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# Analysis of Modified Medical Research Council Scale and Baseline Dyspnea Index to Evaluate Obesity Related Breathlessness

Authors
**Shweta Satish Devare Phadke[1], Ankita Girish Mahajani[2], Ramakrishnan.K.S[3]**

[1]Department of Physiotherapy, D.Y.Patil University, Nerul, Navi Mumbai,India
*Shweta.phadke@gmail.com*
[2]Department of Physiotherapy,D.Y.Patil University, Nerul, Navi Mumbai,India
*mahajani.ankita4@gmail.com*
[3]Professor and HOD of Kinesiotherapeutics,D.Y Patil University, Nerul, Navi Mumbai,India
*kalapathyram@gmail.com*
Corresponding Author
**Shweta Satish Devare Phadke**
Associate Professor, Department of Physiotherapy, 6th floor Medical College, D.Y.Patil University, Sector 7, Nerul, Navi Mumbai-400706.
Email: *shweta.phadke@gmail.com*

**Abstract:**
*Obesity is a chronic disease characterized by excessive accumulation of body fat on human body that causes damage to the individuals health and is regarded as a public health concern[1], Obesity is associated with many health consequences and overall reduction in quality of life. Dyspnea is very frequent chief complaint experienced by obese subjects. The Modified Medical Research council scale(mMRC) and Baseline Dyspnea Index (BDI), both have been used individually to assess dyspnea in respiratory related functional impairment. Our aim is to evaluate the two scales to assess dyspnea in obese individual, analyze it with obesity determining parameters like waist circumference, 6 minute walk distance and Rate of Perceived exertion. And to find out any association of these two scales. Cross sectional assessment study was designed, including apparently healthy obese individuals. Evaluation of dyspnea was carried out using mMRC and BDI in random order. Assessment of waist to hip ratio, 6 minute walk test was carried out. Non parametric correlation test used to determine relationship of mMRC and obesity. Scatterplot matrix was used to determine relationship of BDI and obesity. Association between two scales wasanalyzed using Spearman's rho and gamma results. We concluded from our study Modified medical research council scale and Baseline Dyspnea Index can be used clinically to assess dyspnea in obese individuals. Modified medical research council scale and Baseline Dyspnea Index were moderately associated with each other.*
*Keywords:Dyspnea, Obesity, Modified Medical Research council scale, Baseline Dyspnea Index .*

## 1. Introduction

According to World health Organization (WHO) obesity **defined** as Body mass index (BMI) greater than or equal to 30kg/m$^2$.
For Asian population BMI ranges are as follows: Normal - (18-22kg/m$^2$), Overweight (23-27.4kg/m$^2$) and Obesity (equal or > 27.5kg/m$^2$).
Currently there are estimated to be one billion overweight adults and at least 300 million of them suffer from clinical obesity [3]
Obesity affects respiratory system; its consequences are as follows:[5]-[8],[12]-[15]
1. Alterations in respiratory mechanics, decrease in respiratory muscle strength and endurance, decrease in pulmonary gas exchange, lower control of breathing, and limitations in pulmonary function tests and exercise capacity.
2. Ventilation-perfusion mismatch and airway hyper responsiveness.
3. Hypo tonicity in abdominal muscles impair diaphragmatic activity.Extra adipose tissue in chest wall and abdominal cavity compresses thoracic cage, diaphragm and lungs causing changes in lung function like decrease compliance and increase in elastic recoil[9]and overload on inspiratory muscles.
4. Central fat distribution (i.e. abdominal fat including both subcutaneous and visceral fat) also have the greatest impact on diaphragm position and lung volume regulation.
5.Reduction in expiratory reserve volume, functional reserve volume and occasionally residual volume, also decrease in total lung capacity and vital capacity in extreme cases.
6. Increase in oxygen consumption and work of breathing.

The American Thoracic Society **defines** dyspnea as "a subjective experience of breathing discomfort that is comprised of qualitatively distinct sensation that vary in intensity"; each having different neural mechanism. Being subjective, multi- component experience, its measurement is challenging[18].

Thus assessment of breathlessness should include sensation (intensity, sensory quality or unpleasantness) and/ or the behavioral, emotional consequences of the sensation (i.e. respiratory-related functional impairment, disability or quality of life)[27].

Visual Analog Scale, Modified Borg Scale, descriptors of sensory quality, MRC and BDI were recommended based on their reliability (correlations >0.8) and concurrent validity (correlation with severity of airways obstruction and walking distance).

mMRC Scale and Baseline BDI; both assess respiratory-related functional impairment were, the most frequently reported instruments in daily living[27] and also validated scales to assess dyspnea in chronic respiratory diseases [23]-[25].

As both the Modified Medical Research council scale and Baseline Dyspnea Index have been used individually to assess dyspnea in respiratory related functional impairment, we would like to evaluate the two scales to assess dyspnea in obese , analyze it with obesity determining parameters like waist circumference,6 minute walk distance and Post Rate of Perceived exertion. We would also like to find out if there is any association of these two scales.

### 1. Material and Methods:

Sixty two obese individuals 21 males and 41females selected.Obese individuals aged between 20-50 years ,BMI>or =27.5kg/$m^2$ , Nonsmokers and apparently healthy were included while those excluded were individuals with existing neuromuscular, cardiac and pulmonary co-morbidities, Diabetes mellitus, Hypertension and smokers.

After taking Inform consent a detailed history and examination including demographic data, occupation, co-morbidities, medical history and smoking status were systematically recorded.

Evaluation of Dyspnea was done using both the modified Medical Research Council scale and Baseline dyspnea Index in random order, followed by waist measurement, 6 minute walk test and rate of perceived exertion scale rating.

## 2. Results

### 3.1 Tables

Table 1: Age & Gender Distribution

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| | |
|---|---|
| Total Number of Subjects | 62 |
| Minimum Age(years) | 20 |
| Maximum Age(years) | 50 |
| Mean Age(years) | 32.94 |
| Male | 21 |
| Female | 41 |

Table 2: Demographic Characteristics Distribution.

| | Minimum | Maximum | Mean |
|---|---|---|---|
| Weight(kg) | 62 | 124 | 78.68 |
| Height(cm) | 142 | 175 | 158.82 |
| BMI(Kg/$m^2$) | 27 | 44 | 31.65 |
| Waist Circumference(cm) | 78 | 143 | 92 |

Table 3: Grades of Obesity

| Grades | No. of obese |
|---|---|
| Grade 1 | 42 |
| Grade 2 | 16 |
| Grade3 | 4 |
| Total | 62 |

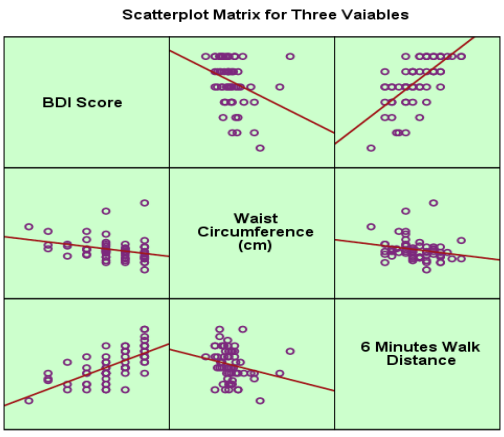
Table 4:Dyspnea assessment by mMRC scale.

| Value on mMRC | Frequency | Percentage (%) |
|---|---|---|
| 0 | 7 | 11.3 |
| 1 | 31 | 50 |
| 2 | 21 | 33.9 |
| 3 | 3 | 4.8 |
| Total | 62 | 100 |

Table 5: Dyspnea assessment by BDI.

| | |
|---|---|
| Average score of functional impairment(0-4) | 4 |
| Average score of magnitude of task(0-4) | 3.38 |
| Average score of magnitude of effort(0-4) | 3 |
| Average of total BDI score(0-12) | 9.78 |

Figure 1: Relationship of BDI with obesity determining parameters.




BDI and Waist circumference have negative slope that indicates inverse relationship between these two variables. Whereas BDI and 6 minutes' walk have positive slope that indicates direct relationship between the two variables.

## 3. Discussion

Obesity has developed to be a major public health concern and dyspnea associated with it still remains controversial. Many instruments have been used to measure dyspnea in obesity however very few have been used to measure dyspnea in obese individual. We used two instruments i.e. modified medical research council scale (mMRC) and baseline dyspnea index (BDI) to assess dyspnea

in obese individual and investigate the inter-relationship between the two scales and with obesity determining parameters.
Our study consisted of total 62 obese subjects with mean age of 32.94, out of which 21 males and 41 females table 1. Demographic details were as shown in table 2.
Sample chosen passed the normative test (one sample Kolmogorov-Smirnov Test), thus making the population homogenous in nature.

### 4.1 Modified medical research council scale for dyspnea

mMRC scale is a one-dimensional five point scale with grade 0 (no dyspnea) to grade 4(complete incapacity).
Negative log-log model was used as more number of cases was seen in lower categories.
Chi-square statistic (Chi-Square$_{(6)}$ = 32.54, p<.0005) used, indicates that the model gives a significant improvement, showing that the model gives better predictions than guessed on the basis of marginal probabilities for the lower categories.
Furthermore, the pseudo R**2**, (Cox and Snell = .408 &Nagelkerke = .459) used also indicate that the model explains between 41% to 46% variance in the outcome of the mMRC scale.
In our study mMRC scale did a good job in assessing obesity related Dyspnea more correctly in category 1 and 2, however this model is performing poorly in predicting dyspnea patients for category 0 and 3 which are extreme categories on the mMRC.
Grade 1 and grade 2 predicts breathlessness while doing normal activities, while grade 0 predicts dyspnea due to stressful activities and grades 3 and 4 signify dyspnea due to underlying co morbidities like respiratory or cardiovascular diseases which impair their functional capacity and also limit basic activities.[26]
Obese who experience dyspnea while doing basic activities of daily living can be well assessed by mMRC scale and thus this scale can effectively use in clinical practice.

### 4.2 Correlation of mMRC with obesity determining parameters

mMRC scale was used to analyze its relationship with obesity determining parameters like waist circumference, six minute walk distance (6MWD), rate of perceived exertion(RPE).
6MWD and Post RPE showed statistically significant correlation with mMRC scale.
Using spearman's rho, 6MWD were statistically significant (-.521), suggesting that its observed effect is not due to chance.
Obese mainly due to increased adiposity show relative decrease skeletal muscle strength, cardiopulmonary capacity, and tolerance and decrease efficiency of gait as a result they tend to walk slower, feel fatigue thus fail to cover maximum distance.[31]
As 6MWD gives good prediction of functional capacity in obese population and statistically significant with the scale, mMRC scale also shows good predictability of dyspnea and Functional capacity in obese population.
Modified Borg scale or Rate of perceived exertion is an objective scale of exertion which helps in individual findings, detects awareness of fatigue and is well correlated with $vo_2$ max, thus supports our hypothesis of using mMRC scale for assessing dyspnea in obese population.

### 4.3 Baseline dyspnea index

Baseline dyspnea index is a multidimensional measurement of dyspnea based on 3 components that evoke dyspnea in activities of daily living. Its components like functional impairment, magnitude of task and effort helps to assess dyspnea in detail and provides insight regarding subjective complain of breathlessness. It also denotes changes in baseline activities using different categories, proving that dyspnea can receive direct clinical rating which provides important information not disclosed by customary physiologic tests.
ANOVA (f for regression=33.57, p<.005) and $R^2$ and adjusted $R^2$ test when used, proved that there is good acceptability and about 47% to 49 % outcome variance of BDI model.
As sample chosen has sedentary lifestyle and no co-morbidities their activities are not restricted much and thus it supports our using of the scale in assessing dyspnea in obese population
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### 4.4 Correlation of BDI with obesity determining parameters

BDI was analyze for its relationship with obesity determining parameters like waist circumference, 6MWD and rate of perceived exertion.
6MWD and Waist circumference were statistically significant with BDI scale.
Pearson's correlation test showed, Waist circumference (-308) is correlated negatively and moderately with BDI.
When BDI score decreases it signifies greater dyspnea, thus when waist circumference is more, BDI score is less leading to increased perception of dyspnea, thus proving the fact that when there is increased obesity there is increase in dyspnea to limit activities.
Also Increased waist circumference is said to decrease pulmonary function parameters and proved the possibility of restrictive pattern association and not airway obstruction in obese individuals.[32]
When Pearson's correlation used,Actual 6 MWD (.677)is correlated positively and strongly with BDI, 6MWD increases BDI score decreases and vice versa.
The limitations in cardio-respiratory and motor functions are obesity related disability.Thus patients tends to walk slower, feel fatigue leading to restriction and reduction in functional capacity.
Its significance with BDI proves that obese population experiencing dyspnea in activities of daily livings and can be assessed with BDI.

### 4.5 Association between mMRC scale and BDI

mMRC scale is commonest self-administered scale because of its simplicity ,ease of administration and established validation in chronic respiratory condition.
BDI is an interviewer administered rating of severity of dyspnea at single state. It provides multidimensional measurement of dyspnea. Total measured between 0-12 which states that lesser the score more is the dyspnea.
BDI is more elaborative than mMRC and is multidimensional but its more time consuming and complex ,however being quantitative i.e. mMRC scale is ordinal variable and BDI being Continuous variable both are amenable to mathematical operations.
Statistically their inter-relationship has showed moderate association. Because of the different ways used by the scales to interpret the dyspnea both can be used interchangeably as per requirement of clinician.

## 5. Conclusion

Modified medical research council scale and Baseline Dyspnea Index can be used to assess dyspnea in obese individual.
Modified medical research council scale and Baseline Dyspnoea Index were moderately associated with each other thus can be used as per convenience.

## 6.Applications of study

Modified medical research council scale and Baseline Dyspnea Index will be useful in clinical evaluation of obesity related dyspnea in clinical setting.
Scales can be used in dyspnea prognosis during weight reduction programs, individualized fitness training programs.

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## 8. Ethical clearance

The study was approved by ethical committee, in Dr.D.Y.Patil University, Navi Mumbai.

## 9. Source of funding

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## 10. Conflict of Interest

Nil.

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## Author Profile

**Dr. Shweta Satish Devare Phadke** – Associate Professor in Department of physiotherapy, D.Y.Patil University, Esteemed University in Navi Mumbai. PhD Scholar in ergonomic field, with same University. Completed Masters in Physiotherapy as cardiopulmonary elective from G.S. Medical College & K.E.M hospital, Mumbai. In teaching field since 2007.

**Dr. Ankita Girish Mahajani** – Bright student of Master of Physiotherapy in D.Y.Patil University. Active and hard working in Research field.Particularly interested in Cardio-Pulmonary field.
Dr. Ramakrishnan.K.S – Professor in Department of physiotherapy, D.Y.Patil University, Esteemed University in Navi Mumbai. PhD Scholar in psych neurology , with same University.And heads Kinesiotherapeutic department.