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Estimation of the Combined Effect of Garlic and Moderate Exercise on Lung Function in Healthy Overweight Adult Human Subjects with no History of Respiratory Defects

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ABSTRACT: Overweight is a condition that reduces lung function. Dietary supplementation of garlic significantly improves pulmonary functions. Physical activity on the one hand positively affects lung function. Hence, the objective of this study was to evaluate the effect of garlic and exercise on the lung function in twenty (20) Healthy overweight adult human subjects, with no history of respiratory defects using standard measurements techniques of Forced vital capacity; Forced expiratory flow 25-75% and Forced expiration volume in 1 second. Data obtained show that the Baseline [FVC (2.961 ± 0.133), FEV1 (2.910 ± 0.134), PEFR (6.595 ± 0.427), FEF25-75% (4.439 ± 0.217)]; Garlic only [FVC (2.803 ± 0.138*), FEV1 (2.761 ± 0.136*), PEFR (6.660 ± 0.367), FEF25-75% (4.772 ± 0.254*) and Garlic + Exercise [FVC (2.777 ± 0.127), FEV1 (2.739 ± 0.123*), PEFR (6.902 ± 0.407), FEF25-75% (4.825 ± 0.239**)] provided an impressive outcomes. From the result, the subject's FVC, FEV_1were significantly reduced following garlic intake, their PEFR remained unchanged and their FEF25-75% was significantly increased. In conclusion, raw garlic may reduce lung function on the short term in the first 2-3hrs of ingestion in overweight subjects as revealed in this study. The combined effect of garlic and exercise may not have any significant effect different from the result garlic alone would have in overweight subjects.

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Overweight is characterized by weight that is above what is considered as healthy weight for a given height. Body Mass Index (BMI), which is calculated as weight in (kg) / height in $(m)^2$, is considered to be the most useful screening tool for classifying overweight, underweight and obesity in adults. According to the WHO classification, individuals with a BMI of 25.0- 29.9 kg/m^2 are classified as overweight (WHO, 2004). The effect of accumulation of excessive body fats has been studied thoroughly in adults and linked with co-morbodities such as cardiovascular diseases, hypertension and pulmonary dysfunction. Overweight subjects tend to have lower lung volumes and chest wall compliance (Harik-khan *et al.*, 2001). It has been recognized that the pattern of fat distribution plays an important role in altering lung parameters and lung function by interfering with the respiratory physiology. The presence of adipose tissue around the rib cage and abdomen and in the visceral cavity loads the chest wall and reduces functional residual capacity (FRC) (Salome *et al.*, 2010). Jones and Nzekwu (2006) reported that there is an exponential relationship between body mass index (BMI) and functional residual capacity, with a reduction in functional residual capacity detectable even in overweight individuals.

In their research, Carolyn *et al.*, (1983) found that weight may have effects on pulmonary function tests by causing small airway dysfunction and expiratory

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flow limitation, alterations in respiratory mechanics, decreased chest wall and lung compliance, decreased respiratory muscle strength and endurance, decreased pulmonary gas exchange, lower control of breathing, and limitations in exercise capacity. Total lung capacity (TLC) is increased by weight loss (Womack *et al.*, 2000). A reduction in the downward movement of the diaphragm, due to increased abdominal mass, is likely to decrease total lung capacity (TLC) by limiting the room for lung expansion on inflation. Alternatively, deposition of fat in sub pleural spaces might directly reduce lung volume by reducing the volume of the chest cavity (Salome *et al.*, 2010). Weight loss can reverse many alterations in pulmonary function produced by overweight (Vengata *et al.*, 2014). Exercise is physical activity that is planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective (Howley 2001). The European Lung Foundation defined exercise as any type of physical activity which could be planned sport such as running, swimming, tennis or bowls, an exercise training programme, or a hobby such as cycling or walking. It could also include physical activities which are part of your daily life, such as gardening, cleaning or walking to the shops (ELF- factsheet). Exercise is widely promoted as a means of improvising the physical endurance. It is recommended not only for the healthy, but also for individuals with various disabilities and diseases (Belman 1993). Anaerobic exercise (training) which is done at very high intensities such that a large portion of the energy is provided by glycolysis and stored phosphocreatine and Aerobic exercise (training) involves large muscle groups in dynamic activities that result in substantial increases in heart rate and energy expenditure. Regular participation results in improvements in the function of the cardiovascular system and the skeletal muscles, leading to an increase in endurance performance.

Garlic (*Allium sativum* L. Family *Liliaceae*), is specie in the onion genus *Allium*. Garlic is a bulbous perennial herb, closely related to the onion. It has a tall, erect flowering stem that reaches 2-3 feet in height. The plant has pink or purple flowers that bloom in mid to late summer. The part used medicinally is the bulb. Its close relatives include the onion, shallot, leek, chive, and Allium chinense (Kathi, 2000). Dietary garlic has been studied and proven to decrease body weight and mass of various adipose tissues (Kuda *et al.*, 2004). Several animal studies have demonstrated that feeding garlic extracts to rats decreased the activity of several important enzymes involved in the synthesis of lipids not only in the liver but also in adipose tissues which are fat pads (Yu-Yan and Lijuan, 2001). Omar and Al-Wabel (2010) stated that garlic contains approximately 33 sulfur compounds (aliin, allicin, ajoene, allylpropyl disulfide, diallyl trisulfide, sallylcysteine, vinyldithiines, S-allylmercaptocystein, and others), several enzymes (allinase, peroxidases, myrosinase, and others), 17 amino acids (arginine and others), and minerals (selenium, germanium, tellurium and other trace minerals). Kathi (2000), also found garlic to contain enzymes such as allinase, peroxidises, myrosinase and others. Biological effects of garlic are attributed to its characteristic organosulfur compounds.

Allicin (diallyl thiosulphate or diallyl disulfide) chemically known as 2-propene-1-sulfinothioc acid S-2-propenyl ester; thio-2-propene-1-sulfinic acid, S-allyl ester and discovered by Cavallito and Bailey in 1944, responsible for garlic's typical pungent smell. It is reported that garlic contains a higher concentration of sulfur compounds than any other Allium species and that allicin does not exist in garlic until it is crushed or cut; injury to the garlic bulb activates the enzyme allinase (Stoll and Seebeck, 1951), which metabolizes alliin to allicin. Allicin is further metabolized to vinyldithiines. This breakdown occurs within hours at room temperature and within minutes during cooking. The sulfur compounds are responsible both for garlic's pungent odor and many of its medicinal effects.

Some studies carried out on garlic constituents reported the presence of two main classes of antioxidant components, namely flavonoids and sulfur-containing compounds (diallyl sulfide, trisulfide and allyl-cysteine) (Kodera *et al.*, 2002; Bozin *et al.*, 2008). Myneni *et al.*, (2016) reported that the organo-sulfur compounds are responsible for most of its therapeutic properties including antibacterial, anti-protozoal, antifungal, hypolipidemic, antiatherosclerotic and anticancer properties. In the study conducted by He *et al.*, (2009) garlic oil was extracted and proven to be effective in reducing fatty acid accumulation at high doses of 20 and 40μg mL^{-1} and this was attributed to the anti-oxidation component of garlic. In a follow-up study, Pelkonen *et al.*, (2003) described an association between the level of physical activity and respiratory function. Azad *et al.*, (2011) reported that forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1) where positively affected by physical activity and BMI reduction. Ghosh *et al.*, (1985), observed higher values of FVC and FEV1 in physically trained cases compared to sedentary control individuals. Despite several works done on garlic and exercise, no work has been done on a combined effect of garlic and exercise on overweight subjects, there has been no comment on the beneficial effect of raw garlic supplementation in improving lung function, therefore this work is

centered on investigating the effect of garlic and exercise on overweight subjects. The objective of this research is to estimate the combined effect of garlic and moderate exercise on lung function in healthy overweight adult human subjects with no history of respiratory defects.

MATERIALS AND METHOD

Materials: Spirometer, Stadiometer (cm), Motorized Treadmill, Raw garlic bulbs, Bathroom scale (kg)

*Preparation of garlic sample***:** Fresh raw garlic (*Allium sativum* L.) bulbs were obtained and identified. The garlic bulbs were peeled and the garlic cloves separated.

Selection of subject: Twenty (20) healthy overweight adult human subjects that are non-smokers and with no history of respiratory defects were selected. Informed consent was obtained from all of them.

Their body weight was measures using digital scale (kg), height measured by stadiometer (cm) and adiposity was assessed by calculating body mass index (BMI) using the formula BMI=weight/height^2 [kg/m^2] (WHO, 2004).

Experimental Design: The study was conducted in the department of Physiotherapy, University of Benin, Benin city over a period of one month. Twenty (20) healthy overweight human adult subjects who are non-smokers with no history of respiratory defects were selected. All subjects were between the ages of 19-25 years.
The subjects were divided into three (3) groups: Group I control group; Group II garlic alone was administered with a single clove of garlic bulb and Group III garlic along with moderate exercise was administered. Each group served as their own control.

Administration: Subjects orally ingested fresh raw garlic cloves of 3-4g and allowed to rest for 2-3hrs to for garlic to metabolize. Metabolism of garlic was noticed in the breath of the individuals.

Subjects were subjected to treadmill exercise. The subjects ran continuously for 15 minutes on the treadmill (%0 incline) and at a speed of 5mph after 2 minutes of warm up set at 2mph (Azad *et al.*, 2011).

*Anthroprometric and Spirometric Measurements***:** Spirometric measurements were taken before and after administration of garlic cloves and after treadmill exercise. Respiratory function parameters were measured by using the Spirometer (Jones spirometer) in accordance with the recommendations of the Spirometer user manual. Subjects were allowed to rest for 10 minutes before measurements and were informed about the procedure. After appropriate placement of mouthpiece and nose clip, each subject was asked to do a forced quick expiration after maximum inhalation. After doing at least three acceptable and repeatable spirometric maneuvers, the largest FVC, FEF25-75% and FEV_1 were recorded after examining the data from all of these attempts. PEFR was also recorded.

FVC, FEV_1, FEF25-75%, were measured in all groups. Measurement of FEV_1 reflects conductive / resistive properties of the large airways, FVC is related to the contractility of the expiratory muscles and FEF25-75% is correlated with viability of the small airway (Devershetty *et al.*, 2015).

*Statistical Analysis***:** In this study, the values are reported as mean ± SEM (standard error of mean). Statistical analysis was done using a one-way ANOVA for comparison between groups and the paired t test for within group comparison. Results were considered to be statistically significant at $P<0.05$.

RESULTS AND DISCUSSION

General Observation: In this study, it was observed that FVC and FEV_1 were significantly reduced upon ingestion of raw garlic. FEF25-75% was significantly increased following the intake of garlic. However, there was no significant difference in lung parameters of subjects in group III (garlic + exercise) when compared to baseline. PEFR remained the same throughout the study with no significant change. Below is the result showing the effect of garlic and exercise on lung function in overweight individuals after a period of 2hrs.

Total body fat and central adiposity are inversely associated with lung function. Overweight subjects have significant restrictive pulmonary defect, evident small airway obstruction and defect in respiratory musculature, weak effort and coordination, with increase airway resistance (Vengata *et al.*, 2014).

Garlic, one of the best-researched herbal remedies, holds a unique position in history, traditionally employed to treat infection, colds, diabetes, heart disease, and it has been evaluated for lowering blood pressure, cholesterol, and glucose concentration, as well as for the prevention of arteriosclerosis and cancer, garlic consumption inversely correlates with the risk of oral, stomach, esophageal, colon, and prostate cancers (Tsai *et al.*, 2012).

Table 1: Comparing the mean values of some respiratory parameters before and after exercise following the intake of garlic.

	Baseline	Garlic	Garlic +Exercise
FVC	2.961 ± 0.133	2.803 ± 0.138*	2.777 ± 0.127*
FEV1	2.910 ± 0.134	2.761 ± 0.136*	2.739 ± 0.123*
PEFR	6.595 ± 0.427	6.660 ± 0.367	6.902 ± 0.407
FEF25-75%	4.439 ± 0.217	4.772 ± 0.254*	4.825 ± 0.239*

Results are expressed in mean ± SEM
**P<0.05 indicates significant difference when baseline is compared to garlic only and garlic with exercise.*
#P<0.05indicates significant difference when garlic only is compared to garlic with exercise.
BMI = 26.393 ± 0.332

Several studies have the reported beneficial effects of the garlic supplementation to treat several lung diseases including common cold, bronchitis, tuberculosis, inflammatory disorders of the lungs and several other diseases, explaining that the possible mechanism is by decreasing the leukocyte inflammatory mediators (Fashner *et al.*, 2012; Hodge *et al.*, 2002).

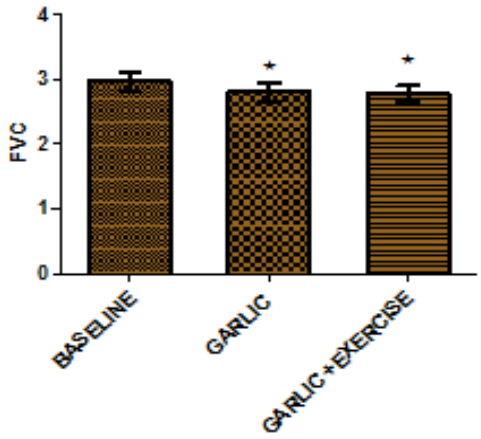

Fig 1: Bar chart showing the Forced Vital Capacity **(FVC)** in subjects before and after administration of garlic only and garlic + exercise. compared to garlic only and garlic with exercise.
*P<0.05 indicates significant difference when baseline is compared to garlic only and garlic with exercise.

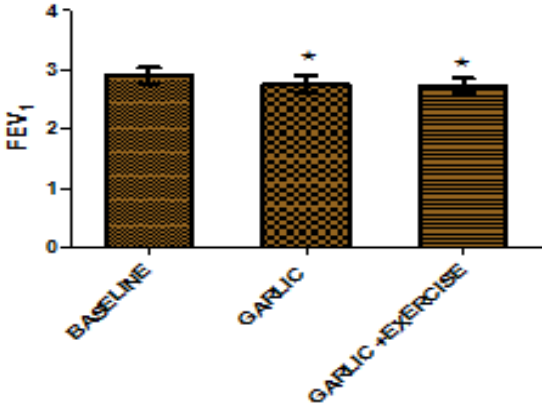

Fig 2: Bar chart showing the Forced Expiratory Volume In 1 Second **(FEV_1)** in subjects before and after administration of garlic only and garlic + exercise.
*P<0.05 indicates significant difference when baseline is compared to garlic only and garlic with exercise

Thus, Nazrul *et al.*, (2017) mentioned that garlic may offer relief from airway restriction and impaired lung function by improving the clearance of mucus from the airways, help airways relax, and improve airflow into the lungs. Nazrul and his associates concluded that dietary supplementation of garlic significantly improved pulmonary functions in smokers. Shamsi *et al.*, (2016) reported that garlic can help to dry up the nasal passages in some cases, improving breathing and helping to reduce snoring in some people concluding that garlic improves lung function and better sleep conditions in asthmatic patients.

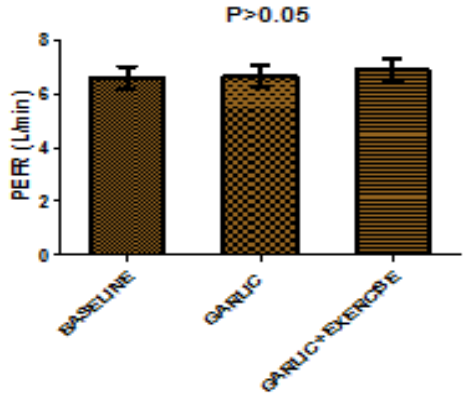

Fig 3: Bar chart showing the Peak Expiratory Flow Rate **(PEFR)** in subjects before and after administration of garlic only and garlic + exercise.
*P<0.05 indicates significant difference when baseline is compared to garlic only and garlic with exercise.

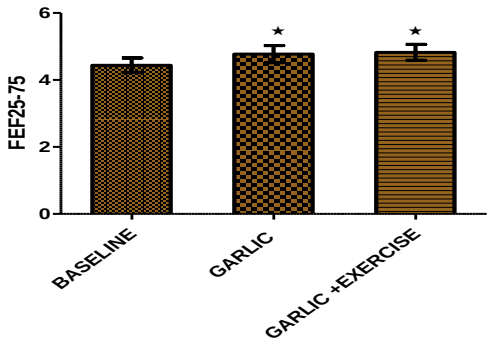

Fig 4: Bar chart showing the Forced Mid Expiratory Flow Rate **(FEF 25-75%)** in subjects before and after administration of garlic only and garlic + exercise.
*P<0.05 indicates significant difference when baseline is compared to garlic only and garlic with exercise.

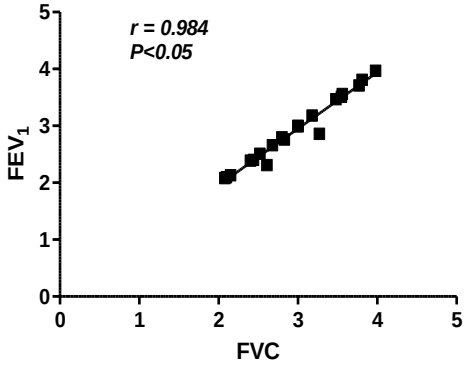

Fig 5: Graphical representation of the relationship between the **FEV_1/FVC (CORRELATION**
FEV_1 and FVC.)
There was a positive correlation between the FEV_1 and FVC

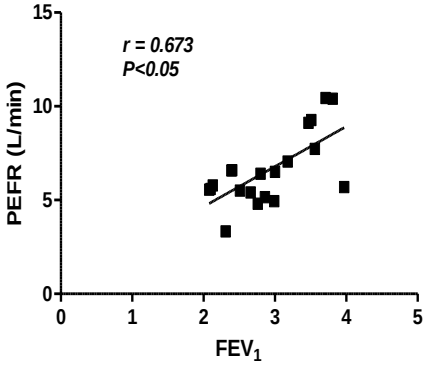

Fig 6: Graphical representation of the relationship between the FEV_1 and PEFR. (**PEFR/FEV_1 CORRELATION)**
There was a positive correlation between the FEV_1 and PEFR

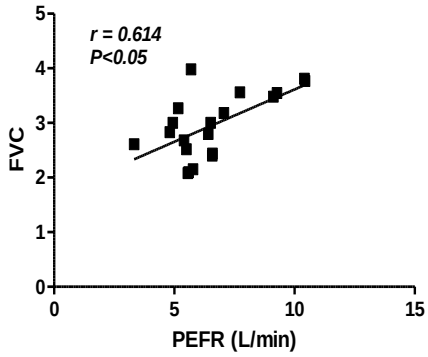

Fig 7: Graphical representation of the relationship between the PEFR and FVC. **FVC/PEFR CORRELATION**
There was a positive correlation between the PEFR and FVC

Some studies have reported a positive association between physical activity, physical fitness and lung capacity (Courteix *et al.*, 1997). Azad *et al.*, (2011), demonstrated that physical inactivity and overweight can impair FVC and FEV_1, while appropriate aerobic exercise training can partly improve FVC and FEV_1 due to the respiratory muscle performance enhancement. However there exist very few literatures on the effect of raw garlic intake on FVC and FEV_1. This study was aimed at investigating the combine effect of garlic and moderate exercise on the lung function in overweight subjects. In previous studies conducted with raw garlic ingestion to determine its effect on the lung function, the results were positive. Ingestion of raw garlic improved breathing parameters such as FVC, FEV1 including FEV1/FVC% ratio but this is contrary to the result obtained in this research. However, in agreement with previous studies FEF25-75% was improved.

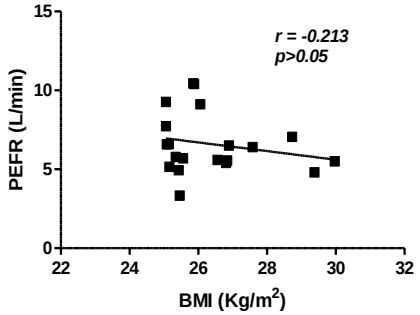

Fig 8: Graphical representation of the relationship between the BMI and PEFR. **(PEFR/BMI CORRELATION)**
There was no significant correlation between the BMI and PEFR.

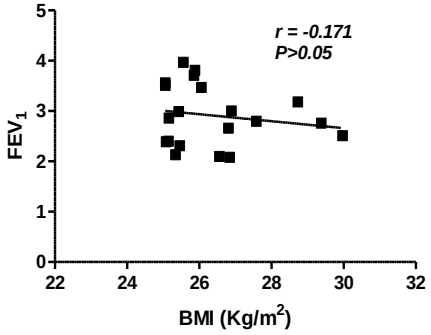

Fig 9: Graphical representation of the relationship between the BMI and FEV_1. **(FEV_1/BMI CORRELATION)**
There was no significant correlation between the BMI and FEV_1

However, it is worthy of note that previous researches investigated the effect of garlic on lung function over a relatively long period of time (least of 2 weeks). This study investigated the immediate effect of garlic on FVC and FEV_1. Lung function parameters were measured within 2-3hrs of garlic consumption. This reduction in FVC and FEV_1 following 2-3hrs of raw garlic ingestion could be attributed to the instability of some active garlic components such as allicin, ajoene, vinyldithiins and DADS. Amagase *et al.*, (2001) already reported an inconsistent result in clinical cholesterol study due to the instability and/or

metabolism of these compounds in garlic. These compounds were present in the blood after 1-24 hrs of oral ingestion of raw garlic elapsing the time our spirometric measurements were taken.

Lybarger *et al.,* (1982) reported bronchial asthma associated with oral ingestion of raw garlic. They also reported same adverse effect with repeated exposure to garlic dust. The likely explanation is that the unstable compounds of garlic was able to cause a greater effect on the larger airways as observed in the reduced FVC and FEV_1 but it was not able to affect the small airways adversely as seen in the improved FEF25-75%. The combined effect of raw garlic ingestion and moderate exercise, which was monitored in subjects in group III, proved to be negative same as with the effect of ingestion of raw garlic only compared to baseline. The result from group III is evidence that exercise produced no significant effect when added to garlic in the short term. The reduction in FEV_1 and FVC obtained could be attributed majorly to raw garlic consumed and not actually from exercise. Whether exercise alone could reduce lung function in overweight subjects is not known.

Nazrul *et al*., (2017) earlier quoted, explained that supplementation of garlic improved lung function in smokers, by increasing endogenous production of nitric oxide, and suggest it might be doing so by stimulating nitric oxide synthase, a membrane bound enzyme. However, the mechanism of action of these unstable compounds of garlic on the lungs is not clear and is a topic for further research.

Conclusion: The results from this study suggests that oral supplementation of raw garlic only may reduce lung function in the first two to three hours of ingestion in overweight subjects. The combined effect of garlic and exercise may not have any significant effect different from the result raw garlic alone would have in overweight subjects.

REFERENCES

Amagase, H; Petesch, BL; Matsuura, H; Kasuga, S; Itakura, Y (2001). Intake of garlic and it's bioactive components. *J Nutr*. 131: 955S-962S.

Azad, A; Gharakhanlou, R; Niknam, A; Ghanbari, A (2011). Effects of aerobic exercise on lung function in overweight and obese students. *Tanaffos*. 10(3):24–31.

Belman, MJ (1993). Exercise in patients with chronic obstructive pulmonary disease. *Thorax*. 48:936–946.

Bozin, B; Dukic, NM; Samojlik, I; Goran, A Igic, R (2008). Phenolics as antioxidants in garlic (*Allium sativum L., Alliaceae*). *Food Chem*. 111: 925–929.

Carolyn, S. R; Darryl, YS; George; B James, E H; Karlman, W (1983). Effects of obesity on respiratory function. *Am Rev Respir Dis.* 128:501–506.

Cavallito, CJ; Bailey, JH (1944). Allicin, the antibacterial principle of *Allium sativum*. I. Isolation, physical properties and antibacterial action. *Journal of the American Chemical Society*, 66(11): 1950-1951.

Courteix, D., Obert, P; Lecoq, AM; Guenon, P; Koch, G (1998). Effect of intensive swimming training on lung volumes, airway resistance and on the maximal expiratory flow- volume relationship in prepubertal girls. *European Journal of Applied and Occupational Physiology*. 76(3): 264-269.

Devershetty, J; Mett, S; Uppala, S; Kamble, G (2015). Effect of obesity on pulmonary function tests in apparently healthy young women. *Int J Med Sci Public Health*. 4(11):1519-1522.

Fashner, L; Ericson, K; Werner, S (2012). Treatment of the common cold in children and Adults. *Am Fam Phys*. 86: 153-160.

Ghosh, AK; Ahuja, A; Khanna; GL (1985). Pulmonary capacities of different groups of sportsmen in India. *Br J Sports Med.* 19(4): 232- 234.

Harik-Khan Raida, I; Wise Robert, A; Fleg Jerome, L (2001). The effect of gender on the relationship between body fat distribution and lung function. *J Clin Epidemiol.* 54(4):399–406.

He, ML; Yang, WZ; You, JS; Chaves, AV; Mir, PS; Benchaar, C; McAllister, TA (2009). *Asian-Aust. J. Anim. Sci.* 22(12):1686-1692.

Hodge, G; Hodge, S; Han, P (2002). Allium Sativum (garlic) suppress leukocyte inflammatory cytokine production in vitro: potential therapeutic use in treatment of inflammatory bowel disease. *Cytometry*. 48: 209-215.

Howley, ET (2001). Type of activity: resistance, aerobic and leisure versus occupational physical activity. *Official Journal of the American College of Sports Medicine*. P*ak Med Assoc.* 32:237-239

Jones, RL; Nzekwu, MMU (2006). The effects of body mass index on lung volumes. *Chest.* 130: 827–833.

Kathi, JKM. (2000). Garlic (*Allium sativum*). *Longwood Herbal Task Force (LHTF)*. 1-49.

Kodera, Y; Suzuki, A; Imada, O; Kasuga, S; Sumioka, I; Kazenawa, A; Taru, N; Fujikawa, M; Nagae, S; Masamoto, K; Maeshige, K; Ono, K (2002). Physical, chemical, and biological properties of Sallylcysteine, an amino acid derived from garlic. *J. Agric. Food Chem*. 50; 622–632.

Kuda, T; Iwai, A; Yano, T (2004). Effect of red pepper Capsicum annuum var. conoides and garlic *Allium sativum* on plasma lipid levels and cecal microflora in mice fed beef tallow. *Food Chem Toxicol*. 42:1695-1700.

Lybarger, JA; Gallagher, JS; Pulver, DW; Litwin, A; Brooks, S; Bernstein, IL (1982). Occupational asthma induced by inhalation and ingestion of garlic. *J All Clin Immunol*. 69(5): 448-454.

Myneni; AA; Chang, S; Niu, R; Liu, L; Swanson, MK; Li, J; Su, J; Giovino, GA; Yu, S; Zhang, Z; Mu, L (2016). Raw garlic consumption and lung cancer in a Chinese population. *Cancer Epidemiol Biomarkers Prev*. 25(4): 624–633.

Nazrul, MI; Rahman, MA; Quayyum, MA (2007). Performance of intercropping banana with vegetables. *SAARC J Agric.* 5(1): 53-57.

Omar, SH; Al-Wabel, NA (2010). Organosulfur compounds and possible mechanism ofgarlic in cancer. *Saudi Pharm J*. 18: 51–58

Pelkonen, M; Notkola, IL; Lakka, T; Tukiainen, HO; Kivinen, P; Nissinen, A (2003). Delaying decline in pulmonary function with physical activity: a 25-year follow-up. *Am J Respir Crit Care Med.* 168 (4): 494-499.

Salome, CM; King, GG; Berend, N (2010). Physiology of obesity and effects on lung function. *J Appl Physiol* 108: 206–211.

Shamsi, TN; Parveen, R; Amir, M; Baig, A; Quresh, MI; Ali, S; Sadaf, F (2016). Allium Sativum protease inhibitor: A novel kunitz trypsin inhibitor from garlic is a new comrade of the serpin family. *PLOS ONE.* 11(11): e015572.

Stoll A. and Seebeck E. (1948). Über Alliin, die genuine MuttersubstanzdesKnoblauchÖls. *Helv. Chim. Acta*. 31: 189–210.

Tsai, CW; Chen, HW; Sheen, LY; Lii, CK (2012). Garlic: Health benefits and actions. *Bio Med*. 2: 17-19.

Vengata, SM; Ganesh, SS; Wan, RW (2014). Effect of physical activity on respiratory function in Obese: a systemic review. *Int J Physiother Res*. 2(1):342-3.46

Womack, CJ; Harris, DL; Katzel, LI; Hagberg, JM; Bleecker, ER; Goldberg, AP (2000). Weight loss, not aerobic exercise, improves pulmonary function in older obese men. *J Gerontol A Biol Sci Med Sci.* 55: M453–M457.

World Health Organization (WHO). Fact about Overweight and Obesity (2004). Available at: http://www.who.int/mediacentre/factsheets/fs311/en/index.html.

Yu-Yan, Y; Lijuan, L (2001). Cholesterol lowering effects of garlic extracts and Orgarnosulphur compounds; Human and Animal studies. *J Nutr*. 131(3) 9895-9935.