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**ORIGINAL ARTICLE**

# Comparative Analysis of Pulmonary Function Impairment in Adolescent Idiopathic vs. Congenital Scoliosis

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## ABSTRACT

**Background:** Scoliosis is the main three-dimensional pathological backbone deformation with direct effects on the thoracic cage and a prevalence of 0.3 to 15.3% of the population.
**Aim:** To assess the comparison of pulmonary function impairment in adolescent idiopathic and congenital scoliosis.
**Place and duration of study:** Department of Orthopedic & Spine Center, Ghurki Trust Teaching Hospital Lahore from 1st January 2020 to 31st August 2020.
**Methodology:** In this cross-sectional study 30 patients diagnosed with Idiopathic congenital scoliosis after the approval from the Ethical Committee of the hospital (15 idiopathic and 15 congenital scoliosis) were enrolled. The data were collected using predesigned proforma, including demographics (gender, age, BMI, Cobb's angle, and side of deviation) and outcome variables to measure pulmonary function impairment. In all patients, pulmonary function tests were performed.
**Results:** In group A, the mean value of FVC (%) was lower than 80% of the predicted normal value as 59.8±12.0 as compared to group B 78.32±21.35%. The average predicted value of FEV1 was 62.3±13.5%slightly decreased in group A (below 80% of the predicted normal value) compared to group B81.47±19.88%. The FEV1/FVC ratio was normal in both groups (>70% predicted). The result also revealed a significant difference in both groups as (p-value<0.05).
**Conclusion:** Idiopathic and congenital scoliosis is a common thoracic cage weakening deformity with potentially significant and permanent effects of the lungs. As pulmonary symptoms may become clinically apparent unless major and permanent changes have taken place in lung function. It is advisable to recognise the issue early and to conduct routine pulmonary function tests.
**Keywords:** Adolescent Idiopathic scoliosis (AIS), Congenital scoliosis (CS), Cobb angles, forced vital capacity (FVC),

## INTRODUCTION

Scoliosis is the main three-dimensional pathological backbone deformation with direct effects on the thoracic cage and a prevalence of 0.3 to 15.3% of the population[1,2]. It results from a pathological process which causes the spine to curve sideways. It may be congenital, secondary to a number of systemic, neuromuscular, or idiopathic disorders because of vertebral or rib malformations. Idiopathic scoliosis accounts for about 85% of cases and is identified as systemic scoliosis with no cause[2].

Patients with untreated scoliosis were shown to have an elevated risk of respiratory failure and premature death, but we have failed to demonstrate increased mortality in more recent research of adolescent patients with idiopathic scoliosis. However, respiratory failure had a high scoliotic angle and low vital capacity in untreated patients with scoliosis, specifically if the onset of their scoliosis was at a younger age[3].

Pulmonary dysfunction, particularly congenital scoliosis (CS), is the most severe consequence of spinal deformity, which can lead to cardiorespiratory disease if treatment is not performed. In most studies the pulmonary function has been evaluated against the lateral spinal curvature, but this correlation has not been verified by some research[4]. Although fewer researchers have taken measurement AIS's pulmonary function by the apical vertebral rotation measurements sagittal or spinal curvature. A study performed by Johnston et al[5] explored that pulmonary function tests (PFTs) impairment did not associate with axial plane deformity. The determinants that reduce %VC were the sagittal diameter of the thoracic cage, complete lung region and vertebral rotation in T8 and T9 levels suggested by Takahashi et al[6].

Previous literature suggests a poor lung function due to severe scoliosis[7,8]. Meanwhile, poor pulmonary function may result in an increased occurrence of post-operative pulmonary complications, preoperative pulmonary function tests (PFTs) are widely used to predict post-operative pulmonary complications[9]. Conversely, detailed analysis of pre-operative pulmonary function with regard to Cobb angles, apical vertebrae place and age in AIS were not performed. The literature review therefore explored-the connection between the preoperative pulmonary function and these three determinants in AIS and congenital scoliosis patients[10].

Many patients suffering from scoliosis have extreme cardiopulmonary insufficiency, sometimes fatal, at comparatively early adulthood but pulmonary physiology tests are rare for children with scoliosis[11].

As AIS and congenital scoliosis is a major disorder and a complex disease, so patients usually suffer from a combination of diseases and comorbid conditions. So during treatment of such patients, surgeons have to be cautious and consider all systems of the body including respiratory system. As patients with scoliosis have respiratory system compromise and during surgery, these compromises in body systems may pose a lot many complications, so it is important to determine the pulmonary functions tests in these patients. Also, there is scarcity of literature from our part of world, so this study will help us to generate a piece of evidence-based medicine from our population. Following this study, we can anticipate the outcome among our patients and will be better able to educate our patients.

So the objective of the study was to compare the pulmonary function impairment in adolescent idiopathic congenital scoliosis.

## MATERIALS AND METHODS

This cross-sectional study was performed at the Department of Orthopedic & Spine Center, Ghurki Trust Teaching Hospital from 1st January 2020 to 31st August 2020 in patients diagnosed with Idiopathic and congenital scoliosis after approval from the Ethical Committee of the hospital. A total of 30 patients (15;idiopathic and 15;congenital scoliosis) fulfilling the inclusion criteria were included. All patients age 10-17 years of both gender were included. Patients with juvenile idiopathic and congenital scoliosis surgery, for patients with documented cases (medical records) and for young people with a Cobb-angle of under 10 or over 20 who were with obstructing pulmonary symptoms were excluded. Those with neuromuscular disorders associated with the condition such as brain paralysis, muscle dystrophy, spina bifida and congenital myopathy were not accepted. Adolescents previously or already managed by any medication for scoliosis were excluded from the research. Informed consent was taken from each of the patients. The data were collected using predesigned proforma, including

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demographics (gender, age, BMI, cobb's angle, and side of deviation) and outcome variables as to measure pulmonary function impairment. In all patients, pulmonary function tests were performed. All subjects' data were collected using standard laboratory procedures preoperatively.

Spirometry was first validated. A nose clip was applied. Through the mouthpiece, the subject was taken deep, forceful inspiration monitored by rapid, forceful expiration. All the data were recorded and analyzed through SPSS version 22. Kolmogorov–Smirnov test was applied. An independent sample t-test was used to examine each variable's relationship with the mean change in pulmonary function (study variables). All the p-values≤of0.05 was considered to be significant.

## RESULTS

In congenital scoliosis group, most of the cases were males 9 (60%), and fewer were females 4 (40%) with an average age of 14.02±4.61 years. As in idiopathic scoliosis group, more than half 11 (73.3%) were females while 4(26.7%) were male cases with an average age of 15.57±5.2 years. There was no significant difference in the average BMI of these two patients as p>0.05. A total of eight scoliotic curves were convex to the right in congenital scoliosis while ten in the case of idiopathic scoliosis patients, respectively. A cobb's angle in group A was 52.3±13.2$^{o}$ and in group B was 57.23±12.74$^{o}$. FVC and FEV1 were compared with normal values as predicted in group A (congenital scoliosis) and group B (idiopathic scoliosis). In group A, the average value of FVC (%) was lower than 80% of the predicted normal value as 59.8±12.0 compared to group B 78.32±21.35. The average predicted value of FEV1 was 62.3±13.5, mildly reduced in group A (below 80% of the predicted normal value) compared to group B81.47±19.88. The FEV1/FVC ratio was normal in both groups (>70% predicted). The result also revealed a significant difference in both groups as (p-value<0.05) [Table 1].

Table 1: Comparison of variables in both groups

| Variable | Congenital Scoliosis | Idiopathic scoliosis | P value |
|---|---|---|---|
| Male | 9 (60%) | 4 (26.7%) | 0.1406 |
| Female | 6(40%) | 11 (73.3%) | |
| Age | 14.02±4.61 | 15.57±5.2 | 0.395 |
| BMI (kg/m2) | 17.25±4.28 | 18.75±5.9 | 0.4322 |
| **Side of deviation** | | | |
| Right | 8 (53.3%) | 10 (66.7%) | 0.1389 |
| Left | 8 (46.7%) | 5 (33.3%) | |
| Cobb's angle | 52.3±13.2 | 57.23±12.74 | 0.1134 |
| Preoperative FEV1% | 62.3±13.5 | 81.47±19.88 | 0.0044 |
| Preoperative FVC% | 59.8±12.0 | 78.32±21.35 | 0.0066 |
| FEV1/FVC % | 107.79±10.5 | 104.02±15.4 | 0.440 |

## DISCUSSION

Scoliosis has a number of implications for the pulmonary function. In addition to reducing volume and conformity of the lung parenchyma as described previously, the portion of the spinal deformity on the transverse plane contributes to asymmetrical thorax deformity, which some regard as the fourth scoliosis dimension.[12,13] A deformed thoracic cage improves the stiffness of the chest wall and decreases breathability, and increases mechanical diaphragm instability[10,14]. These improvements are more prominent in early onset scoliosis five years ago and in congenial forms of fused ribs and vertebral abnormalities. The observed respiratory failure in patients is also restrictive[3].

In this study, the findings showed that the average value of FVC (%) was lower than 80% of the predicted normal value in congenital cases 59.8±12.0 as compared to idiopathic 78.32±21.35. The average predicted value of FEV1 was 62.3±13.5, mildly reduced in group A (Congenital) (<80% of the predicted normal value) as compared to group B (idiopathic) 81.47±19.88. The FEV1/FVC ratio was normal in both groups (>70% predicted).

In another study based on pulmonary impairment in idiopathic scoliosis patients, the results showed that average age of cases was 16.68±6.04 years. A majority of the patients were female (92.1%) patients. The average Cobb angle was 58.11±19.63. The mean preoperative FVC and FEV1 were 75.32%±20.05% and 80.47%±21.68%, respectively[10]. In another study based on pulmonary function impairment in congenital scoliosis patients, the mean FVC and FEV1 were 58.0±14.8 and 60.8±15.4 and the ratio of FEVA/FVC (%) was 104.8±10.7[6].

Our study had a drawback that the total number of patients was less, and no control group. The sample size was the study's limitation, and selection bias was another drawback of the study to draw the results significantly.

## CONCLUSION

Further studies should be conducted to help understand other causes that lead to congenital and idiopathic scoliosis. In summary, idiopathic and congenital scoliosis is a typical thoracic cage deformity with potentially serious and irreversible functions of the lung. Because pulmonary symptoms may only become clinically apparent until there are already substantial or irreversible improvements in the lung function, it is advisable to recognise the issue at an early stage and periodically assess the pulmonary function.

**Conflict of interest:** Nil

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