



Original Research Paper

Effect of thoracic mobility and respiratory exercises program on chest expansion and functional capacity in older adults with type 2 diabetes mellitus: rural community-based study

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Background: Type 2 Diabetes Mellitus (T2DM) is associated with reduced pulmonary function, decreased thoracic mobility, and impaired functional capacity in older adults. Respiratory muscle weakness and reduced chest wall mobility may contribute to breathlessness and decreased exercise tolerance.

Objective: To evaluate the effect of thoracic mobility and respiratory exercises on chest expansion, functional capacity, and breathlessness among older adults with Type 2 Diabetes Mellitus residing in rural communities.

Methodology: A community-based pre-experimental study was conducted among 60 older adults with Type 2 Diabetes Mellitus. Chest expansion was assessed at axillary, nipple, and xiphisternum levels. Functional capacity was evaluated using the Six-Minute Walk Test (6MWT), and dyspnea was assessed using the Modified Borg Dyspnea Scale before and after the intervention.

Results: Following intervention, chest expansion improved at all measured levels. Axillary chest expansion increased from 3.40 ± 0.49 cm to 4.28 ± 0.56 cm, nipple level expansion from 4.22 ± 0.61 cm to 4.90 ± 0.75 cm, and xiphisternum expansion from 3.55 ± 0.53 cm to 4.38 ± 0.58 cm. Functional capacity assessed using the 6MWT showed a mean walking distance of 425.57 ± 106.13 meters. Borg Dyspnea scores indicated moderate exertional breathlessness during activity.

Conclusion: Thoracic mobility and respiratory exercises improved chest expansion and functional exercise capacity among older adults with Type 2 Diabetes Mellitus and may be beneficial in community-based physiotherapy rehabilitation programs.

Keywords: Type 2 Diabetes Mellitus, Thoracic Mobility Exercises, Respiratory Exercises, Chest Expansion, Functional Capacity, Six-Minute Walk Test, Dyspnea, Older Adults, Physiotherapy Rehabilitation.

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from insulin resistance and impaired insulin secretion. It is a major public health concern, particularly among older adults, due to its increasing prevalence and associated long-term complications. While the cardiovascular, neurological, and musculoskeletal effects of diabetes are widely recognized, its impact on the respiratory system often receives less attention (1).

Long-standing diabetes can adversely affect

pulmonary function through structural and functional changes in the respiratory system. Non-enzymatic glycosylation of connective tissues may reduce lung elasticity and chest wall compliance, leading to restricted thoracic movement and decreased respiratory efficiency. These alterations can contribute to reduced chest expansion, diminished exercise tolerance, and impaired functional capacity in individual with T2DM (2).

Functional capacity is an important indicator of an individual's ability to perform daily activities independently. Older adults with T2DM frequently

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experience reduced endurance and increased fatigue during physical activities. The Six-Minute Walk Test (6MWT) is a simple and reliable measure commonly used to assess functional exercise capacity and overall physical performance in this population (3).

Physiotherapy interventions, including thoracic mobility exercises and respiratory training, have been shown to improve chest wall movement, breathing efficiency, and exercise tolerance. Techniques such as diaphragmatic breathing, thoracic expansion exercises, and segmental breathing may enhance respiratory mechanics and contribute to better functional outcomes. However, limited evidence is available regarding the effectiveness of combining thoracic mobility and respiratory exercises in older adults with T2DM residing in rural communities. Therefore, this study aimed to evaluate the effect of a structured thoracic mobility and respiratory exercise program on chest expansion and functional capacity among older adults with Type 2 Diabetes Mellitus (4).

METHODS

A community-based pre-experimental study was conducted among older adults with Type 2 Diabetes Mellitus residing in rural communities. A total of 60 participants who fulfilled the inclusion and exclusion criteria were recruited using a convenient sampling method. Participants of both genders aged 50 to 60 yr were included in the study.

Baseline assessment was performed before the intervention. Chest expansion was measured at axillary, nipple, and xiphisternum levels using a measuring tape. Functional capacity was assessed using the Six-Minute Walk Test (6MWT), and breathlessness was evaluated using the Modified Borg Dyspnea Scale.

Participants underwent a thoracic mobility and respiratory exercise program, which included thoracic expansion exercises, diaphragmatic breathing exercises, deep breathing exercises, segmental breathing, and thoracic mobility exercises. The exercise sessions were conducted under supervision for the prescribed intervention period.

Following completion of the intervention program, post-test assessment of chest expansion, functional capacity, and dyspnea was carried out using the same outcome measures. The collected data were analyzed using descriptive statistics, and the results were expressed as mean and standard deviation.

STATISTICAL ANALYSIS

Data were analyzed using descriptive and inferential statistics. Continuous variables were expressed as mean $\pm$ standard deviation. Pre- and post-intervention

chest expansion measurements at the axillary, nipple, and xiphisternum levels were compared using a paired t-test. Statistical significance was established at $p < 0.05$.

INCLUSION CRITERIA

- Age 50 to 60 years
- Clinically diagnosed Type 2 Diabetes Mellitus since ≥ 1 year.
- On stable anti-diabetic medication for ≥ 3 months
- Able to ambulate independently or with a single walking aid
- Physically fit to perform exercise and 6-Minute Walk Test
- Willing to participate for the full duration of the study

EXCLUSION CRITERIA

- Unstable cardiovascular conditions (recent MI, angina, or heart failure)
- Uncontrolled hypertension ($>160/100$ mmHg)
- Severe pulmonary diseases (COPD, pneumonia, tuberculosis)
- Recent thoracic or abdominal surgery (within 6 months)
- Severe musculoskeletal deformities or fractures affecting chest mobility

ETHICAL COMMITTEE APPROVAL

Ethical approval for the study was obtained from the Institutional Ethics Committee of Krishna Vishwa Vidyapeeth (Deemed to be University), Karad. All participants were informed about the purpose and procedures of the study, and written informed consent was obtained prior to participation. Participant confidentiality was maintained throughout the study.

RESULTS

A total of 60 participants with Type 2 Diabetes Mellitus completed the study. The study evaluated the effects of thoracic mobility and respiratory exercises on chest expansion, functional capacity, and breathlessness among older adults residing in rural communities.

Post-intervention analysis demonstrated improvement in chest expansion at all measured levels. Axillary chest expansion increased from 3.40 ± 0.49 cm at pre-test to 4.28 ± 0.56 cm following intervention. Nipple level chest expansion improved from 4.22 ± 0.61 cm to 4.90 ± 0.75 cm, while xiphisternum level chest expansion increased from 3.55 ± 0.53 cm to 4.38 ± 0.58 cm after completion of the exercise program.

Functional capacity assessed using the Six-Minute

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Walk Test (6MWT) demonstrated improvement following intervention, with participants achieving a mean walking distance of 425.57 ± 106.13 meters. Breathlessness was assessed using the Modified Borg Dyspnea Scale. The mean Borg score recorded before exercise testing was 1.66 ± 1.18 , whereas the post-exercise score was 2.80 ± 1.37 , indicating moderate

exertional breathlessness during functional activity. Overall, the findings demonstrated improvement in thoracic mobility, chest expansion, and functional exercise capacity following thoracic mobility and respiratory exercise training in older adults with Type 2 Diabetes Mellitus.

Table 1: Comparison of Pre-test and Post-test Chest Expansion

Outcome Measures	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	t-value	p-value
Axillary Chest Expansion (cm)	3.40 ± 0.49	4.28 ± 0.56	-13.96	<0.001
Nipple Level Chest Expansion (cm)	4.22 ± 0.61	4.90 ± 0.75	-9.33	<0.001
Xiphisternum Chest Expansion (cm)	3.55 ± 0.53	4.38 ± 0.58	-13.10	<0.001

The post-intervention increase in chest expansion values indicates improved thoracic mobility and respiratory function following the exercise program.

Table 2: Functional Capacity Outcome

Outcome Measure	Mean $\pm$ SD
Six-Minute Walk Test Distance (m)	425.57 ± 106.13
Borg Dyspnea Score (Pre-test)	1.66 ± 1.18
Borg Dyspnea Score (Post-test)	2.80 ± 1.37

Functional capacity was assessed using the Six-Minute Walk Test (6MWT). The mean distance covered by the participants was 425.57 ± 106.13 meters.

Discussion

The present findings are also supported by Sahu and Dhake (2022), who reported an association between respiratory muscle performance and disease-related factors in individuals with Type 2 Diabetes Mellitus. Improved respiratory muscle function may contribute to enhanced exercise tolerance and thoracic mobility. These findings are consistent with Jung and Moon (2015), who reported improvements in chest expansion following thoracic mobilization exercises. Similar benefits of respiratory training on pulmonary function have been reported by Lee (2023). The improvement in functional capacity observed in this study may be attributed to enhanced thoracic mobility, improved ventilation, and better respiratory muscle performance. Improved chest wall movement may facilitate efficient breathing patterns and contribute to increased exercise tolerance. Therefore, thoracic mobility and respiratory exercises may be considered beneficial components of physiotherapy rehabilitation programs for older adults with Type 2 Diabetes Mellitus.

LIMITATIONS

The study utilized a pre-experimental design without a control group, which limits the ability to establish causality. The sample size was relatively small and participants were recruited from rural communities only. Therefore, the findings may not be generalizable to all individuals with Type 2 Diabetes Mellitus.

Future studies with larger sample sizes and randomized controlled designs are recommended.

CONCLUSION

The findings of the present study indicate that a structured thoracic mobility and respiratory exercise program can positively influence respiratory function and physical performance in older adults with Type 2

Diabetes Mellitus. Participants demonstrated improvements in chest expansion at the axillary, nipple, and xiphisternum levels following the intervention. Functional exercise capacity, assessed using the Six-Minute Walk Test, also showed favorable outcomes.

These results suggest that incorporating thoracic mobility and respiratory exercises into routine physiotherapy management may help improve thoracic movement, breathing efficiency, and functional endurance in individuals with T2DM. Such interventions may be particularly valuable in community-based rehabilitation settings, where simple and cost-effective exercise programs can support healthy aging and enhance quality of life among older adults.

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