ORIGINAL ARTICLE

USEFULNESS OF MODIFIED BORG SCALE FOR DYSPNOEA IN CHRONIC OBSTRUCTIVE PULMONARY DISEASES AND ASTHMA IN A RURAL POPULATION OF KARACHI

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ABSTRACT

Objective: To assess Modified Borg Scale (MBS) for subjective rating of dyspnoea in patients with chronic obstructive pulmonary diseases (COPD) and asthma and to find correlation between MBS and spirometry.

Background: Measurement of dyspnoea in acute asthma is difficult. Rating of dyspnoea by subjective assessment and objective parameters becomes difficult when patient is in respiratory distress. Modified Borg Scale, a vertical subjective rating scale was tested to see whether it provides an alternative, flexible and easy means of assessment of dyspnoea as perceived by patients.

Methodology: 53 patients between 16-70 years, 25 females with mean age 46.24±5.56 and 28 males with mean age 39.5±5.43 suffering from COPD and asthma who presented with dyspnoea were included in the study. They were asked to mark the MBS prior to and after the bronchodilators administration. Simultaneous recording of spirometry was also done.

Results: The mean MBS decreased from 3.39±1.87 to 1.51±1.27 (p<0.01). The mean Forced vital capacity (FVC) increased from 1.81±0.84 to 2.21±0.92 L/min (p<0.01) after the treatment. The mean Forced expiratory volume in first second (FEV₁) increased from 1.21±0.73 to 1.62±0.85 L/min (p<0.01) after the treatment. The mean Peak expiratory flow (PEF) increased from 1.67±1.07 to 2.37±1.28 L/min (p<0.01). The mean Percentage ratio (FEV₁/FVC) increased from 66.47±18.01 to 71.19±16.47 (p<0.01). As the spirometry improved, the perception decreased showing inverse relationship with MBS. The regression analysis showed R²=-0.3418, R²=-0.2407 and R²=-0.4025 respectively for the above parameters.

Conclusion: Modified Borg Scale is a reliable and valid tool for perception of dyspnoea and can be used for subjective assessment of shortness of breath. It correlates with spirometry.
INTRODUCTION

Most healthy subjects during moderate to high levels of exercise, and patients with cardio-pulmonary disease experience a subjective feeling called breathlessness or dyspnoea which may be the chief presenting complaint of patients with underlying respiratory, cardiac, hematological and functional disorders [1]. Both asthma and COPD including pulmonary emphysema and chronic bronchitis are diseases characterized by airway obstruction, consequently their clinical manifestations overlap [2]. In many situations it is adequate for lung function to be measured whenever the patient attends the asthma clinic. Breathlessness is a subjective sensation, and like pain, it needs to be perceived and reacted to. The main methods to assess dyspnoea are either indirect when an attempt is made to clinically define severity in terms of the disability brought on by the symptoms, or direct, which quantify the perceived intensity of the sensation that include the visual scales, spirometry and pulse oximetry [3].

A frequently used scale for quantifying breathlessness is the modified Borg scale. It was originally a 21-point category scale for measuring perceived exertion during exercise, later was reduced to 15 points [4]. It was further modified to produce a 12-point scale and was adapted to estimate breathlessness [5]. Descriptors are positioned on the scale, at different numbers, relating to their quantitative meaning. As with magnitude estimation, the Borg scale incorporates ratio scaling properties, for example if the score is 2, then this would be twice that
perceived as 1 and half that perceived as 4. At one end of the scale ‘0’ is labeled nothing at all’ and at the other end, ‘10’ is labeled’ maximal. Figure-2

**Translation of Modified Borg scale in Urdu;** In order to overcome the interpretational difficulties a careful translation of MBS was used in Urdu language side by side with English. Martinez et al [6] carried out a study to use dyspnoea scale in the assessment of illiterate patients with COPD and concluded that dyspnoea scale showed comparable reliability in both literate and illiterate COPD subjects.
Figure-2
The modified Borg scale (from Burden 1982)

0  nothing at all
0.5 very, very slight
1  very slight
2  slight
3  moderate
4  somewhat severe
5  severe
6
7  very severe
8
9  very, very severe (almost maximal)
10 maximal
In order to test its validity, ratings of breathlessness obtained by the MBS have been compared to values obtained using the visual analogue scale (VAS). Wilson and Jones studied 10 healthy subjects who rated the intensity of their breathlessness every minute during exercise on a cycle ergometer. There was a good correlation between Borg score and VAS score. The Borg scale was also shown to be more reproducible over 2-6 weeks [7].

We decided to use modified Borg scale for assessment of dyspnoea in patients of asthma and COPD who presented in emergency room (ER) or in outpatient department (OPD). A diagnosis of COPD is suggested by history and physical examination and is confirmed by spirometry that is one of the most common pulmonary function tests [8]. Spirometry is essential in monitoring the course of respiratory diseases [9].

Gabriel Laszlo defined and described the primary spirometric parameters that included peak flow rate (PEFR), forced vital capacity (FVC), residual volume (RV), total lung capacity (TLC), vital capacity (VC) and forced expiratory volume in first second (FEV₁) [10]. Measurement of vital capacity (VC) is an excellent means of detecting respiratory muscle weakness [11]. Spirometry is not only essential in making the diagnosis but also in grading the disease according to forced expiratory volume in first second (FEV₁) measurements [12]. Therapeutic interventions and prognostic evaluations are made according to the grading of the disease. Early detection and accurate diagnosis are necessary steps to improve the management and prevention of COPD [13]. Spirometry can also be used as screening test for early detection of COPD in susceptible smokers [14].
The purpose of the study was to assess severity of dyspnoea using spirometry as well as MBS to show whether they have value in patients’ assessment in local settings. MBS can be used to reliably assess severity of dyspnoea when it is difficult to perform spirometry especially when patients present with severe dyspnoea. A better assessment would result in better management of patients suffering from COPD and asthma.
MATERIAL AND METHODS

This study was carried in Fatima hospital and Institute of chest diseases, Baqai Medical University Karachi, from May 2002 to December 2002 at an ambient room temperature between 22-38 °C. Four hundred and seventy (470) patients were attended in the hospital but only fifty-three (53) met the inclusion criteria. Rests of the patients were dropped from the study. The 53 patients included 28 males and 25 females with age ranging from 16 to 70 years who presented with dyspnoea. Patients were evaluated in outpatient department/emergency room (OPD/ER) and on follow up after administration of the treatment that included bronchodilators delivered by inhalers and/or nebulizers. A written or verbal consent was taken from the patients before they were included in the study.

Patients suffering from asthma and chronic obstructive pulmonary diseases who presented with dyspnoea were assessed. The patients suffering from acute asthma and acute on chronic bronchitis who were able to perform spirometry were included in the study.

Patients having other causes of dyspnoea like Pneumothorax, pneumonia, pleural effusion, pulmonary fibrosis, anemia, cardiac failure and functional cases were excluded from the study by carefully evaluating them on clinical grounds including detailed history and clinical examination. The relevant investigations like chest x-ray, arterial blood gases, electrocardiogram, complete blood count, blood urea nitrogen and random blood sugar were done where appropriate.
The MBS was shown to the patients at the start of the test and they were asked to point to the corresponding number on the scale that was commensuration with the degree of dyspnoea. The MBS was marked again after the administration of bronchodilators.

The modified Borg scale and its translation in Urdu were shown to the patients who could read. All the patients who were unable to read, the MBS was read out either in Urdu or carefully translated verbally in patients’ own language like Sindhi, Balochi, Pashto, Punjabi, and Persian etc. Fig-3
<table>
<thead>
<tr>
<th>Description</th>
<th>Urdu Translation</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>No breathlessness at</td>
<td>ساس تھیش بھیج ہیں ریلے</td>
<td>0</td>
</tr>
<tr>
<td>Very, very slight</td>
<td>بہت بھیج معمولی سیاہ</td>
<td>0.5</td>
</tr>
<tr>
<td>Very slight</td>
<td>بہت معمولی / بکا سیاہ</td>
<td>1</td>
</tr>
<tr>
<td>Slight</td>
<td>معمولی / بکا سیاہ</td>
<td>2</td>
</tr>
<tr>
<td>Moderate</td>
<td>ٹھٹرا بھیج / دوسری نیم</td>
<td>3</td>
</tr>
<tr>
<td>Somewhat severe</td>
<td>کچھ بھیج سیاہ</td>
<td>4</td>
</tr>
<tr>
<td>Severe</td>
<td>شدید بھیج سیاہ</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Very severe</td>
<td>سب سے سہیلہ بھیج</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>very, very severe</td>
<td>کلیٹا زیادہ بھیج / بھیج سہیلہ</td>
<td>9</td>
</tr>
<tr>
<td>(almost maximal)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximal</td>
<td>سب سے انچیا کہیٹ بھیج سیاہ</td>
<td>10</td>
</tr>
</tbody>
</table>
The patients were also subjected to spirometry. A calibration of the spirometer was performed with a 3 liters syringe prior to commencement of the study according to the recommendations of the National Asthma Education Programme [15]. A daily calibration of the spirometer was not required with the model used in this study. Spirometry variables were measured for a series of at least 3 acceptable forced expiratory readings [16]. The guidelines by American Thoracic Society (ATS) were followed for obtaining satisfactory spirometric values [17]. The best values were selected. Patients performing the test for the first time were asked to make two or more practice blows to develop a correct technique. Thereafter, three technically satisfactory blows were recorded [18,19]. A minimum exhalation time of six seconds was required to obtain maximal FVC results. Patients were given adequate rest of two to three minutes in between the tests. Applying nose clips bears no effect on the result of spirometry as a very insignificant amount of air is expelled through nose during a forceful expiration. Nose clips were not used in our study. Patients were made to sit upright while performing the test [20]. They were asked to take in a deep breath then to blow out in the mouthpiece of spirometer as hard and as long as possible.
THE EQUIPMENT USED

Micro Medical Ltd. Kent, U.K
Calibration Syringe 3 Liters Vitalograph Ltd.

STATISTICAL ANALYSIS

Comparison of MBS in males and females was done before and after the treatment by finding means and calculating standard deviation.
Student t-test was applied to MBS to prove null hypothesis.
Correlation was found between Borg score and spirometry by regression analysis.
RESULTS

Twenty five out of 53 subjects were females (n-25) between the ages of 16 and 70 years with mean age 46.24 ± 5.56 and twenty-eight males (n-28) between the ages of 16 and 70 years with mean age 39.5 ± 5.43 were included in this study. They were divided in four age groups, 16-25, 26-40, 41-55 and 56-70 years for both sexes (Table-1)
### Table-1

**NUMBER OF PATIENTS BY AGE GROUP**

<table>
<thead>
<tr>
<th>Years of Age</th>
<th>Male (n=28)</th>
<th>Female (n=25)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. Of patients</td>
<td>Percentage %</td>
</tr>
<tr>
<td>16-25</td>
<td>6</td>
<td>21.43%</td>
</tr>
<tr>
<td>26-40</td>
<td>9</td>
<td>32.14%</td>
</tr>
<tr>
<td>41-55</td>
<td>9</td>
<td>32.14%</td>
</tr>
<tr>
<td>56-70</td>
<td>4</td>
<td>14.28%</td>
</tr>
<tr>
<td>Total No. Of patients</td>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>
Comparison of Modified Borg Scale before and after the treatment:

All cases were analyzed for Modified Borg Scale values prior to and after the treatment.

The minimum Borg value was 0.5 and maximum 8 with mean 3.39 ± 1.87 pre-treatment. Post-treatment Borg value was between 0 and 5 with mean 1.51 ± 1.27. Change in Modified Borg scale (MBS) before and after the treatment showed a significant P-value (p<0.01) (Table-2)
Table-2

Comparison of Modified Borg Scale before and after treatment combined for both sexes (n=53)

<table>
<thead>
<tr>
<th>Borg score</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRE-TREATMENT</td>
<td>3.39 ± 1.87</td>
</tr>
<tr>
<td>POST-TREATMENT</td>
<td>1.51 ± 1.27</td>
</tr>
</tbody>
</table>
Comparison of spirometric values prior to and after the treatment

The comparison of spirometric values, Forced Vital Capacity (FVC), Forced Expiratory Volume in 1st second (FEV₁), Peak Expiratory flow (PEF) and ratio of the FEV₁ and FVC prior to and after the treatment was carried to all the cases. The minimum value for FVC was 0.61 Liters per minute and maximum 3.96 L/min with mean 1.81 ± 0.84 prior to treatment. Post treatment FVC was between 0.85 and 4.03 L/min with mean 2.21 ± 0.92. The minimum value for FEV₁ was 0.4 and maximum 3.82 with mean 1.21± 0.73 prior to treatment. Post treatment FEV₁ was between 0.47 and 3.73 L/min with mean 1.62 ±0.85. The minimum value for PEF was 0.55 L/min and maximum 5.89 L/min with mean 1.67 ± 1.07 prior to treatment. Post treatment PEF was between 0.58 and 5.64 L/min with mean 2.37 ± 1.28. The minimum value for FEV₁/FVC was 23 and 98 with mean 66.47 ± 18.01 prior to treatment. Post treatment FEV₁/FVC was between 37 and 100 with mean 71.19 ± 16.47. Change in FEV₁ and FVC showed P- values <0.01 and change in PEF was significant with P<0.01.

(Table-3)
Table-3

Comparison of Forced Vital Capacity, Forced Expiratory Volume in First second, Peak Expiratory Flow and Ratio of FEV₁ and FVC before and after treatment of dyspnoea (n-53)

<table>
<thead>
<tr>
<th>TREATMENT</th>
<th>FVC (L/min)</th>
<th>FEV₁ (L/min)</th>
<th>PEF (L/min)</th>
<th>FEV₁/FVC (Percentage Ratio)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>PRE-TREATMENT</td>
<td>1.81 ± 0.84</td>
<td>1.21 ± 0.73</td>
<td>1.67 ± 1.07</td>
<td>66.47 ± 18.01</td>
</tr>
<tr>
<td>POST-TREATMENT</td>
<td>2.21 ± 0.92</td>
<td>1.62 ± 0.85</td>
<td>2.31 ± 1.28</td>
<td>71.19 ± 16.47</td>
</tr>
</tbody>
</table>
REGRESSION ANALYSIS

Figure-3

Correlation between Change in FEV₁ and change in modified Borg scale before and after the treatment in dyspnoea patients

Equation: \[ y = -0.1218x \]
\[ R^2 = -0.3418 \]

Figure-4

Correlation between Change in Forced Vital Capacity (FVC) and change in Modified Borg Scale (MBS) before and after the treatment in dyspnoea patients

Equation: \[ y = -0.1269x \]
\[ R^2 = -0.2407 \]

Figure-5

Correlation between Change in Peak Expiratory Flow (PEF) and change in Modified Borg Scale (MBS) before and after the treatment in dyspnoea patients

Equation: \[ y = -0.187x \]
\[ R^2 = -0.4025 \]
Figure-3

FEV1 VS MBS

Figure-4

Change in FVC vs Change in MBS

Figure-5

Change in PEF vs Change in MBS
DISCUSSION

The need for subjective rating of shortness of breath arises in emergency room or outpatient department when patient presents with dyspnoea facing difficulties in expressing his discomfort. [21]. Subjective rating scale like Modified Borg Scale (MBS) in assessing the severity of shortness of breath in asthma and chronic obstructive pulmonary diseases (COPD) was evaluated in 53 patients, twenty-five females with mean age 46.24 ± 5.56 SD (n=25) and twenty-eight males with mean age 39.5 ± 5.43 SD  (n=28). A comparison of pre-treatment to post-treatment spirometric parameters and pre-treatment to post-treatment Borg score was made. FVC, FEV$_1$ and PEF were all increased significantly after the treatment (p<0.01).Whereas MBS decreased significantly after the treatment (p<0.01).An inverse correlation was found between MBS and spirometry with R$^2$=-0.3418, R$^2$=-0.2407, R$^2$=-0.4025 for FVC, FEV$_1$ and PEF respectively.

Gupta et al assessed severity of asthma using visual analog scale (VAS) and found its correlation with PEF and FEV$_1$ [22]. In our study we used MBS instead of VAS. A comparison of the change in Borg score before and after the administration of bronchodilators was highly significant (p<0.01).

Nannini et al created a simple test for perception of dyspnoea was created using MBS and percentage ratio [23] we however tested MBS as a simple test of perceiving dyspnoea and showed its reliability using spirometry.

Patients suffering from chronic obstructive pulmonary diseases experience exacerbations of dyspnoea from time to time during the course of illness. The intensity of discomfort not only changes in the patients but it also varies from
patient to patient. A comparison of continuous and discrete measurement of dyspnoea showed that reliability of MBS is excellent for both continuous and discrete measurements of dyspnoea in exercise laboratory [24]. We however, studied the actual patients whose presenting complain was dyspnoea due to COPD and asthma. Modified Borg Scale (MBS) was used as an assessment tool to measure shortness of breath. It was found that MBS was reliable measure of dyspnoea.

Martinez et al compared the perception of dyspnoea scales in literate and illiterate patients suffering from COPD showed comparable reliability in both groups [6]. I therefore read and explained each Borg score to illiterate patients and all those who were otherwise unable to understand the scale. They were asked to mark the score after they understood the MBS. All patients were able to adequately communicate their level of dyspnoea using MBS.

The perception of dyspnoea by MBS and subsequent induction of dyspnoea by histamine provocation test showed that perception of dyspnoea during stability period and perception during asthmatic attack are independent phenomenon. [25]. In our study we showed that perception of dyspnoea during asthmatic attack and during stability period after the treatment were equally reliable., Pre-treatment to post-treatment MBS showed significant p-value (p< 0.01).

Grazzini et al compared asthma scores with VAS and MBS showing that level of bronchoconstriction and bronchial hyper-responsiveness on either scale was of questionable clinical significance [26]. Asthma scores used were based on shortened version of the International Union Against Tuberculosis and Lung
Diseases (IUALTD) questionnaire, which evaluates patient symptoms during past twelve months using lengthy descriptions. However, in our study, we used objective parameters rather than questionnaire to show a (highly significant) correlation between FEV1, FVC and PEF with MBS. Cullen and Rodak checked various dyspnoea measurement scales and showed VAS and Borg were applicable to any cardio pulmonary patient to determine dyspnoea [27]. In our study the MBS was utilized to measure patient’s progress. Kunitoh et al used historical data, physical findings, pulmonary functions, arterial blood gases and subjective degree of dyspnoea rated on MBS to correlate eventual requirement of hospitalization in patients with acute asthma attack. The patients who had apparently been successfully treated in the emergency room and discharged home were included in the study. Residual degree of subjective dyspnoea was shown to be the only significant variable to predict the eventual need for hospitalization with a sensitivity of 75% and a specificity of 78% [28]. We evaluated the reliability of MBS with the intention to use the Borg score in the centers where facilities for more objective parameters are not available. As a result, MBS would help to make a better management plan even in the absence of sophisticated instruments like spirometers and oximeters. Turcotte et al induced breathlessness by inhaled antigens and found its relationship with the fall of expiratory flows in 28 asthmatics. Breathlessness was evaluated on MBS before each FEV1 measurement obtained at regular intervals after the antigen challenge. Rate of fall of expiratory flows and perception of dyspnoea on MBS were measured in an attempt to check early and late
asthmatic response. It was shown that both early and late response correlated strongly with MBS, the slower the fall in FEV$_1$, the weaker the perception (p<0.001) [29]. Whereas in this study, correlation was found between pre-treatment spirometry to post-treatment spirometry and showed that all values significantly improved after the treatment. However, the Borg scores were decreased after the treatment. As the spirometry improved the perception decreased showing significant inverse statistical relationship with MBS. However MBS is not a substitute for spirometry which still remains the gold standard for objective assessment of dyspnoea.
CONCLUSION:

It was concluded that MBS is valid and reliable assessment tool for perception of dyspnoea. It is correlated with spirometry.

It is recommended that MBS can be used as a reliable alternate measure of severity of dyspnoea in centers where facilities for more objective tests are not available.

The importance of present ratio scale with respect to other scales will be found.
REFERENCES


