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Effect of Four Weeks of Respiratory Muscle stretch Gymnastics on Inspiratory Muscle Strength and Functional Capacity of Welders

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ABSTRACT

Context: Respiratory muscle stretch gymnastics (RMSG) has been proposed as a valuable additional form of rehabilitation for patients with respiratory diseases. Existing literature suggests that welders have an increased risk of chronic bronchitis, pneumoconiosis and impairment of pulmonary function.
Aim: This study aimed to investigate the effect of RMSG in welders.
Materials and Method: Welders from various workshops of Ahmedabad city were screened for this study. An Interventional study was conducted with 26 welders, purposively assigned to either an experimental group (EG) or a control group (CG). The EG performed 10 repetitions each of 5 patterns of RMSG, five times a week for four weeks, while the CG received no intervention. IMS was measured using a capsule sensing pressure gauge. Functional capacity was assessed using the six-minute walk test (6MWT) distance.
Results: After four weeks, the EG showed a significant increase in MIP (from 112.5 ± 3.535 cmH2O to 130 ± 14.142 cmH2O; $p < 0.05$) and 6MWT distance (from 524.5 ± 21.92 meters to 592.5 ± 38.890 meters; $p < 0.05$). The CG showed no significant change in either MIP or 6MWT distance.
Conclusion: Four weeks of RMSG significantly improved IMS and functional capacity of welders. This suggests that RMSG may be an effective intervention for improving respiratory health and exercise performance in welders.

Keywords: Respiratory Muscle, Welders, Inspiratory muscle strength

INTRODUCTION

Welding refers to any process of joining pieces of metal at joint faces that have been made soft or liquid by heat or pressure.[1] One of the most common processes, electric arc welding, is performed with hand held electrodes coated with suitable slag forming flux to protect the arc. The adverse health effects of welding come from chemical, physical, and radiation hazards. Common chemical hazards include particulates (lead, nickel, zinc, iron oxide, copper, cadmium, fluorides, manganese, chromium) and gases (carbon monoxide, oxides of nitrogen, ozone).[1] [2] Existing literature suggests that welders have an increased risk of chronic bronchitis, pneumoconiosis and impairment of pulmonary function.

Respiratory muscle stretch gymnastics (RMSG) has been proposed as a valuable additional form of rehabilitation for patients with respiratory diseases.[3] RMSG is designed to decrease chest wall stiffness, particularly in the chest wall respiratory muscles.[3] It involves 5 patterns in which inspiratory and expiratory muscles are stretched while inspiration and expiration respectively.

MATERIALS & METHODS

Subjects were enrolled in the study after screening various workshops of Ahmedabad. Individuals with age between 18-55 years with at-least one year of experience as a welder were selected. Individuals had to be Non-Smokers in order to be enrolled in the study. Individuals had to have absence of a musculoskeletal, respiratory disorder and any other comorbidity. This study was an Interventional study where 26 individuals who met the inclusion and exclusion criteria and consented to participate in the study were divided into Group A, an experimental group (n=13) and Group B, control group (n=13) purposively. The interventional group were taught Respiratory Muscle Stretch Gymnastics and were given a home-based protocol consisting of ten repetitions of each of five patterns to be followed for five days a week for four weeks. The control group received no intervention.

Respiratory muscle stretch gymnastics training program

Pattern 1: Patients were instructed to elevate and pull their shoulders back. Elevate and pull back both shoulders as you slowly breathe in through your nose. After taking a deep breath, slowly exhale through your mouth while relaxing and lowering your shoulders.

Pattern 2: Upper chest stretching uncross your hands on your chest. Pull your elbows back and down slowly while lifting your chin and taking a deep breath through your nose. Relax and exhale slowly through your mouth.

Pattern 3: Back muscle stretching keeps your hands clasped in front of your chest. As you slowly inhale through your nose, stretch your back by moving your hands forward and down. After a deep inspiration, slowly exhale and return to the original position.

Pattern 4: Lower chest stretching grasp the ends of a face towel at shoulder height with both hands outstretched. After taking a deep breath, raise your arms and slowly exhale. Lower your hands and breathe normally after a deep exhalation.

Pattern 5: Elbow elevation one hand should be held behind your head. Breathe deeply through your nose. Stretch your trunk by raising your elbow while slowly exhaling through your mouth.

Outcome Measures were Maximum Inspiratory Pressure and 6 Minute Walk Test Distance which are reflective of an individuals' Inspiratory Muscle Strength and Functional Capacity.

Maximum Inspiratory Pressure (PImax)

It was measured using a Capsule-Sensing Pressure Gauge.[4] The participants were made to be comfortably seated.[4] They were instructed to exhale slowly and completely, seal lips firmly around the new mouthpiece and 'pull in hard like they were trying to suck up a thick milkshake'.[4] The largest negative pressure that could be sustained for at least 1 second; Maximum Inspiratory Pressure was noted.[4] A rest period of 1 minute was given and the manoeuver was repeated thrice and best of the 3 readings was taken.[4]

6 MWT Distance - Was measured using ATS guidelines.[5]

The outcome measures of PImax and 6 MWT distance were collected at baseline and after 4 weeks for both the groups. Statistical analysis was done and results were prepared using the above data.

STATISTICAL ANALYSIS

For comparisons of pre and post outcome measures of both the groups, students' t-test was used. The level of significance was 0.05 and all the analysis were performed using SPSS version 21 (Chicago, IL, USA; IBM Corp.) software.

RESULT

	Maximum Inspiratory Pressure (PImax)	6 Minute Walk Test Distance	P value
Group A	112.5 ± 3.535 cmH2O to 130 ± 14.142 cmH2O	524.5 ± 21.92 meters to 592.5 ± 38.890 meters	For PImax: 0.002439 For 6 MWT distance: 0.000799
Group B	77.5 ± 3.53 cmH2O to 85 ± 7.071 cmH2O	523.5 ± 12.020 meters to 553 ± 35.35 meters	For PImax: 0.4930 For 6 MWT distance: 0.4326

Table 1: Presentation of changes in mean PImax and 6MWT distance in both groups

There was significant difference found in the maximum inspiratory pressure and 6 MWT distance of interventional group whereas the difference in maximum inspiratory pressure and 6MWT distance of the control group was not significant.

DISCUSSION

Many studies done in the past have shown that individuals involved in the profession of welding have increased risk of chronic bronchitis and Pneumosiderosis.[7] Over long exposure to this profession, there is increased risk of developing chest wall stiffness and tissue damage to lung parenchyma.[7] Reduced chest wall compliance has been associated to reduced inspiratory muscle strength which in turn reduces the functional capacity. RMSG helps improving chest wall compliance by stretching the chest wall respiratory muscle while breathing.[6] Thus, we aimed to evaluate the efficacy of Respiratory Muscle Stretch Gymnastics in improving inspiratory muscle strength and functional capacity of welders. After completion of the study, we found significant improvement in the interventional group for both inspiratory muscle strength and functional capacity. This observation could be attributed to various factors such as increased chest wall mobility caused by increased respiratory muscle extensibility. Our study demonstrates applicability of Respiratory Muscle Stretch Gymnastics for improving physiological and functional status of high-risk special population like that of welders. Smaller sample size and lack of stratification of participants based on years of experience can be considered limitations of our study and we recommend future studies with absence of these limitations.

CONCLUSION

On the basis of our result, we conclude that Respiratory Muscle Stretch Gymnastics improves Inspiratory Muscle Strength and Functional Capacity of welders. It should be used as a preventive as well as rehabilitative tool in this special population.

Declaration by Authors

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