The effect of Lymphatic Pump Techniques on the FEV_1 and FVC measurements in people with asthma… A pilot study.

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Abstract

This study investigated the effect of lymphatic pump administration on lung function, forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC) outcomes, in 15 subjects with asthma and 15 subjects without asthma. All 30 subjects performed spirometry testing, followed by the single application of a lymphatic pump technique to their upper chest. Spirometry measurements were again taken immediately after this technique, and then ten and twenty minutes thereafter. No significant changes in FEV_1 or FVC were observed when comparing pre and post treatment measures between asthmatic and non-asthmatic subjects. The application of the lymphatic pump technique was not shown to be beneficial in improving short term lung function in people with or without asthma.

Key words; lymphatic pump technique, asthma, manual therapy, osteopathy

Introduction

Asthma is a common condition that affects more than 300 million people worldwide. [1] It involves the small airways of the lungs and results in over-sensitivity of the smooth muscle within the airways to irritants. Several specific (e.g., viruses, allergens) and non-specific (e.g., weather, exercise) factors have been linked with asthmatic attacks.[2] These factors increase the susceptibility of an individual with asthma to having an attack, or an exacerbation of symptoms. In recent years, the number of cases of asthma amongst the population has significantly increased,[3] especially among children. Approximately 600,000 Victorians are currently diagnosed with the condition, which results in up to 700 deaths Australia wide each year.[3] Asthma was the sixth most sought complaint for treatment seen by general practitioners in Australia in 1998-1999,[4] and may demonstrate a poor adherence to pharmacological treatment, amongst adults.[4] There is no known cure for asthma[5], but adequate management through preventative treatment (pharmacological or non-pharmacological) and awareness of the condition can dramatically reduce the number of incidents and severity of attacks. Jackson & Steele[6] states that with the potential side effects of pharmacological interventions for asthma, alternative non-pharmacological therapies should be vigorously investigated.

Symptoms experienced by people with asthma, including breathlessness, chest tightness, chest pain, light-headedness,[7] wheeze and a cough,[8] are assumed to result from spasm of bronchial smooth muscle. Asthma is primarily an inflammatory disease of the airways, and any airway irritation can result in excessive bronchoconstriction and mucus production.[8] The aetiology of asthma is poorly understood, and factors such as a genetic predisposition, allergen sensitivity, infection, chemical and allergen exposure, and industrialisation factors are thought to influence a person's susceptibility to suffering asthma.[8] Current pharmacological treatment of the inflammatory nature of this condition is effective in the majority of sufferers in attaining symptomatic relief during exacerbations or attacks,[9] however, a small number of sufferers do not attain adequate symptomatic relief from pharmaceutical administration.[9] This may suggest the coexistence of an underlying respiratory dysfunction in these sufferers.

The presence of dysfunctional breathing in sufferers of respiratory disorders has been recognised, in the literature,[7,10-12] as a contributing factor to asthma. Altered breathing patterns have been associated with obstruction, bronchoconstriction, oedema and inflammation of the airways within the lungs.[7,10,11,13] Altered breathing patterns cause upper chest movement rather than deeper diaphragmatic or abdominal breathing,[10] further compromising lung function. Courtney-Belford[10] attributes this dysfunction in breathing to heightened airway responsiveness to inhaled air during respiration. Exposure of environmental pollutants, infections and allergens to these sensitised airways can exacerbate an asthmatic's symptoms,[9] further inflaming the airways. Thomas[7] demonstrated that about one third of women and one fifth of men with asthma exhibited dysfunctional breathing patterns, a treatment aspect not routinely addressed in general practise. Woolcock et al[14] suggests abnormal lung function could exist in up to 80 % of Australian adults with persistent asthma, outlining the need for breathing pattern retraining to be incorporated into the pharmaceutical treatment regime currently adopted in general practise.

The ventilatory capacity of the lungs is dependent on airway distensibility, inspiratory muscle function and thoracic cage mobility. [10,13,15-17] During normal, quiet breathing, 75% of air movement is undertaken by the diaphragm.[18] Elevation of the ribs by the internal and external intercostal muscles increases the volume of the thoracic cage, accounting for the remaining 25% of air volume.[18] In people with asthma and those suffering from obstructive lung disease, bronchial constriction increases the workload of the respiratory muscles, predisposing them to fatigue. Reduced mobility and rigidity of the thoracic cage alters the total thoracic compliance[15] and decreases the forced expiratory volume (FEV) of the lungs. Airflow obstruction is best determined by measuring forced expiratory volume in one second (FEV_1), and the relationship between FEV_1 and forced vital capacity (FVC).[19] Malfunction to an individual component of the respiratory system, such as the ribs, diaphragm or thoracic cage,[10] predisposes an individual to disturbances in pulmonary circulation, ventilation, and respiratory function.[19] Any treatment regime that restores function to the thoracic cage should enhance respiration,[15] and improve ventilation.

Courtney- Belford,[10,20] Keeley & Osman[12] and Thomas et al[7] propose that asthmatics undergo a state of hyperventilation during an acute asthma attack, resulting in airway narrowing and an inability to inspire air. Hyperventilation is a state in which more air is entering the lungs than usual, which inhibits the ability of the lungs to remove waste products such as carbon dioxide.[21] Hyperventilation amongst asthmatics has also been linked with airway narrowing, aggravation of symptoms and a decline in FEV_1.[10] Buteyko Breathing techniques are a method of breathing retraining, sought by some asthmatics to address the suspected hyperventilation state experienced during an attack. Buteyko breathing techniques have been demonstrated to reduce inhaled steroid use and improves quality of life amongst sufferers, and reduces the hyperventilation state experienced by many asthmatics.[22] Physiotherapy intervention to people with asthma demonstrating similar breathing dysfunctions, showed improvements in quality of life scores in over half of asthmatics treated.[23] A quarter of the people with asthma who were taught the diaphragmatic breathing exercises to slow their breathing rate by physiotherapists, reported experiencing benefits six months post treatment,[23] demonstrating the need for further research into the management and prevention of respiratory dysfunctions amongst asthmatics.

Jackson et al[24] encouraged research into alternative asthma treatments, suggesting Osteopathic Manipulative Treatment (OMT) may aid in the treatment of people with asthma by providing symptomatic relief to sufferers, and assisting in the overall management of the condition.[24] Concerns have been raised regarding the safety of long-term corticosteroid administration and the potential side effects of their use.[25] Seventy three percent of asthmatics questioned by Goeman et al[25] reported medication side effects such as tremor, mouth or throat soreness, hoarseness, skin changes and osteoporosis a health concern. Anxiety by patients in the use of medications has highlighted a need to investigate the mechanical function of the thorax, ribs and diaphragm in the existence of dysfunctional breathing patterns amongst people with asthma. Asthma results in reversible airway obstruction,[11] which osteopathic treatment aims to decrease. OMT aims to improve the underlying respiratory dysfunctions contributing to asthmatic symptoms, and should be used in conjunction with an effective asthma management plan,[2] closely monitored by a doctor. A successful asthma management plan prevents attacks, allowing the sufferer to be in control of their condition. An acute attack indicates a failed plan.[1] Wheatley et al[26] stated that the use of manual therapy should complement, not outplace conventional medical therapy.

Very little valid research regarding the effectiveness of OMT in the treatment of asthmatics has been published in recent years. Murphy's 1966 study, investigated the benefits of thoracic mobilisation on pulmonary function in healthy individuals. Murphy demonstrated increases in tidal volumes and respiratory rate, and a decrease in functional residual capacity following thoracic mobilisation.[27] Murphy also studied the effect of thoracic mobilisation on the distribution of Iodine-131 throughout the lungs, demonstrating an improvement of iodine-131 flow post manipulation.[28] This suggests that an improvement in blood flow throughout the lungs can be achieved with thoracic manipulation, by improving chest expansion. No studies have investigated the role of manipulation in providing symptomatic relief amongst asthmatics. Masarsky & Weber,[29] demonstrated increases in FEV_1 and FVC volumes post chiropractic manipulation in healthy subjects, however the study demonstrated many flaws. Pre treatment spirometry measurements were not taken, and a uniformed treatment approach wasn't given to each subject. Manipulative treatment was given to dysfunctional segments as they were found. This study could therefore not accurately determine if the increased values post treatment were due to the technique application.

Wheatley et al., [26] investigated the change in FEV_1 and FVC values following rib raising. This study demonstrated a 15.1 percent change in FEV_1 scores and a 17.5 percent change in FVC scores amongst the asthmatics tested when a rib raising technique was applied to the upper ribs. Also, a 3.8 percent change in FEV_1 scores and 5.7 percent change in FVC scores amongst the control group administered the same treatment technique was also observed in this study[26]. This study suggests benefits, especially amongst asthmatics with the application of rib raising techniques to the upper six ribs in improving measured lung parameters. No other research has been demonstrated to support Wheatley et al's[26] finding or the benefits of other OMT in improvements of FEV_1 and FVC measurements or in the treatment of asthma.

Thoracic Lymphatic Pump Technique (TLPT)

The lymphatic system functions in tissue drainage, lipid transport, and immunity,[30] and is regarded by Wallace et al[31] to be the second circulatory system of the body. Within a 24-hour period, the entire volume of serum contained within the body circulates through the heart via the lymphatics,[32] and therefore any factor that reduces normal lymphatic flow increases the likelihood of stagnant lymph accumulating in tissues. Death can result within 24 hours in a person whose lymphatic function is absent.[31]

Kuchera & Kuchera[32] consider the diaphragm to be an important extrinsic pump for the lymphatic system. Contraction of the diaphragm during respiration creates pressure differences between the abdominal and thoracic cavities, promoting fluid to return to the heart.[33,34] This fluid shift occurs according to Boyle's law and the inverse relationship between volume and pressure.[35] As the diaphragm flattens during inspiration, intrathoracic pressure drops, enhancing lymphatic flow.[33] Inadequate function of the diaphragm amongst asthmatics lowers these pressure differences, impeding circulation and lymphatic flow.[32] Wallace et al[31] considers adequate diaphragmatic motion to be essential in obtaining and managing optimal lung function.

Tissue congestion, impaired tissue oxygenation and a heightened chance of infection can all result as a consequence of lymphatic congestion.[31,36] Prolonged obstruction to lymphatic flow has been proposed to increase the likelihood of fibrosis and scar tissue development in the alveolar spaces,[36] reducing tissue perfusion and eventual cardiac output.[32] The lymphatic system is an initial defence mechanism from invasion by toxins, bacteria and viruses entering the body, and is therefore essential in maintaining health.[32] Any treatment that improves thoracic cage function and restores regulatory mechanisms in asthmatics should be beneficial[15] in providing symptomatic relief and in enhancing homeostasis.[32] Chronic asthmatics may benefit from osteopathic techniques, which enhance respiration.[37]

Lymphatic pump techniques are used within manual medicine to promote lymphatic fluid movement. These techniques combine a compressive force through the chest cage with breathing to create pressure differences between the thoracic and abdominal cavities.[33] Kuchera and Kuchera[32] speculate that the application of an oscillatory and compressive force applied directly through the chest wall throughout the expiratory phase of respiration, may potentially enhance blood and lymphatic fluid return back into the circulation, and towards the heart.[32,33] They suggest lymphatic fluid may move out of tissues, reducing tissue congestion and improving tissue oxygenation,[32,33] however, this has not yet been validated. TLPTs may enhance deeper diaphragmatic breathing by restricting upper chest movement,[10] which sometimes develops in people with chronic asthma. TLPTs may effectively increase both the volume of air able to enter the lungs and the amount of air available for oxygen transport.[32,33]

TLPTs can be applied to a variety of organs and structures including the thoracic and abdominal contents, liver, spleen and upper and lower limbs.[32,24,35] All techniques function similarly in rhythmically applying a compressive force to congested tissues, with or without the assistance of respiration. TLPT's administration to post-abdominal surgical patients proved beneficial in shortening their recovery periods and reducing their breathing rate.[33,34] Sleszynski & Kelso[33] hypothesised that resisted inspiratory breathing undertaken in LPT eases the forceful nature of breathing by providing respiratory muscle strength training. A strong link between the administration of TLPTs and the enhancement of immune function has also been evident through studies conducted by Measel,[38] Mesina et al.[35] and Jackson et al.[24] Each author measured antigen exposure following vaccine administration in healthy individuals. TLPTs were administered post vaccination, and blood tests to assess antigen exposure were undertaken at periodically within the following week. LPT were confirmed to enhance the body's immune response by accelerating the rate of antibody production in healthy individuals. TLPT can directly influence the increased mucous secretions and subsequent mucosal oedema common amongst asthmatics.[30]

The aim of this study was to investigate the effect of lymphatic pump administration on lung function, as measured by forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC) outcomes, in participants with and without asthma

Method

Subjects

Fifteen people with asthma (Age:22 ± 1.2, Height:169.8± 7.7, Weight: 65.5±11.9, Sex; M=2, F=13) and fifteen without asthma (Age:23 ±2.6, Height: 173.9±10.0, Weight:70.1±10.6, Sex: M=7, F=8)) studying at Victoria University, Melbourne were voluntarily recruited for the study. Subjects were excluded if they had suffered an acute upper respiratory tract infection in the two weeks prior to testing, or had a recent history of rib trauma, resulting in a fracture. People with asthma were included if prior diagnosis of asthma was made by a general practitioner (GP) within the last ten years, and had not suffered an acute attack in the two weeks prior to testing. All subjects gave written consent prior to testing. The Human Research Ethics Committee of Victoria University approved the study.

Asthma Bother Profile

The fifteen asthmatic participants were also asked to complete an additional questionnaire [Asthma Bother Profile (Hyland et al.)[39]] to rate the severity of their asthma symptoms. This profile measures the degree of distress asthma has on lifestyle, through a six-point scale. Investigation into the analysis of the data obtained within the profile failed to uncover the statistical analysis originally used in rating the distress resulting from having asthma. In hindsight, data analysis in this study was undertaken using a Leichart scale, where answers were rated numerically from 0 (no bother) to 5 (makes my life a misery). The below scale was developed to rate the numerical scores from the questionnaire with the degree of asthma severity.

Degree of Asthma	Score (obtained from Asthma Bother Profile)
Mild Asthma	0-29
Moderate Asthma	30-59
Severe Asthma	60-75.

Procedure

Data collection took place at the City campus of Victoria University, over a six week period. Four sessions were required for testing. Height and Weight measurements were recorded for each subject prior to testing.

Subjects were asked to disrobe above the waist, including loosening of belts in male subjects and bra's in female subjects. A gown was provided for their comfort. Standard instructions, relating to the study procedure and use of the spirometer (Vitalograph 2160) were given to all subjects prior to the commencement of testing. A familiarisation trial using the spirometer was given to all subjects prior to testing. Subjects were seated during spirometry, and supine during, and after testing.

FEV_1 and FVC measurements were taken prior to testing. Each subject wore a nose peg during the spirometry measures, and the spirometer was calibrated using a one-litre syringe between subjects. Three spirometry measurements were recorded for each tested time (pre and post (0), post (10) and post (20)), provided the highest two measurements were within 0.25 litres. If this was not the case, an additional measurement was taken, with a maximum of eight measurements taken at each time frame tested. The procedure for measuring FEV_1 and FVC readings was adopted from the American Thoracic Society (ATS) Guidelines[36]. All values were recorded at the time of testing, with the highest acceptable value for each time frame being analysed. Following initial spirometry, subjects were instructed to lie supine on the treatment table, for administration of the lymphatic pump technique, and between each lung measure.

Thoracic Lymphatic Pump Technique, adapted from Sleszynski & Kelso[33]

The practitioner was situated at the head of the table, facing the subject. The practitioner applied bilateral pressure with her thenar eminences to the upper ribs, situated inferior to the clavicles. The fingers of both hands were fanned over the upper ribs and anterior pectoral girdle in order to maintain broad contact. Pressure was applied to the upper thoracic cage in a posterior and caudal direction, equal to the force exerted by the thoracic cage.

Subjects were then instructed to inspire deeply, whilst the bilateral hand pressure over the upper chest was maintained. The force applied to the rib cage was adjusted to equal the force exerted by the rib cage, to prevent undue discomfort and allow full inspiration to take place. At the commencement of expiration, a vibratory force was applied to the upper chest, at a rate of 100 cycles per minute. This rate was maintained, using a Metronome (Nikkon). At the end of expiration and the commencement of inspiration, rib cage pressure was maintained, and the technique repeated. A total of five maximal inspirations, and five oscillatory compressions were applied rhythmically to the upper chest. On the sixth inspiration, the compressive pressure directed through the thenar eminences bilaterally was slowly released, and a full inspiration allowed.[33]

Insert Figure 1 near here

Subjects were given a minute to regain their normal breathing patterns, and time recording was commenced, using a stopwatch. Spirometry measurements were then repeated immediately with the subject seated, and at ten and twenty minutes after that. Subjects were encouraged to remain supine between lung measurements.

Statistical Method

Results were analysed using Microsoft® Excel (1997). Mean ±SD, and skew were calculated for asthmatic (15) and non-asthmatic (15) groups, and pre and post test (0, 10 and 20) scores. A 2-tailed dependent T test was calculated to analyse pre and post (0, 10,20), test scores. The raw data was then broken up to analyse and compare asthmatic and non-asthmatic males with asthmatic and non asthmatic females using the same statistical independent t test calculations as above. Body Mass Index (BMI) was then calculated for each male and female subject, and a 2-tailed t test was again calculated to analyse pre and post (0) scores. This method was used in calculating both the raw FEV_1 and FVC data separately.

Results

Thêre were no statistically significant results obtained within asthmatics and non-asthmatics in this study. Breaking up this data, according to other variables including gender and body mass index (BMI) revealed no significant results either. It appears that the administration of the lymphatic pump technique does not alter lung function.

In analysing results within asthmatic participants regarding the effectiveness of the treatment pre and post testing (0) on FVC volumes, there was no significant change observed ($p= 0.994$). We also observed no significance ($p= 0.686$) in the non asthmatics tested over the same time course. In analysing FEV_1 volumes, there was no significant change for the same time period (0) in asthmatics ($p=0.821$) or non asthmatics ($p= 0.854$). Therefore, it is possible to conclude that the FVC and FEV_1 results from within the asthmatic and within the non-asthmatic participants, were not significant if a significance value of $p<0.05$ was used. Non- significant findings were also present at 10 and 20-minute post treatment testing ($p>0.05$).

Insert Table 1&2 here

Participant demographics, including sex and BMI were then analysed to see if significance existed between participants that could have accounted for the insignificant results. Analysis of male asthmatic (2) and non-asthmatic (7) participants FVC results, pre and post (0) testing was also statistically insignificant (p= 0.873). The FEV_1 (post (0)) of male asthmatics and non asthmatics was $p>0.05$.

Female participants' FVC values, both asthmatic and non-asthmatic were also analysed according to the same participant demographics as above, revealing no significant results. A FVC significance value of p=0.643 was calculated pre and post testing (0). FEV_1 calculations also failed to reveal significance amongst female asthmatic and non asthmatic subjects (p= 0.661) at the same time interval. Data analysis of both the male asthmatic and non asthmatic, and the female asthmatic and non asthmatic groups were further divided, according to BMI, but again, insignificance in the results was observed.

When calculating the effect size of asthmatics pre and post (0) testing, Cohen's d was 0.07. Cohen's d was also 0.07 when calculated for non asthmatics pre and post(0) testing. This indicates low effect size, indicating a larger sample size of 60 subjects within each group would be needed to be used in repeated study to obtain adequate power.

In ranking the results from the asthma bother profile, mean score was calculated as 15.3 ± 9.02. 14 subjects rated their asthma as mild, and one subject obtained a value of 30 from the profile, suggesting their asthma to be moderate.

Discussion

The lymphatic pump technique, adapted from Sleszynski & Kelso[33] was included within this study as it encouraged repeated deep diaphragmatic breathing (5 deep breaths) whilst firm, sustained pressure was applied to the upper ribs. No other studies to date have investigated the role of the lymphatic pump amongst people who suffer asthma, and the single administration of the technique was undertaken in order to determine if any short-term effects to lung volumes existed. Other studies to date, including Paul et al.,[13] Measel,[38] Sleszynski & Kelso,[33] Messina et al.[35] and Breithaupt,[41]investigated the use of repeated lymphatic pump techniques in the heightening of immunity following antigen exposure in healthy adults, with promising results. These studies measured continual immunity, following vaccine administration. The lack of significant results from this study may have been due to the single administration of the technique or the immediate measurements of lung excursion using a spirometry, post treatment.

As asthma is a chronic condition affecting the airways, repetitive administration of the technique throughout an extended period of time may be more beneficial in obtaining significant results. Repeated measurements of lung parameters (FEV_1 and FVC), daily variations in experienced symptoms and medication usage, may have been more applicable in further understanding treatment for this chronic condition. Wallace et al.[31] proposed the combined administration of thoracic pump and rib elevation in enhancing fluid removal from the lungs. It is our opinion that incorporating more than one treatment technique into the study may have obtained more significant results, and should set a basis for treatment of asthmatics. Bockenhauer et al.[37] investigated the benefits of four osteopathic techniques in people with chronic asthma, with improvements in thoracic cage excursion noted, but no change reported in peak expiratory flow rates or asthma symptoms when comparing this treatment procedure with sham treatments. Peak expiratory flow is a poor measure of lung function, especially when measured using a hand held peak flow meter, as in the Bockenhauer[37] et al study. Peak expiratory flow measurements depend largely on the respiratory effort of the subject and are not an entirely objective measure of lung function. Changing the method of respiratory excursion to exclude the subjects influence on test results may account for more accurate results.

The four techniques incorporated into Bockenhauer et al's[37] pilot study were balanced ligamentous tension in the occipitoatloid and the cervicothoracic junctions, A.T Still's technique for "upward displacement" of the first rib, direct action release of the "lower rib exhalation restriction", and diaphragmatic release,[37] each sustained for approximately 15 minutes duration. Only ten subjects were included within Bockenhauer et al [37] study, the effect size not calculated. Further studies, focusing on the development of an entire management /treatment plan incorporating common Osteopathic techniques, may improve efficacy for manual therapy in the treatment of asthma.

FEV_1 and FVC measurements via spirometry were repeated a minimum of three times for each time frame tested. Initial spirometry measurements, prior to testing, and immediately after the administration of the lymphatic pump were undertaken within a few minutes of each other, and an aspect of fatigue associated with spirometry and deep inspiration required throughout the technique may have accounted for the plateau or decline in values. Normally, deep inspiration results in dilation of the bronchial smooth muscles within the airways to account for the change in respiration. In people with mild asthma, a greater degree of airway narrowing following deep inspiration is evident, and in people with severe asthma. Bronchoconstriction can result from deep inspiration.[41] As no people with severe asthma were included within this study, bronchoconstriction and fatigue were less likely to influence the results. Instruction, regarding the use of the spirometer to measure the tested lung parameters were given to all participants prior to testing, and a practice session was available to all subjects for familiarisation with the equipment. Regardless of this, variations within the subjects perception of what was being asked, or their ability to fully inspire, then forcefully expire may have altered baseline measurements in which post testing comparisons were made. Three measured recordings, with the best recording being used within the study accounted for this variation in respiratory effort. All FEV_1 and FVC recordings, and technique administration were undertaken by the same practitioner to prevent variations in the results.

Analysis of the data based solely on the effectiveness of the technique was difficult, as differences existed between the participants within each group. More asthmatic females (13) volunteered for the study than asthmatic males (2), in comparison to eight non-asthmatic females and seven non-asthmatic males. This may be a contributing problem to the skewed data and non significant results as males have increased lung volume and pulmonary function capacities. Use of a stratified random sample to recruit subjects in future studies may be more beneficial in obtaining a more accurate representation of the population of people with asthma. The small sample size (N= 30) included within this study was not ideal. Cohen's d, calculated for both people with asthma and people without asthma (pre and post (0) testing) was 0.07, indicating the need for a larger sample size in order to obtain significant results. Repeating the study to include only people with asthma, and comparing the long-term benefits of the techniques administration to a placebo, may possibly result in more significant results.

No data was obtained regarding the pharmaceutical agents participants were prescribed, their frequency of administration and their perceived effectiveness. The profile, included within the study focused more on the burden of the condition on the subject's daily living, and their ability to function normally, with asthma. Obtaining data from subjects regarding their frequency of consultation with a general practitioner in obtaining prescriptions, (and whether preventer and /or reliever medications had been prescribed) and education (Asthma Management Program) about their condition would have allowed further assessment regarding the severity and effectiveness of their asthma treatment. Other studies[5,7,37] into non-pharmaceutical asthma treatment via the incorporation of manual techniques also failed to recognise the importance of the role of pharmacological assessment and management in asthma.

It was expected that the administration of the lymphatic pump technique to asthmatics would increase their lung volumes. This was not demonstrated in the results. Reasons for the unexpected results could be due to variations in the type of technique administration, FEV_1 or FVC measurements, or the type and number of subjects recruited.

Conclusion

The administration of the Lymphatic Pump technique as a method of increasing FEV_1 and FVC outcomes in asthmatics has not been demonstrated to be beneficial in isolation. No statistically significant differences in lung volumes were demonstrated by either groups tested, immediately after treatment.

Further investigation into the benefits of lymphatic pump techniques need to be examined, incorporating a larger sample size. Investigating the long-term benefits of repeated technique application in more severe asthmatic sufferers, when compared to a placebo control would be advisable, due to the chronicity of the condition. Further research, into an entire treatment plan rather than the application of a single technique would benefit the entire manual therapy profession. The increase in prevalence of asthma worldwide, demonstrates the need for manual therapists to seek interest in researching treatment modalities beneficial to this, and other respiratory conditions.

Table 1. FEV_1 and FVC Volumes (L) (mean +SD) in people with Asthma.
No significant differences ($p>0.05$) were observed in all measures.

	PRE	POST (0)	POST (10)	POST (20)
FEV_1	3.44±0.88	3.36±0.91	3.39±0.94	3.39±0.87
FVC	3.81±1.17	3.81±1.01	3.81±1.17	3.79±1.11

Table 2. FEV_1 and FVC Volumes (L) (mean +SD) in people without Asthma
No significant differences ($p>0.05$) were observed in all measures.

	PRE	POST (0)	POST (10)	POST (20)
FEV_1	4.04±1.02	3.97±1.12	4.02±1.08	3.98±1.18
FVC	4.53±1.17	4.35±1.28	4.33±1.23	4.16±1.34

[1] National Asthma Council Australia. Asthma Management Handbook, The National Asthma Council Australia website, located on the world-wide web at http://www.nationalasthma.org.au/publications/amh/amhintro.htm. Accessed 26th August 2003.

[2] Murtagh, J. *General Practice, 2nd Edition*, Sydney Australia, McGraw Hill Company Inc. 1999. 1051-1062.

[3] Asthma Victoria (2002). The Victorian Asthma Foundation website, located on the world-wide web at http:/www.asthma.org.au/asthma.html. Last updated 19th September, 2003.

[4] Britt, H, Sayer, GP, Miller GC, et al. Bettering the evaluation and care of health: general practice in Australia, 1998-1999. Sydney: *University of Sydney and Australian Institute of Health and Welfare*, 1999.

[5] Rowane, W, Rowane. M, An Osteopathic approach to asthma, *JAOA*, 1999(5); 259-265.

[6] Jackson, K, Steele. Osteopathic Treatment of Asthma: A literature Review and a call for research, *AAO Journal*, Winter Edition 1999; 23-27

[7] Thomas, M, McKinley, R, Freeman, E, Foy, C. Prevalence of dysfunctional breathing in patients treated for asthma in primary care: a cross sectional survey, *BMJ*, 2001; Vol 322 (7294);1098-1100.

[8] Commonwealth Department of Health and Ageing, Health Priorities Branch, *Asthma Fact Sheet*, Produced by Priorities and Quality Branch, Commonwealth Department of Health and Ageing, Victoria, Australia, May 2002. Retrieved on the world-wide web at http://www.health.gov.au/pq/asthma/pubs/asthfact.htm. Last updated January, 2003.

[9] Green, R.H, Brightling, C.E, Pavord, I.D, Wardlaw, A.J. Management of asthma in adults: current therapy and future directions, *Postgrad Med J* 2003: 79;259-267.

[10] Courtney-Belford, R. The Buteyko Method, an Osteopathic Approach to asthma?, *Aust J. Osteo.*, 1997;9 (2); 16-23.

[11] Felton, C. Osteopathic manipulation, Asthma and Dysmenorrhea: A review of the literature, *BOJ.*, 2000;Vol XXII;17-21.

[12] Keeley, D, Osman, L. Dysfunctional breathing and asthma, *B MJ.*,2001;Vol 322 (7294);1075-1076.

[13] Paul, R, Stomel, R, Broniak, F, Williams, B. Interferon levels in human subjects throughout a 24 hour period following thoracic lymphatic pump manipulation, *JAOA* 1986(1); 92-95.

[14] Woolcock, A.J, Bastiampillai, S.A, Marks, G.B, Keena, V.A. The Burden of Asthma in Australia, *MJA* 2001;175:141-145[13] UK Asthma Foundation (2002), The United Kingdom Asthma Foundation Website, located on the world-wide web at http://www.asthma,org.uk/infoan36.html. Accessed 12th May, 2002

[15] Allen, T.W. (editorial). Investigating the role of Osteopathic Manipulation in the treatment of Asthma, *JAOA*, 1993, Vol 93(6);654-659.

[16] Martin,J.G. Clinical Intervention in chronic respiratory failure, *Chest*, 1990, vol 97;no.3;105-110.

[17] Tiep, B.L. Disease Management of COPD with pulmonary rehabilitation, *Chest*, 1997; vol 112; no.6;1630-1657.

[18] Martini, F. *Fundamentals of Anatomy and Physiology*, 4th Edition, Prentice Hall Inc.USA.1998. 111-151.

[19] D'Alonzo, G, Krachman, S. Respiratory System. In: AOA, *Foundations for osteopathic medicine AOA*, USA, 1997; 441-457.

[20] Courtney-Belford, R. Eucapnic breathing, asthma and the role of hyperventilation in human health, *Aust. J Osteo.* 1995;7(1);14-17

[21] *Dorland's Illustrated Medical Dictionary, 28th Edition*, W.B Saunders Company, Philadelphia, USA, 1994. 803.

[22] Bowler, S.D, Green, A, Mitchell, C.A. Buteyko Breathing Techniques in asthma: a blinded randomised controlled trial, *MJA* 1998;169;575-578.

[23] Thomas, M, McKinley, R.K, Freeman, E, Foy, C, Price, D. Breathing retraining for dysfunctional breathing in asthma: a randomised controlled trial, *Thorax*, 2003; Vol 58; 110-115.

[24] Jackson, K, Steele, T, Dugan, E, Kukulka, G, Blue, W, Roberts, A. Effect of lymphatic splenic pump techniques on antibody response to hepatitis B vaccine: A pilot study, *JAOA*, 1998;98 (3);155-160.

[25] Goeman, D.P, Aroni, R.A, Sawyer,S, Thein, F.C, Abramson, M.J, Douglass, J.A. Patients' view of the burden of asthma: a qualitative study, *MJA* 2002;177;295-299.

[26] Wheatley, A.L, Gosling, C. McR, Gibbons, P. Investigation of the effects of using a rib raising technique on FEV_1 and FVC outcomes in people with asthma: A clinical evaluation, *JOM*, 2000;3(2);60-64.

[27] Murphy, A.J, Preliminary Studies of the influence of pulmonary and thoracic mobilisation procedures on pulmonary function, *JAOA,* 1965;64:951-952.
[28] Murphy ,A.J, Continuation of the study of the effects of thoracic mobilisation on the distribution of ^{131}I in the lungs, *JAOA*, 1971;70:1057-1058.
[29] Masarsky, C, Weber, M, Chiropractic Lung Volumes- A retrospective Study. *ACA,* 1986:20 (9):65-67.
[30] Grabowski, S, Tortora. G, *Principles of Anatomy and Physiology (9th Edition)*, Biological Sciences Textbooks Inc., USA, 2000, 810.
[31] Wallace, E, McPartland, J.M, Jones, J.M, Kuchera, W, Buser, B. Lymphatic System. In: AOA, *Foundations for osteopathic medicine AOA,* USA, 1997; 941-948.
[32] Kuchera, M, Kuchera, W. *Osteopathic considerations in systemic dysfunction, Second Edition,* Greyden Press Ohio.1994.
[33] Sleszynski, S, Kelso, A. Comparison of thoracic manipulation with incentive spirometry in preventing postoperative atelectasis, *JAOA,* 1993;Vol 93(8);834-845.
[34] Pratt-Harrington, D, Neptune-Ceran, R. The effect of Osteopathic Manipulative Treatment in the Post Abdominal surgical patient (A preliminary study), *AAO Journal*, Fall Edition,1999;9-13.
[35] Mesina, J, Hampton, D, Evans, R, Ziegler, T, Mikeska, C, Thomas, K, Ferretti, J. Transient basophilia following the application of lymphatic pump techniques: A pilot study, *JAOA*, 1998;Vol 98(2);91-94.
[36] Mein, E, Richards, D, McMillin, D, McPartland, J, Nelson, C. Physiological Regulation through manual therapy, Virginia USA, *Meridian Institute,* 2000;1-16. Copyright 1999 Meridian Institute. Retrieved Sept 25th 2003 from the world-wide web http://www.meridianinstitute.com/ceu/ceu13phy.html.
[37] Bockenhauer, S.E, Julliard, K.N, Sing Lo, K, Huangs, E, Sheth, A.M. Quantifiable effects of Osteopathic Manipulative Techniques on patients with chronic asthma, *JAOA*, 2002;Vol 102; no.7; 371-375.
[38] Measel, J. The effect of lymphatic pump on the immune response: I Preliminary studies on the antibody response to pneumococcal polysaccharide assayed by bacterial agglutination and passive hemagglutination, *JAOA*, 1982; 82(1);28-31.
[39] Hyland, M.E, Ley, A, Fisher, D.W, Woodward, V. Measurement of psychological distress in asthma and asthma management programmes, *B J Clin. Psych.,* 1995:Vol 34: 601-611.
[40] American Thoracic Society. Standardization of Spirometry, 1994 update. Am J Respir Crit Care Med 1995:152:1107-1136
[41] Breithaupt, T, Harris, K, Ellis, J, Purcxell, E, Weir, J, Clothier, M, Boesler, D. Thoracic Lymphatic pumping and the efficacy of influemzy vaccination in healthy young and elderly populations, *JAOA*, 2001;vol 101; no.1;21-25.

Figure 1. Application of the Thoracic Lymphatic Pump Technique

Table 1. FEV_1 and FVC Volumes (L) (mean +SD) in people with Asthma.
No significant differences (p>0.05) were observed in all measures.

	PRE	POST (0)	POST (10)	POST (20)
FEV_1	3.44±0.88	3.36±0.91	3.39±0.94	3.39±0.87
FVC	3.81±1.17	3.81±1.01	3.81±1.17	3.79±1.11

Table 2. FEV_1 and FVC Volumes (L) (mean +SD) in people without Asthma
No significant differences (p>0.05) were observed in all measures.

	PRE	POST (0)	POST (10)	POST (20)
FEV_1	4.04±1.02	3.97±1.12	4.02±1.08	3.98±1.18
FVC	4.53±1.17	4.35±1.28	4.33±1.23	4.16±1.34