Effect of Pilates mat exercises on Chest Expansion, Q angle and Body fat Percentage in Male Smokers

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Abstract
Background: The purpose of this study is to find out the positive effects of Pilates mat exercises on chest expansion level, Q- angle and Body fat Percentage.
Methods: 40 clients were selected by convenient sampling at JSPL, Delhi who were divided into two groups consisting of the experimental group and control group each of 20 members. It was an experimental study which was carried out for 3 months. The inclusion criteria include clients of age 30 to 50 years males, smokers, sedentary lifestyle, disease free, BMI<24.9, up to 5 to 10 cigarettes per day. The exclusion criteria include patient with recent recent cardiac surgery and arrest, acute Pulmonary embolism, any cardio pulmonary surgery in between 6 months before study, any neurological deficit, any musculoskeletal deformity.
Findings: The results represent that both the Groups (group 1 experimental group and group 2 control group are effective in decreasing Q angle and Body Fat Percentage and Increasing Chest expansion Level in male smokers but Group 2 (Experimental group) is more effective in decreasing Q angle and Body Fat Percentage and Increasing Chest expansion Level in male smokers then group 2 (Control group)
Interpretation: The conclusion of this study show that Group 2 (Experimental group) is more effective in decreasing Q angle and Body Fat Percentage and Increasing Chest expansion Level in male smokers than Group 1 (Control group) for reducing body fat and increasing chest expansion levels in men who smoke e-cigarettes.
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Keywords: Pilates, Body fat, Chest expansion, Q-angle

I.   Introduction

Joseph Hubertus was the first to invent Pilates. Pilates is a popular form of exercise treatment that promotes physical strength, flexibility, control, and core stability, among other things [1]. It's been widely used in the management and inhibitor of musculoskeletal problems. Strength, core stability, flexibility, muscle control, and posture are all addressed in this exercise therapy [2]. This method has developed into a useful therapeutic tool for the prevention and recovery of a wide range of injuries [3]. Pilates is a popular exercise that can be done with or without equipment and consists of isometric contraction exercises that are easy to manage at low frequencies and enhance the skeleton-muscle system [4].

The goal of this study is to see if the Pilates method, as a complementary type of exercise, can help obese adults improve their pulmonary function and functional ability [5]. The goal of the study was to see if Pilates might be used as an innovative intervention for obese individuals with respiratory problems. Pilates has been shown to be beneficial in enhancing chest capacity and expansion, as well as lung volume, in investigations with various populations [6]. This is because Pilates operates through the centre of force, which is made up of abdominal muscles and lumbar gluteus muscles, and is responsible for the stabilisation of the static and dynamic body, as well as breath control. Different Pilates movements have been shown to promote the activation and recruitment of the abdominal muscles. Through the stimulation of diaphragmatic movement, those muscles are vital in respiration, both in expiration and inspiration. As a result, abdominal muscular strengthening can aid respiratory function, resulting in increased lung volume and capacity [1,3,4].

Various research involving a variety of people have revealed that pilates workouts have varying impacts on the heart and pulmonary systems. Pilate's exercise was proven to raise maximal inspiratory and maximal expiratory pressures in cystic fibrosis patients. The current study's goal was to perform a systematic review of literature to synthesise the evidence on the influence of pilates activities on respiratory function, based on these findings and the fact that breathing is the most important factor in pilates exercises. If the research confirms these findings, pilates rehabilitation may be recommended when the goal is to enhance pulmonary

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function and static respiratory pressures in a variety of situations [5,7,8]. The Q angle is the angle of the knee as seen from the front. The Q-angle displays how the thigh muscles move the knee and how the patella (knee cap) tracks in the knee joint groove. A normal knee cap should move up and down within the groove during flexion and extension of the knee. When the Q angle is excessively high, the knee cap tends to track out of alignment, producing wear and tear (degeneration) of the cartilage behind the knee cap. The intersection of two lines creates a Q angle. The first line connects the ASIS (bony projection at the front of the pelvis) to the centre of the patella. The second line runs from below the patella to the middle of the knee cap, extending from the tibial tuberosity (protrusion on the top of the shin bone) [9].

Many knee injuries in active people are caused by the Q angle. However, incorporating a conditioning programme that focuses on strengthening the muscles around the knee can help to lessen the risk of injury. Pilates provides a variety of low-impact workouts that also improve knee muscular strength and stability. Pilates, especially mat Pilates, is great for strengthening the muscles surrounding the knees and preventing damage. Pilates exercises are also impact-free, as your knee isn't overloaded with extra weight, causing it to surge through your joint at an oblique (non-vertical) angle. However, to get the most out of Pilates, you must concentrate on the vastus medialis, the star muscle of the knee [10,11,12]. Pilates focuses on the muscles of the core (also called the powerhouse). Both stability and suppleness are emphasized in Pilates movements. Pilates's workouts involve both closed and open kinetic chain movements and its movements emphasizes on both concentric and eccentric muscular contractions and work muscles both statically and dynamically. Its exercises are designed to be functional and emphasizes the significance of proper breathing. Pilates is a type of conditioning that involves both the mind and the body and it can be tailored to a variety of patient demographics. The apparatus of pilates is both safe and simple to use (with proper training). Anyone looking to expand their wellness offerings might consider Pilates as a viable option [13,14,15].

Pilates is based on a set of concepts that include awareness, balance, breath, focus, Centre, control, efficiency, flow, precision, and harmony. Relaxation, focus, alignment, breathing, centering, coordination, control, movement flow, and stamina are some of the core characteristics of pilates [1,3]. The objective of this study to find out the effectiveness of pilates mat exercise on chest expansion, Q- angle, body fat (%).

II.   Material And Methods

40 clients were selected by convenient sampling at JSPL, Delhi who were divided into two groups consisting of the experimental group and control group each of 20 members. It was an experimental study which was carried out for 3 months. The inclusion criteria include clients of age 30 to 50 years males, smokers, sedentary lifestyle, disease free, BMI<24.9, up to 5 to 10 cigarettes per day. The exclusion criteria include patient with recent recent cardiac surgery and arrest, acute Pulmonary embolism, any cardio pulmonary surgery in between 6 months before study, any neurological deficit, any musculoskeletal deformity.

Instruments and tool used
•   Inch Tape measured Body Circumference and Chest expansion level.
•   Goniometer measure Q- Angle
•   Body fat percentage measured by body fat formula

Procedure

Table 1: Three phases representing different level

Phase 1 1 to 3 weeks (Basic level)	Phase 2 4 to 6 weeks (intermediate level)	Phase 3 7 to 9 weeks (Advanced level)
• Warm up 5 to 10 minutes • Basic hundreds • Bridging • Ab prep • 4 point kneeling • Cobra • Single leg stretch • Table top with toe touch • Criss ctross • Shell stretch • Side leg circles • Cool down exercises 5 to 7 minutes	• Warm up 5 to 10 minutes • Intermediate hundreds • Double table top without toe touch • Double leg stretch • Straight leg bridging • Oblique bicycle with ab prep • Side leg banana • Spinal rotation • Clam shell • Rolling like a ball • Cool down exercises 5 to 7 minutes	• Warm up 5 to 10 minutes • Advanced hundreds • Double table top without toe touch with ab prep • Spine twist • Half roll back with rotation • Seal • Side kick lift • Plank bridge • Jacknife • Side bridges on knees • Cool down exercises 5 to 7 minutes

- 40 to 45 minutes session
- 4 days/week

❑ Phase 1 (Basic level)- Basic level 1 exercises (2 weeks protocol: The hundreds, Ab prep, Double table top with toe touch, Bridging, Cobra, single leg stretches and 4-point kneeling).

❑ Basic level 2 exercise (3rd week protocol: continue with same and some exercise added shell stretch, Single leg circles and Criss cross)

❑ Phase 2 (Intermediate level)- Intermediate level 1 exercises (4-week protocol: intermediate hundreds, double table top without toe touch, straight leg bridging, double leg stretches and clamshell).

❑ Intermediate level 2 exercises: (5th and 6th week protocol) Double leg kick, oblique bicycle with Ab prep, side leg banana, spinal rotation and rolling like a ball.

❑ Phase 3 (Advanced level 1 exercise): (7th week protocol) Advanced Hundreds, Double table top with Ab prep and without toe touch, half roll back with rotation, opposite arm and leg raise, seal, side kick lift.

❑ Advanced level 2: (8th and 9th week protocol): Spine twist, plank bridge, side bridge on knees, Jac knife and seal.

❑ Level 1 exercise performed (Basic, intermediate and advanced) each and every exercise performed 7 to 8 minutes and 10 repetitions each exercise.

❑ Level 2 exercise performed (Basic, intermediate and advanced) each and every exercise performed 4 to 5 minutes and 10 repetitions each exercise.

Group 2 (Control group): Exercise programme
- 40 to 45 minutes session
- 4 days/week
- 8 to 10 repetitions each exercise
- 3 months protocol
- Warm up period before the exercise 7 to 10 minutes
- Cool down period after the exercise 5 to 7 minutes

Table 2: Detailed exercise programme

First 45 days	Next 45 days
• Basic Hundred	• Spinal rotation
• Bridging	• Rolling like a ball
• Ab prep	• Cat stretch
• 4-point kneeling	• Double table top with toe touch
• Single leg stretch	• Arm circles
• Double leg stretch	• Hip release
• Straight leg bridging	• Knee hug
• One leg circle	• Criss cross
• Side leg banana	• Shell stretch
• Hip clamshell	• Side bridge on knees

Basic Principles with each exercise
1. Breathing
2. Finding neutral
3. Lumbar stabilisation
4. Rib cage placement
5. Scapulae movement/ stabilisation
6. Head and neck position

Breathing
- Lateral thoracic breathing- breathe deep & wide into ribcage & lower lungs
- Breathe in to prepare (wide & deep)
- Breathe out melting down ribcage
- Breathe in to recover, out to relax

Breathing out with movement encourages activation stabilisers & stops you creating unnecessary tension

Finding neutral
Neutral allows:
- Local stabilisers activate easier in this position
- Lessen arch to reduce pressure on joints & nerves
- Lengthens spine

- Facilitates use abdominals as oppose to overactive back muscles

Balances head, neck, shoulders & ribcage to bring body into perfect alignment

Lumbar stabilisation
❑ **Pelvic floor**
- Femurs together
- Lift up spine
- Sub maximal contraction (15%)
❑ **Transversus abdominis**
- Sinking lower belly to make distance between stomach & lower back smaller & smaller.
- Sub maximal contraction (15%)
- Function- flatten stomach, core strength, segmental protection & lengthening of spine.
❑ **Multifidus**
- Don't grip lower back (gentle contraction)
- Grow taller without losing neutral, draw lower back muscles to belly button
- Mind body connection
- Function: deep segmental stabiliser
❑ **Psoas**
- Shorten leg into hip socket without spinal/ pelvic movement
- Function: deep stabiliser spine, creates stiffening in spine
- Stabilises hip joint
- Diaphragm
- Gluts
- Iliacus
- Pectineus
- Adductor brevis

Rib cage placement
- Soften ribs with exhale
- Ribs must slide down towards pelvis without 'jamming' into back
- Do not 'pop' ribs out
- Don't allow ribs to deviate forward in sitting
- Breathe into post lateral aspect ribcage
- Tight Thoracic results in difficulty breathing & ribcage movement

Scapulae movement & stabilisation
- Scapulae melting onto ribcage and slightly down & out towards hips
- 'pump' muscle behind arms

Head and neck positions
- Lift head as if hanging from a string
- Keep soft chin to maintain length in back of neck (peach under chin)

(Length stretches posterior neck muscles & strengthens anterior neck muscles)

Basic useful terms use before pilates
- Inhale through nose
- Exhale through mouth
- Inhale to prepare
- Exhale on movement
- Keep ribs connected
- Scoop belly button in to spine
- Pump muscles behind the arm
- Nod the head
- Lengthen
- Relax shoulders
- Zip up/ hollowing

Clients in both the groups was reassessed after 3 months of Pilates mat exercise programme (Q- angle measured with the help of Goniometer, Chest expansion level measured with the help of inch tape and Body fat percentage (%) measured with the help of Body fat formula in male smokers).

Data Analyses:

Data was analyses using T- test (paired two sample for means)

III.   Results

Q angle (Graph 1): Represent that the Q angle before 3 months and Q angle after 3 months readings

Table 3: Showing Q angle value Before and after 3 months Pilate's mat exercise Programme with the help of Goniometer in Group 1 (Experimental group) and group 2 (Control group).

	Q angle before 3 months	Q angle after 3 months	T value	P value
Mean (Experimental group)	14.7	10.53	50.5	0.0000023
Mean (Control group)	14.8	12.15	65.7	0.0000054
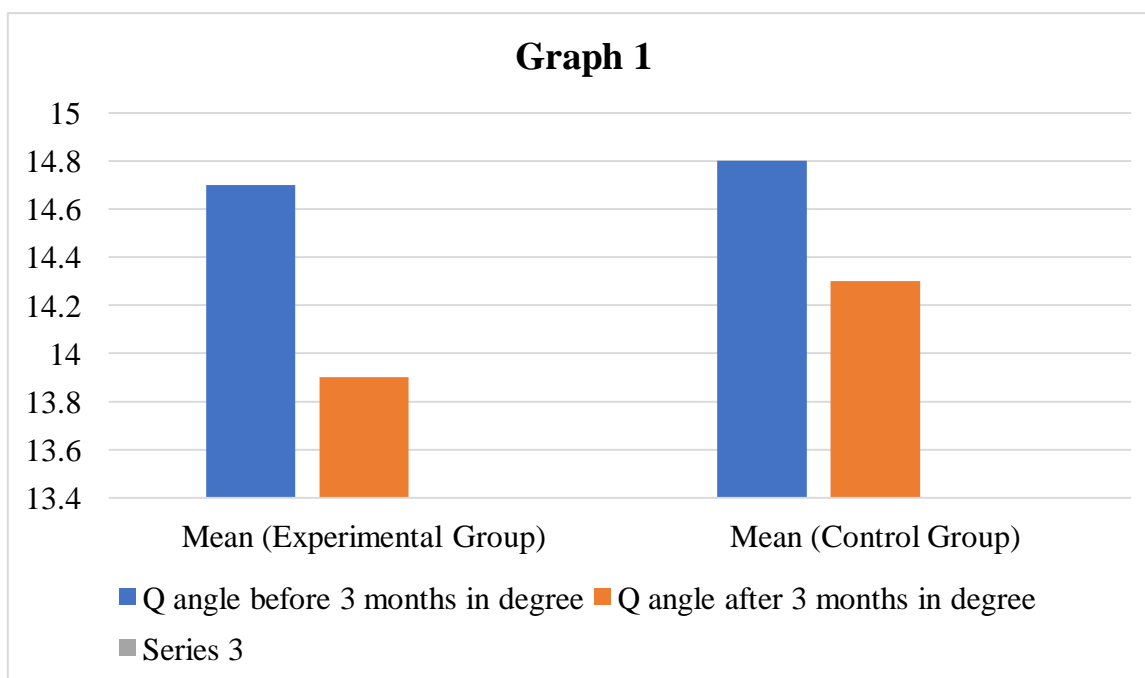
Graph 1: Represent that the Q angle before 3 Months and after 3 months readings
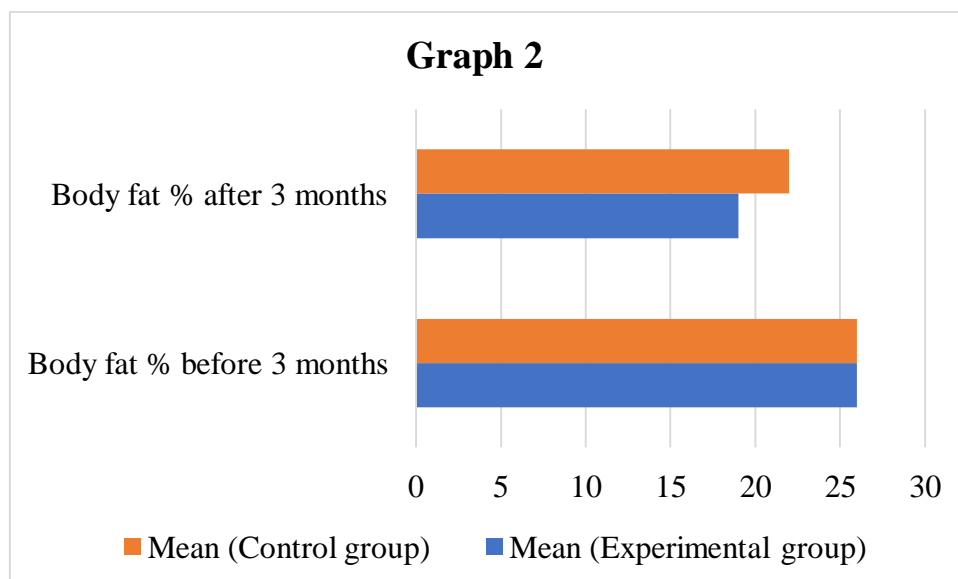
Group 1 (Experimental group) Clients, prior exercise programme Q angle was 14.7 and which was reduced to 13.9 after the Pilates mat exercise programme and showing highly significant difference (p 0.0000023) between the before and after Pilates's mat exercise programme (t= 50.2)

Group 2 (Control group) Clients, prior exercise programme q angle was 14.8 and which was reduced to 14.3 after the Pilates mat exercise programme and showing highly significant difference (p 0.0000054) between the before and after Pilates's mat exercise programme (t= 50.2)

Body fat percentage (%) (Graph 2): Represent that the Body Fat Percentage before 3 months and after 3 months readings with the help of Body fat percentage formula

Table 4: Body Fat Percentage Before and after 3 months Pilate's mat exercise Programme with the help of Body fat formula in Group 1 (Experimental group) and group 2 (Control group).

|	Body fat % before 3 months	Body fat % after 3 months	T value	P value
Mean (Experimental group)	26	19	86.5	0.000000053
Mean (Control group)	26	22	84.5	0.000000082

Graph 2

Graph 2: Represent that the Body Fat Percentage before 3 Months and after 3 months readings.

Group 1 (Experimental group) Clients, prior exercise programme Body Fat Percentage was 26 and which was reduced to 19 after the Pilates mat exercise programme and showing highly significant difference (p 0.00000053) between the before and after Pilates's mat exercise programme (t= 86.5)

Group 2 (Control group) Clients, prior exercise programme Body Fat Percentage was 26 and which was reduced to 22 after the Pilates mat exercise programme and showing highly significant difference (p 0.00000082) between the before and after Pilates's mat exercise programme (t= 84.5)

Table 3: Chest expansion level Before and after 3 months Pilate's mat exercise Programme with the help of inch tape in Group 1 (Experimental group) and group 2 (Control group).

	Chest expansion level before 3 months (cm)	Chest expansion level after 3 months (cm)	T Value	P Value
Mean (Experimental group)	2.1	5	30.5	0.000012
Mean (Control group)	2.1	3	32.5	0.000015
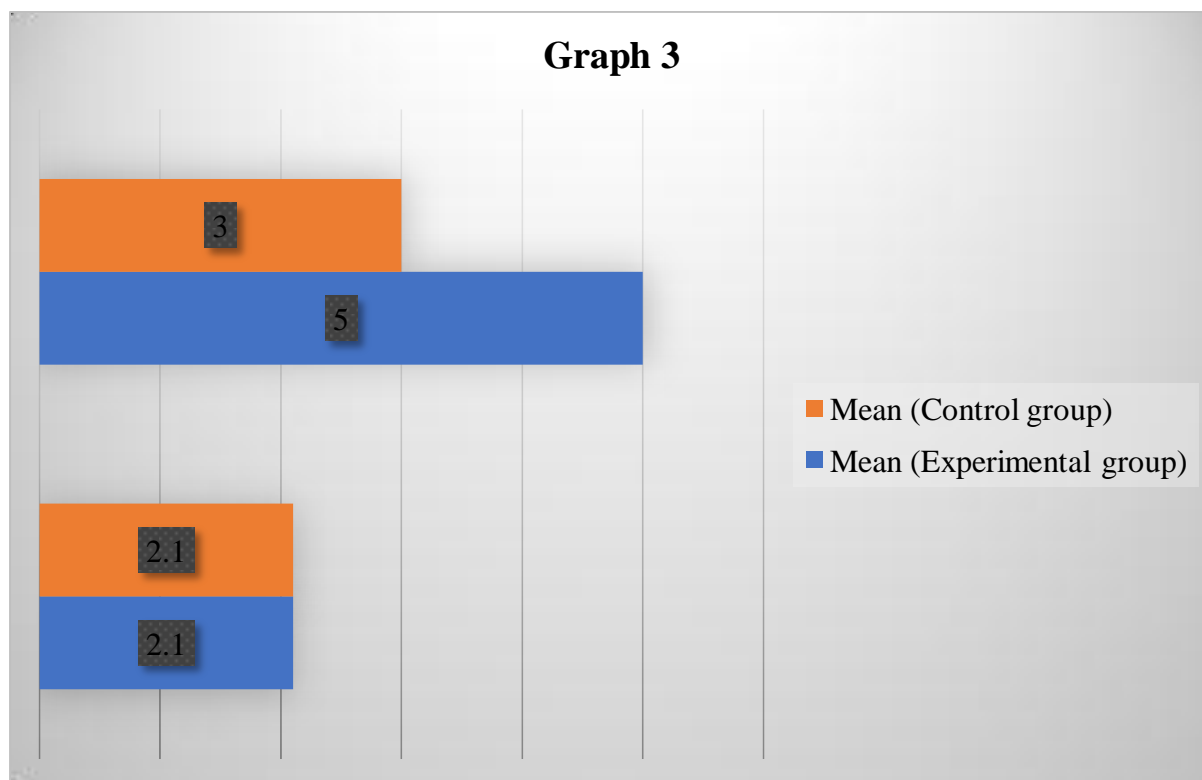
Graph 3: Represent that the Chest expansion level before 3 Months and after 3 months readings.

Group 1 (Experimental group) Clients, prior exercise programme Chest expansion level was 2.1 and which was reduced to 5 after the Pilates mat exercise programme and showing highly significant difference (p 0.00012) between the before and after Pilates's mat exercise programme (t= 30.5)
Group 2 (Control group) Clients, prior exercise programme Chest expansion level was 2.1 and which was reduced to 3 after the Pilates mat exercise programme and showing highly significant difference (p 0.00015) between the before and after Pilates's mat exercise programme (t= 32.5)

IV. Discussion
The main aim of this study is to find out the positive effects of Pilates mat exercises on chest expansion level, Q- angle and Body fat Percentage. The test was carried out for a group of 40 people by dividing them into two groups each comprising of 20 people. Inclusion and exclusion criteria were also included before the study. The study was carried out for a span of 3 months and the results were compared.

Various instruments were used for the measurement such as inch tape for body circumference and chest level expansion, goniometer for Q-angle measurement. Both the groups were made to do various pilates based mat exercises according to the schedule and the results were mathematically compared after a span of 3 months. The main objective of the study was successful as it was clearly observed that the pilates mat exercises provided better results in each of the three cases i.e., body fat%, Q-angle value, Chest expansion value. The body fat percentage was calculated by body fat formula after the prescribed exercises.

Overall better results were found after pilates exercises which is visible from the comparison of the three variables. Pilates can be implemented in larger population to treat various deformities and to improve the performance among individuals up to a large extent under proper guidance.

V. Conclusion
The results represent that both the Groups (group 1 experimental group and group 2 control group are effective in decreasing Q angle and Body Fat Percentage and Increasing Chest expansion Level in male smokers but Group 2 (Experimental group) is more effective in decreasing Q angle and Body Fat Percentage and Increasing Chest expansion Level in male smokers then group 2 (Control group).

Limitations:
1.   Sample size is small
2.   Study duration is short

Acknowledgements

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