TOTAL RESPIRATORY COMPLIANCE OF NORMAL INDIAN SUBJECTS

by

K. KHETARPAL*

Department of Physiology, M.G.M. Medical College, Indore

The normal values for pulmonary function tests published by us earlier (5) did not include the figures for respiratory compliance. The aim of the present study is to present normal figures for the compliance of the total respiratory system in young Indian adults. A notable point is the simplicity of the method used which makes it easy for clinical use in a large number of chest clinics in the country.

MATERIALS AND METHODS

22 Medical students 18 males and 4 females in the age group 18—22 years have been studied. They were tested during working hours which ensured an interval of about three hours from the last meal. They had no clinical evidence of present or past cardiorespiratory disease.

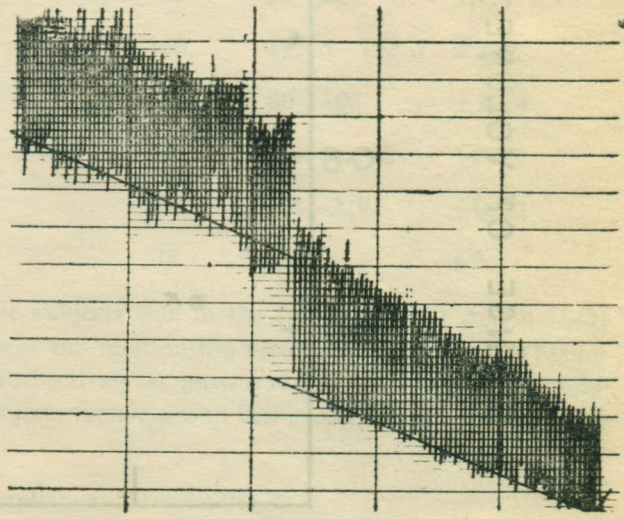
Compliance of the Respiratory system means a change in volume b rought about by each unit of pressure change, when a positive pressure is applied to the system. A simple method of applying the pressure and measuring the volume change has been used. The method of recording was described by Cherniack and Brown (2). The apparatus consisted of :

(1) A spirometer filled with 100% O_2 and fitted with a CO_2 absorber.

(2) Weights of varying size which when put on the spirometer bell, produced pressure ranging from 2 to 14 cm H_2O inside the bell.

(3) A water manometer connected with the O_2 inlet of the spirometer by means of a pressure tubing.

The subject was tested sitting on a laboratory stool. He was required to breath in closed circuit with the spirometer for a minimum of 2 minutes to ensure a steady end-expiratory line (Graph 1). Then a weight was placed on the spirometer bell to create a positive pressure in the spirometer gas and therefore in the lungs of the subjects which are in free communication with it. The increased pressure forces more gas into the lungs and the volume of the Res piratory system increases. The increase in volume is noticed as a moving up of the end expiratory level of the subject who continues to breath for a minimum of another two minutes to ensure a constant end expiratory level again. A line was drawn through the points of end expiration at each



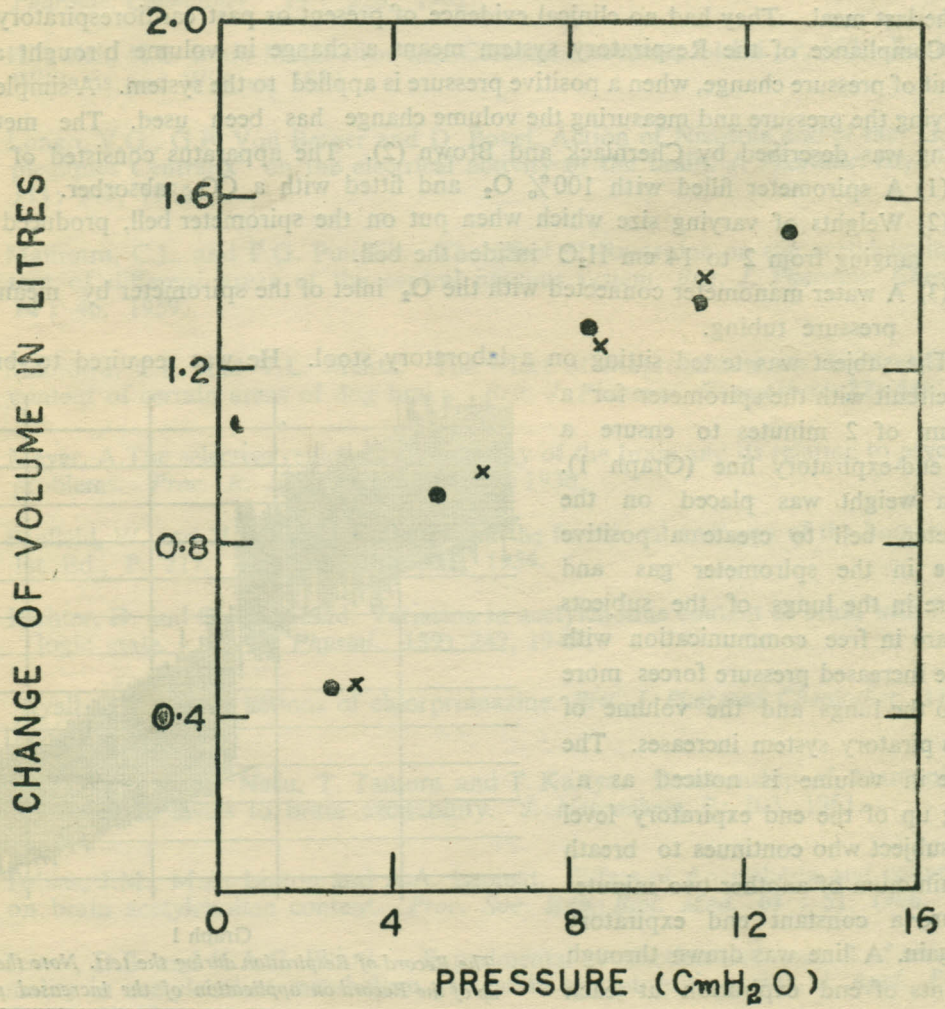
Graph 1

The Record of Respiration during the test. Note the moving up of the Record on application of the increased pressure.

*Present Address : Department of Physiology, All India Institute of Medical Sciences, Ansari Nagar, New Delhi.

of the two levels (Graph 1), and the vertical distance between the two represents the change in volume brought about by the pressure which is simultaneously read from the manometer. This change in volume is corrected for the compression of gas and water under the bell by the application of the same weight when the subject is not connected with spirometer. The volume is changed to V at BTPS. This procedure was repeated to produce pressure variations between 2 to 14 cm H_2O.

The change in volume brought about by each end-expiratory pressure was plotted against it after the above corrections, and a pressure volume curve was drawn through these points (Graph 2). The compliance of the total respiratory system was calculated from the straight portion of the curve. The procedure was repeated in the same individual on different days and almost identical figures were obtained (Graph 2). Vital capacity and MBC were tested in



Graph 2

Pressure Volume Relationship of The Respiratory System of a Subject on two diffrent days.

the spirometer after removing the CO_2 absorber and the valves. Height and weight of the subject were measured and the body surface area was computed from Dubois Chart.

Observations and results

The figures for physical characteristics and ventilatory functions were as follows :

Males : 18 subjects	Mean	Range	S.D.
Age, (years)	19	18—21	±1
Height, (cm)	165	158—170	±6.0
Weight, (lbs.)	108	92—130	±8.1
BSA, (M^2)	1.53	1.39—1.71	±0.09
V.C., (Litres)	3.5	2.8—4.5	±0.44
MBC, Litres/min.	107	84—150	±20

Total Respiratory compliance of these subjects was in the range 80—120 ml/cm/H_2O; Mean-111 ml. S.D.±20.4

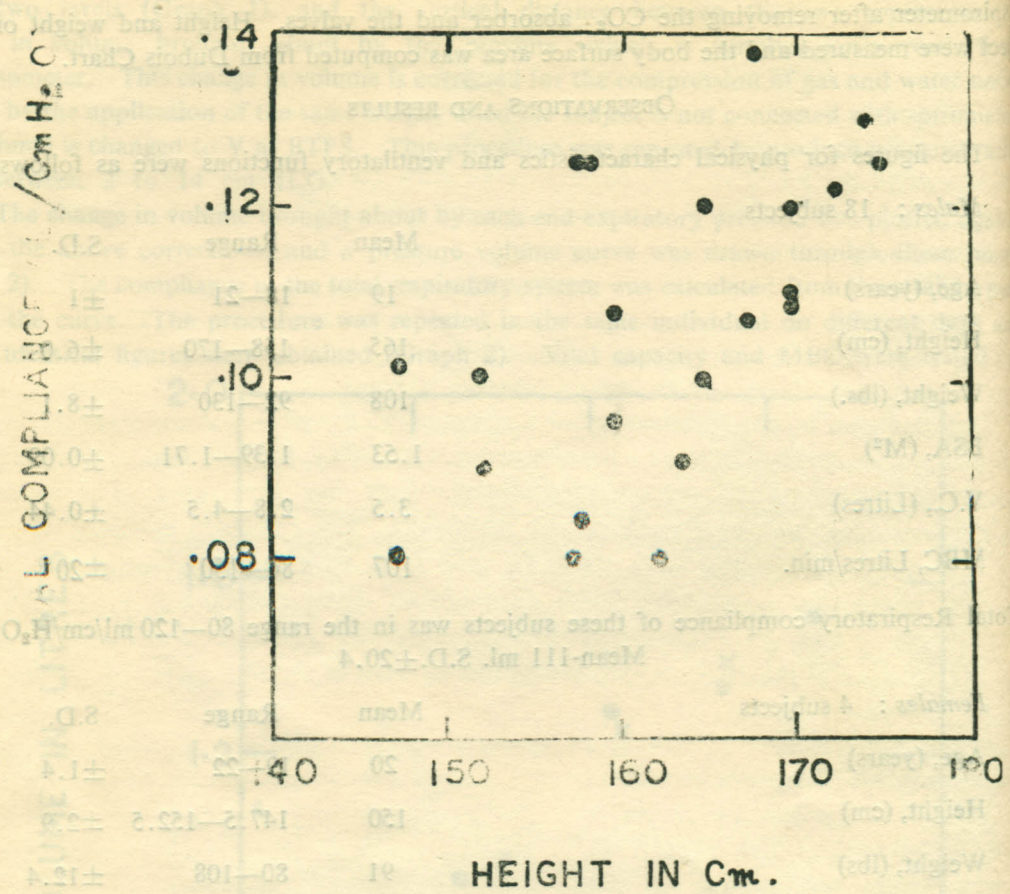
Females : 4 subjects	Mean	Range	S.D.
Age, (years)	20	19—22	±1.4
Height, (cm)	150	147.5—152.5	±2.9
Weight, (lbs)	91	80—108	±12.4
BSA, (M^2)	1.56	1.26—1.42	±0.29
V.C., (litres)	2.6	2.4—2.9	±0.22
MBC litres/min.	78	64—84	±9

Total respiratory compliance of these subjects was in the range 80—160 ml/cm H_2O; Mean 96; S.D.±12.0. Graphs 3 to 6 present the relationship between total respiratory compliance and height, BSA, V.C. and MBC respectively as measured by this method. Correlation coefficients were calculated for male subjects female group being very small, and the value of it was found to be—

V.C. and Total compliance = +0.826

MBC and Total compliance = +566

Height ahd Total Compliance = +0.959

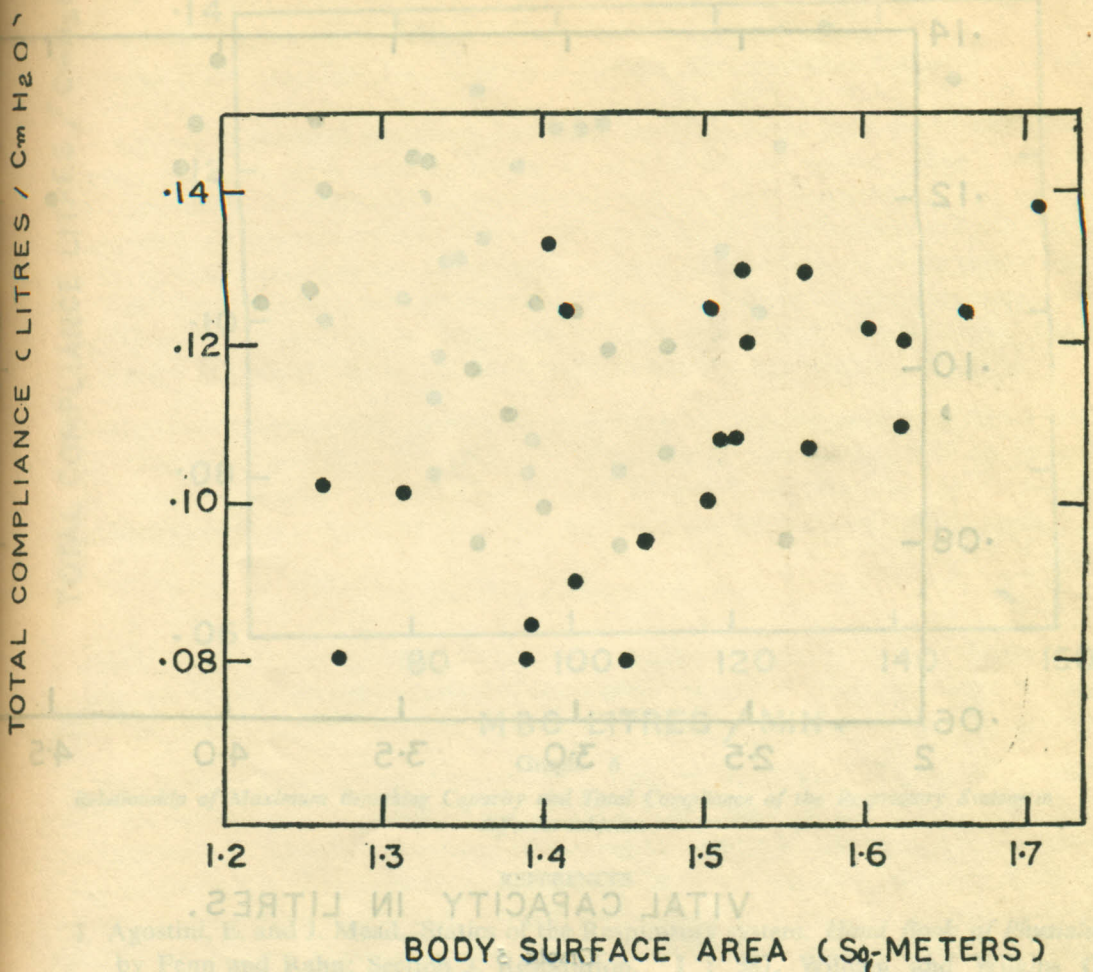


Graph 3

Relationship of the Height of the Subjects with the Total Compliance of the Respiratory System

DISCUSSION

Since this is a pressure breathing technique, it is important to ensure complete relaxatio of the respiratory muscles at the end expiratory point when the pressure and volume measure ments are made. It has been shown by Johnson and Mead (3) that the results obtained b pressure breathing techniques are similar to those obtained by the voluntary relaxation metho of Rahn *et al* (4). The pressures applied to the respiratory system in our expreiments wer kept below 15 cm H_2O because it is only in this range that the abdominal muscles have bee shown by Agostini and Mead (1) to exhibit complete relaxation. The pressure breathing tech niques are more accurate because they give less scatter of results as compared to the voluntar relaxation method when the test is preformed on the same subject at different times in untrain ed individuals. This has been confirmed by the author as can be seen in Graph 2. The value

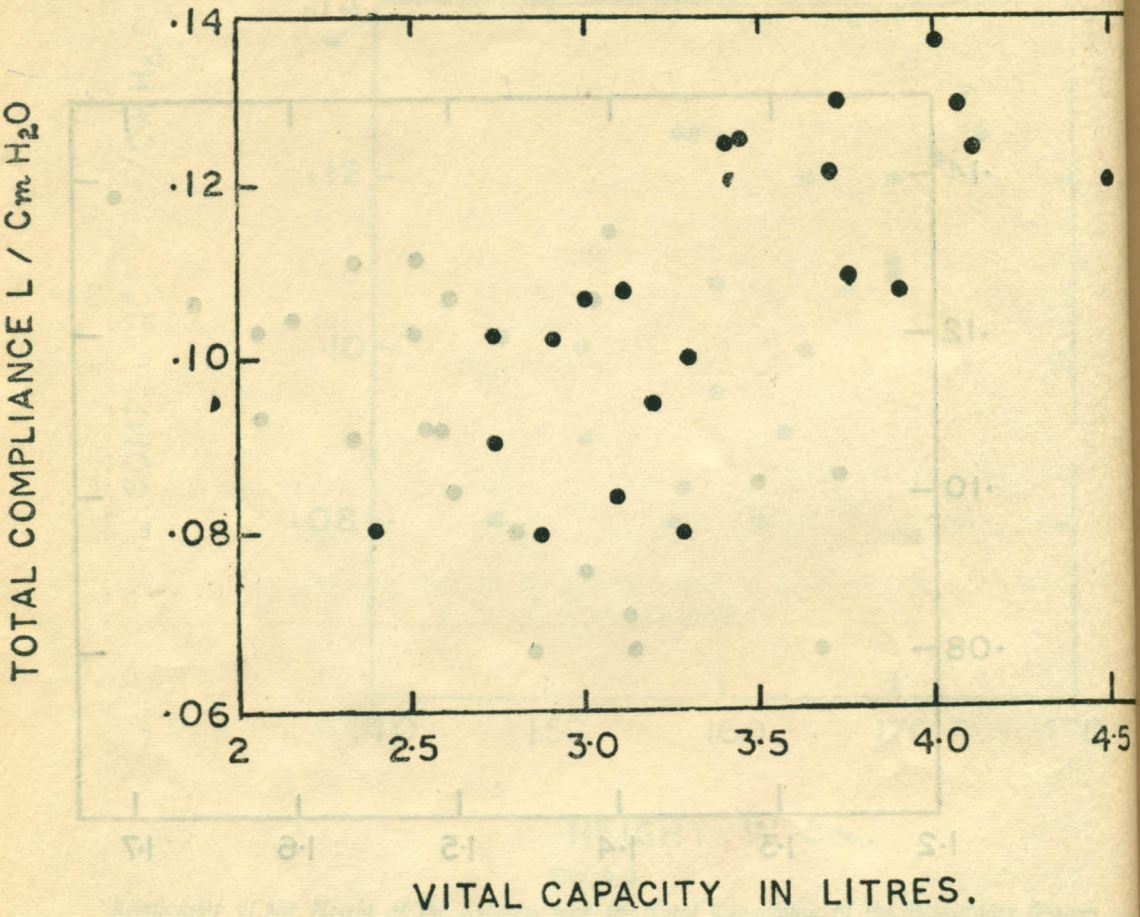


Graph 4

Relation ship of the Body Surface Area & Total Compliance of the Respiratory System in different Subjects.

in the study presented here approach very closely those of Cherniack and Brown's series of the same age group. The mean value for total compliance of the female subjects is lower than of males as is true for all other pulmonary function values. The Correlation Coefficients also point to the fact that height, vital capacity and MBC vary in the same direction as the total compliance.

In view of these facts and the simplicity of the method used in the present study the author recommends that this method should be used for routine study of total compliance in the respiratory laboratories.



Graphs 5

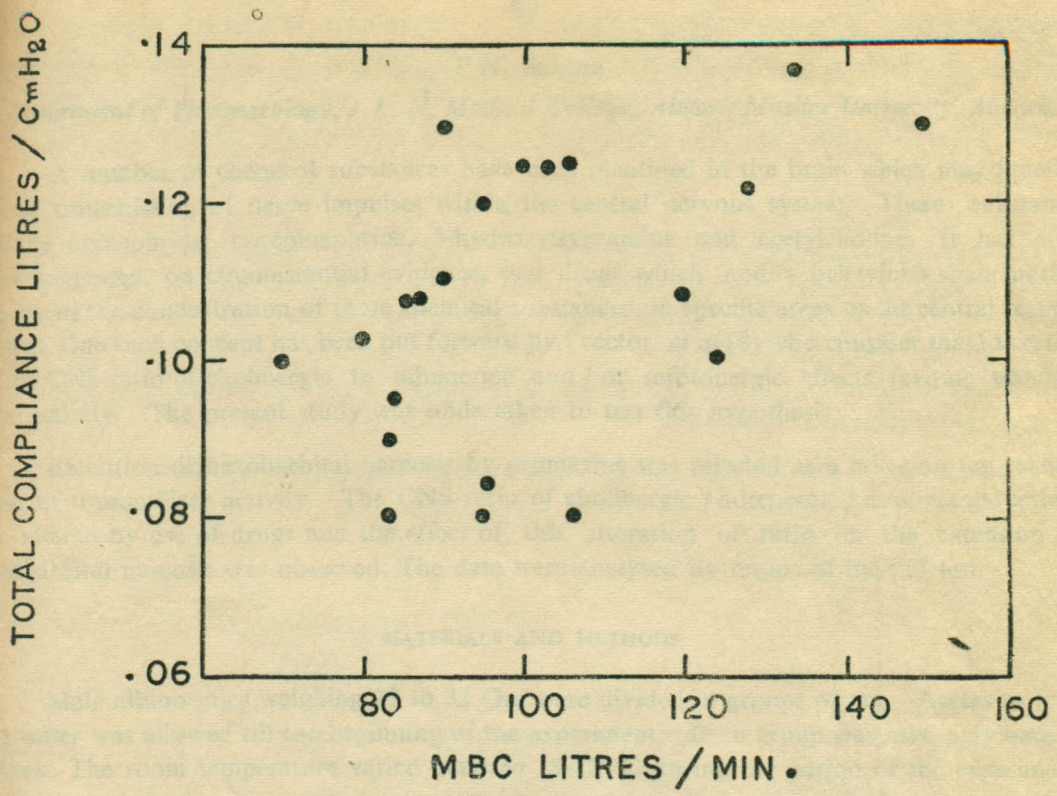
Relationship of Vital Capacity and Total Respiratory Complinace in different subjects.

SUMMARY AND CONCLUSIONS

1. Total respiratory compliance of 22 normal Indian subjects has been studied using the method of Cherniack and Brown.

2. The total compliance of male subjects is 111 ml/cm$\pm H_2O$ S.D.$\pm$20.4 and females is 96 ml/cm H_2O S.D.$\pm$12.

3. A significant correlation is found between total compliance and height, V.C. and MBC.



Graph 6

Relationship of Maximum Breathing Capacity and Total Compliance of the Respriatory System in different subjects.

REFERENCES

1. Agostini, E. and J. Mead. Statics of the Respiratory system. *Hand Book of Physiology* by Fenn and Rahn; Section 3, Respiration. **I** : 387. William and Wilkins Co. Baltimore.

2. Cherniack, R.M. and E. Brown. A simple method for measuring Total Respiratory Compliance. Normal values for males. *J. Appl. Physiol.* **20:** (1), 87,1965.

3. Johnson, L.F. Jr.; and Jere Mead. Volume—Pressure relationship during pressure breathing and voluntary relaxation. *J. Appl. Physiol.* **18** : 505, 1963.

4. Rahn H.; A.B. Otis; L.E. Chadwick and W.O. Fenn. The pressure volume diagram of the thorax and lung. *Am. J. Physiol.* **146** : 161, 1946.

5. Vishwanathan R., S. Jain, K. Kapoor and G. Natarajan. Pulmonary Function Tests, *Ind. Jour. Chest* Diseases **1** : 51, 1959.