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Effect of Breathing Pure Oxygen on Respiratory Volume in Humans.*

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Although previous investigators have concluded that the respiratory volume is not altered by the inspiration of high concentrations of oxygen[1, 2] we have found an increase in the average respiratory volume in normal males when pure oxygen was breathed.

A group of 33 white male students, ages 18-33, served as subjects (mean age 23.5±.8). Each subject was given a preliminary trial on the day before the experiments were conducted and was then tested with oxygen at the corresponding hour of 2 subsequent days. In each experiment the subject rested for 20 minutes in the supine position and no tests were run sooner than one hour following a meal. Expired air was collected through a Siebe-Gorman half-mask and mercury valves (opened by a pressure of 1.5 mm of water), into a pair of spirometers of the Tissot type, each with a capacity of 9.19 liters (at 0°, 760 mm). The apparatus, which is described in detail elsewhere[3] was arranged so that the time was electrically recorded when 9.19 liters of air were expired. Expired air was measured continuously over a period of 15 minutes before the administration of the pure oxygen and for 30 minutes during the inspiration of oxygen.

Oxygen was obtained in 1150-gallon pressure tanks from which a pair of Tissot spirometers, each with a capacity of 60 liters, was filled. In this way the oxygen was allowed to come to the same temperature and pressure as room air before being breathed. The valve system was arranged so that the change in inspired air from 21% to 100% oxygen could be made without the knowledge of the subject. Each experiment consisted of: (1) a 20-minute rest period in the supine position; (2) a 15-minute period for the measurement of respiratory volume with the subject breathing outdoor air; (3)

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1 Benedict, F. G., and Higgins, H. L., *Am. J. Physiol.*, 1911, **28**, 1.

2 Davies, H. W., Brow, G. R., and Binger, C. A. L., *J. Exp. Med.*, 1925, **41**, 37.

3 Shock, N. W., and Ogden, E. Child Development. In press.

a 20-minute period for the measurement of respiratory volume with the subject breathing 100% oxygen. In 36 experiments a fourth period of 15 minutes of air collection was continued with the subject again breathing outdoor air from the larger spirometers.

Respiratory volumes were computed in liters per minute at 0° C and 760 mm Hg. The resting level was determined for each experiment from the average of at least 8 observations. The change in respiration resulting from breathing pure oxygen was expressed as

TABLE I.

Effect of Breathing 100% O_2 on Resting Respiratory Volume

	Resting Respiratory Volume.						
	Test I.			Test II.			I. and II.
Subject No.	Breathing 21% O_2 l./sq m/ min	Breathing 100% O_2 l./sq m/ min	% Increment	Breathing 21% O_2 l./sq m/ min	Breathing 100% O_2 l./sq m/ min	% Increment	Avg. % Increment
7	2.95	3.14	6	2.87	2.75	4	1
8	3.80	4.11	8	4.02	4.13	3	6
9	4.16	4.05	- 3	5.41	5.88	9	3
10	2.97	3.04	2	3.32	3.73	13	8
11	3.75	4.35	16	4.38	5.14	17	17
12	3.65	4.11	12	3.31	3.64	10	11
13	4.12	4.32	5	3.85	3.98	3	4
14	4.16	4.39	6	3.64	4.10	13	10
15	3.08	3.45	12	2.95	3.28	11	12
16	3.26	4.02	23	3.33	3.95	18	21
17	3.56	4.85	36	3.45	4.17	21	29
18	2.55	2.62	3	2.41	2.51	4	4
19	3.10	4.26	37	3.48	4.46	28	33
20	4.67	3.73	-20	4.10	4.27	4	- 8
21	3.18	4.08	28	3.12	3.63	16	22
22	3.38	4.04	20	3.39	4.29	26	23
23	2.52	2.89	32	2.29	2.62	14	23
24	3.67	4.57	24	3.88	4.52	17	21
25	2.52	2.89	15	2.46	3.06	24	20
26	2.98	4.93	66	3.63	3.41	- 6	30
27	4.01	4.23	5	3.78	4.30	14	10
28	3.84	3.97	3	4.21	4.42	5	4
29	2.48	3.02	22	2.59	2.83	9	16
30	2.66	3.29	24	2.83	3.48	23	24
31	3.52	3.70	5	3.32	3.36	1	3
32	2.97	3.05	3	3.07	2.94	- 4	- 1
33	3.59	4.15	15	3.61	3.90	8	12
34	3.06	3.26	7	3.35	3.41	2	5
35	2.55	2.59	1	2.47	2.46	0	1
36	2.70	3.60	33	3.39	3.64	7	20
37	3.25	3.31	2	2.92	3.56	22	12
38	3.30	3.60	9	2.60	3.99	54	32
39	3.46	3.77	9	3.35	4.02	20	15
Mean	3.32	3.75	14.1	3.36	3.75	12.2	13.4
						S.D. Mn.	1.8
						C.R.	7.5

a percentage deviation from the resting value obtained in the period prior to the breathing of oxygen. Since similar results were obtained when computations were based on the period of breathing air after the administration of oxygen, it is clear that the results cannot be attributed to increased restlessness of the subjects during a prolonged experiment.

Results are shown in Table I. It may be seen that in all but 5 experiments in the total of 66 an increase in respiratory volume occurred with the inspiration of pure oxygen. The average increment was 13.4% for 66 experiments with 33 subjects. Statistical tests indicate that this average increment would occur by chance only once in 1×10^{-6} trials.

The cause of this increase in respiration is speculative but the following possibilities are suggested: (1) because of the increased oxygen tension in the blood, less oxyhemoglobin is reduced in the tissues, thus releasing less base for CO_2 transport from the tissues. In this way the CO_2 tension of the respiratory center itself may be increased with a resulting increase in respiratory volume;[4] (2) the increase in oxygen tension of the blood reduces cerebral blood flow[5] which may result in a local increase in CO_2 in the respiratory center; (3) an increase in oxygen tension in the respiratory center may increase the sensitivity of the center to the normal stimulus so that respiratory volume is increased although no rise in [H+] or pCO_2 occurs.[6]

Summary. Breathing pure oxygen causes a significant rise in the average resting respiratory volume in normal males.

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Thermo-coagulation in Destruction of Tissue in Cerebral Cortex of Small Animals.

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In order to overcome certain mechanical difficulties inherent in the trephining method when applied particularly to the removal of tissue in the none too accessible auditory areas of the rat's cerebral hemispheres, the technic about to be described was devised.

[4] Gesell, R., *Am. J. Physiol.*, 1923, **66**, 5.

[5] Lennox, W. G., and Gibbs, E. L., *J. Clin. Invest.*, 1932, **11**, 1155.

[6] Eastman, W. J., *International Clinics*, Series 46, 1936, **11**, 275.