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# A comparative study on Lung Capacity in *Sthula Purusha* and *Swastha Purusha*

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## ABSTRACT

*Vayu* called as the "life of all living organism" in ancient text. Presence of *Vayu* in the body in equal proportion is one of the main reasons of health of healthy persons, on other hand due to accumulation of excess fat on the chest in obese individuals the air passage is obstructed and *Vayu* (atmospheric air) does not inter into the lungs properly due to this reason *Prana Vayu* in obese individuals is less than its normal quantity which affects the daily routine and decreases the normal age of a person. Assessment the health of healthy peoples with the help of general signs and symptoms of equilibrium of *Dosha*, *Dhatu*, *Mala* and *Agni* etc. while according to modern science vital signs are the indicators of normal health of any individual. Assessment of obesity is done by the symptoms given in the text such as *Chala Sphika*, *Udara Stana*, *Khudhadhikya*, *Trishadhikya*, *Khudraswas* etc. and according to modern science body mass index (BMI) is used as measurement tool of obesity. Measurement of lung volume and capacity with the help of student spirometer and make comparison of lung capacity in both the groups (*Sthula* & *Swastha Purusha*).

**Key words:** *Vayu*, *Swastha*, *Sthula*, *Dosha*, *Dhatu*, *Mala Agni*, *Lung capacity*.

## INTRODUCTION

*Acharya Charaka* has described the benefits of *Vayu* and said that *Vayu* is life, strength and sustainer of creature, *Vayu* is the entire world and it is the master of all. The person whose *Vayu* is with unimpeded movements and in normal state lives long for hundred years devoid of disorders.<sup>[1]</sup> *Acharya Sharangdhara* has described that the *Ayu* is nothing but combination of the body and *Pranavayu* (Oxygen), and due to period, its detachment is death.<sup>[2]</sup> Whenever *Medodhatu* is increased in the body *Vayu* get obstructed.

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## Breathing rate as per Ancient Period

There is no mention of the rate of *Shwas Kriya* (Breathing activity) in *Ayurvedic Samhitas*. However, mention of this subject is found in ancient *Vangmay*. According to the *Sathpath Bramhan Granth*, a normal person has 15 breaths per minute.<sup>[3]</sup> Lung volumes are also known as respiratory volumes. It refers to the volume of gas in the lungs at a given time during the respiratory cycle. Lung capacities are derived from a summation of different lung volumes. Lung capacities are of four types. They are Inspiratory, Vital capacity, Functional residual capacity & Total lung capacity. The average total lung capacity of an adult human is about 6 liters of air.

## "Swastha" and "Swasthya"

The word "*Swa*" means Soul. From the perspective of *Ayurveda* the word "*Atm*" or "*Swa*" can be used for "*Ayu*" (Life). The word "*Stha*" signifies stability. "*Stha*" means to remain stable with our efforts. Only one who remains engrossed in the needs of the body after escaping from the various attractions of the world, can be called immovable and stable, and that person is

healthy. Only such a man gets spiritual health.<sup>[4]</sup> According to *Aacharaya Chakrapani*, a person who is situated in a state without disorder is called healthy and the feeling of a healthy person is called health. According to *Acharya Charak* a healthy person is, the one having balanced proportion of muscles, compactness, firmness in organs does not fall prey to prowess of a disorder. The person having balanced musculature has got tolerance for hunger, thirst, the sun, cold and exercise, balanced *Agni* (Digestive fire) and normal metabolism<sup>[5]</sup> According to *Acharya Susruta*, a healthy person is, whose humors and metabolic state are in equilibrium, whose functional activities of the tissues and excretory products (i.e., the physical state) are in balance and the soul senses and mind (i.e., the mental state of the body) feel well.<sup>[6]</sup> Willingness to eat, digestion of food eaten comfortably, proper excretion of feces, urine, air, lightness in body, all the senses feel happiness, sleeping and awakening happily, strength in body benefit of normal body color and age. These are the *Arogya Lakshanas* explained by *Acharya Kashyap*<sup>[7]</sup>

The word *Sthaulya* is derived from *Mula Dhatu* “*Sthu*” with suffix “*Ach*” *Pratyaya*, which stands probably for bulky or big or thick. A person having heaviness and bulkiness of body due to extensive growth especially in abdomen region is termed as ‘*Sthula*’ and the state of *Sthula* is called as ‘*Sthaulya*’.<sup>[8]</sup> *Charaka* mentioned *Atisthula Purusha* in the *Ashtanindita Purushas* while *Sushruta* mentioned *Sthaulya* in *Dosha Dhatu Mala Kshaya - Vridhhi Vignaniyam*. *Sushruta* and *Madhav* both *Acharyas* have mentioned many symptoms of *Sthaulya* and *Kshudrashwasa* (shortness of breath) one of them.<sup>[9][10]</sup> There is a major epidemic of obesity, and many obese patients suffer with respiratory symptoms and disease.

The overall impact of obesity on lung capacity is multi-factorial, related to mechanical and inflammatory aspects of obesity.<sup>[11]</sup> In general, the effort to breath becomes more difficult among people who are obese. It is difficult to expand the lungs against the added pressure that the excessive weight imposes. The extra weight on an obese person makes it challenging for the lungs to fill up.

Breathing is an essential function for survival and alterations in lung function can hinder quality of life and performance of activities in daily life. To maintain respiratory homeostasis, the structures that compose the respiratory system need to work in equilibrium, that is, the lungs should be ventilated and the gases should diffuse through the alveolar-capillary barrier. Obesity causes mechanical compression of the diaphragm, lungs and chest cavity, which can lead to restrictive pulmonary damage, so they have shortness of breath. This affects their quality of life. So, it is important to make them aware the consequences of Obesity. Breathlessness after slight exertion is one of the complications of Obesity. This is same which explained by *Acharyas* under the term *Kshudra Shwasa*. Hence the study is selected to assess the Respiratory capacities in both type of persons (Both *Swastha* and *Sthula*).

### AIM AND OBJECTIVES

1. Conceptual study of Respiration, Lungs Volumes & Lung Capacities
2. Assessment of Lung Capacities in *Swastha Purusha*
3. Assessment of Lung Capacities in *Sthula Purusha*
4. To compare Lung Capacities between *Sthula Purusha* and *Swastha Purusha*
5. To compile the data generated and analyze them by proper statistical methods so as to draw the conclusion objectively.

### MATERIALS AND METHODS

For the present study, first of all Total 60 (30 *Swastha* + 30 *Sthula*) Person were selected from Shri N.P.A Govt. Ayurved College Raipur, Khudadad Dungaji Govt. Ayurvedic Hospital, Raipur and other areas of Raipur (Chhattisgarh) on the basis of inclusion criteria. Obese individuals will be selected according to prepared proforma on the basis of phenotypes mentioned in Ayurvedic text. Lung Capacities in each (*Swastha* & *Sthula*) person will be assessed using student’s spirometer. A comparison will be done between lung capacities of both individuals.

## DISCUSSION

Swastha Lakshanas explained by Acharyas can be categorized under:

### i) Physical health

For representing Physical health Acharyas used the terms like *Prasanna Varna* (Good complexion) *Kayagniabhivardhana* (Good appetite), *Sama Samhanana* (Organs of the body are of unexceptional size), *Srusta Vindmutra Vata* (Regular activity of bowel and bladder) etc. All the sense organs are intact. In Resting condition, temperature Pulse rate, Blood pressure, Respiratory rates should be in normal range for the individuals according to age and sex. Physical health can be assessed by taking history of hospitalization, clinical examination, anthropometry, biochemical and lab investigation.

### ii) Mental health

A person can be called mentally healthy if his *Atma* and *Indriya* is in balanced state. And should be devoid of mental factors like *Krodha*, *Ersya*, *Shoka* etc The mental health can be assessed by his behavior and attitude, A perfect state of balance with the surrounding world, Having harmonious relation with others, Intelligence, Memory, Learning capacity, Judgment are normal, Not having any internal conflicts, Accepts criticisms supportively, Good self-control Solves the problem intelligently and own, Self-confident, Well-adjusted with others, Satisfied with what he possesses, Cheerful and calm, Self-satisfaction, Adjustment, Self-control

### iii) Social health

Accepted, Respected, Loved by all in the family, by his friends, relatives, neighbors, colleagues and others. Possession of social skills, Proper social involvement, Ability to see oneself as member of larger society. A person who is healthy physically, mentally, and socially is said to be in a state of, positive health i.e., highest standard of health.

### Obesity and Lung Capacity

Main *Dosha* causing the pathogenesis of *Sthaulya* is *Kapha* but *Vata* and *Pitta* are associated with the complications arising due to *Sthaulya*. In *Sthaulya*,

excessive intake of *Guru*, *Snigdha*, *Madhuradi Guna* dominant diet increases accumulation of *Meda*. Various etiological factors of *Sthaulya* can be divided into four categories, viz. *Aharatmaka*, *Viharatmaka*, *Mansika* & *Anyā Nidana*. Thus, along with *Sharirika Nidana*, *Mansika Nidana* like *Harshnityatwa*, *Achintan* etc. also play important role in the development of *Sthaulya*. *Acharya Charaka* mentioned *Beejadushti* as one of the most important etiological factors. *Acharya Charaka* accepted *Ahara* as most common pathogenic factor whereas *Sushruta* mentioned *Amadosha*. *Charaka* elaborated that due to *Medovaha Srotosanga*, *Vata* enters in the *Koshtha* and causes *Agni Vriddhi*. This results in increased *Ahara Rasa Shoshana* & the *Medovriddhi* person craves for more food and the overeating results in *Sthaulya*. *Acharya Sushruta* emphasized that the state of *Medovriddhi* and *Karshya* depends upon *Ahara Rasa*. He explained that due to indulgence in *Kapha Vardhaka Ahara Vihara*, *Adhyasana* etc. *Ama Rasa* is produced. This *Madhura Bhava Ama Rasa* moves about within the body, the *Snigdhansha* of that *Ama Rasa* causes *Medovriddhi* finally resulting in *Atisthaulya*. Apart from *Kapha Dosha Vata* plays important role in pathogenesis of *Medovriddhi* by provoking *Agni* and increasing the *Abhyavaharan Shakti*. As the function of *Agni* is disturbed so, *Pitta* vitiation also occurs due to excessive indulgence in *Medovardhaka Dravya*. Due to *Kaphavardhaka Nidana Sevena Rasavaha Srotodushti* also occurs. *Atisweda* and *Dourgandhya* indicate involvement of *Swedvaha Srotas*. *Atipipasa* is indicating of *Udakvaha Srotodushti* and *Mamsavaha Srotodushti* occurs due to *Vasa* deposition.

### Classification of Obesity

On the basis of BMI

- Overweight 25 – 29.9 Kg/m<sup>2</sup>
- Obesity (class-I) 30 – 34.9 Kg/m<sup>2</sup>
- Obesity (class-II) 35 – 39.9 Kg/m<sup>2</sup>
- Severe or morbid obesity (class-III) > 40kg/m<sup>2</sup>

Obesity is currently one of the major epidemics of this millennium and affects individuals throughout the world. It causes multiple systemic complications, some



of which result in severe impairment of organs and tissues. These complications involve mechanical changes caused by the accumulation of adipose tissue and the numerous cytokines produced by adipocytes. Obesity also significantly interferes with respiratory function by decreasing lung volumes and capacities. Because of the ineffectiveness of the respiratory muscles, strength and resistance may be reduced. All these factors lead to inspiratory overload, which increases respiratory effort, oxygen consumption, and respiratory energy expenditure. It is noteworthy that patterns of body fat distribution significantly influence the function of the respiratory system, likely via the direct mechanical effect of fat accumulation in the chest and abdominal regions. Weight loss caused by various types of treatment, including low-calorie diet, intragastric balloon, and bariatric surgery, significantly improves lung function and metabolic syndrome and reduces body mass index. Despite advances in the knowledge of pulmonary and systemic complications associated with obesity, longitudinal randomized studies are needed to assess the impact of weight loss on metabolic syndrome and lung function.

### Discussion on lung capacity

Lung capacity or Total Lung Capacity (TLC) is volume of air in the lungs upon maximum effort of inspiration. Among healthy adults, the average lung capacity is about 6 liters. Age, gender, body composition, and ethnicity are factors affecting the different ranges of lung capacity among individuals. TLC rapidly increases from birth to adolescence and plateaus at around 25 years old. Males tend to have a greater TLC than females, while individuals with tall stature tend to have greater TLC than those with short stature, and individuals with a high waist to hip ratio generally have a lower TLC. Individuals of African descent have a lower TLC compared to individuals of European descent. Additional factors that affect an individual's lung capacity include the level of physical activity, chest wall deformities, and respiratory diseases.

### Discussion on comparative study

The end result of the trial was assessed individually on both subjective and objective parameters, subjected to

bio statistical analysis and finally inferences were drawn. Total 60 volunteers divided by two groups and each group has 30 volunteers were registered for the trial. The method adopted was randomized observational study. Results were assessed from subjective and objective parameters after trial. Analysis of data was done by using SPSS (Statistical Program for Social Science Version 20.0). Unpaired "t" test used for the purpose of finding significance. The accurate validity of trial for the Lung volume & Capacity were assessed through p-value. The observation and result of the patients are discussed below.

#### 1. Chala Sphik Udara Stana

Maximum volunteers i.e., 21 from G2 were having symptoms of *Chala-Sphika-Udara-Stana*. Due to sedentary life style and faulty food habits causes accumulation of excess fat in the body especially around chest, lower abdomen, buttock etc. Because of the excessive accumulation, even though there is a slight change in body positions produces movement in *Sphik, Udara* and *Sthana*.

#### 2. Kricchavyavayta.

Maximum volunteers i.e., 19 from G0 were having symptoms of *Kricchavyavayta*. *Sthula Purusha* having sexual difficulty due to physical inactivity and fat cell leads to capillary damage of penis causes *kricchavyavayata*. In this study most of the volunteers did not show the symptom of *Kricchavyavayta*, it may be because the majority of volunteers were female and they were not willing to reveal about their sexual life.

#### 3. Angagandhata

Maximum volunteers i.e., 9 from G1 and G2 were having symptoms of *Angagandhata*. Obese person sweats more and sweat may stuck in thick skin layers, which in turn gives bacteria a chance to thrive and produce foul smell.

#### 4. Swedadhikya

Maximum volunteers i.e., 12 from G2 were having symptoms of *Swedadhikya*. Obese person sweating more because of few reasons, they have to physically exert themselves more to perform daily activities and

are more likely to get overheated. They also have low surface area related to their weight, so their body has to work harder to cool itself down, leading to more sweating.

#### 5. *Kshudhadhikya*

Maximum volunteers i.e., 13 from G2 were having symptoms of *Kshudhadhikya*. In *Sthula Purusha* both *Agni* & *Vayu* are aggravated causes consuming of more food.

#### 6. *Pipasadhikya*

Maximum volunteers i.e., 12 from G2 were having symptoms of *Pipasadhikya*. In obesity there are huge amount of fluid loss through sweating and body gets dehydrate that's why the person drinks more water.

#### 7. *Kshudrashwas*

Maximum volunteers i.e., 14 from G2 were having symptoms of *Kshudrashwas*. Obesity causes mechanical compression of the diaphragm, lungs and chest cavity, which can lead to restrictive pulmonary damage, so they have shortness of breath.

#### 8. *Nidradhikya*

Maximum volunteers i.e., 12 from G1 were having symptoms of *Nidradhikya*. Due to overeating of *Kaphaja Ahara*, *Kapha Dosa* and *Tama Guna* get vitiates in *Sthoola*.

### Discussion on Result

#### Difference on Lung volumes & Capacities

##### 1. Difference on Tidal Volume

The p value of Tidal volume (TD) between both groups was  $p>0.05$  which is statistically non significant difference between both groups.

##### 2. Difference on IRV

The p value of Inspiratory reserve volume (IRV) between both groups was  $p<0.001$  which is statistically highly significant difference between both groups.

##### 3. Difference on ERV

The p value of Expiratory reserve volume (ERV) between both groups was  $p<0.001$  which is statistically highly significant difference between both groups.

##### 4. Difference on IC

The p value of Inspiratory Capacity (IC) between both groups was  $p<0.001$  which is statistically highly significant difference between both groups.

##### 5. Difference on VC

The p value of Vital Capacity (VC) between both groups was  $p<0.001$  which is statistically highly significant difference between both groups.

### CONCLUSION

The five types of *Vayu* are located in their specific places and *Prana Vayu* which circulate in the oral cavity and maintain the body and supports of life. When vitiated, it often produces disorders like hiccough, respiratory difficulty etc. In present study females were seen to be more affected due to intake of energy dense diet and less physical activity. Comparative study of Lung volume & capacity in *Swastha Purusha* (Healthy person) & *Sthula Purusha* (Obese person) have highly significant result on difference of Inspiratory reserve volume (IRV), Expiratory reserve volume (ERV), Inspiratory capacity (IC) and Vital capacity (VC). It has non-significant result on Tidal volume (TD). In present study the normal individuals (Group A) have better lung volumes and capacities including Inspiratory reserve volume (IRV), Expiratory reserve volume (ERV), Inspiratory capacity (IC) and Vital capacity (VC) than Obese individuals (Group B) and there is no much difference in Tidal volume (TD) of both the groups. *Swastha Purusha* (Normal individuals) have good musculature which helps in flexibility, movement of chest wall and ultimately ventilation. So, they can expand their chest wall in large diameter resulting good aeration whereas *Sthula Purusha* (Obese individuals) have accumulation of adipose tissue around the airways and deposition of fat over the chest wall causing mechanical resistance in expansion of thorax or ventilation. Majority of the sign and symptoms of *Sthaulya* described by *Acharya Charaka* are comes under G<sub>2</sub>.

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