Respiratory Muscle Strength, Chest Wall Expansion, and Functional Capacity in Singers, Non-Smokers, and Smokers

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Introduction

The lung's anatomical features include three boundaries, three surfaces, and an apex. Above the first rib is the apex. The anterior, posterior, and inferior borders are the three boundaries. A cardiac notch is formed in the left lung by the anterior edge of the lung, which is equivalent to the pleural reflection. The lung develops a concavity to provide room for the heart, known as the cardiac notch. The base of the lung and the costal surface are divided by the narrow inferior border. The thick posterior border runs from the apex of the lung to the inferior border, as well as from the C7 to the T10 vertebra.

The primary purpose of the lungs, the foundational organs of the respiratory system, is to enable the exchange of gases from the surrounding environment into the circulation. After passing via the alveoli and into the capillary network, oxygen can enter the arterial system and eventually perfuse tissue. The nose, oropharynx, larynx, trachea, bronchi, bronchioles, and lungs make up the majority of the respiratory system. The lungs further split into separate lobes, each of which splits into more than 300 million alveoli. The main site of gas exchange is the alveoli. The nerve roots of C3, C4, and C5 innervate the diaphragm, the main breathing muscle, through the phrenic nerve. Exercise and respiratory distress are the main uses for the inspiratory muscles known as the external intercostals.

The brainstem's medulla contains a central respiratory pacemaker that keeps the respiratory system under precise control. The respiratory muscles receive neural output from this center via the spinal cord. The inspiratory and expiratory muscle groups, which contract and relax to create a rhythmic respiratory rate and pattern, are responsible for the alterations. The pace and pattern are remarkably consistent in the majority of people with constant metabolic demand, with just a greater inspiratory effort or sigh occurring every few minutes. Most people only need their inspiratory muscles to breathe while they are at rest. The respiratory system returns to its resting state after expiration, which is typically passive. Consequently, the inspiratory time is the active respiratory pacemaker output during silent breathing. The number of breaths per minute and the volume of each inspiration or tidal volume can be altered by varying the pacemaker's brain output rate, duration, and intensity. The two elements of ventilation are the rate and tidal volume, which are the respiratory pacemaker's final outputs. With illness or elevated ventilator demands, the expiratory muscles start to become involved. When this happens, variations in pace and tidal volume will also result from how long it takes to sufficiently empty the lungs.

Rate multiplied by tidal volume equals minute ventilation. It is crucial to distinguish between how changes in tidal volume and rate affect gas exchange. There are two halves to each given tidal volume. The dead space is one component. This is the part of the volume that

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is transferred into the lungs during ventilation but does not come into touch with pulmonary capillaries that are in use. Air at the conclusion of inspiration, for instance, only reaches the trachea or bronchi, which lack capillaries. O2 cannot enter the bloodstream or be eliminated since there is no air–blood interaction. The alveolar volume is the other component. This portion of a tidal breath reaches the lung's air spaces, which are supplied with oxygen by working capillaries. These air spaces, which include the respiratory bronchioles, alveolar ducts, alveolar sacs, and alveoli, make up the terminal respiratory unit in healthy individuals. Each tidal breath's alveolar volume component alone contributes to gas exchange; all other ventilation is essentially lost. Gas exchange will be more affected if minute ventilation is increased by raising the tidal volume than if the same minute ventilation is achieved by increasing the rate.

The goal of respiratory muscle strength training (RMST) is to increase the inspiratory and expiratory muscles' ability to generate force. The desired result determines which respiratory muscles are targeted with RMST. For instance, inspiratory muscle strength training might be the selected rehabilitation aim if a person has diminished inspiratory muscle strength as a result of a neurogenic injury and is unable to ventilate the lungs. On the other hand, an expiratory muscle strength training paradigm can be the selected rehabilitation aim if a professional voice user complains of having trouble producing sufficient vocal loudness during song composition and is experiencing laryngeal dysfunction. Increasing expiratory muscular force generation for Parkinson's patients who struggle with breathing, swallowing, and coughing has been the focus of our most recent RMST work. As the illness worsens, this problem usually gets worse.

One measure of chest wall mobility is chest expansion, which is the difference in thoracic girth between maximum inspiration and expiration. It is an easy, affordable, and non-invasive method of evaluating chest mobility since it is evaluated with a measuring tape. The ability of a person to carry out tasks and activities that are required or desired in their lives under controlled circumstances is referred to as functional capacity.

In the 1998 SFMS and the 2004 SRSBS, the majority of respondents were male heads of households who smoked and provided both proxy and personal data on other household members, including their spouses. In the SFMS, respondents were asked if any household members who were 10 years of age or older currently smoked (including both daily and occasional smokers), and if so, whether they smoked bidis or cigarettes. Respondents who were 15 years of age or older were questioned by the SRSBS if they were regular smokers, occasional smokers, ex-smokers, or never smokers. We classified current smokers as either regular or infrequent smokers. One respondent was chosen at random from each home in the 2010 GATS, and they were asked to classify themselves as either daily smokers, less than daily smokers, ex-smokers, or never-smokers. We classified current smokers as either daily or less than daily smokers. The SRSBS only reported data for the age ranges of 15–29, 30–44, 45–59, and 60 years or older; it did not publish information on the type of tobacco smoked. Only the 2010 GATS and the 2004 SRSBS reported ex-smoking; the latter only reported smoking in general. Respondents who only smoked bidis or cigarettes were categorised as "exclusive," whilst those who smoked both were categorised as "both." Additionally, we created a distinct group called "any smokers" for people who smoked any other kind of tobacco, such as hookah or cheroot, or who were either exclusive or both.

One of the leading avoidable causes of premature death worldwide is tobacco usage. With an estimated 120 million adult smokers in 2010, India is second only to China in terms of smokers. In the past, bidis—small, locally produced cigarettes with tobacco wrapped inside a Tendu leaf—have accounted for the majority of tobacco consumption in India. Approximately 1 million deaths, or 10% of all deaths in India, were attributed to smoking in 2010; roughly 70% of these deaths occurred in those between the ages of 30 and 69. The use of manufactured cigarettes, or bidis, varies by location and socioeconomic status. Compared to high-income nations, quitting smoking is much less prevalent.

The last ten years have probably seen a shift in tobacco usage patterns due to modest tobacco control initiatives. In order to obtain estimates of the shifting patterns in any tobacco

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smoking, bidi and cigarette smoking, and quitting smoking between 1998 and 2015, we look at three nationally representative surveys that included over 2.5 million houses and 14 million individuals. We look at these patterns by gender, education level, age and generation, and whether a person lives in an urban or rural area.

Special Fertility and Mortality Survey (SFMS) [1998] Sample Registration System Baseline Survey (SRSBS) [2004] The Global Adult Tobacco Survey (GATS) [2010]

The degree of chest wall mobility in nonsmokers is determined by a number of factors, such as the strength of the respiratory muscle, the form of the chest, and the flexibility of the soft tissue structures surrounding the thorax. In clinical practice, chest wall expansion may be helpful in assessing chest wall mobility. Stronger inspiratory and expiratory muscles may be the cause of higher chest wall expansion.

Physical exercise increases both the frequency and depth of breathing, which raises ventilation. The diaphragm, auxiliary muscles, and external intercostal muscle all contract more during training to increase breathing depth.

The terms maximum inspiratory pressure (MIP) and maximum expiratory pressure (MEP) refer to measures of the strength of the inspiratory and expiratory muscles, respectively. higher lung capacity and higher negative pressure in the pleural cavity may be partially caused by an increase in inspiratory muscle strength. In addition to the rib cage's movement and the external intercostal muscle's expansion of the transverse dimensions, the diaphragm's contraction during the expansion of the thoracic cavity's vertical diameter also contributes to the degree of chest expansion. Furthermore, an increase in expiratory volume may lead to an increase in inspiratory volume. Lung volume is therefore affected by either expiratory or inspiratory muscle deficits.

When it comes to neuromuscular disorders, respiratory muscle strength has been shown to be a reliable indicator of long-term results. Additionally, compared to spirometry, maximum inspiratory pressure and maximum expiratory pressure may be more sensitive in identifying early respiratory muscle failure. Exercise limitation has been found to be substantially correlated with respiratory muscle fatigue or weakness in athletes, heart failure patients, and healthy individuals. An individual's ability to carry out submaximal tasks that call for the coordinated efforts and well-being of the skeletal muscle, cardiovascular, and pulmonary systems is referred to as exercise capacity or functional capacity. Reduction of chest wall expansion was favourably connected with pulmonary function, according to a clinical research including patients with chronic obstructive pulmonary disease. Additionally, a cross-sectional study of sickle cell disease patients found strong associations between peripheral muscle strength (handgrip strength), maximum inspiratory pressure, and the 6MWD, as well as between pulmonary function (maximum voluntary ventilation) and maximum expiratory pressure.

As chest wall expansion and functional capacity may be associated with respiratory muscle strength, it is realistic to assume that these variables are correlated. In other words, the purposes of this study were to find out the interactions among functional capacity, chest wall expansion, and respiratory muscle strength. These findings of this study may be used to improve recovery and activities of daily living in pulmonary and cardiac rehabilitation programs, such as respiratory muscle training in patients with reduced chest wall expansion and lung volume resulting from respiratory muscle weakness or thoracic surgery.

Smokers The adverse effect of smoking on adults' pulmonary function has already been observed in some prior research. Forced vital capacity (FVC), forced expiratory volume in one second (FEV1), FEV1/FVC, and forced expiratory flow at 25–75% (FEF25–75%) were all shown to be reduced by smoking. Deficits in FEV1/FVC and FEF25–75, which show airway obstruction and small airway disease in adult smokers, are caused by cigarette smoking. According to a prior study, young adult smokers had FVC levels that were either greater or equal to those of age-equivalent non-smokers, but elderly symptomatic smokers with histories of many pack-years had lower FVC levels than non-smokers. Elderly smokers' length and intensity of smoking, together with the degenerative impact, are likely to have significant negative consequences on their lung health. However, there is no conclusive proof that smoking has

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the same harmful impacts on young people's lung function as it does on senior citizens.

Early smoking may have an impact on young people's respiratory function since it has been demonstrated that breathing cigarette smoke causes acute lung changes, such as changes in resistance to airflow, coughing, and irritation of the airway. Nevertheless, there aren't many research that look at how smoking impacts adolescents' pulmonary health. Adolescent boys and girls' lung function was revealed to be impacted by cigarette smoking in earlier research13, 14. Adolescent smokers of both sexes had lower FEV1/FVC, according to those studies. In those trials, only the spirometer-based pulmonary function test was used. Therefore, we assessed and compared the lung function test using a spirometer, respiratory muscle strength, and chest expansion of smoking and non-smoking teenagers to better understand the impact of smoking on respiratory function and to learn more about the risks associated with cigarette smoking. We postulated that early adolescent smoking would impact pulmonary function, respiratory muscle strength, and chest expansion.

Singers Compared to non-singers, who had an average lung vital capacity of 2.73 L, choir singers had an average lung vital capacity of 3.12 L. The non-singer group's average inspiratory capacity was 1.71 L, whereas the singer group's average was 1.79 L. For those with long-term respiratory conditions, especially chronic obstructive pulmonary disease, singing has grown in popularity. Groups, including those with respiratory conditions, are using a variety of singing styles, from "Singing for Lung Health" (SLH) to community choirs with limited disease-specific content adaption. In order to promote optimal breathing and vocalising, "SLH" includes breathing and vocal exercises similar to those employed by respiratory and speech-language pathologists. About 120 singing leaders were previously educated by the British Lung Foundation to lead "SLH" groups; before the COVID-19 epidemic, these leaders were in charge of 65 groups. A typical SLH session might incorporate vocal and physical warm-ups, breathing exercises, relaxation, and carefully selected vocal repertoire to promote breath control rather than concentrating on learning material for performance. These elements' performance has already been assessed, proving the authenticity of the intervention. The physical advantages of SLH methods include increased flexibility, less hyperinflation, better breathing control, and better utilisation of respiratory and postural muscles. For instance, participants use biofeedback techniques to repeat voiced fricatives and expand sung phrases with acceptable repertoire. The goal of these approaches is to synchronise breath and phonation and match the action of the major respiratory muscles in a way that promotes proper vocal effort. The "SLH" repertoire, which covers a range of vocal characteristics and extended vocal ranges, aims to enhance vocal efficiency and support breath control techniques in order to have therapeutic effects. These methods are applied artistically and musically while encouraging full body movement.

Programs offered by SLH are typically held at least once a week for a minimum of six weeks. There is some data that suggests SLH may be therapeutically useful, enhancing people's functional ability and quality of life. However, according to a Cochrane systematic review, the field's general study quality has been low to extremely low, and there is a dearth of large-scale randomised controlled trial (RCT) data. Current SLH and ongoing RCTs include comparing singing as a physical training intervention in pulmonary rehabilitation with the gold-standard aerobic and strength exercise training for individuals with COPD, or comparing SLH with routine care. The need to expand the body of data supporting singing's therapeutic efficacy and underlying physiological effects associated with participation has been brought to light by a number of systematic reviews.

Objective

Need 0f Study

This study was necessary to compare the lung physiology of smokers, non-smokers, and performers who sing. Physiotherapy helps patients recover from, chronic lung diseases, fatigue, and other complication that may arise due to smoking, improving their physical and functional abilities, preventing long term complications, and promoting overall health and wellbeing.

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Aim of Study

The aim of study in physiotherapy in respiration is to better understand how physiotherapy can be used to help these patients recover from the lungs disease and cardio disease and improve their overall health and wellbeing.

Hypothesis

Alternative hypothesis

Strength of the respiratory muscles, expansion of the chest wall, and functional ability would all be vital for singers, smokers, and non-smokers.

Null hypothesis

Strength of the respiratory muscles, expansion of the chest wall, and functional capacity in singers, smokers, and non-smokers would not be significant.

Review of literature

Each investigation needs to contain a review of the literature. It enhances comprehension of a certain topic and aids in the analysis of the development of innovative ideas. Literature review gives an outline and critical analysis if relevant published books, thesis, research reports, and scholarly articles. On the participant and problems that need to be examined. The work that is pertinent to the current investigation is included in the review of literature. The following parts address the literature review for the current study : -

1. **Adachi D, Yamada M, Nish Iguchi S, Fukuzaki N, Hatta T, Tashiro Y, Morino S, Shirooka H, Nozaki Y, Hirata H, et, al. Age-related decline in chest wall mobility: a cross-sectional study among community-dwelling elderly women.** ***J Am Osteopath Assoc.*** **2015.** Although there is a substantial correlation between respiratory performance and chest wall mobility, it is yet unknown how ageing affects this mobility and at what point. Age-related variations in respiratory function and chest wall movement in older women across age groups.
2. **Burchfiel CM, Marcus E, Maclean C, et al.: Effects of smoking and smoking cessation on longitudinal decline in pulmonary function.** ***Am J Respir Crit Care Med*****, 1995, 151: 1778–1785**. These findings corroborate earlier findings of faster rates of FEV1 decline in smokers, and they show that middle-aged men and men with established pulmonary impairment experience less rapid declines in pulmonary function after quitting smoking.
3. **Sujata Mishra, Renu Ann Joseph, Prakash C Gupta, Brendon Pezzack, Faujdar Ram et.al BMJ Global health 2016 and Published online 2016 April**. Trends in cigarette and bidi smoking by age, gender, and education in India between 1998 and 2015. Over the past a period of ten years, smoking cigarettes or bidis—small, locally produced smoked tobacco—has probably altered in India. Between 1998 and 2015, we aimed to record patterns in the prevalence of smoking among Indians aged 15 to 69.
4. **Anong Tantisuwat and Premtip Thavera titham et.al. J Phys Ther** Sci **2014 Feb and Published online 2014**. indicated that there were notable differences between the smoking and non-smoking groups in the pulmonary function tests. In that article, the effects of smoking on youth's chest expansion, lung function, and respiratory muscle strength were discussed. Smokers started smoking between the ages of 15 and 18. The most common duration of cigarette smoking was 1-3 years, and the degree of nicotine dependence among the youth was low.
5. **Xu X, Dockery D, Ware J, et al.: Effects of cigarette smoking on rate of loss of pulmonary function in adults: a longitudinal assessment.** ***Am Rev Respir Dis*****, 1992, 146: 1345–1348.** The quantity of cigarettes smoked daily during the time between exams had a linear relationship with the increased rate of FEV1 decrease among smokers. For males and women, the projected increase in the rate of loss linked to smoking was 12.6 ml/yr per pack/day and 7.2 ml/yr per pack/day, respectively. Compared to estimates derived from cross-sectional analysis of the initial pulmonary function assessment, these longitudinal estimates of the effects of smoking were around 50% greater. Both men and women who began smoking saw faster rates of loss (55.9 ml/yr and 43.1 ml/yr, respectively). Compared to continuing smokers, smokers who quit between exams saw lower reductions (41.2 ml/yr for males and 28.7 ml/yr for women). The age-specific rates of loss indicate that young smokers may benefit most from quitting.
6. **Jha P,Ranson MK, Nguyen SN et al.. Estimates of global and regional**

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smoking prevalence in 1995, by age and sex. ***Am J Public Health*** **2002** In 1995, 29% of people worldwide who were 15 years of age or older smoked regularly. Of the 1.1 billion smokers worldwide, four-fifths resided in low- or middle-income nations. A disproportionately large fraction of smokers worldwide (38%) were from East Asian nations. Four-fifths of smokers were men, and the highest incidence among both genders was seen in individuals between the ages of 30 and 49 (34%). Tobacco-related mortality in low- and middle-income areas will rise sharply in the next decades. Quitting smoking is still uncommon in low- and middle-income nations, despite the fact that it can save a large portion of this extra mortality.

7. **Reddy RS, Alahmari KA, Silvian PS, Ahmad IA, Kakarparthi VN, Rengaramanujam K. Reliability of chest wall mobility and its correlation with lung functions in healthy non-smokers, healthy smokers, and patients with COPD.** ***Can Respir J.*** **2019;** Therapists frequently use chest wall circumference measures in clinical settings to assess chest wall mobility. There is a great deal of variation in the testing methodology, necessitating testing in various situations, and previous reported results have been inconsistent.
8. **Kaasgaard M,Andersen IC, Rasmussen DB, et al.. Heterogeneity in Danish lung choirs and their singing leaders: delivery, approach, and experiences:a survey-based study.** ***BMJ Open*** **2020;10:e041700.10.1136/bmjopen-2020-041700**. People with respiratory illnesses are thought to benefit from singing as a recreational activity, and lung choirs are becoming more and more popular. However, results, delivery, and advantages are unknown because there are no established guidelines about recommended methods. The current study examined delivery, approach, and experiences in Danish lung choirs and their singing leaders for the first time ever. It was hypothesised that the array would be diverse, lack a disease-specific strategy, and be a difficult area for the singing leaders to traverse.
9. **Bernardi NF, Snow S, Peretz I, et al.. Cardiorespiratory optimization during improvised singing and toning.** ***Sci Rep*** **2017**. Toning reduced breathing to nearly precisely six breaths per minute ($p < 0.001$), which is known to optimise cardiovascular function and coincides with the time of endogenous circulatory cycles. It also considerably increased heart rate variability and ventilatory efficiency. Although to a lesser degree, singing songs also improved cardiorespiratory function. In the absence of voice output, the participants' forced breathing rhythm was adequate to provide the physiological advantages. Toning has benefits that are comparable to those previously reported from formal breathing exercises. Singing and toning may be a fun and affordable way to induce healthy breathing patterns and the associated cardiovascular advantages.
10. **Thomasson M, Sundberg J. Consistency of phonatory breathing patterns in professional operatic singers.** ***J Voice*** **1999;** Because breathing technique is thought to have an impact on phonation, it is typically considered a crucial component of operatic singing. If this is the case, experienced vocalists should repeat the same line with regulated, repeatable breathing motions. The current study sought to determine the degree to which experienced opera singers exhibit a constant, exhalatory breathing pattern in a quasi-realistic concert setting.
11. **Ravi SK, Shabnam S, George KS, et al.. Acoustic and aerodynamic characteristics of Choral singers.** ***J Voice*** **2013 The results from acoustic analysis of female groups revealed higher F0 in singers than non-singers;** Compared to singers, non-singers had greater jitter, shimmer, and noise-to-harmonics ratio (NHR) values. The acoustic study of male groups showed that singers had much greater F0 than non-singers, while non-singers had significantly higher shimmer and NHR values. Aerodynamic analysis results for the male and female groups showed that singers had greater vital capacity, forced vital capacity, and slow vital capacity than non-singers.
12. **Traser L, Knab J, Echternach M, et al.. Regional ventilation during phonation in professional male and female singers.** ***Respir Physiol Neurobiol*** **2017** Although the respiratory system plays a crucial role in producing voice, the specifics of breath management during phonation remain unclear. Therefore, the purpose of this study is to examine lung regional ventilation during phonation. Electrical impedance tomography

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was used to analyse it in 11 professional singers while they were breathing and phonating at their maximal phonation time. In the time and amplitude normalised curves, our findings demonstrate variations in impedance changes between phonation and exhalation.

13. **Wüthrich TU, Notter DA, Spengler CM. Effect of inspiratory muscle fatigue on exercise performance taking into account the fatigue-induced excess respiratory drive. *Exp Physiol.* 2013;98:1705–1717.** Exercise performance may be hampered by inspiratory muscle fatigue (IMF), potentially through a respiratory muscle metaboreflex that reduces blood supply to working muscles and speeds up the development of tiredness in these muscles. An excessive ventilatory response has also been linked to cycling with IMF, which may negatively impact performance in and of itself. Therefore, the current study examined whether fatigue-induced excess ventilation would contribute to this impairment and if prior-induced IMF would impact later cycling performance only through greater quadriceps muscle fatigue.
14. **Jonathan D Witt[1], Jordan A Guenette, Jim L Rupert, Donald CMcKenzie, A William SheelJPhysiol 2007 Nov/jphysiol.2007; Epub 2007 Sep 13** The human respiratory muscle metaboreflex is attenuated by inspiratory muscle exercise.A dampened sympatho-excitation to resistive inspiratory effort is suggested by this diminished cardiovascular response. Our results, which we attribute to a decreased activity of chemosensitive afferents in the inspiratory muscles, may explain part of the benefits in whole-body exercise endurance linked to inspiratory muscle training.
15. **Traser L, Knab J, Echternach M, et al.. Regional ventilation during phonation in professional male and female singers. *RespirPhysiol Neurobiol* 2017;239:26–33. 10.1016/j.resp.2017.01.006** Although the respiratory system plays a crucial role in producing voice, the specifics of breath management during phonation remain unclear. Therefore, the purpose of this study is to examine lung regional ventilation during phonation.
16. **Evans JA, Whitelaw WA: The assessment of maximal respiratory mouth pressures in adults. *Respir Care*, 2009, 54: 1348–1359** the connection between respiratory muscle strength and vital capacity, as well as provide guidance for interpreting measures of maximum pressure. In a pulmonary function laboratory, the method need to enable the direct use of MIP and MEP.
17. **Ambrose JA, Barua RS: The pathophysiology of cigarette smoking and cardiovascular disease: an update. *J Am Coll Cardiol*, 2004, 43: 1731–1737**. Cardiovascular morbidity and mortality are greatly increased by cigarette smoking (CS), which is still a serious health risk. Cigarette smoking affects every stage of atherosclerosis, from acute clinical events—which are primarily thrombotic—to endothelial dysfunction. Exposure to both active and passive (environmental) cigarette smoking increases the risk of cardiovascular events. Since several recent experimental clinical trials have demonstrated a non-linear relationship to cigarette smoke exposure, it is questionable if there is a clear direct dose-dependent association between risk and cigarette smoke exposure.
18. **Gold DR, Wang X, Wypij D, et al.: Effects of cigaratte smoke on lung function in adolescent boys and girls. *N Engl J Med*, 1996, 335:** 931–937Adolescents who smoke cigarettes have slower lung function development and signs of minor airway blockage. Teenage females may be more susceptible than boys to the negative effects of smoking on lung function development.
19. **Prokhorov AV, Emmons KM, Pallonen UE, et al.: Respiratory response to cigarette smoking among adolescent smokers: a pilot study. *Prev Med*, 1996, 25: 633–640**. An effort was made to discover both objective and subjective respiratory issues among teenage smokers since smoking cigarettes affects the respiratory system before many other bodily systems.
20. **Janssens L, Brumagne S, McConnell AK, Raymaekers J, Goossens N, Gayan-Ramirez G, Hermans G, Troosters T. The assessment of inspiratory muscle fatigue in healthy individuals: a systematic review. *Respir Med.* 2013; 107:331–346**. Exercise restriction and respiratory failure may arise as a result of inspiratory muscle fatigue (IMF). Finding inspiratory muscle exhaustion necessitates a thorough and comprehensive scientific approach. The best method for inducing and evaluating the inspiratory muscles' fatigability, however, is still up for debate. To find,

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examine, and compile the literature on the evaluation of induced IMF in healthy persons, a systematic review was conducted.

21. **Jalayondeja W, Verner O, Jarungjitaree S, Tscheikuna J. Respiratory muscle strength explained by age and weight in female and male. *J Med Assoc Thai.* 2014;97(Suppl 7):S16–20.** Using a mouth pressure meter, 249 individuals between the ages of 30 and 70 had their maximum inspiratory mouth pressure (MIP) and maximal expiratory mouth pressure (MEP) measured ten times at residual volume and twelve times at complete lung capacity, respectively. The relationship between respiratory muscle strength and attributes data was evaluated using Pearson's correlation. The prediction equation for respiratory muscle strength was developed using several linear regressions.
22. **Lewis A, Cave P, Hopkinson NS. Singing for lung health: service evaluation of the British lung Foundation programme. *Perspect Public Health* 2018; 138:215–22. 10.1177/1757913918774079** Participants in SLH groups report better respiratory health-related quality of life and lower healthcare use, according to this service review. SLH may be advantageous for both health and the economy. Therefore, these outcomes should be further assessed in large-scale randomised controlled trials (RCTs) in order to validate these findings.
23. **Lee L, Loudon RG, Jacobson BH, et al.. Speech breathing in patients with lung disease. *Am Rev Respir Dis* 1993;147:1199–206. 10.1164/ajrccm/147.5.1199 .** The breathing patterns and lung volumes utilised during speaking are distinct from those used during calm respiration, and they may change depending on the kind of lung illness. A speech protocol was performed by 16 healthy individuals and 41 patients with sarcoidosis, emphysema, or asthma in order to test this theory. During a counting activity and during a discussion, volumes, timings, and flow rates were noted. For every breath, a total of sixteen measurable variables were obtained and statistically evaluated. Speech breathing changes were task-specific and disease-specific. When applied to data from either speech task, discriminant function analysis was able to accurately categorise participants with above 50% accuracy, demonstrating that distinct patterns were considerably disease-specific.
24. **Zhang Z. Respiratory laryngeal coordination in airflow conservation and reduction of respiratory effort of phonation. *JVoice* 2016;30: 760.e7760.e13.10.1016/j.jvoice.2015.09.015** . According to simulations, phonation may be maintained for a longer breath group duration when glottal resistance is increased since it decreases glottal airflow. The decreased airflow also permits phonation to be maintained within a limited range of lung volumes for a particular breath group time, so reducing the total respiratory effort.
25. **Lanza Fde C, de Camargo AA, Archija LR, Selman JP, Malaguti C, Dal Corso S** In healthy individuals, lung capacities and respiratory muscle strength are correlated with chest wall mobility. Take care of your breath. 58:2107–2112 (2013). In healthy individuals, lung function and respiratory muscle strength are correlated with chest mobility; higher axillary and thoracic cytometry values are associated with larger lung volumes, maximum inspiratory pressure, and maximum expiratory pressure.
26. **Moll JM, Wright V: An objective clinical study of chest expansion. *Ann Rheum Dis*, 1972, 31: 1–8.** Restricted spinal mobility in these individuals is caused by ossification of the spinal ligaments, fusion of the apophyseal joints, and formation of syndesmophytes along the vertebral column. Chest expansion is severely limited as a result of the fusion of the joints at the costovertebral, costosternal, manubriosternal, and sternoclavicular levels, in addition to the involvement of the thoracic vertebrae. Patients with restrictive respiratory illnesses are often diagnosed with limited chest wall movement rather than respiratory abnormalities. The diagnosis of AS essentially depends on the modified New York criteria described in 1984, despite the fact that new classification criteria created by the Assessment of Spondylo Arthritis International Society have been widely used in recent years to identify patients with axial spondyloarthropathy in the early period. The main criteria for diagnosing AS, according to the 1984 modified New York criteria, are limitation of lower back motions in all three planes and chest expansion below normal levels for age and sex. A significant shortcoming is the lack of standards for typical reference ranges for lumbar mobility and chest expansion in the healthy population, as well as

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recommendations about the variables influencing these. In this investigation, we used modified Schober measurement values to show lumbar mobility and chest expansion in healthy male and female populations aged 15 and older, as well as to discover factors influencing these measurements.This will make it possible to get the necessary healthy population reference values for lumbar spinal mobility limitation and chest expansion, two of the key AS diagnostic criteria.

27. **Singer J, Yelin EH, Katz PP, Sanchez G, Iribarren C, Eisner MD, Blanc PD. Respiratory and skeletal muscle strength in chronic obstructive pulmonary disease: impact on exercise capacity and lower extremity function.** ***J Cardiopulm Rehabil Prev.*** **2011;31:111–119** Reduced exercise and functional ability are linked to respiratory and lower limb muscle weakness in COPD. In individuals with COPD, muscle weakness is probably a significant factor in impairment and disability.
28. **Watson AH. Breathing in Singing. In: Welsh GF, Howard DM, Nix J, eds.** ***The Oxford Handbook of singing*****. Oxford**: Oxford University Press, 2014. For many millennia, singing has been a defining human activity. According to Chorus America (2009), 42.6 million adults and children, or more than one in five families, routinely participate in one of the 270,000 choruses in the United States. In a similar vein, new data from Europe indicates that over 37 million persons participate in group singing. One important work on this subject is the Oxford Handbook of Singing. For anybody interested in learning more about the pluralistic nature of singing, it is an extensive resource. The story uses a lifetime perspective, from pre-cradle to senescence, to show how singing is a widespread activity that is fundamental to what it is to be human.
29. **Kenfield SA, Wei EK, Rosner BA, et al.: Burden of smoking on cause-specific mortality: application to the nurses' health study.** ***Tob Control,*** **2010, 19: 248–254** . When using repeated assessments of smoking data obtained throughout follow-up, the dangers of smoking and the benefits of quitting are higher than previously reported and differ by cause of death. To lessen the global mortality burden caused by smoking, concentrated efforts to inform smokers of the advantages of quitting and to stop children and young people from starting to smoke should continue to be top public health priority.
30. **Clift S, Skingley A, Page S, et al..** ***Singing for better breathing: findings from the Lambeth and Southwark singing and COPD project.*** **Kent, England: Sidney De Haan Research Centre for Arts and Health, 2017.** Introduction Over the past eight years, there has been an increase in interest in the potential benefits of singing groups for individuals with respiratory conditions such as chronic obstructive pulmonary disease (CODP). The growing number of singing for breathing groups that have been formed around the UK at this time is evidence of this. Through its "Singing for Lung Health" initiative, the British Lung Foundation has taken the lead in promoting this practice.

Methodology

Research design And Sampling
Research design- Experimental design
Types of Sampling – Simple random sampling
Sample Size – 60 [20 Singers, 20 Non Smokers, 20 Smokers]

Materials and Method:

❖ Materials –
• Couch
• Pillow
• Spiro meter
• Respirometer
• Measurement tape

❖ Methods –

The lung function test employing spirometry, the measurement of chest expansion, and the strength of the respiratory muscles comprised the respiratory function test.

- Participants were encouraged to completely inhale and exhale while standing in order to measure the circumference and diameter of their chests. Chest expansion was used to measure the variations between complete intake and exhalation. The axilla (4th rib) for upper chest movement, the xiphoid process for middle chest movement, and the 10th costal cartilage levels for lower chest movement were the three levels at which the chest circumference was measured using a tape measure. A calliper was used to measure the chest diameter at the xiphisternal junction in both the anteroposterior (AP) and mediolateral (ML) directions.

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- The lung function was measured using a spirometer. Forced vital capacity (FVC) and forced expiratory volume in the first second (FEV1) were the lung function metrics assessed. Before the test was administered, the individuals were instructed and given a quick and thorough inhale, as well as a demonstration of the proper performance posture, which included positioning the mouthpiece with the head slightly raised, and exhaling with maximum power.
- A respiratory pressure meter for maximal inspiratory and maximal expiratory pressure was used to test the strength of the respiratory muscles. For the MIP test, participants were told to fully exhale, then quickly and completely inhale; for the MEP test, they were told to fully inhale, then quickly and completely exhale. The best value was utilised in the study after all parameters were obtained in three trials.
- The independent t-test for normally distributed data and the Mann-Whitney U test for non-normally distributed data were used to compare the respiratory function data between the smoker and non-smoking groups. At $p<0.05$, differences were deemed statistically significant.

Selection of criteria

Inclusion criteria

- Age 15-30 years
- Respiratory problems
- Muscle weakness
- Multiple organ involvement
- A persistent state of bewilderment and psychological issues that make it difficult to wake up
- Cardiac problems
- Dyspnea [grade2]
- Dyspnea [grade3]

Exclusion criteria

- Hyper tension
- Obesity
- Diabetes mellitus
- Cardiovascular instability
- Uncooperative patient

Protocol

- ❖ Respiratory muscle strength, chest wall expansion, and functional capacity in singers, smokers, and non-smokers as determined by the study's inclusion and exclusion criteria.
- ❖ A written constant was obtained from each subject.
- ❖ Taking assessment of each subject for well fitted sampling.
- ❖ Documentation of data collected
- ❖ Data Analysis.
- ❖ Discussion of Result.
- ❖ Conclusion of study.

Procedure

Regulating your breathing while singing While expiration is passive and mostly driven by lung elastic recoil during silent breathing, inspiration is an active process involving the respiratory muscles. Minute ventilation rises during physical exercise due to an increase in tidal volume and respiratory rate as metabolic demands rise. In order to provide active expiration, this calls for higher flow rates and the activation of abdominal muscles. Ventilation is also regulated by laryngeal muscle activity, which controls the glottic aperture. When inspiration occurs, the glottis opens, and when expiration occurs, it narrows. The glottis functions as a valve to affect the respiratory cycle's expiratory timing, and glottic opening takes place before the diaphragm descends during inspiration. As a result, the larynx may be regarded as a crucial expiratory flow modulator.

Breath duration and flow rates are regulated throughout speech and singing to facilitate the larynx's production of sound. In order to modify lung volumes for phrase length and sound loudness, inspiration and expiration are therefore both active. Herbst criticised the conventional linear relationship of the power-source-filter concept, in which the larynx and vocal tract modify the sung voice after the lungs decide it. Instead, he claims that every system and voice subsystem affects every other system physically. Exhalation will therefore change in accordance with variations in vocal function. The rectus abdominus, internal and external obliques, and transverse abdominus are among the abdominal muscles that singers use to regulate their expiration. During phonation, the ribcage is also drawn by the internal intercostals.

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In contrast to a passive breathing cycle, speaking causes a decrease in inspiratory time and an increase in expiratory time. Compared to unphonated breathing, subglottic pressure is controlled more aggressively during speaking and singing, and much more so during singing. Sustained, regulated exhalation is necessary for phonation. Because phonation stops most of the air from being expelled at the beginning of the breath, it modifies expiratory airflow in a more uniform pattern than unphonated breathing, according to a research utilising electrical impedance tomography. With little glottal resistance, subglottal pressures can be sustained during exhalation. As a result, the lung volume at the conclusion of the phrase is nearly equal to the residual volume. In order to alter lung volumes at this stage of lung capacity, larger expiratory pressures must come after inspiratory pressures. The vocal and respiratory systems cooperate to maximise singing efficiency.

The balance between inspiratory muscular strength and the respiratory system's elastic recoil, as well as the person's size, sex, ethnicity, and illness status, determine the lung function parameters in singer's total lung capacity. Particular training or pulmonary rehabilitation can increase the strength of the respiratory muscles. Singing and non-singing ventilator activities are compared by professional vocalists. In contrast to non-singing ventilator activities, the study discovered that vocalisation required activation of extra muscles, such as latissimus dorsi, which may be crucial in connection to respiratory muscle strength. Additionally, forced expiratory volumes and vital capacities have been demonstrated to be higher in vocalists than in the general population.

The duration of singing participation, a tendency for individuals with pre-existing above-average respiratory function to become singers as is known from other physically demanding professions, and possibly lifestyle choices like smoking less and exercising more than peers are all likely contributing factors to the differences in lung function parameters between singers and non-singers. Nonetheless, it is hypothesized that frequent concentration on deliberate exhalation strengthens the expiratory muscles.

Nine professional singers were found to be able to manage their breathing by dynamically changing their abdomen volumes and vocal fold aperture. Additionally, a small study that compared seven singers with classical training to four untrained individuals revealed that singers could significantly change the coordination of thoracic and abdominal volume change during singing as opposed to quiet breathing by using a higher percentage of abdominal contribution to lung volume change. By maximizing muscle length-tension ratios and force-generation capabilities, vocalists with classical training raise abdominal pressures to facilitate a more efficient expiration. The front diaphragm and ribcage, as well as the middle and posterior diaphragm and ribcage, are thought to operate as distinct functional units while singing. With varying recoil forces during expiration, these distinct units sustain sub glottal pressures.

Abdominal muscle activity rises during singing. Using ultrasonography, 25 healthy people' abdominal muscles were examined for the immediate effects of singing. Both the internal oblique and transverse abdominis [TA] muscles activate while singing, with the TA exhibiting a higher percentage contraction as compared to baseline circumstances at a comfortable inspiration. Compared to untrained controls, trained singers employ a larger belly contribution to alter lung volumes while singing, as seen by respiratory inductance plethysmography bands. It is crucial to acknowledge that most singing research has been done on singers with classical training, whose breathing needs are unique to the manner they sing and distinct from modern pop or global repertoire, which is frequently employed in SLH.

Forced Expiration Technique: Huffing or Coughing: Sit upright with your mouth open and your chin tilted slightly up. Take a slow breath to fill your lungs about 75%. Hold it for two or three seconds. Then, exhale forcefully but slowly in a continuous exhalation to move mucus from the smaller to the larger airways. Repeat this process two or more times. Finally, cough vigorously to clear mucus from the larger airways.

The three phases of the active cycle breathing technique are Breathing Control Phase, Deep Breathing, Thoracic Expansion Phase, and HUFFING PHASE. The first phase helps to relax your airways, the second phase helps you get air behind and clear mucus, and the third phase helps force the mucus out of your lungs. Breathing is done while sitting comfortably,

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with the shoulders, neck, and lumbar spine in a neutral position. The patient was urged to breathe through their nose, hold as long as they could, and then release. Until the individual feels prepared to go on to the next phase of the cycle, breathing control should be maintained. Thoracic expansion exercises are deep breathing exercises that emphasise inspiration. The patient is encouraged to breathe in slowly and profoundly through, if at all feasible. After reaching maximal inspiration, the patient may be asked to do an end inspiratory breath hold for three seconds prior to passive expiration. For a maximum of five breaths, this is repeated. When used in conjunction with breathing control, a huff, also known as forced expiration methods, directed patients to take a medium breath in and exhale with mild to moderate force and prolonged expiratory flow.

BreathingActivities:

Diaphragmatic breathing, also known as deep breathing or belly breathing, is a useful technique to help the body relax and increase diaphragm excursion. The patient should be in a relaxed and comfortable position, rehabilitate the shoulder muscles, place hands on the rectus abdominis (just below the auto costal margin), ask the patient to breathe slowly and deeply through their nose, feel their abdomen rise, and then ask them to exhale slowly through their mouth and allow their abdomen to fall.

While keeping other parts silent, segmental breathing works well for expanding the lungs. Apical expansion, posterior basal expansion, and lateral costal expansion. Cardio respiratory fitness is enhanced by aerobic exercise or sustained low-intensity training. The significance of ongoing exercise in preventing the deterioration of lung function in cigarette and hookah users has been demonstrated through careful monitoring of training volume and intensity. Similarly, regular exercise combined with physical training appears to be helpful in preventing hypertension. Lastly, these findings may have significant ramifications for preventive and treatment initiatives for hookah and cigarette users who are unable or unwilling to give up.

Figure 4.1 Showing Spirometer, Respirometer, Measurement tape.

Figure 4.2 Showing the Diaphragmatic Breathing technique exercise

Figure 4.3 Showing the Respiratory exerciser resistance training

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Figure 4.4 Showing Chest circumference at the Axilla

Dyspnoea scale

The modified Medical Research Council (mMRC) dyspnoea scale and the Edmonton Symptom Assessment Scale (ESAS) were the particular symptom questionnaires. The ESAS is a symptom-based, self-rated, numerical rating scale designed to evaluate symptoms. On a scale of 0 (no symptoms) to 10 (the worst conceivable symptoms), ESAS rates various symptoms. We utilised a modified version of the questionnaire in this study, which included 12 questions on symptoms, one question about general wellness, and a standardised body diagram where patients may indicate their pain points.

The mMRC scale is a self-rating tool that measures how much breathlessness interferes with daily activities on a scale of 0 to 4: 0, no breathlessness except during intense exercise; 1, shortness of breath when hurrying on the level or walking up a slight hill; 2, walks slower than people of the same age on the level due to breathlessness or has to stop to catch breath when walking at their own pace on the level; 3, stops for breath after walking about 100 meters or a few minutes on the level; and 4, too breathless to leave the house or undress.

33 (13%) of the patients had a mMRC score of 0 (no breathlessness), 88 (35%) had a score of 1 (breathless when hurrying or walking up a hill), 75 (30%) had a score of 2 (breathless when walking slower than people of the same age or having to stop when walking), 34 (13%) had a score of 3 (breathlessness stops walking after approximately 100 m or a few minutes), and 23 (9%) had a score of 4 (breathlessness when dressing or unable to leave the house).

Reliability and validity of the Spirometer

Our study's goal was to verify the incentive spirometer. Spirometry is a useful tool for managing and treating respiratory muscle strength, chest wall expansion, and functional capacity in singers, non-smokers, and smokers. An incentive spirometer is a tool used in this technique to strengthen and regulate breathing. A flexible tube is fastened to a transparent, hollow cylinder. You may breathe in and out through the mouthpiece at the other end of the tube. Depending on how much can be exhaled, a little ball or other indication within the spirometer rises and falls. A gauge to gauge how slowly you exhale is also included in the gadget.

It will calculate the forced vital capacity, which is the total quantity that can be expelled, and the forced expiratory volume in one second (FEV1), which is the amount that was exhaled in the first second. Other characteristics that affect FEV1 include height, race, age, and sex. FEV1 is computed as a percentage of FVC (FEV1/FVC).

Data Analysis

Every participant who meets the selection criteria will be assessed clinically. A statistical approach was used to analyze the data. When the means of the two groups were compared, it was determined that the outcome measures were significant. Before being included in the trial, all patients gave their informed permission to ensure their willingness, information confidentiality, and awareness of all procedures and interventions. During treatment sessions, Group A will get an activity intervention program that includes breathing exercises, cardiovascular exercise, pulmonary rehabilitation, and phonation methods.

Group B will only receive standard treatment. In order to keep the therapy session going, the participants or the carer were taught activities to perform at home on the remaining days.

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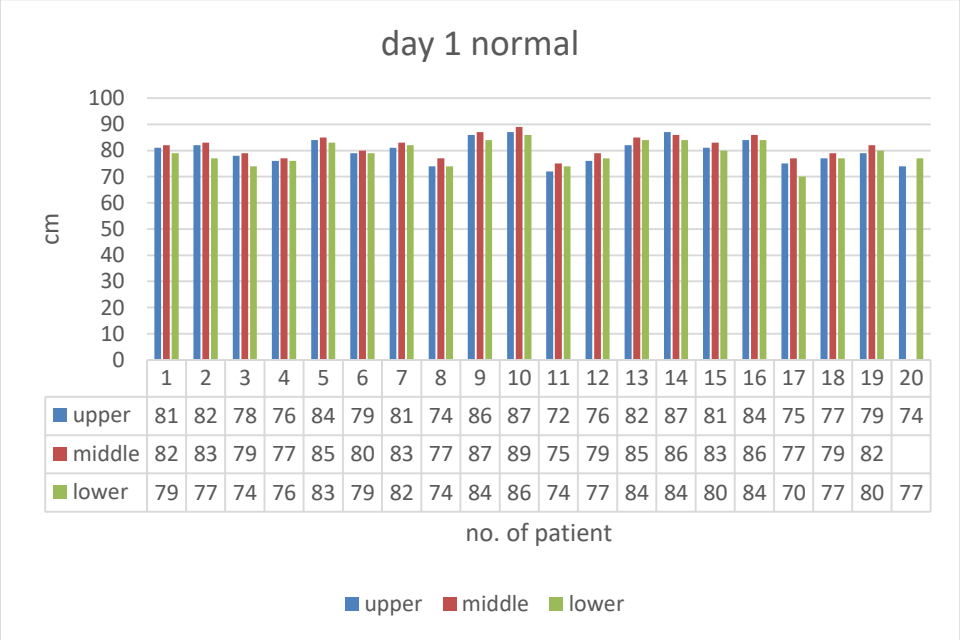
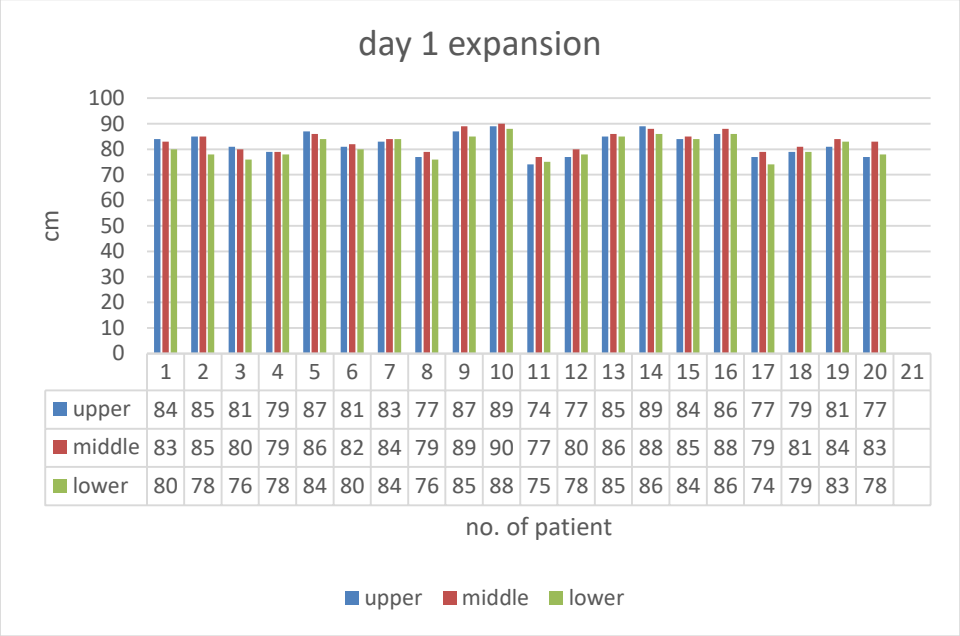
A. Statistical analysis of data in upper, middle and lower chest circumference of Singers on day 1



Graph 5.1: Comparison study of Day 1 of Normal chest circumference.



Graph 5.2: Comparison study of Day 1 of Expansion chest circumference.

Day1	mean	Standard deviation
Normal	80.2	4.32
expansion	82.1	4.21

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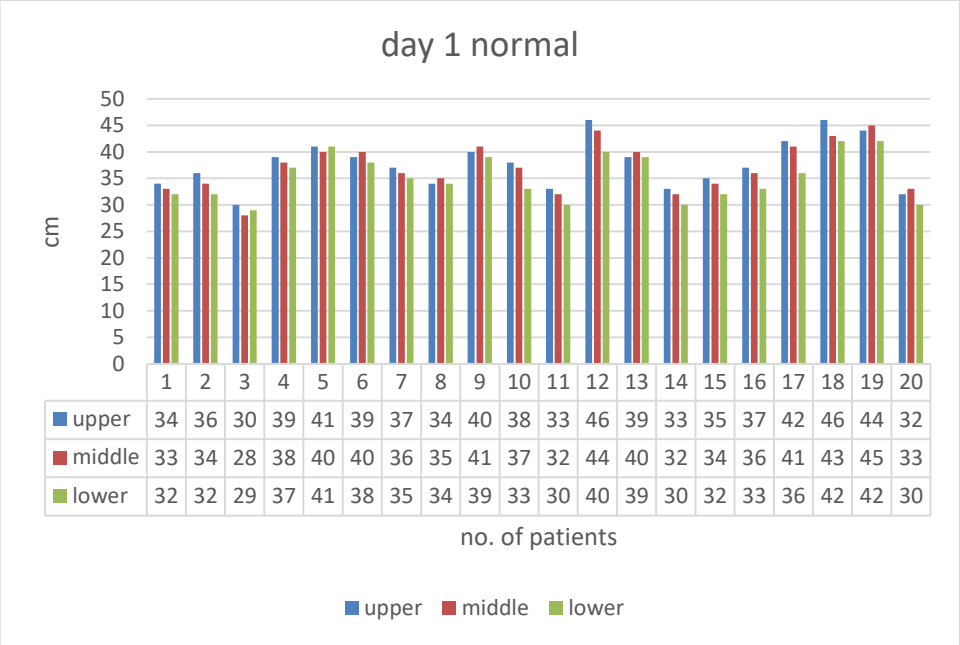
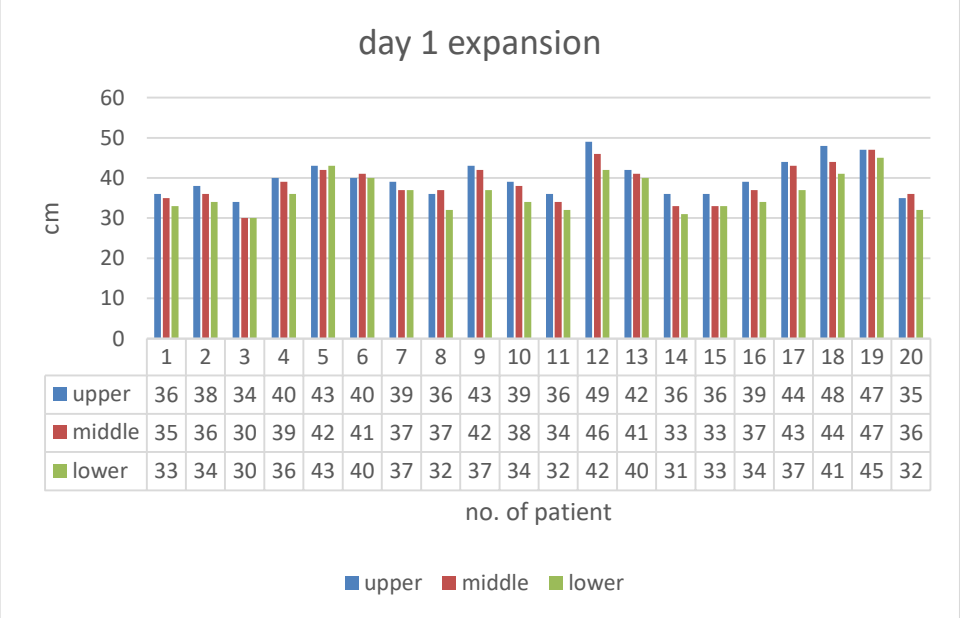
Table5.1: Comparison study of Day 1 of Mean and Standard deviation of Normal and Expansion chest Circumference.

A. [a] Statistical analysis of data in upper, middle and lower chest circumference of Non-Smokers Day 1



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
upper	34	36	30	39	41	39	37	34	40	38	33	46	39	33	35	37	42	46	44	32
middle	33	34	28	38	40	40	36	35	41	37	32	44	40	32	34	36	41	43	45	33
lower	32	32	29	37	41	38	35	34	39	33	30	40	39	30	32	33	36	42	42	30

Graph 5.3: Comparison study of Day 1 of Normal chest circumference.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
upper	36	38	34	40	43	40	39	36	43	39	36	49	42	36	36	39	44	48	47	35
middle	35	36	30	39	42	41	37	37	42	38	34	46	41	33	33	37	43	44	47	36
lower	33	34	30	36	43	40	37	32	37	34	32	42	40	31	33	34	37	41	45	32

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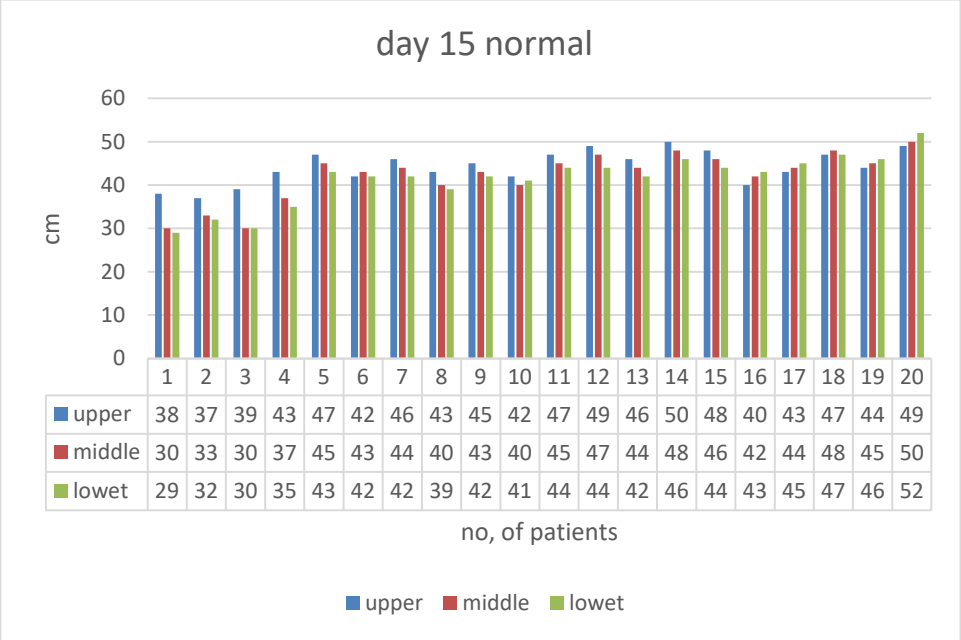
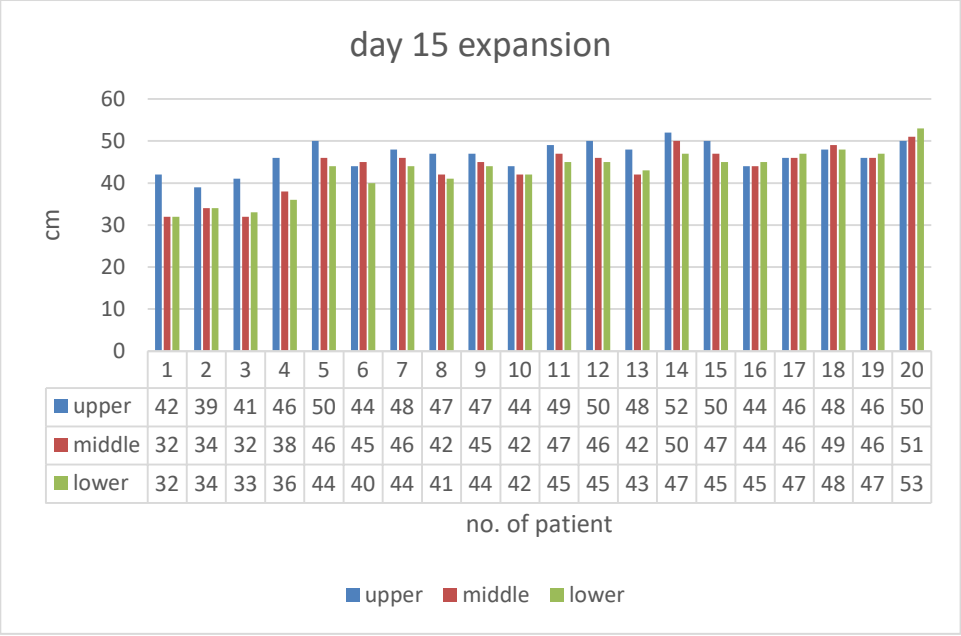
Graph 5.4: Comparison study of Day 1 of Expansion chest circumference.

[b]. Statistical analysis of data in upper, middle and lower chest circumference of Non-Smokers Day 15



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
upper	38	37	39	43	47	42	46	43	45	42	47	49	46	50	48	40	43	47	44	49
middle	30	33	30	37	45	43	44	40	43	40	45	47	44	48	46	42	44	48	45	50
lowet	29	32	30	35	43	42	42	39	42	41	44	44	42	46	44	43	45	47	46	52

Graph 5.5: Comparison study of Day 15 of Normal chest circumference



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
upper	42	39	41	46	50	44	48	47	47	44	49	50	48	52	50	44	46	48	46	50
middle	32	34	32	38	46	45	46	42	45	42	47	46	42	50	47	44	46	49	46	51
lower	32	34	33	36	44	40	44	41	44	42	45	45	43	47	45	45	47	48	47	53

Graph 5.6: Comparison study of Day 15 of Expansion chest circumference.

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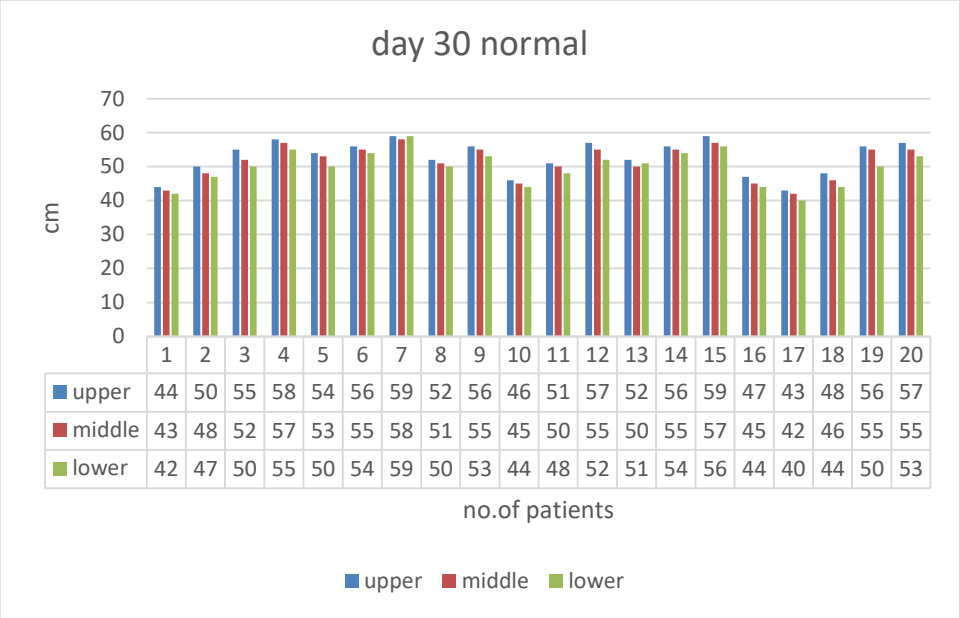
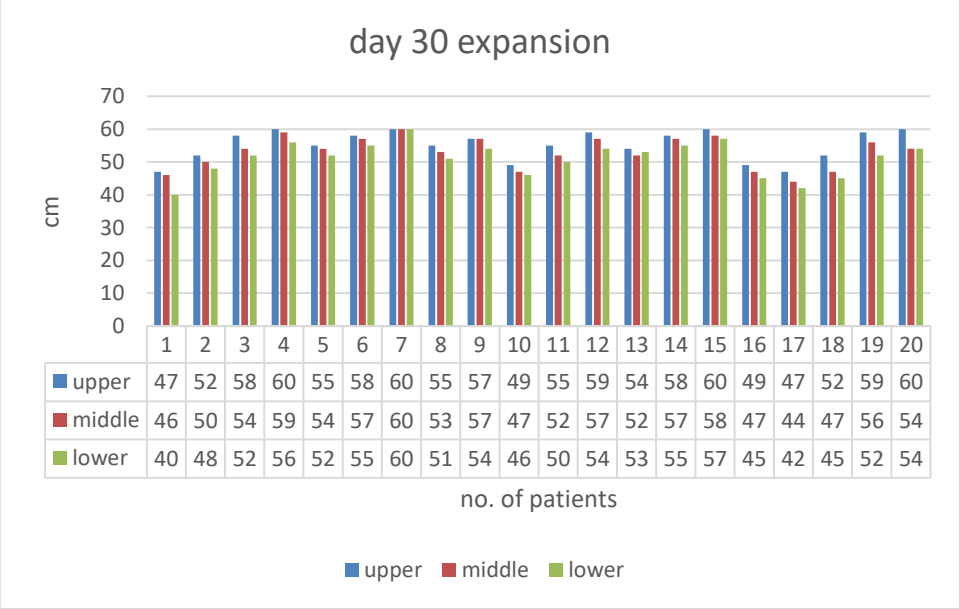
[c]. Statistical analysis of data in upper, middle and lower chest circumference of Non-Smokers Day 30



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
upper	44	50	55	58	54	56	59	52	56	46	51	57	52	56	59	47	43	48	56	57
middle	43	48	52	57	53	55	58	51	55	45	50	55	50	55	57	45	42	46	55	55
lower	42	47	50	55	50	54	59	50	53	44	48	52	51	54	56	44	40	44	50	53

Graph 5.7 : Comparison study of Day 30 of Normal chest circumference.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
upper	47	52	58	60	55	58	60	55	57	49	55	59	54	58	60	49	47	52	59	60
middle	46	50	54	59	54	57	60	53	57	47	52	57	52	57	58	47	44	47	56	54
lower	40	48	52	56	52	55	60	51	54	46	50	54	53	55	57	45	42	45	52	54

Graph 5.8 : Comparison study of Day 30 of Expansion chest circumference.

B. [a] Statistical analysis of data in upper, middle and lower chest circumference of Smokers Day 1

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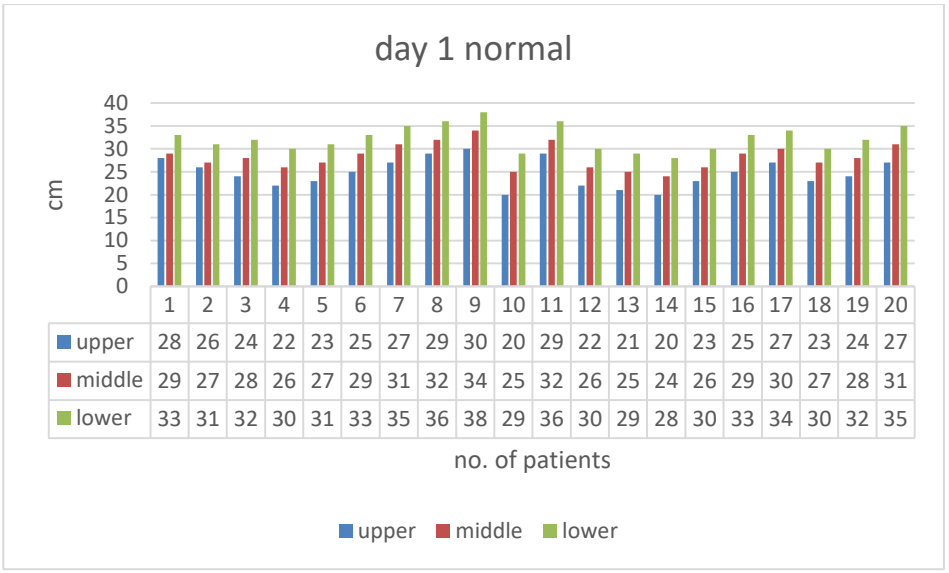
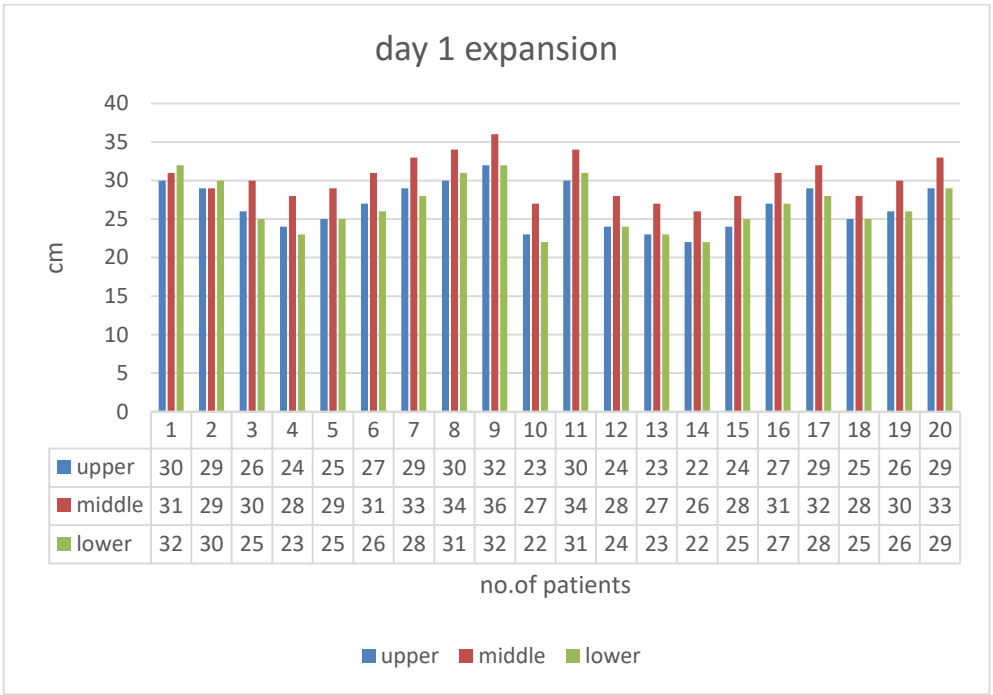


Graph 5.9: Comparison study of Day 1 of Normal chest circumference.



Graph 5.10: Comparison study of Day 1 of Expansion chest circumference.

[b] Statistical analysis of data in upper, middle and lower chest circumference of Smokers Day 15

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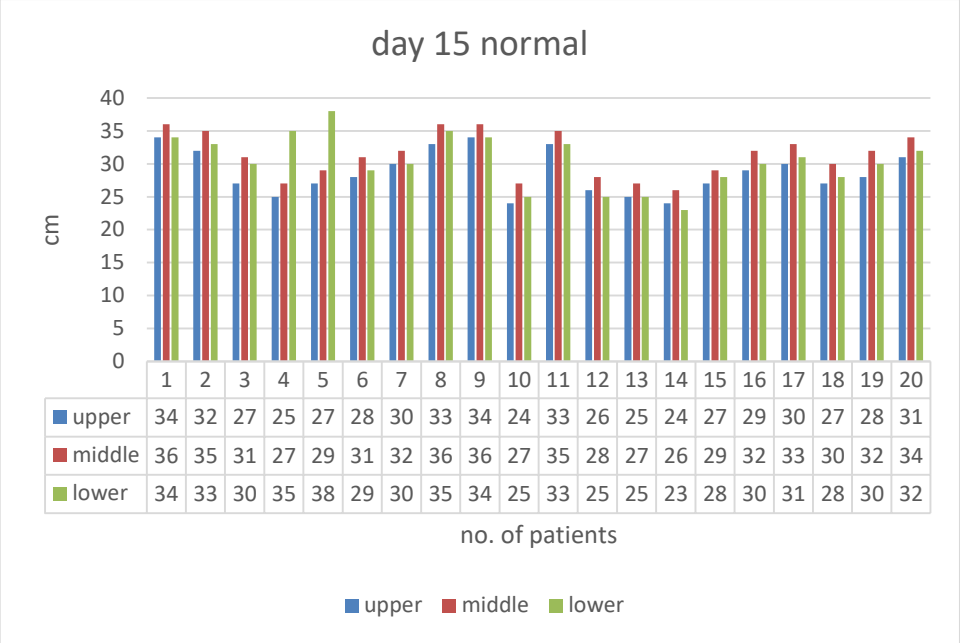
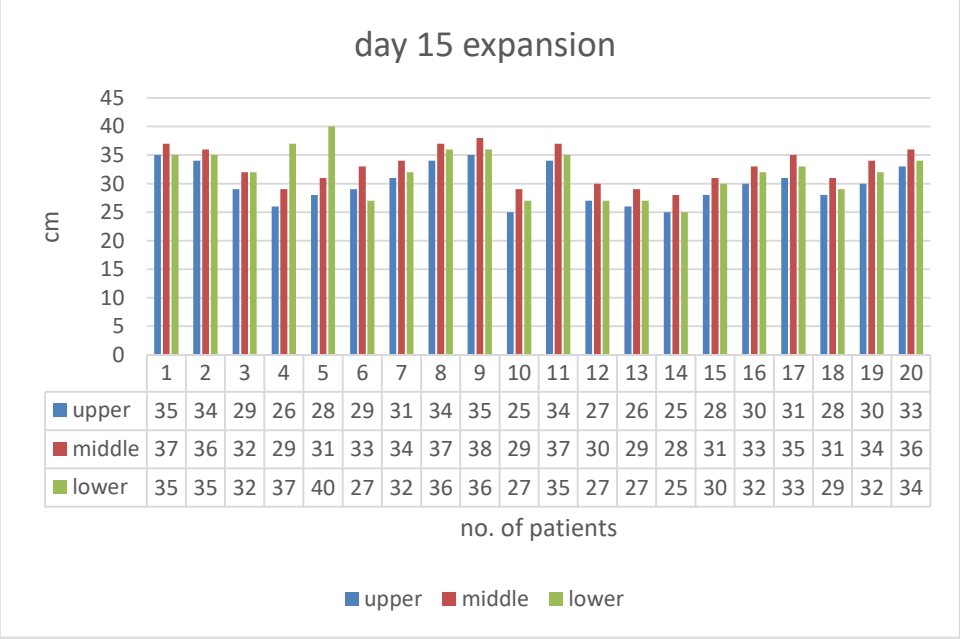


Graph 5.11 : Comparison study of Day 15 of Normal chest circumference.



Graph 5.12 : Comparison study of Day 15 of Expansion chest circumference.

[c] Statistical analysis of data in upper, middle and lower chest circumference of Smokers Day 30

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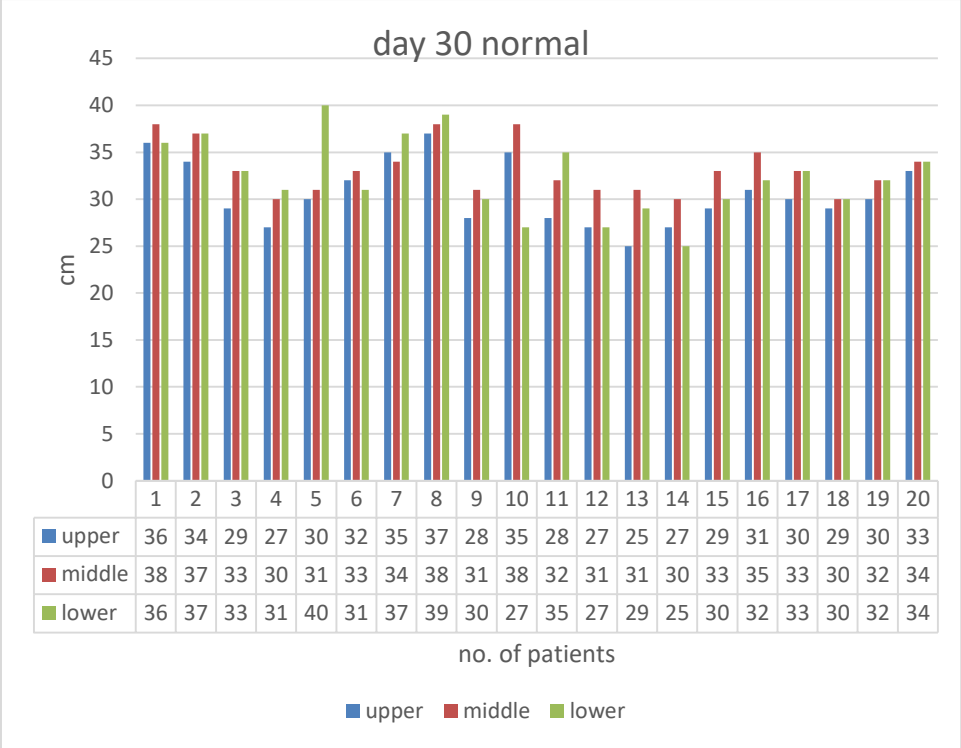
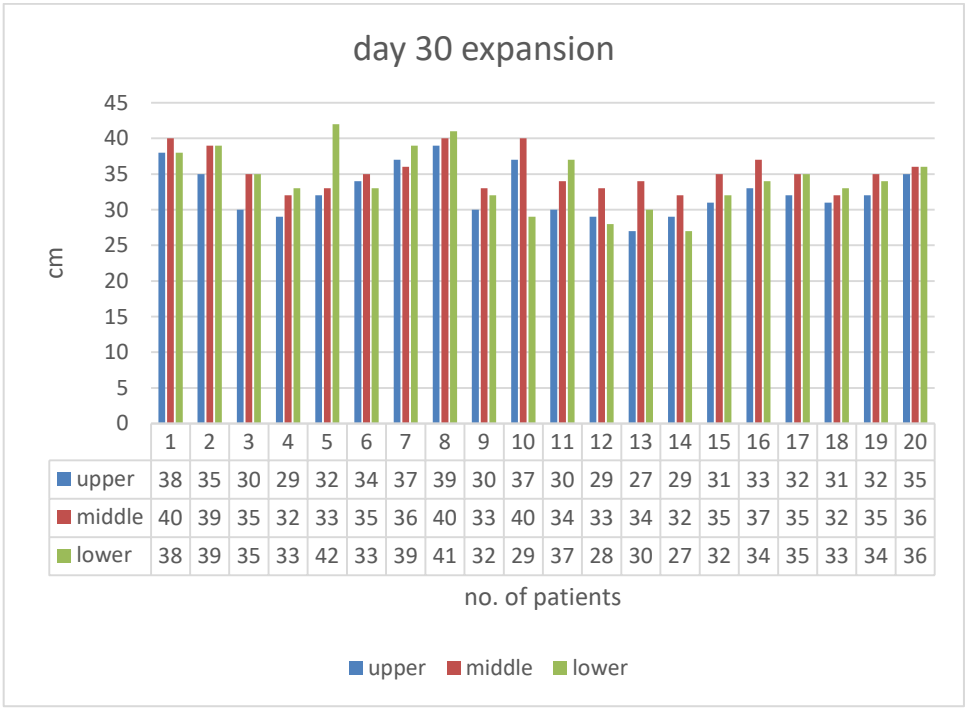


Graph 5.13 : Comparison study of Day 30 of Normal chest circumference.



Graph 5.14 : Comparison study of Day 30 of Expansion chest circumference.

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Smokers		Mean	Standard Deviation
Day 1	Normal	28.43	4.16
	Expansion	28.88	3.38
Day 15	Normal	30.13	3.65
	Expansion	31.65	3.73
Day 30	Normal	32.07	3.55
	Expansion	34.05	3.6

Table 5.2: Comparison study of smokers of Mean and Standard deviation of Normal and Expansion chest Circumference.

Non smokers		Mean	Standard deviation
Day 1	Normal	36.68	4.52
	Expansion	38.23	4.68
Day 2	Normal	42.61	5.25
	Expansion	44.26	5.07
Day 3	Normal	51.31	5.07
	Expansion	53.1	5.05

Table 5.3 : Comparison study of Non-smokers Mean and Standard deviation of Normal and Expansion chest Circumference.

Result

Data from both groups were collected prior to therapy sessions and following four weeks of treatment in order to compare them to the singers for statistical analysis. For Days 1, 15, and 30, the analysis was conducted at the axilla level (upper), the xiphoid process (middle), and the tenth costal cartilage level (lower). The graph displays the mean and standard deviation of the Day 1, Day 15, and Day 30 data. The parametric test was used for the statistical analysis.

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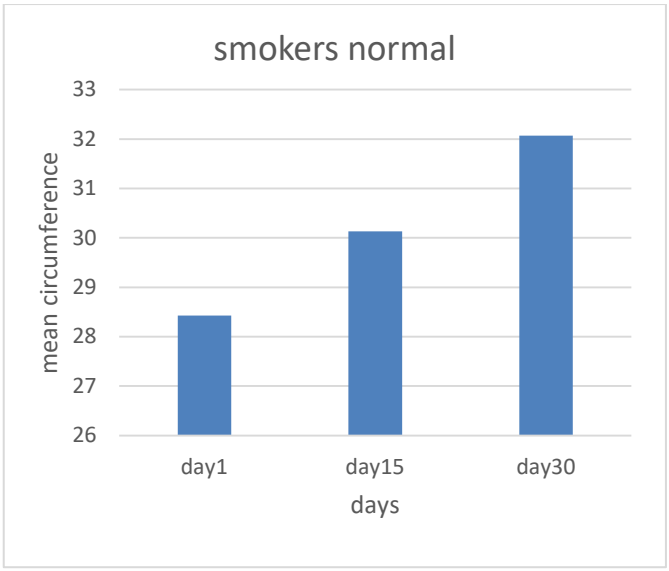
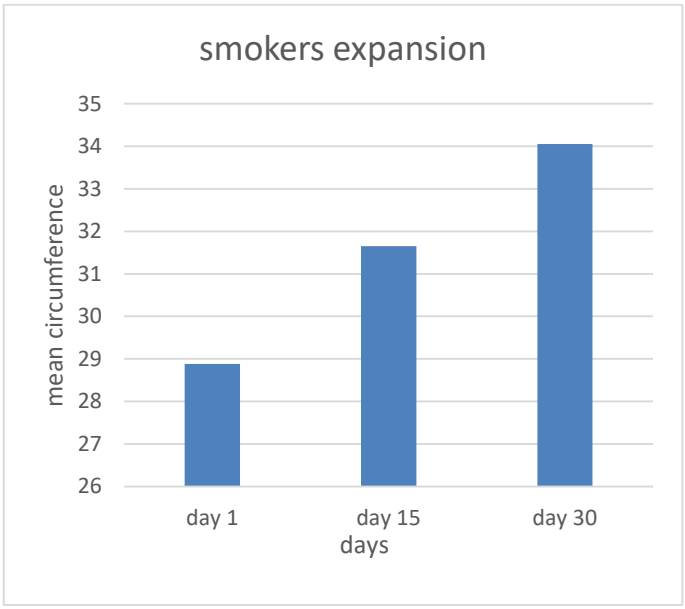


Graph 6.1: Showing normal chest circumference pre [day 1] and post [4 weeks] treatment in smokers



Graph 6.2: Showing Expansion chest circumference pre [day 1] and post [4 weeks] treatment in smokers

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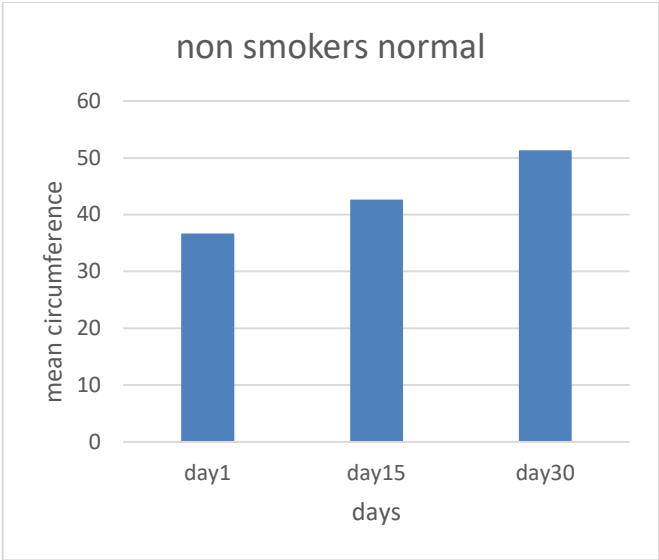
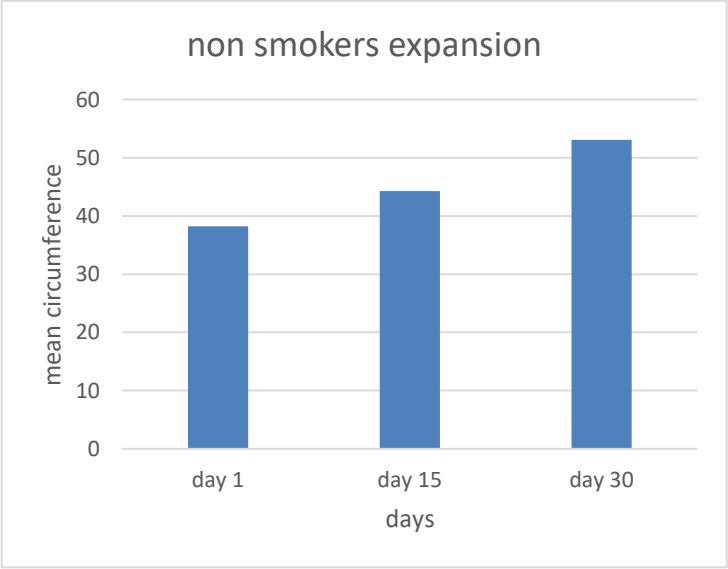


Graph6.3: Showing normal chest circumference pre [day 1] and post [4 weeks] treatment in non-smokers



Graph6.4: Showing Expansion chest circumference pre [day 1] and post [4 weeks] treatment in Non smokers

Discussion

The association between cigarette smoking and the pulmonary function test was assessed in this study. The teenagers who did not smoke had higher values for every metric compared to the youths who did smoke. The non-smoking group's chest wall expansion, forced vital capacity, and maximum expiratory muscular strength differed considerably from those of the smoker group.

In this study, the non-smoking teens' chest expansion characteristics were all higher than the smoking youths'. Reductions in the AP and ML diameters were linked to decreased chest circumference at the axillary level. This is because the upper chest breathing pattern,

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which combines upward and forward chest movements (also known as the pump-handle movement) with upward and outward chest movements (also known as the bucket handle movement), is represented by chest expansion at the axillary level. This finding implies that teenage smokers' upper chest enlargement is impacted by cigarette smoking. The performance and effort of breathing would be impacted by a decrease in chest expansion brought on by decreased chest wall motion and flexibility, indicating a susceptibility to dyspnoea.

Previous research has examined the connection between teenage respiratory function tests and cigarette use. Adolescent smokers had lower FEV1/FVC. The decrease in FEF was linked to smoking practices and daily cigarette use. We did not anticipate finding advanced lung function degradation because our individuals were young people with no evident respiratory disease. In fact, the great majority of young people had respiratory function values that were within the normal range. Furthermore, the severe respiratory health problems often seen in older smokers were unlikely to be caused by the young group's low degree of nicotine dependency, as well as the intensity and duration of smoking. In this study, there was no significant difference in FEV1 between the groups, however the non-smoker group's FVC was considerably higher than the smoking groups. This finding implies that juvenile smokers' lung capacity is impacted by cigarette smoking, resulting in a lower volume associated with the FVC test compared to non-smokers. Smokers' decreased respiratory muscle strength might account for their decreased FVC. The individuals' instructions to conduct maximal inhalation and subsequently maximal exhalation as quickly and thoroughly as possible may have had an impact on the FVC findings. As a result, the FVC test depends on respiratory muscle strength. Due to the impact of free radicals on the vascular system, smoking cigarettes reduces the blood supply to the respiratory muscles, which negatively affects respiratory performance.

Our results regarding smokers' forced vital capacity during the early stages of smoking are in line with other research showing that juvenile smoking lowers lung function. Although the average daily cigarette consumption in this study was comparable to that of other studies—roughly 10 cigarettes—the average duration of cigarette smoking in this study was significantly shorter—1-3 years as opposed to the 2-5 years reported in other studies. Our findings about smokers' forced vital capacity in the early stages of smoking are consistent with other studies that demonstrate the detrimental effects of youth smoking on lung function. The average length of cigarette smoking in this study was much shorter—1-3 years as opposed to the 2-5 years reported in previous studies—despite the fact that the average daily cigarette intake was similar to that of other studies—roughly 10 cigarettes.However, misunderstanding with the individuals might have led to variations in our data. The majority of young smokers began smoking cigarettes between the ages of 15 and 18. The average number of cigarettes smoked daily was less than or equal to ten, and the typical duration of cigarette smoking was one to three years. Young smokers have a low level of nicotine dependency. The non-smokers' chest expansion, FVC, and MEP were substantially higher than those of the smokers. These results demonstrate that respiratory issues may result from the early consequences of childhood cigarette smoking. Young people should be encouraged to give up or refrain from smoking cigarettes by using such material to highlight the negative effects of smoking.

Singing and breathing are closely intertwined. The therapeutic use of singing for COPD patients as a way to improve physiological parameters and respiratory control has a solid theoretical foundation, however there is little and typically poor quality research in this field. To better evaluate the benefits of singing for lung health in individuals with COPD and identify the physiological mechanisms behind any changes seen, more study is needed.

Limitation of study

One potential weakness of the current study is the absence of a control group (smokers continue the same daily activities throughout the same training period). Additionally, I believe that a group of passive smokers should be included in future studies. Similarly, we might not have been able to identify group differences in the selected characteristics due to the very small sample size. Our should be

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taken into consideration in light of our findings as it is a limitation of our experiment.

Conclusion

In summary, our findings indicate that the majority of young smokers began smoking cigarettes between the ages of 15 and 30. The average number of cigarettes smoked daily was less than or equal to ten, and the typical duration of cigarette smoking was one to three years. Smoking has a modest level of nicotine dependency. The Singers' FVC, MEP, and chest expansion were all considerably higher than those of smokers. These results demonstrate that respiratory issues may result from the early impacts of cigarette smoking. Young people should be encouraged to give up or refrain from smoking cigarettes by using such material to highlight the negative effects of smoking.

Both the burden of tobacco-related malignancies and the tobacco pandemic are on the increase in emerging nations. India is predicted to have the largest increase in tobacco use among all nations by 2020, with an estimated 1.5 million tobacco-related fatalities per year. This would seriously jeopardise not just the health of the populace but also the nation's healthcare system, which is still developing in basic and secondary care and has no infrastructure for cancer screening, diagnosis, and treatment. Patients' and healthcare providers' finances, as well as the government's economic structure, are severely impacted by the ongoing overload of advanced cancer diagnoses in tertiary care systems. Without putting tobacco at the top of the nation's public health agenda and emphasising tobacco prevention, it is impossible to undo the impacts of the tobacco pandemic. For many years, India has led the way in tobacco reduction initiatives. There are a lot of prospects for policy change and improvement in Indian law when compared to a worldwide standard. This research emphasises the necessity of reviewing India's tobacco control legislation and removing current obstacles in order to significantly improve the country's tobacco situation. The findings of this study will influence policy from a variety of perspectives, including the government responsible for enforcing the country's tobacco control laws, public health specialists working on behavioural aspects of tobacco use and its effects on youth tobacco awareness, and policymakers in the public and private sectors regarding the current gaps in support for quitting. Addressing the tobacco epidemic will need sustained interaction with a wide variety of parties. In general, tobacco control must be viewed as both a basic human right and a public health concern.

Future scope of study

- A significant sample can be used for additional research.
- To get long-term follow-up, the study's duration might be extended.
- Further investigation may be conducted on various therapies to enhance lung airway values, respiratory muscle strength, functional capacity, and chest wall expansion in smokers.

Abbreviation

- **AP** – Antero-Posterior
- **ML** - Medio-lateral
- **TA** - Transverse abdominis
- **FVC** - Forced Vital Capacity
- **FEF** - Forced Expiratory flow
- **MIP** - Maximum Inspiratory Pressure
- **MEP** - Maximum Expiratory Pressure
- **RCT** - Randomised Controlled Trial
- **FEV1** - Forced Expiratory volume in one sec**.**
- **SLH** - **S**inging for Lung Health
- **RMST** - Respiratory muscle strength training
- **SFMS** – Special fertility and mortality survey [1998]
- **GATS** -The Global adult tobacco survey [2010]
- **SRSBS** – Sample registration system baseline survey [2004]
- **COPD** – Chronic Obstruction Pulmonary Disease
- **ESAS** - Edmontton Symptom Assessment Scale [dyspnea scale]
- **mMRC** - Modified Medical Research Council**.**
- **6MWD** – Six Minute Walk Distance.

References

1.Mackay J, Eriksen M, Eriksen MP. *The Tobacco Atlas*. World Health

DOI: https://doi.org/10.5281/zenodo.20265313

Organization.
2.Kumar S. WHO intensifies war against tobacco in developing countries. *Lancet.* 2000;355(9199):210. doi: 10.1016/S0140-6736(05)72090
3.World Health Organization, Regional Office for South-East Asia (2009) *Global Adult Tobacco Survey India (GATS)* New Delhi: [19/02/18]
4.Adam Lewis ,Keir Elmslie James Philip, Adam Lound, Phoene Cave, The physiology of singing and implications for 'Singing for Lung Health' as a therapy for individuals with chronic obstructive pulmonary disease BMJ Open Respir Res. 2021; 8(1): e000996.Published online 2021 Nov 11. doi: 10.1136/bmjresp-2021-000996.
5.Lewis A, Cave P, Stern M, et al. Singing for lung Health-a systematic review of the literature and consensus statement. *NPJ Prim Care Respir Med* 2016; 26:16080. 10.1038/npjpcrm.2016
6.Bott J, Blumenthal S, Buxton M, et al. Guidelines for the physiotherapy management of the adult, medical, spontaneously breathing patient. *Thorax* 2009;64 Suppl 1: i1–52. 10.1136/thx.2008.11072
6.Langer D, Ciavaglia C, Faisal A, et al. Inspiratory muscle training reduces diaphragm activation and dyspnea during exercise in COPD. *J Appl Physiol* 2018; 125:381–92. 10.1152/japplphysiol.01078.2017
7.Sibu P Saha, Deepak K Bhalla,Thomas F Whayne, Jr,Int J Angiol. 2007 Autumn; 16(3): 77–83.doi: 10.1055/s-0031-1278254. Cigarette smoke and adverse health effects: An overview of research trends and future needs.
8.AnongTantisuwat, and Premtip Thaveeratitham,J Phys Ther Sci. 2014 Feb; 26(2): 167–170.Published online 2014 Feb 28. doi: 10.1589/jpts.26.167 Effects of Smoking on Chest Expansion, Lung Function, and Respiratory Muscle Strength of youth.
9.Philip KE, Cartwright LL, Westlake D, et al. Music and dance in respiratory disease management in Uganda: a qualitative study of patient and healthcare professional perspectives. *BMJ Open* 2021; 11:2021.04.27.21255985. 10.1136/bmjopen-2021-053189
10.Downes C, Philip KEJ, Lewis A, et al. Singing for breathing Uganda: group singing for people with chronic lung disease in Kampala. *J Appl Arts Health* 2019; 10:219–28. 10.1386/jaah.10.2.219_1.
11.Lewis A, Cave P, Stern M, et al. Singing for lung Health-a systematic review of the literature and consensus statement. *NPJ Prim Care Respir Med* 2016; 26:1608010.1038/npjpcrm.2016.80.
12.Kaasgaard M, Andersen IC, Rasmussen DB, et al. Heterogeneity in Danish lung choirs and their singing leaders: delivery, approach, and experiences: a survey-based study. *BMJ Open* 2020;10: e041700. 10.1136/bmjopen-2020-041700.
13.Bott J, Blumenthal S, Buxton M, et al.. Guidelines for the physiotherapy management of the adult, medical, spontaneously breathing patient. *Thorax* 2009;64 Suppl 1:i1–52. 10.1136/thx.2008.110726.

14.Titze IR. Voice training and therapy with a semi-occluded vocal tract: rationale and scientific underpinnings. *J Speech Lang Hear Res* 2006; 49:448–59. 10.1044/1092-43882006/03

15. Cave P, Lewis A, Fancourt D. Singing for Lung Health. In: Heydon R, Fancourt D, Cohen AJ, eds. *The Routledge companion to Inter diciplinary studies in singing, volume III: wellbeing*. New York: Routledge, 2020.
16.Lewis A, Cave P, Hopkinson NS. Singing for lung health: a qualitative assessment of a British lung Foundation programme for group leaders. *BMJ Open Respir Res* 2017;4:e000216. 10.1136/bmjresp-2017-000216
17.Herbst CT. A Review of Singing Voice Subsystem Interactions-Toward an Extended Physiological Model of "Support". *J Voice* 2017; 31:249.e13–249.e19. 10.1016/j.jvoice.2016.07.019.
17.McNamara R, Epsley C, Coren E. Singing for adults with chronic obstructive pulmonary disease (COPD). *Cochrane Database of Systematic Reviews* 2017;12:CD012296. 10.1002/14651858.CD012296.pub2.
18.Lord VM, Cave P, Hume VJ, et al. Singing teaching as a therapy for chronic respiratory disease--a randomised controlled trial and qualitative evaluation. *BMC Pulm Med* 2010; 10:41. 10.1186/1471-2466-10-41.

DOI: https://doi.org/10.5281/zenodo.20265313

19. Langer D, Ciavaglia C, Faisal A, et al. Inspiratory muscle training reducediaphragm activation and dyspnoea during exercise in COPD. *J Appl Physiol* 2018; 125:381–92. 10.1152/japplphysiol.01078.2017
20.Daynes E, Greening NJ, Harvey-Dunstan TC, et al. High-Frequency airway oscillating device for respiratory muscle training in subjects with COPD. *Respir Care* 2018; 63:584–90. 10.4187/respcare.05837
21. Lee EN, Kim MJ. Meta-Analysis of the effect of a pulmonary rehabilitation program on respiratory muscle strength in patients with chronic obstructive pulmonary disease. *Asian Nurs Res* 2019; 13:1–10. 10.1016/j.anr.2018.11.005.
22.Watson AHD, Williams C, James BV. Activity patterns in latissimus dorsi and sternocleidomastoid in classical singers. *J Voice* 2012;26: e95–105. 10.1016/j.jvoice.2011.04.008.
23.Carroll LM, Sataloff RT, Heuer RJ, et al.. Respiratory and glottal efficiency measures in normal classically trained singers. *J Voice* 1996;10:139–45. 10.1016/S0892-1997(96)80040-3.
24.Irzaldy A, Wiyasihati SI, Purwanto B. Lung vital capacity of Choir singers and Nonsingers: a comparative study. *J Voice* 2016;30:717–20. 10.1016/j.jvoice.2015.08.008.
25. Roy AS, Bandyopadhyay A. Pulmonary function studies in female singers of Kolkata, India. *J Hum Ergol* 2015;44:75–81.
26.Schorr-Lesnick B, Teirstein AS, Brown LK, et al.. Pulmonary function in singers and wind-instrument players. *Chest* 1985;88:201– 10.1378/chest.88.2.201
27. Lam Tang JA, Boliek CA, Rieger JM. Laryngeal and respiratory behavior during pitch change in professional singers. *J Voice* 2008; 22:622–33. 10.1016/j.jvoice.2007.04.002.
28.Salomoni S, van den Hoorn W, Hodges P. Breathing and singing: objective characterization of breathing patterns in classical singers. *PLoS One* 2016;11: e0155084. 10.1371/journal.pone.0155084.
29.Traser L, Özen AC, Burk F, et al. Respiratory dynamics in phonation and breathing-A real-time MRI study. *Respir Physiol Neurobiol* 2017; 236:69–77. 10.1016/j.resp.2016.11.007
30. Murray J, Lopez AD. Alternative projections of mortality and disability by cause 1990–2020: Global burden of disease study. *Lancet.* 1997; 349:1498–504.
31.Doll R. Cancers weakly related to smoking. *Br Med Bull.* 1996; 52:35–49.
32.Doll R. Risk from tobacco and potentials for health gain. *Int J Tuberc Lung Dis.* 1996; 3:90–9.
33.Boyle P. Cancer, cigarette smoking and premature death in Europe: A review including the Recommendations of European Cancer Experts Consensus Meeting, Helsinki, October 1996. *Lung Cancer*. 1996; 17:1–60.
34.Hoffman D, Hoffman I. The changing cigarette. *J Toxicol Environ Health.* 1997; 50:30764
35.9. Pryor WA. Cigarette smoke radicals and the role of free radicals in chemical carcinogenicity. *Environ Health Perspect.* 1997;105:875–82.
36.10. Powell J. Vascular damage from smoking: Disease mechanisms at the arterial wall. *Vascular Med.* 1998; 3:21–8.
37.Hutchinson S. Smoking as a risk factor for endothelial dysfunction. *Can J Cardiol.* 1998; 14:20D–2D.
38.Nitinberg A, Antony I, Foult JM. Acetylcholine-induced coronary vasoconstriction in young, heavy smokers with normal coronary arteriographic findings. *Am J Med.* 1993; 95:71–7.
39.Celermajer D, Adams MR, Clarkson P, et al. Passive smoking and impaired endothelium-dependent arterial dilatation in healthy young adults. *N Engl J Med*. 1996; 334:150–4.
40.Poredos P, Orehec M, Tratnik E. Smoking is associated with dose-related increase of intima-media thickness and endothelial dysfunction. *Angiology.* 1999; 50:201–8.
41.Raitakari OT, Adams MR, McCredie RJ, Griffiths KA, Celermajer DS. Arterial endothelial dysfunction related to passive smoking is potentially reversible in healthy young adults. *Ann Intern Med.* 1999; 130:578–81
42.Ravi S Reddy, Khalid A Alahmari , Paul S Silvian , Irshad A Ahmad , Venkata Nagaraj Kakarparthi , Kanagaraj Rengaramanujam 2019 Feb 25:2019:5175949 Doi: 10.1155/2019/5175949. recollection 2019. Reliability of Chest Wall Mobility and Its Correlation with Lung Functions in Healthy

DOI: https://doi.org/10.5281/zenodo.20265313

Non-smokers, Healthy Smokers, and Patients with COPD.
43.Putt M. T., Watson M., Seale H., Paratz J. D. Muscle stretching technique increases vital capacity and range of motion in patients with chronic obstructive pulmonary disease. Archives of Physical Medicine and Rehabilitation. 2008;89(6):1103–1107. doi: 10.1016/j.apmr.2007.11.033.
44.de Cordoba Lanza F., de Camargo A., Archija L. R. F., Selman J. P. R., Malaguti C., Dal Corso S. Chest wall mobility is related to respiratory muscle strength and lung volumes in healthy subjects. Respiratory Care. 2013;58(12):2107–2112. doi: 10.4187/respcare.02415.
45.Romer L. M., McConnell A. K. Inter-test reliability for non-invasive measures of respiratory muscle function in healthy humans. European Journal of Applied Physiology. 2004;91(2-3):167–176. doi: 10.1007/s00421-003-0984-2.
46. Bestall JC, Paul EA, Garrod R, et al. Usefulness of the medical research council (MRC) dyspnoea scale as a measure of disability in patients with chronic obstructive pulmonary disease. *Thorax* 1999; 54: 581–586
47.De Lorenzo A, Petrone-De Luca P, Sasso GF, Carbonelli MG, Rossi P, Brancati A. Effects of weight loss on body composition andpulmonary
function. *Respiration.* 1999;66(5):407–12.
48.Bottai M, Pistelli F, Di Pede F, Carrozzi L, Baldacci S, Matteelli G, et al. Longitudinal changes of body mass index, spirometry and diffusion in a general population. *Eur Respir J.* 2002;20(3):665–73.

DOI: https://doi.org/10.5281/zenodo.20265313