

Effect of Balloon Blowing Exercise and Liuzijue Exercise on Peak Expiratory Flow Rate (PEFR) in Third Trimester Pregnant Women: A Comparative Study

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Abstract:

➤ *Background:*

Pregnancy is associated with various anatomical and physiological changes, particularly affecting the respiratory system. During the third trimester, lung volumes and pulmonary function parameters such like Peak Expiratory Flow Rate (PEFR) are reduced. Breathing exercises are considered beneficial during third trimester of pregnancy.

➤ *Objective:*

To compare the effectiveness of balloon blowing exercise and Liuzijue exercise on Peak Expiratory Flow Rate (PEFR) in third-trimester pregnant women.

➤ *Methods:*

A comparative experimental study was conducted on third-trimester pregnant women. The participants were randomly divided into two groups: Group A (Balloon Blowing Exercise, n = 20) and Group B (Liuzijue Exercise, n = 20). PEFR was measured using a peak expiratory flow meter before and after the intervention period.

➤ *Results:*

Both groups showed a statistically significant improvement in PEFR following the intervention. On comparison, Group B demonstrated a significantly greater improvement in PEFR than Group A ($p < 0.05$), indicating the superior effectiveness of Liuzijue exercise.

➤ *Conclusion:*

Liuzijue exercise was found to be more effective in enhancing respiratory function involving controlled breathing, diaphragmatic activation, and relaxation.

Keywords: *Pregnancy, Third Trimester, Peak Expiratory Flow Rate, Balloon Blowing Exercise, Liuzijue Exercise, Antenatal Physiotherapy.*

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I. INTRODUCTION

Pregnancy can be referred to the time period in which the foetus develops inside the woman's womb or uterus. Pregnancy lasts for about 40 weeks, or 9 months and 1 week, from the start of the last menstruation period until the time of

giving birth. Health practitioners have divided the time of pregnancy into three stages, referred to as "trimesters." Important events in each trimester of pregnancy are listed below¹.

➤ *Balloon Blowing Exercise (BBE):*

Blowing balloons helps improve the body's oxygen levels, enabling individuals to remain active for longer periods without experiencing breathlessness or fatigue. Oxygen plays a key role in restoring energy to cells and muscles by supporting glucose metabolism and fuel production. Regular practice, such as inflating 10 to 20 balloons daily, can gradually increase lung capacity and improve the body's ability to maintain sufficient oxygen levels over time. Balloon blowing exercises also strengthen the respiratory muscles and assist in lifting the rib cage, allowing the lungs to expand more effectively. As the balloons are slowly inflated, multiple muscle groups are engaged, leading to improved stamina, increased lung capacity, and better oxygen saturation⁷. The exercise involves blowing balloons with the help of intercostal muscles, which stretches and raises the diaphragm and ribs to allow the lungs to inhale oxygen and exhale carbon dioxide. Therefore, this current study proposed to investigate the impact of balloon blowing exercises on PEFR in third trimester pregnant women².

Peak Expiratory Flow Rate is more of a measure of airflow in the larger airways and relies on voluntary effort as well as muscle strength; the greatest airflow occurs during the effort stage of exhalation, so a low expiratory rate indicates poor effort rather than airway obstruction. The calculation of the Peak Expiratory Flow is done through the use of the "Peak Flow Meter". The "Peak Flow Meter" is a small portable device which indicates the rate at which air is expelled from the lungs when one forces a blow after taking a gasp of air. In this way, the breathing capacity of an individual can be assessed in relation to this aspect⁸.

➤ *Liuzijue Exercise (LE):*

Liuzijue exercise was developed by the China Qigong Management Centre, is very safe and effective. It stresses the necessity of the activities involved in meditation and exercise. It regulates the exhalation process using 6 various mouth forms, namely "Xu, He, Hu, Si, Chui, and Xi." Liuzijue exercise, therefore, regulates and controls the breathing rates in people, in addition to the functions of the breathing muscles⁷. Liuzijue exercise is based on a global pattern. The notion is helpful in promoting blood circulation in all body parts, as well as improving respiratory functions¹¹.

II. METHOD AND METHODOLOGY

➤ *Study Design:*

The present study was designed as a Comparative study to determine the effectiveness of Balloon blowing exercise and Liuzijue exercise on Peak Expiratory Flow Rate (PEFR) among third trimester pregnant women. Ethical approval was obtained from the Institutional Ethics Committee of Dr. APJ Abdul Kalam College of Physiotherapy, Pravara Institute of Medical Sciences (PIMS), Loni (Approval Number: PIMS/DR.APJAKCOPT/IEC/2025/765). All procedures were carried out in accordance with institutional and national ethical guidelines. Written informed consent was obtained from each participant in their native language prior to inclusion in the study. The research was conducted in the

OPD 101, Department of Obstetrics and gynaecology, Pravara rural hospital, Loni, Maharashtra, India. Participants were recruited in coordination with the Departments of Medicine and Obstetrics and Gynaecology (OPD) at Dr. Vitthalrao Vikhe Patil Pravara Rural Hospital under Pravara Institute of Medical Sciences.

➤ *Sample Size*

A total of 40 third trimester pregnant women were enrolled in the study. Participants were randomly assigned to two groups using a lottery method in an open-label manner.

• *Inclusion Criteria:*

- ✓ Women with reduced expiratory capacity.
- ✓ Third trimester pregnant women.
- ✓ Willingness to participate and perform the prescribed techniques regularly.

• *Exclusion Criteria:*

- ✓ Non-pregnant women.
- ✓ Women who are not willing to do exercises.
- ✓ Women with normal respiratory functions.

➤ *Procedure*

Participants were allocated into two intervention groups in a 1:1 ratio using an open-label design, where both researchers and participants were aware of group allocation. Group A received Balloon Blowing Exercise, and Group B received Liuzijue Exercise with. The intervention period lasted four weeks.

• *Group A – Balloon Blowing Exercise*

Participants were positioned in high sitting position on a chair. Pillows were provided behind their back when necessary to enhance comfort. The participants were instructed to position the balloon in their mouths, take a deep inhalation through the nose, and rest their tongues against the roof of the mouth. Maximum volume intake for three to four seconds was followed by an exhale for 8 to 10 seconds, with an interval of two to three seconds at the conclusion of the exhalation.

Each session consisted of ten repetitions per set, with two sets performed daily, three days per week, for four weeks. Safety precautions included avoiding forceful or excessively prolonged expiration to reduce the risk of bronchospasm, minimizing the use of accessory respiratory muscles, and limiting deep breathing to three to four consecutive cycles to prevent hyperventilation.

• *Group B – Liuzijue Exercise*

Participants in Group B Performed Liuzijue Exercise. For LE, participants were seated comfortably on a chair. A controlled exhalation was taught to perform by utilizing 6 distinct mouth forms of "Xu, He, Hu, Si, Chui, and Xi. Breathing was maintained in a natural and relaxed manner through the nose. During each exhalation, participants utilized the mouth forms, maintaining a passive attitude. This

approach managed and oversaw the breathing rate in individuals and the functions of respiratory muscles.

The relaxation session lasted approximately 30 minutes and was practiced once a daily, three days per week, for four weeks. It also supported mental well-being of the patient.

➤ *Outcome Measures*

The outcome measure was Peak Expiratory Flow Rate.

Peak Expiratory Flow Rate is more of a measure of airflow in the larger airways and relies on voluntary effort as well as muscle strength; the greatest airflow occurs during the effort stage of exhalation, so a low expiratory rate indicates poor effort rather than airway obstruction. The calculation of the Peak Expiratory Flow is done through the use of the “Peak Flow Meter”. The “Peak Flow Meter” is a small portable device which indicates the rate at which air is expelled from the lungs when one forces a blow after taking a gasp of air. In this way, the breathing capacity of an individual can be assessed in relation to this aspect.

PEFR readings are commonly interpreted using a color-coded zone system in which the Green zone means 80–100% of the predicted or personal best PEFR value and it indicates good airway function with effective breathing control, the Yellow zone means 50–79% of the predicted or personal best value and suggests caution, as airflow is reduced and breathing may be compromised and the Red zone means less than 50% of the predicted or personal best value and signals severe airway limitation. The Normal value is 100-850 litres/min. Peak Flow Meter is used to monitor the Peak Expiratory Rate.

- Statistical Analysis: Data were analysed using Instat software. Paired and unpaired t-tests were applied. Significance was set at $p < 0.05$.



Fig 1 Outcome Measures

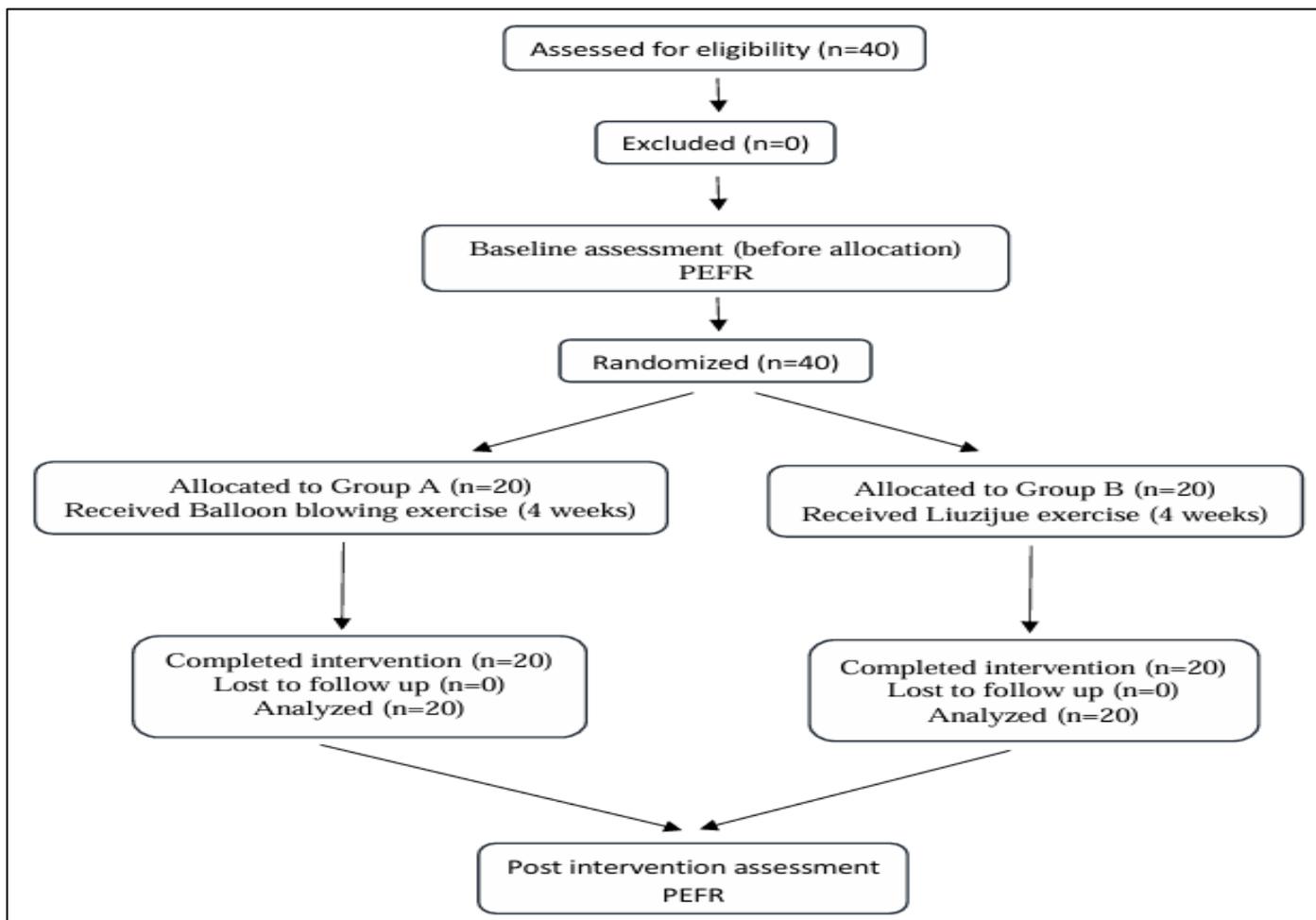


Fig 2 Consort Flow Diagram

III. RESULTS

A total of 40 third trimester pregnant women completed the study, with 20 participants allocated to each group. Group A received balloon blowing exercise, while Group B received Liuzijue exercise. Outcome measure was PEFR. Data were analysed using paired t-tests for within-group comparisons and unpaired t-tests for between-group comparisons. Results were presented as mean ± standard deviation.

Following the intervention, Group A demonstrated statistically significant improvement across the outcome measure. Mean PEFR showed a significant improvement from pre-intervention to post-intervention values ($p = 0.0001$). The finding indicates that balloon blowing exercise was effective in improving PEFR in third trimester pregnant women. The pre- and post-intervention comparisons for Group A are illustrated in Figure 3.

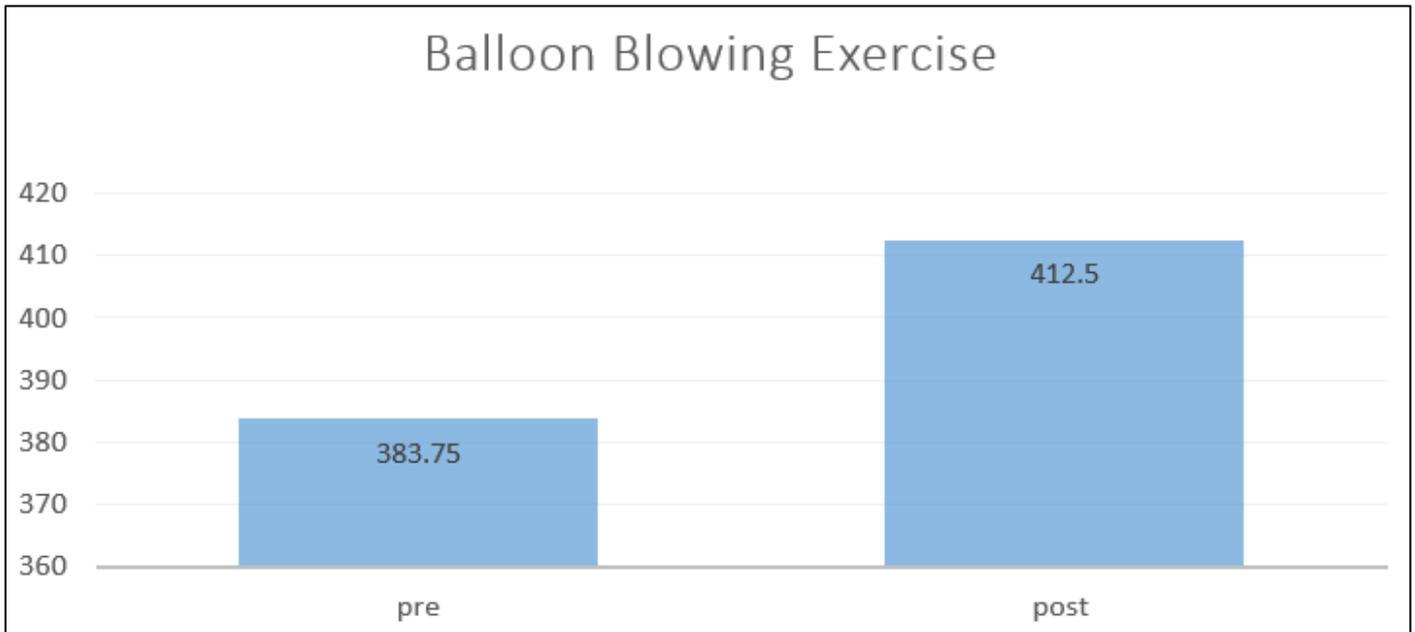


Fig 3 (PRE-POST Intervention Comparisons)

Group B shows that the post-intervention PEFR of Group B (Liuzijue Exercise) has increased from 398.25 ± 50.83 L/min to 445 ± 49.74 L/min. This change is statistically significant with $p < 0.05$, demonstrating a significant

improvement in Peak Expiratory Flow Rate in Group B following the Liuzijue exercise. The pre- and post-intervention comparisons for Group B are illustrated in Figure 4.

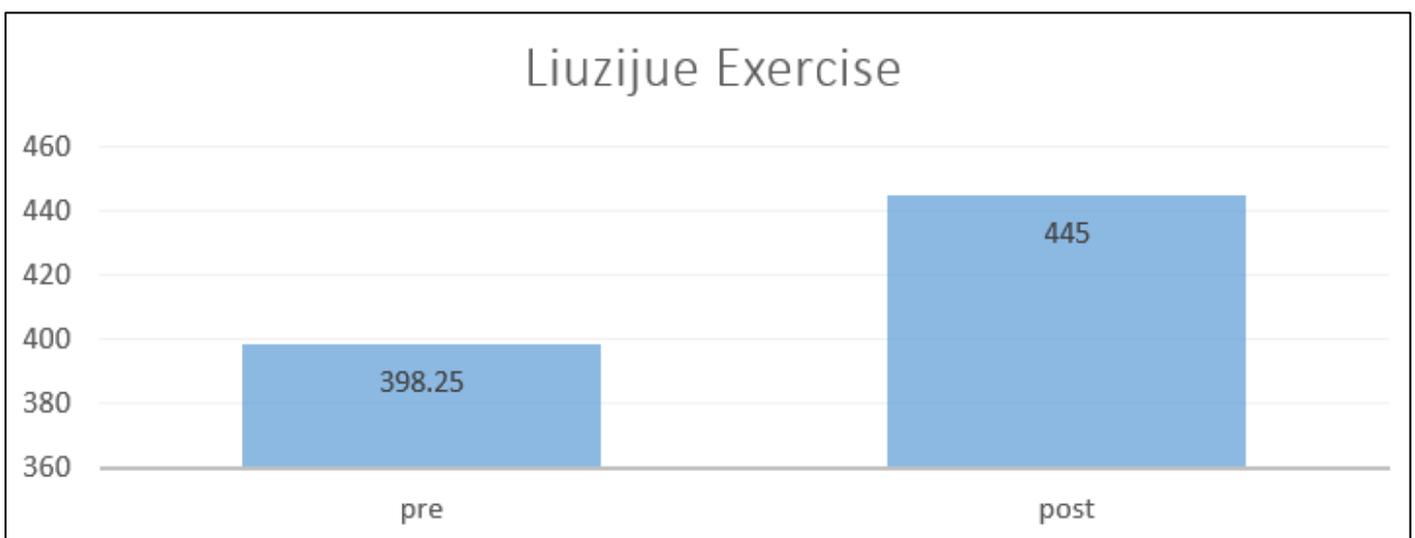


Fig 4 (PRE-POST Intervention Comparisons)

Post-intervention comparison between Group A and Group B revealed a statistically significant difference in PEFR values, with Group B demonstrating a greater

improvement in PEFR compared to Group A ($p = 0.0287$). The comparative post-intervention outcomes between both groups are presented in Figure 5.

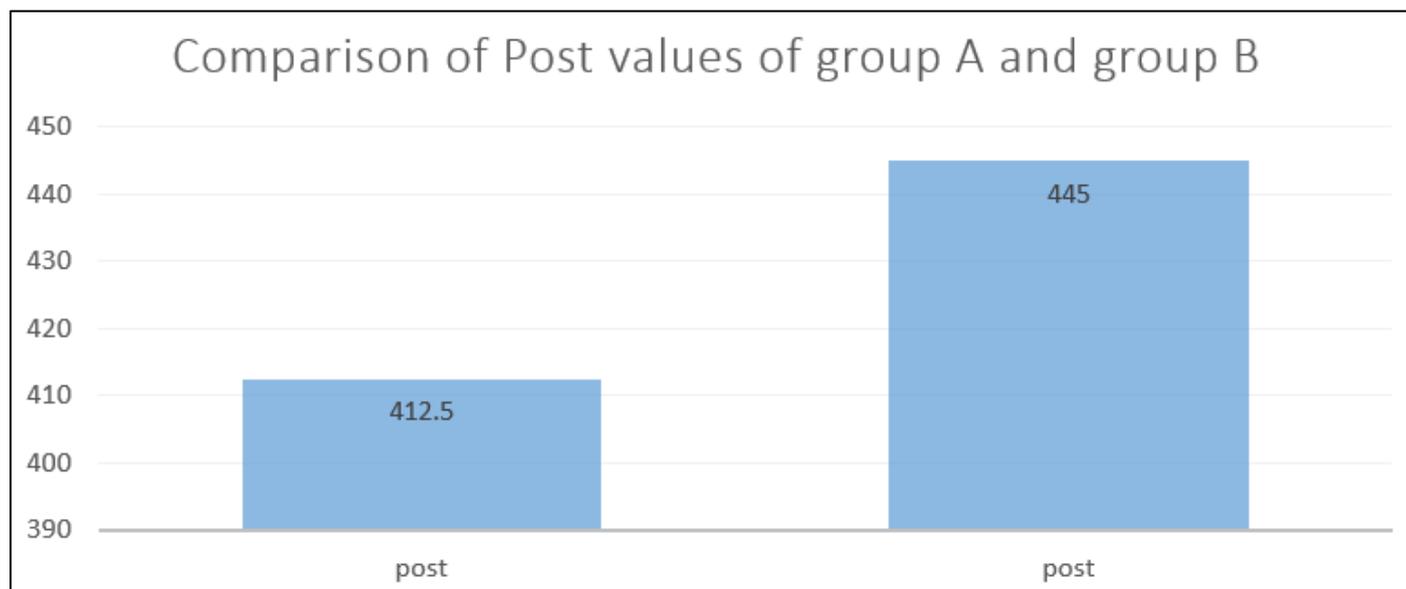


Fig 5 (Comparative Post- Intervention in Between Groups)

IV. DISCUSSION

Pregnancy represents a complex physiological condition marked by extensive anatomical, hormonal, and functional adaptations that support foetal growth and maternal health. Among the various systems affected, the respiratory system undergoes notable changes, particularly during the later stages of pregnancy. In the third trimester, continuous enlargement of the uterus leads to an upward shift of the diaphragm, alterations in rib cage configuration, and a reduction in thoracic compliance. These changes limit the expansion of the lungs, resulting in decreased lung volumes and compromised ventilatory efficiency. As a consequence, pulmonary function parameters such as Peak Expiratory Flow Rate (PEFR) tend to decline. Considering these physiological challenges, the present study was designed to evaluate and compare the effectiveness of balloon blowing exercise and Liuzijue exercise in improving PEFR among women in their third trimester of pregnancy.

The primary aim of this study was to evaluate the effectiveness of balloon blowing exercise and Liuzijue exercise on peak expiratory flow rate in third trimester pregnant women. The findings indicate that both interventions were effective in improving these outcomes. Intragroup analysis demonstrated significant improvement in PEFR following intervention in both groups. Intergroup analysis revealed that the Liuzijue exercise produced a significantly greater improvement in PEFR compared to balloon blowing exercise.

Participants in Group A, who performed balloon blowing exercises, showed a marked increase in PEFR after the intervention. Balloon blowing exercise primarily targets the expiratory phase of breathing by encouraging forceful and prolonged exhalation. This activity requires active recruitment of the abdominal and intercostal muscles, leading to improved expiratory muscle strength and endurance. Strengthening these muscles enhances the ability to generate

higher expiratory pressures, thereby increasing airflow through the large airways. Additionally, balloon blowing may improve lung emptying efficiency and reduce air trapping, contributing to the observed improvement in PEFR. These findings support the use of balloon blowing exercise as an effective and simple respiratory training method during pregnancy.

In contrast, participants in Group B who practiced Liuzijue exercise demonstrated a statistically significant and comparatively greater improvement in PEFR. Liuzijue exercise is a traditional breathing technique that emphasizes slow, rhythmic, and controlled breathing patterns combined with gentle body movements and focused mental relaxation. This form of exercise promotes effective diaphragmatic breathing, prolongs the expiratory phase, and enhances coordination between respiratory muscles. By encouraging diaphragmatic activation rather than reliance on accessory muscles, Liuzijue exercise facilitates more efficient ventilation and improved lung mechanics. Furthermore, the mental relaxation component of Liuzijue exercise may reduce stress-related muscle tension and anxiety, which are known to adversely affect breathing patterns.

Based on the findings of the present study, Liuzijue exercise may be considered a preferable intervention due to its greater effectiveness and additional benefits related to relaxation and breathing control. The integration of physical and mental components makes Liuzijue exercise particularly suitable for pregnant women, as it addresses both physiological and psychological aspects of maternal well-being.

V. CONCLUSION

Clinically, both balloon blowing exercise and Liuzijue exercise represent simple, cost-effective, and safe interventions that can be easily incorporated into routine antenatal physiotherapy programs. The present study shows

that the normal anatomical and physiological changes that occur during the third trimester of pregnancy have a clear impact on respiratory function, resulting in a noticeable reduction in Peak Expiratory Flow Rate (PEFR). As the uterus enlarges, it pushes the diaphragm upward and alters chest wall movement, making breathing less efficient. This highlights the need for suitable respiratory interventions during the later stages of pregnancy.

The results of this study indicate that breathing exercises are safe, simple, and cost-effective methods that can be easily incorporated into antenatal physiotherapy programs to improve respiratory efficiency in third-trimester pregnant women. Among the two exercises studied, Liuzijue exercise appears to be a more effective and practical option due to its combined physical and mental benefits, making it a valuable addition to routine antenatal care.

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