However, 24 out of 98 had excess fat and 69 had high fat mass in no physical activity group. These findings raise the need to carry out further studies on the level of their physical activity, dietary habits and stress level, as these factors have an influence on their fat mass percentages.

Furthermore, we found that our medical students had excessive and high fat mass percentages, perhaps less physical activity, junk foods and exam stress led to accumulation of unhealthy fats.

In addition, when we compare BMI categories with relative fat mass, we revealed that 63 women with excess fat and 60-women with high fat mass belong to overweight category, similarly 24 with excess fat and 48 with high fat mass belong to obese group. Unexpectedly, we found that 50 women with normal BMI had excess fat and 5 had high fat content. These findings suggest that a normal BMI women may also have excess or high fat contents and the relative fat mass is a better predictor of whole-body fat percentage as compare to BMI.

Discussion:

Obesity is a major health concern in recent years globally, ACOG committee found extreme obesity in 8% of reproductive age women,[16] similarly Galan and Hernandez reported 8.3% women with morbid obesity.[17] Cynthia and linda[18] reported 23% while, lynch et al[19] found 25% obese women in their population. This rising incidence of obesity associated with adverse health consequences especially in reproductive age women.

Even though BMI has limited accuracy to estimate body fat percentages, it is still used widely to measure obesity.[20-28] For example, a BMI ≥30 would overlook nearly 50% of women who had a body fat percentage higher than 35%.[20]

Our findings are consistent with a recent Mexican study,[29] they included younger women (20-37 years) and proved that the performance of the relative fat mass equation to estimate whole body fat percentage was better and more consistent than BMI.

They suggested that this equation would better represent body fat distribution especially in the abdominal region (visceral fat), measured at the waist level, and validated by DXA or MRI and this is a better predictor of the metabolic syndrome, type II diabetes and cardiovascular diseases.

Our study has certain limitations, (i) We studied a small number of women, a larger representative sample is needed to confirm these findings. (ii) Physical activity was not well defined (iii)

dietary habits were not enquired, it is necessary to explore eating habits and level of physical activity to compare the results.

Conclusion:
Our findings showed better diagnostic accuracy of overweight or obesity with relative fat mass than with BMI. Due to its simplicity in terms of the anthropometric measurements required (height and waist circumference) the relative fat mass could be used in daily clinical practice in improving the diagnostic accuracy of obesity assessment in women.

Furthermore, relative fat mass index could be used with BMI as a tool for the evaluation and monitoring of body composition to assess cardio-metabolic risk factors in reproductive age women worldwide.

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Role and contribution of authors:
Dr Tehmina Perveen, collected the data, references and did the initial writeup

Dr Rakesh Kumar, critically reviewed the article and did the final changes

Hafiz Muhammad Ali Khan, collected the data

Shahzaib Qureshi, collected the data

Dr Haresh Kumar, critically reviewed the article

Dr Sarmad Jamal Siddiqui, critically reviewed the article and made final changes

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