

## ORIGINAL ARTICLE

# EFFECT OF DIFFERENT SITTING POSTURES IN WHEELCHAIR ON LUNG CAPACITY, EXPIRATORY FLOW IN PATIENTS OF SPINAL CORD INJURY (SCI) OF SPINE INSTITUTE OF AHMEDABAD

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## ABSTRACT

**Background:** People with Spinal Cord Injury (SCI) frequently experience various complications. Subjects with SCI are in a sitting posture for prolonged periods of time, it is important to know how different sitting postures affect pulmonary function.

**Aim:** To see the effect of different sitting postures on lung capacity and expiratory flow (LC-EF) in patient of Spinal Cord Injury (SCI).

**Material and Method:** Hospital based experimental study carried out on 26 patients of SCI during July to September 2009 at Spine Institute of Civil Hospital, Ahmedabad in which two different sitting positions given to patients in wheelchair: 1) Normal sitting posture and 2) WO-BPS sitting posture. The lung capacity and expiratory flow (LC-EF) measures forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), peak expiratory flow rate (PEFR) and average forced expiratory flow between 25-75% FVC levels (FEF25-75%).

**Results:** All variables including FEV1, FVC, and PEFR were analyzed statically significant in both sitting posture: Normal and WO-BPS posture and FEF25-75% was also increase but not statically significant.

**Conclusions:** WO-BPS with lumbar curve is better option for patients of SCI, sitting for prolong period of time because in this position improve the lung function in SCI patients than normal sitting posture.

**Key Words:** spinal cord injury, posture, lung volume measurements

## INTRODUCTION

People with Spinal Cord Injury (SCI) frequently experience a range of complications. Respiratory dysfunction<sup>1</sup>, pain<sup>2, 3</sup>, muscle fatigue<sup>4</sup>, and pressure ulcers<sup>5-12</sup> are among the most common complaints. A major cause of morbidity and mortality in these people is long-term respiratory complication in the form of pneumonia or atelectasis<sup>5</sup>, with pneumonia being the leading cause of their deaths.<sup>13</sup>

Many factors can contribute to poor lung function, including smoking habits, surgical history, hazardous occupational or environmental exposure, asthma, allergies, chronic obstructive pulmonary disease, and obesity. Additionally, the connection between posture and lung performance has proved significant.<sup>1, 6, 14-16</sup>

In SCI populations, Chen<sup>1</sup> and Baydur<sup>14</sup> and colleagues found that the supine posture produced the best spirometric recordings. But subjects with SCI are in a sitting posture for prolonged periods of time, it is

important to know how different sitting postures affect pulmonary function. A new seating position that changes in ischial and lumbar support<sup>17</sup> has been developed to suggest a new sitting posture to mimic the spine's natural curvature in the stance, and provide better postural support for seated subjects<sup>17</sup>. This posture has been designated as the back part of the seat without ischial support (WO-BPS),<sup>18</sup> and the enhanced lumbar support.

Because the WO-BPS's design imitates standing spinal alignment, it was expected that use of this model by subjects would result in improved sitting posture and respiratory capacity. This study was already performed in normal individual and purpose of this study to know effect of these postural changes on lung capacity and expiratory flow in spinal cord injury patient.

Purpose of this study is to evaluate the effect of different sitting posture in wheelchair on lung capacity

(LC) and expiratory flow (EF) in spinal cord injury patients.

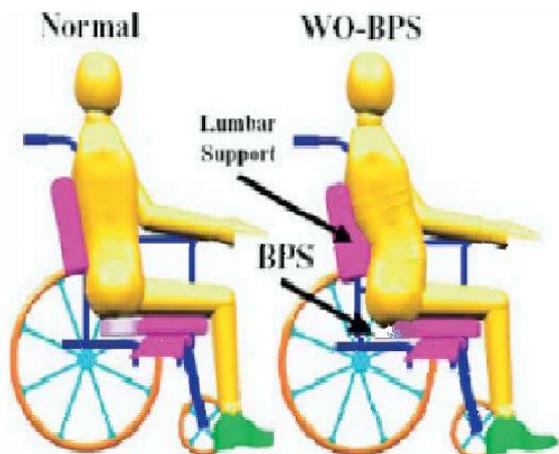
**MATERIALS AND METHOD**

The present study is hospital based experimental study carried out during July to September 2009 at Spine Institute of Civil Hospital, Ahmedabad in which independent variable: sitting posture and dependent variable: lung function. Total 26 patients of age group of 17 to 50 years of SCI were taken as sample population without gender disparity.

Material comprised in this study were pen, paper, nose clip, mouth piece, spirometer, weighing machine standard measures tape for height measurement, wheelchairs etc. All 26 subjects were selected from wards and OPD in the hospital. Explained whole procedure to the subjects before the study carried out and then randomly given two different sitting positions in wheelchair in patients:

- 1) Normal sitting posture, with full ischial support and flat lumbar support
- 2) WO-BPS sitting posture; back part of seat without support with partially removed Ischia support and total back rest with lumbar curve.

In sitting postures, knees were flexed at 90° with feet fully supported.



Subject were told how to properly complete 1 trial, which consisted of (1) deepest inhalation possible (without spirometer), (2) clamping of the nostrils with help of nose clip and (3) exhalation with maximum effort into transducer tube of spirometer. Subjects were given time to practice the breathing protocol until they felt comfortable in the wheelchair and could reproduced, to fullest extent possible, consistent trend on flow –volume loop. Three trails were then recorded for each of the postures. The posture testing sequence was randomized according to a randomization schedule generated beforehand. Brief rest of 30 seconds between trials minimized the fatigue effect on the respiratory muscles.

The lung capacity and expiratory flow (LC-EF) measures forced vital capacity (FVC), forced expiratory volume in 1 second (FEV1), peak expiratory flow rate (PEFR) and average forced expiratory flow between 25-75% FVC levels (FEF25-75%). A Helios 401 spirometer with RMS software was used to measure each subjects LC-EF.

After all the subjects completed the breathing measurements we selected higher value among the 3 trails in each posture. The mean and standard deviation (SD) of FVC, FEF25-75%, PEFR and FEV1 were calculated. When significance was found, paired t tests were done to test posture effect on each of LC-EF parameters between two sitting posture. Statistical analysis was performed with SPSS software.

**RESULT**

Data were analyzed by student ‘t’ test. Paired ‘t’ test was used to find out if there in any significant difference in lung function test in two different sitting posture. All variables including FEV1, FVC, and PEFR were analyzed stastical significant in both sitting posture; Normal and WO-BPS posture and FEF25-75% was also increase but not stastical significant.

**Table 1: Comparison of mean values of variables with Normal sitting posture and WO-BPS sitting posture in wheel chair**

Outcome measures	Normal sitting posture Mean±SD	WO-BPS sitting posture Mean±SD	t values
FVC	1.97±.71	2.20±.65	4.74
FEV1	1.72±.59	2.02±.52	7.26
FEF25-75%	2.51±1.01	2.75±.87	1.51
PEFR	3.72±1.43	4.64±1.41	5.95

**FVC:** A “t” value of FVC is 4.744 which is higher than that of table value 2.787.This indicate that there is significant difference in FVC values in Normal and WO-BPS sitting posture.(p<0.01)

**FEV1:** A “t” value of FEV1 is 7.263 which is higher than that of table value 2.787.This indicate that there is significant difference in FEV1 values in Normal and WO-BPS sitting posture. (p<0.01)

**FEF25-75%:** A “t” value of FEF25-75% is 1.511 which is less than that of table value 2.060.This indicate that there is no stastical significant difference in FEF25-75% values in Normal and WO-BPS sitting posture.

**PEFR:**A “t” value of PEFR is 5.944 which is higher than that of table value 2.787.This indicate that there is significant difference in PEFR values in Normal and WO-BPS sitting posture. (p<0.01)

All variables including FEV1, FVC, and PEFR were analyzed statically significant in both sitting posture:

Normal and WO-BPS posture and FEF25-75% was also increase but not statically significant.

## DISCUSSION

We evaluated the biomechanical effects on the LC-EF of different sitting postures on the LC-EF. Results show that posture significantly influenced spirometric parameters in tested subjects. The flow-volume loop is widely used in clinical practice to assess lung function for the condition of airways and the strength of the respiratory muscles.

The PEF reflects and measures the rate of flow from the large airways; it is also affected by the strength of the thoracic and abdominal muscles and the degree of muscular effort generated by the subject.<sup>20</sup> The FVC is the total volume of air exhaled with maximal effort. FEF25%–75% is the flow rates at the corresponding percentage point of the FVC exhaled, and indicate the function of small or distal airways.<sup>19</sup> The results of lumbar lordosis in this study are, in general, consistent with other published studies.<sup>22-26</sup>

In parallel with Subjects' improved respiratory performance in the WO-BPS sitting posture over performances in the normal sitting posture. Although there is no evidence in the literature that changes in lumbar lordosis and kyphosis have significant influence on lung function, we think that these significant differences in lumbar lordosis in different postures may account for the changes in pulmonary capacity between the postures we tested.

A shape change in any one of these curvatures will cause compensatory changes in the others to help maintain balance and conserve muscular energy.<sup>27</sup> adjustments to spinal alignment may change the volume of air available to the lung and/or influence the efficacy of contraction of the diaphragm and other respiratory muscles. Therefore, an increase in spinal lordosis in the lumbar region is likely to induce a decrease in thoracic kyphosis, thus giving the ribcage greater room to expand during inspiration.<sup>21</sup> in this study, lumbar curve more in WO-BPS with lumbar curve than the normal sitting posture.

## CONCLUSION

By this study, we can say that WO-BPS with lumbar curve is better option for patients of SCI, sitting for prolong period of time because in this position improve the lung function in SCI patients than normal sitting posture. The WO-BPS with lumbar support sitting posture show significant improvement in FVC, PEF, FEV1 and increasing values of FEF25-75% but it is not statistically significant.

The following are recommendation for future study:

1. Including upper thoracic level of SCI patients and cervical level also.

2. To evaluate postural change effect on lung function particular in WO-BPS with lumbar curve, over a longer period of time by full wheelchair users with SCI patients.

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