ORIGINAL ARTICLE

Effects of Anulom Vilom Pranayama and Rope Mallakhamb Training on respiratory parameters in young females with athletic backgrounds

Julien S. Baker[1DC], Baljinder S. Bal[2ABCE], Rashmi Supriya[3DC], Parmjit Kaur[4AC], Maman Paul[5AC]

[1]*Department of Sport, Physical Education and Health, Hong Kong Baptist University, Kowloon Tong, Hong Kong*
[2]*Department of Physical Education (T), Guru Nanak Dev University, Amritsar, Punjab, India*
[3]*Department of Sport, Physical Education and Health, Hong Kong Baptist University, Kowloon Tong, Hong Kong*
[4]*Department of Physical Education, Government College, Hoshiarpur, Punjab, India*
[5]*Department of Physiotherapy, Guru Nanak Dev University, Amritsar, Punjab, India*

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Abstract

Background and Study Aim: To assess the effects of Anulom Vilom Pranayama (AVP) or alternative nostril breathing and Rope Mallakhamb Training (RMT) on respiratory parameters among university females with athletic backgrounds.

Material and Methods: A quasi experimental study was performed on thirty-six, university female students from the Department of Physical Education (T), Guru Nanak Dev University, Amritsar, Punjab, India. The subjects were divided in three groups. The groups were subjected to 4-weeks of intervention including: Group A (n_1=12) subjected to AVP, Group B (n_2=12) subjected to RMT, and Group C: (n_3=12) no training or control. Respiratory parameters were measured twice, pre and post intervention using a wet spirometer. All measurements were performed three times and the average values were recorded for analysis.

Results: 4-weeks of AVP resulted in positive increases for respiratory parameters measured including Tidal Volume (VT) 25.7%, Inspiratory Reserve Volume (IRV) 29.4%, Expiratory Reserve Volume (ERV) 27.1%, Vital Capacity (VC) 33.2%, and Inspiratory Capacity (IC) 31.6% compared to the control group. Also, 4-weeks of RMT had a positive impact on respiratory parameters including (VT) 19.8%, (IRV) 22%, (ERV) 19.4%, (VC) 32 % and (IC) 28.1% compared to the control group.

Conclusions: Both AVP and RMT had a positive impact on respiratory parameters. Also, AVP training has a more positive impact on respiratory parameters than RMT and may also contribute to the enhancement of concentration-based performance and voluntary control of breathing among young females from athletic backgrounds. As a result, AVP training can be more beneficial for a competitive edge in order to improve the athletes' primary need for respiratory endurance.

Keywords: anulom vilom, tidal volume, expiratory reserve volume, inspiratory reserve volume, vital capacity, inspiratory capacity.

Abbreviations:

VT: Tidal Volume
ERV: Expiratory Reserve Volume
VC: Vital Capacity
IRV: Inspiratory Reserve Volume
IC: Inspiratory Capacity
AVP: Anulom Vilom Pranayama
RMT: Rope Mallakhamb Training
PEF: Peak Expiratory Flow
VO_2 max: Maximal Oxygen Consumption

Introduction

Yoga has been practised in India for thousands of years and is one of the pre-eminent lifestyle modifications. There are many established methods available for individuals to reach the ultimate goal of a healthy life [1, 2]. Yoga is a blend of physical exercise, controlled breathing, and relaxation practice. One of the ancient forms of yoga is pranayama, which is an art form of controlling the life force of breath. Mallakhamb is another form of yoga, a traditional Indian sport in which the practitioner practices yoga-like postures and movements on a vertical wooden pole or rope.

Yoga breathing, or pranayama, is the science of breath control. It consists of a series of exercises especially intended to meet the body's needs and to keep the body in vibrant health. Pranayama is the combination of words -Prana "life force or life energy", Yama "discipline or control" and Ayama - "expansion, non-restraint, or extension". Pranayama means controlling all physical tasks including, the breath, oxygen supply, digestion, and the use of ventilatory parameters within the discipline. Furthermore, pranayama includes inhalation, exhalation and retention. Retention is further divided into inhalation retention (after inhaling) and exhalation retention (after exhaling). The significant part of pranayama is breath retention. To

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achieve breath retention effectively, the function of respiration must be gradually controlled. Therefore, in the practise of pranayama more importance is given to inhalation and exhalation at the onset of practise, in order to strengthen the lungs, balance the nervous system and to regulate the breath in preparation for the practice of breath retention. Pranayama is an important part of yoga that is thought to have an impact on the physiological systems. Pranayama and other breathing exercises have gained importance as it has been shown to improve blood oxygenation and utilization the capacity of lungs, thereby helping in the prevention of many diseases [3]. The role of pranayama has been studied extensively in different pathological diseases including asthma, chronic obstructive pulmonary diseases, systemic hypertension, post-operative management in general surgery, cardiovascular surgeries, and head and neck surgeries have also been documented [4-8].

Mallakhamb is a traditional Indian sport in which the practitioner practices yoga-like postures and movements on a vertical wooden pole or rope only. Mallakhamb is the name given to a little-known style of physical culture practiced in India. It is combination of yoga, gymnastics, and martial arts. The exercises of rope mallakhamb are performed against gravity using upward and downward movements [9]. Postures can be performed in the air with the use of appropriate equipment. There are three ways in which mallakhamb may be performed – on a fixed pole, or on a hanging pole or rope. Three decades ago, pole mallakhamb gave way to the rope mallakhamb. This is the closest type of exercise mimicking the legendary Indian rope trick and requires alertness, focus and balance. There are many studies on yoga and its effects on physical function [10] but there is a surprising lack of research in the effect of rope mallakhamb on physical function despite its popularity in the past few years.

Aerobic endurance performance also known as aerobic fitness, cardiovascular endurance, or cardiorespiratory endurance, is the ability to keep exercising at a moderate intensity for extended periods of time. Aerobic endurance performance is dependent on three important components: maximal oxygen uptake (VO2max), anaerobic threshold, and work economy. VO2max is an extensively used index for measuring the aerobic fitness of athletes and can be determined by laboratory and field tests [11, 12]. Studies suggest that pranayama has demonstrated its positive impact on respiratory parameters. A study reported the effects of short- term pranayama training over a 6-week period on 50 young adults (age = 18-35 years) related to their pulmonary function parameters. Their results indicated significant increases in all the lung parameters including forced vital capacity, forced expiratory volumes, peak expiratory flow rate and forced expiratory flow in the regular yoga practitioners compared to pre yoga practice [13]. Similarly, our previous study has shown that mallakhamb has a positive impact on respiratory parameters among high school girls. Our previous results indicated that a 4-week RMT on 24 high-school girls (age = 12-16 years) improved respiratory indices including VT, expiratory and inspiratory reserve volume, vital capacity, forced vital capacity and inspiratory capacity compared to a control group [14].

Many investigators have determined that AVP and RMT have favourable effects on respiratory parameters [15, 16]. The literature has outlined that short-term pranayama and mallakhamb practices have a positive impact on respiratory parameters of young adults, however studies related to their impact on respiratory parameters of individuals with athletic backgrounds are not readily available. Additionally, AVP and RMT as sport disciplines are very popular in India and many sports competitions are conducted at university at a national level. Both disciplines need respiratory endurance for increased performance. During physical exercise, the respiratory system is an important system of the human body that facilitates gaseous exchange and the diffusion of large amounts of oxygen into the blood [17]. During sports training, breathing and exercise have been strongly linked, and any physical effort is obviously dependent on effective lung ventilation. An increase in tidal volume (VT), expiratory reserve volume (ERV), inspiratory reserve volume (IRV), vital capacity (VC) and inspiratory capacity (IC) can be achieved in activities that place a high demand on respiratory effort [18, 19]. Therefore, athletes primarily need respiratory endurance for a competitive edge. Therefore, this study was designed to examine if AVP or RMT would be effective in improving respiratory parameters among females with athletic backgrounds.

Material and Methods

Participants.

A quasi-experimental study was conducted on thirty-six, girls (age 21-26 years) from the Department of Physical Education (T), in Guru Nanak Dev University, Amritsar, Punjab, India. All the subjects were informed about the objective and protocol of the study. Subjects with history of any infective or respiratory ailment condition were excluded from the study. The subjects were purposively divided into three groups: Group-A: AVP (n1=12), Group-B: RMT (n2=12) and Group-C: Control (n3=12). Purposive sampling was used keeping in view of administrative feasibility. The participants participated in the study voluntarily and all the subjects were also informed about the objective and protocol of the study. The informed

consent of participants was not conducted or granted in this study because all participants' privacy and personal identity information were maintained. The study protocol was conducted at Department of Physical Education (T), Guru Nanak Dev University, Amritsar, Punjab, India.

Research Design.

All training and testing were performed at the same time of day to minimise the effects of diurnal contamination. Prior to training, data and testing all subjects were fully familiarized with training methodologies and testing procedures to minimise learning effects. During the experimental period, all subjects refrained from participation in additional exercise that was not related to the experiment. Subjects in Group-A were athlete students who were indulged in yogic practices precisely in yogic asanas and pranayama. Subjects in Group-B were athlete students who indulged in mallakhamb training (rope) only, whereas subjects in Group-C were athlete students specialized in various major and minor games other that yogic asanas, AVP and RMT. Distribution and demographics of subjects are presented in Table-1. Group A and Group B were subjected to an AVP and RMT for 4-weeks (6 days/ week) of intervention respectively. First week they practiced the intervention for 20 minutes, second week 25 minutes, third week 30 minutes and fourth week 35 minutes respectively. Whereas Group C did not receive any training. The training was provided by single trainer. In practice sessions the trainer was responsible for corrective actions. The weight and height were collected of all the participants prior to the interventions using a calibrated weighing scale and anthropometric rod. Participants were made familiar with the wet spirometer (RMS PC Based Spirometer Helios-401) and all procedures for performing the test. Pre and Post measurements of respiratory parameters including VT, IRV, ERV, VC and IC were measured in a relaxed seated position, collated and presented as means ± standard deviations (S.D). The units for the expired and inspired gases were recorded in litres. All the measurements were collected three times and average of three data sets was taken for further analysis. A study flow diagram is presented in Figure 1.

Respiratory parameters measurement:

Respiratory parameters were measured twice (pre & post) using a wet spirometer, the respective averages of three values were used in the analysis. The methods of measurement of respiratory indices are described below:

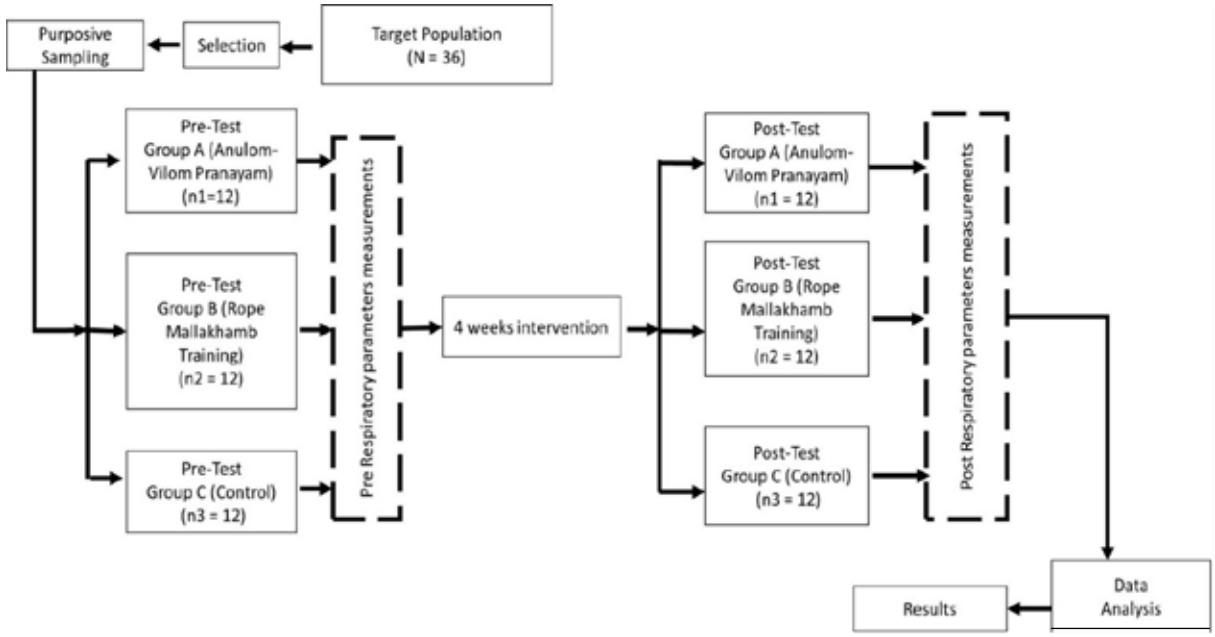

Figure 1. Study flow chart.

Table 1. Distribution and demographics of subjects.

Distribution and Demographics (Mean ± S.D.)				
Variables	**Total (N = 36)**	**Anulom Vilom Pranayama (n1 = 12)**	**Rope Mallakhamb (n2 = 12)**	**Control (n3 = 12)**
Age (yrs)	23.64 ± 1.13	23.67 ± 1.15	23.92 ± 1.16	23.33 ± 1.07
Height (cm)	158.17 ± 4.70	159.83 ± 5.95	157.75 ± 3.02	156.92 ± 4.56
Weight (kg)	56.26 ± 6.40	55.58 ± 9.73	57.34 ± 4.56	55.87 ± 3.58

VT- The subjects were asked to inhale a normal breath and were then asked to place the mouthpiece of the spirometer between the lips and exhale normally into the spirometer.

IRV- After inhaling normally and placing the mouthpiece between the lips, the subjects were asked to forcefully inhale all the additional air possible.

ERV- After exhaling normally and placing the mouthpiece between the lips, the subjects were asked to forcefully exhale all the additional air possible.

VC- Following a maximum inspiration, all the air possible was forcibly exhaled through the mouthpiece. The vital capacity was calculated as the sum of the three primary volumes that can be directly exchanged with the atmosphere (VC = IRV + VT + ERV).

IC- After exhaling normally, subjects were asked to breathe in as deeply as possible, and then were asked to place the mouthpiece and exhale normally. The inspiratory capacity was calculated as the sum of the inspiratory reserve volume and the tidal volume (IC = IRV + VT).

AVP intervention:

Participants were asked to perform preliminary exercises before doing AVP such as pre-position Padmasana and Vajrasana, neck movement, shoulder movement, hand movement and back exercises. In the AVP intervention participants were asked to close their right nostril with their thumb and exhale completely and then draw in air from their left nostril. They were then asked to release the thumb and close the left nostril with their ring finger and exhale slowly through their right nostril. Then subjects were asked to take the air in from the right nostril and then release it through the left nostril (after closing the right nostril with the thumb) (Figure 2) (20). After the AVP intervention, participants were asked to relax and were asked to perform relaxing postures including Balasana and Shavasana. The full protocol for the 4-weeks AVP intervention is presented in Table 2.

RMT intervention:

Participants were asked to perform preliminary exercises before doing RMT such as stretching exercises and climbing up and down exercises on the rope.

In RMT participants practiced the RMT postures mentioned below (Figure 3) [14]. After the AVP intervention, participants were asked to relax and were asked to perform relaxing postures including Balasana and Shavasana. The full protocol for the 4-weeks RMT intervention is presented in Table 3. Procedures followed in the RMT training are described below:

Table 2. Full protocol of 4-Weeks Anulom Vilom Pranayama Training.

4-Weeks Anulom Vilom Pranayama (AVP)			
Weeks	**Schedule**	**Time**	**Duration**
1st Week	Preliminary Yogic Exercises	5 Minute	20 Minute
	Practice of AVP	10 Minute	
	Relaxation Posture	5 Minute	
2nd Week	Preliminary Yogic Exercises	5 Minute	25 Minute
	Practice of AVP	15 Minute	
	Relaxation Posture	5 Minute	
3rd Week	Preliminary Yogic Exercises	5 Minute	30 Minute
	Practice of AVP	20 Minute	
	Relaxation Posture	5 Minute	
4th Week	Preliminary Yogic Exercises	5 Minute	35 Minute
	Practice of AVP	25 Minute	
	Relaxation Posture	5 Minute	

a. **b.** **c.** **d.**

Figure 2. Steps followed by participants in Anulom Vilom intervention [20].

Padamasana: Participants were asked to stand on a mat and then climb on the rope, subjects had to stretch out their right leg forward and bend their left leg and the individual had to pull the rope again and having both legs crossed and feet on opposite thighs. After making Padamasana on the rope participants had to lock their necks by the left side of the rope before placing their hands on knees in mudra position.

Dhanurasana: Participants were asked to stand on a mat and then climb on the rope, subjects had to perform a twisting movement of the trunk on the rope and then they made a knot. After that, every individual kept their body straight on the rope and maintained a lying position in the air by holding the rope, and then slowly, by folding their knees downward they were asked to hold their ankles of their feet with their hands.

Natrajasana: Participants were asked to stand on a mat and then climb on the rope, subjects had to lock their necks from the right side before tightening the rope with the left leg by crossing the rope along the thigh and hold the rope with the help of their foot. After that, they were asked to draw their right legs upward and hold their right ankles firmly with their hands. Then in the final position participants were asked to keep their left hands straight to made balance on the rope.

Padhastasana: Participants were asked to stand on a mat and then climb on the rope, subjects had to cross the rope from one side of their body and were asked to touch their heads with knees.

Statistical Analysis.

The normality of the data were checked by using the Shapiro-Wilk Test of Normality. Analysis of covariance (ANCOVA) was used to remove the effects of some antecedent variables. ANCOVA assessed the effect of an independent variable on dependent variable while removing the effect of the covariate factor. The level of significance was set at 0.05. The statistical techniques were used to analyze the data on Statistical Package for Social Science (SPSS) version 26.0.

Results

AVP improves respiratory parameters compared to control:

Our result indicates that there was a significant difference between Group A (AVP) and Group C (control) on respiratory parameters among girls from athletic background. Moreover, the Partial Eta Squared value showed that 4-weeks of AVP have positive impact on the respiratory parameters

Table 3. Full protocol for 4-weeks Rope Mallakhamb Training.

4-Weeks Rope Mallakhamb Training (RMT)			
Weeks	**Schedule**	**Time**	**Duration**
1st Week	Preliminary Yogic Exercises	5 Minute	20 Minute
	Practice of RMT	10 Minute	
	Relaxation Posture	5 Minute	
2nd Week	Preliminary Yogic Exercises	5 Minute	25 Minute
	RMT	15 Minute	
	Relaxation Posture	5 Minute	
3rd Week	Preliminary Yogic Exercises	5 Minute	30 Minute
	RMT	20 Minute	
	Relaxation Posture	5 Minute	
4th Week	Preliminary Yogic Exercises	5 Minute	35 Minute
	RMT	25 Minute	
	Relaxation Posture	5 Minute	

a. **b.** **c.** **d.**

Figure 3. Selected asanas (a) Padmasana, (b) Dhanurasana, (c) Natrajasana and (d) Padhastasana [14].

including VT 25.7 %, IRV 29.4 %, ERV 27.1 %, VC 33.2 % and IC 31.6 % on Group A compared to Group C (Table 4).

RMT improves respiratory parameters compared to control:

We found that there was a significant difference between the Group B (RMT) and Group C (control) on respiratory parameters among girls from athletic background. Moreover, the Partial Eta Squared value showed that 4-weeks of RMT have positive impact on the respiratory parameters including VT 19.8 %, IRV 22 %, ERV 19.4%, VC 32 % and IC 28.1% on Group B compared to Group C. Our results also indicate that there is a significant difference (P<0.05) between Group B compared to Group C (Table 5).

AVP improves respiratory parameters more than RMT:

AVP training helps raising the respiratory parameters above the respective values of RMT. Increase in each parameter including VT=5.9%, IRV=7.4%, ERV=7.7%, VC= 1.2% and IC=3.5 %. Thus, outcomes of the above said respiratory parameters showed that short-term AVP improves respiratory parameters more than RMT significantly. (Figure 4 & 5).

Table 4. Analysis of Covariance (ANCOVA) between Group A (AVP) and Group C (control) on respiratory parameters

Group	Mean± S.D.	F	Sig.	Partial Eta Squared
A. Respiratory Parameters (Tidal Volume (VT) (Litre)				
AVP Pre	0.365±.0117	7.279	0.013	0.257
AVP Post	0.373±.0123			
Control Pre	0.357±.0114			
Control Post	0.358±.0140			
B. Inspiratory Reserve Volume (IRV) (Litre)				
AVP Pre	1.909±.1134	8.740	0.008	0.294
AVP Post	1.945±.1206			
Control Pre	1.800±0702			
Control Post	1.808±.0686			
C. Expiratory Reserve Volume (ERV) (Litre)				
AVP Pre	0.759±.0355	7.812	0.011	0.271
AVP Post	0.773±.0403			
Control Pre	0.765±.0278			
Control Post	0.770±.0292			
D. Vital Capacity (VC) (Litre)				
AVP Pre	3.033±0.143	10.426	0.004	0.332
AVP Post	3.092±0.161			
Control Pre	2.922±0.100			
Control Post	2.937±0.102			
E. Inspiratory Capacity (IC) (Litre)				
AVP Pre	2.274±0.115	9.696	0.005	0.316
AVP Post	2.318±0.127			
Control Pre	2.157±0.080			
Control Post	2.167±0.081			

NOTE: A. Respiratory Parameters Tidal Volume (VT), B. Inspiratory Reserve Volume (IRV), C. Expiratory Reserve Volume (ERV), D. Vital Capacity (VC), E. Inspiratory Capacity (IC) among girls from university. Pre-test was taken as covariate. The P-values less than (P < 0.05) were considered significant.

Table 5. Analysis of Covariance (ANCOVA) between Group B (RMT) and Group C (control) on respiratory parameters

Group	Mean± S.D.	F	Sig.	Partial Eta Squared
A. Respiratory Parameters (Tidal Volume (VT) (Litre)				
RMT Pre	0.366±0.012	5.183	0.033	0.198
RMT Post	0.372±0.012			
Control Pre	0.357±0.011			
Control Post	0.358±0.014			
B. Inspiratory Reserve Volume (IRV) (Litre)				
RMT Pre	1.788±0.093	5.914	0.024	0.220
RMT Post	1.815±0.096			
Control Pre	1.800±0.070			
Control Post	1.808±0.068			
C. Expiratory Reserve Volume (ERV) (Litre)				
RMT Pre	0.750±0.032	5.049	0.036	0.194
RMT Post	0.759±0.031			
Control Pre	0.765±0.028			
Control Post	0.770±0.029			
D. Vital Capacity (VC) (Litre)				
RMT Pre	2.904±0.125	9.895	0.005	0.320
RMT Post	2.946±0.126			
Control Pre	2.922±0.100			
Control Post	2.936±0.102			
E. Inspiratory Capacity (IC) (Litre)				
RMT Pre	2.154±0.100	8.205	0.009	0.281
RMT Post	2.187±0.103			
Control Pre	2.157±0.080			
Control Post	2.167±0.081			

NOTE: A. Respiratory Parameters Tidal Volume (VT), B. Inspiratory Reserve Volume (IRV), C. Expiratory Reserve Volume (ERV), D. Vital Capacity (VC), E. Inspiratory Capacity (IC) among girls from university. Pre-test was taken as covariate. The P-values less than ($P< 0.05$) were considered significant.

Discussion

The Indian sage Patanjali prescribed adherence to eight limbs of yoga, aimed at quieting one's mind to achieve the union of mind, body and spirit- the ultimate aim of traditional yoga. Yoga interventions are equal or superior to other physical exercises in most outcome measures. Breathing regulation and mindfulness during yogic practice and maintenance of postures characterize yoga practices and make it distinct from other physical exercise modalities [21]. The purpose of this study was to investigate the effects of AVP and RMT on respiratory parameters among athletic young girls. It is evident from the results that 4-weeks of AVP have positive impact on the respiratory parameters including VT 25.7 %, IRV 29.4 %, ERV 27.1 %, VC 33.2 % and IC 31.6 % on AVP group. AVP is one of simplest and best yoga breathing exercises (pranayama) for health and fitness [15]. AVP exercise has therapeutic effects on metabolism performed in both healthy and pathological individuals. Previous findings show that relaxation induced by diaphragmatic breathing improves athletes' antioxidant defence status after strenuous exercise [22].

Another study concluded that yogic breathing practiced for 30 minutes every afternoon along with habitual bodily sports for 5 days a week, decreases airway resistance, increases respiration muscle endurance, and reduces variety of strokes possibly through higher autonomic reactivity, oxygen diffusion and decreased tension in competitive swimmers [16]. Researchers also suggest that yogic pranayama primarily based on totally volitional respiratory muscle training may be utilized in sports activities conditioning programme for athletes to enhance their maximal exercising performance, and as a part of rehabilitation training to recover from injury [23]. Interestingly, studies have also demonstrated that incorporating complete yoga-based breathing techniques (OM Mantra Chanting and AVP Pranayama) into one's daily routine helps to enhance lung function [24]. Additional studies acknowledged that the practice of Pranayama enhances maximal respiratory pressures, breath holding time and are particularly beneficial in increasing lung function and respiratory endurance [25]. Yoga training has been demonstrated by many researchers to increase vital capacity and improve lung function in participants [26,27,28,29]. According to previous research, pranayama training

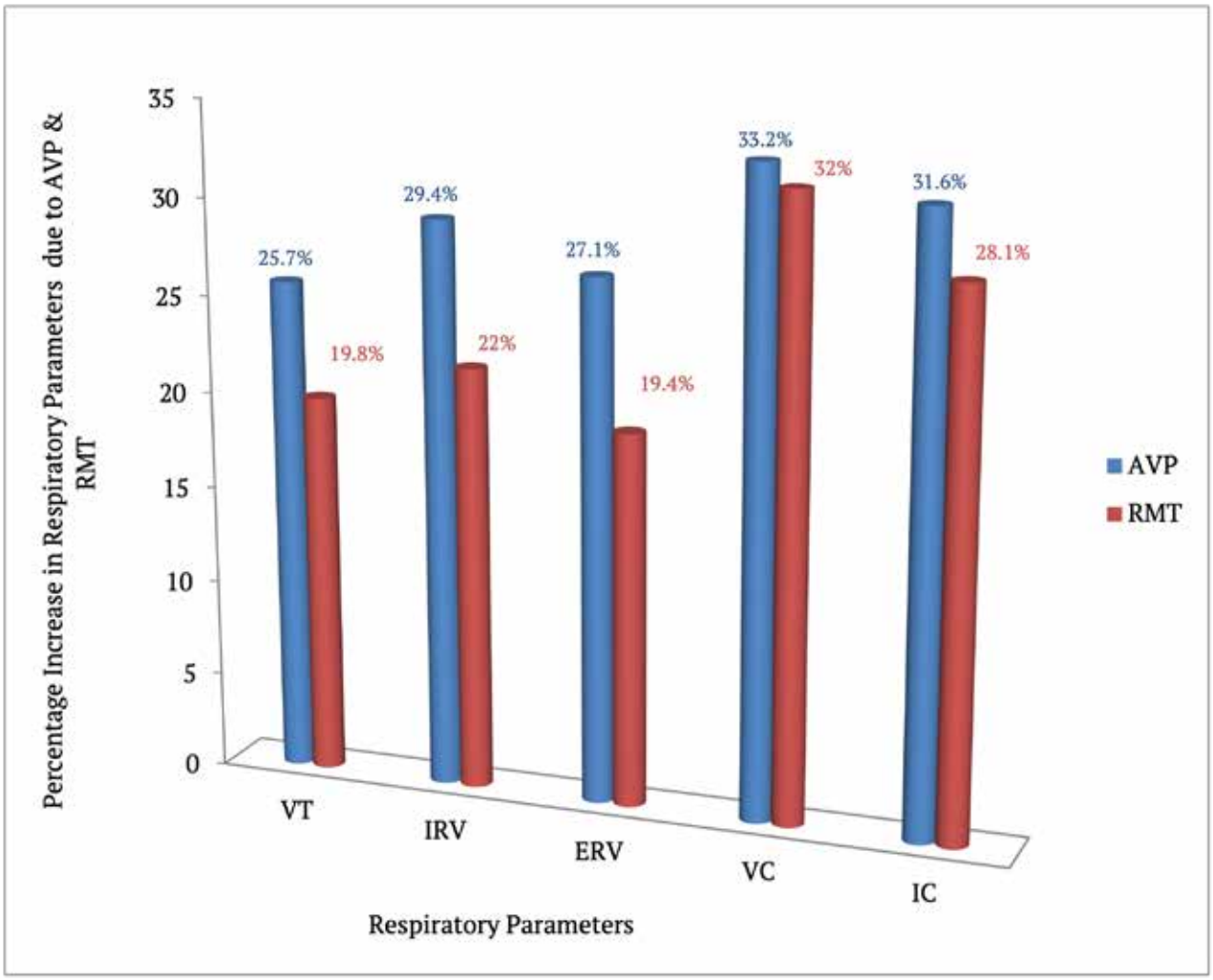

Figure 4. Comparison matrix between Group A verses Group C (VT=25.7%), (IRV=29.4%), (ERV=27.1%), (VC=33.2%) & (IC=31.6%) and Group B verses Group C (VT=19.8%), (IRV=22%), (ERV=19.4%), (VC=32%) & (IC=28.1%) of respiratory parameters including in percentage.

enhances ventilatory functions by increasing forced expiratory volume (FEV), and peak expiratory flow rates [29]. Similarly, we found that pranayama also helped to increase maximum inspiratory pressure, maximum expiratory pressure, and maximum voluntary ventilation, forced vital capacity, and forced expiratory volume in young girls from athletic backgrounds. The results of our study may be used to emphasize the role of pranayama in strengthening respiratory muscles and improving respiratory endurance, and we suggest that regular practice of pranayama may prove to be a step in the direction of a healthy lifestyle.

Furthermore, it is evident from the results that 4-weeks of RMT have significant effects on the respiratory parameters viz; VT 19.8 %, IRV 22%, ERV 19.4%, VC 32 % and IC 28.1% on RMT group. Physiological responses to physical training, including yoga, have been well studied by many investigators. Yoga, is a traditional method of learning that aims to attain the unity of mind, body, and spirit through exercise, breathing and meditation that employs means like RMT, may be expected to positively influence many physiological functions including respiration [24]. The results of this study demonstrate that RMT lasting 4-weeks significantly improved several respiratory indices. The results of this study are consistent with the results of our previous study conducted among girls (age = 12 – 16 years) [14]. In our previous study we explored the effect of 4-weeks of RMT on adolescent girls and we found that it enhanced voluntary control of breathing [14]. Our findings are supported by those of who reported that yoga exercise significantly increased chest circumferences by 15 (middle and lower) to 37% (upper) as well as several respiratory indices – Forced expiratory volume first second (FEV1), Forced Expiratory Flow between 25 and 75 (FEF 25-75%) and Forced vital capacity (FVC) by 12 – 17%) [30].

In conclusion, we found that the 4-weeks AVP and RMT on university girls from athletic backgrounds had a significant effect on their respiratory parameters (viz., VT, IRV, ERV, VC and IC). Thus, such training may be recommended to improve physical and physiological fitness-based performance. The

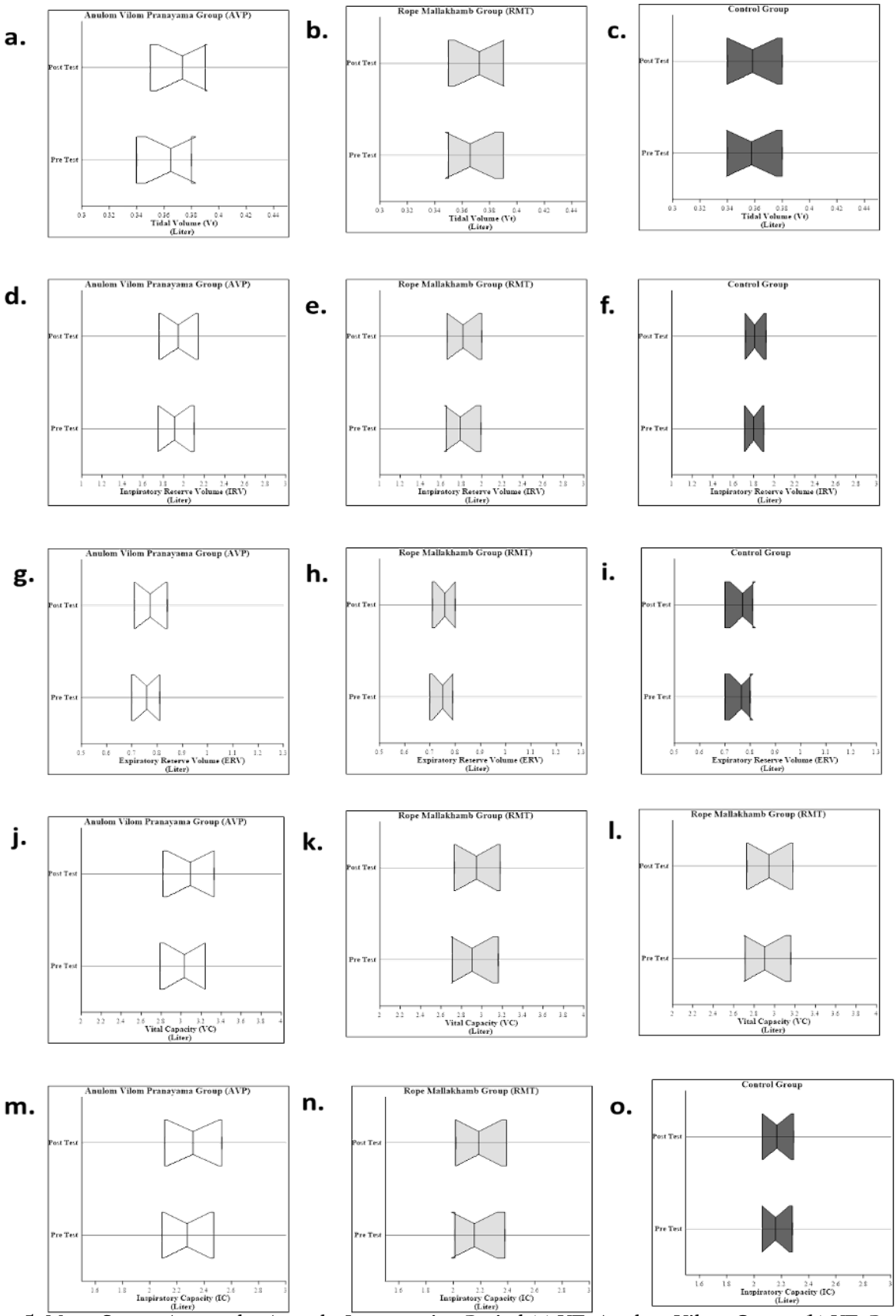

Figure 5. Mean Scores Across the 4-weeks Intervention Period (a) VT; Anulom Vilom Group, (b) VT; Rope Mallakhamb Group, (c) VT; Control Group, (d) IRV; Anulom Vilom Group, (e) IRV; Rope Mallakhamb Group, (f) IRV; Control Group, (g) ERV; Anulom Vilom Group, (h) ERV; Rope Mallakhamb Group, (i) ERV; Control Group, (j) VC; Anulom Vilom Group, (k) VC; Rope Mallakhamb Group, (l) VC; Control Group, (m) IC; Anulom Vilom, (n) IC; Rope Mallakhamb Group, and (o) IC; Control Group.

positive outcomes found in this present study might apply to athletes to improve body efficiency. The day-to-day exercise can also be components of physical health and a way of life modification to keep higher physical, intellectual and spiritual health. Also, our study suggests that AVP has a more positive impact on respiratory parameters than RMT and may contribute to enhance concentration-based performance and voluntary control of breathing. Further research is needed examine the benefits of this type of training on aerobic performance and related exercise parameters.

Declaration of competing interest

All authors declare there are no potential financial, personal, or otherwise conflicts of interest.

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Information about the authors:

Julien S. Baker; https://orcid.org/0000-0002-9093-7897; jsbaker@hkbu.edu.hk; Department of Sport, Physical Education and Health, Hong Kong Baptist University Kowloon Tong, Hong Kong.

Baljinder S. Bal; https://orcid.org/0000-0003-2173-2748; bal_baljindersingh@yahoo.co.in; Department of Physical Education (T), Guru Nanak Dev University; Amritsar, Punjab, India.

Rashmi Supriya; https://orcid.org/0000-0003-2995-1910; rashmisupriya@hkbu.edu.hk; Department of Sport, Physical Education and Health, Hong Kong Baptist University; Kowloon Tong, Hong Kong.

Parmjit Kaur; (Corresponding Author)**;** https://orcid.org/0000-0002-3370-7366; parmpurewal90@gmail.com; Department of Physical Education, Government College; Hoshiarpur, Punjab, India.

Maman Paul; https://orcid.org/0000-0003-4573-9581; mamanpaul@gmail.com; Department of Physiotherapy, Guru Nanak Dev University, Amritsar, Punjab, India.

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