VITAL CAPACITY OF THE LUNGS OF CHILDREN *

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The vital capacity of the lungs is the volume of air which can be expelled after the deepest possible inhalation. We have been unable to find any recorded measurements of vital capacity in normal children, and this was one reason for making these determinations. West² has shown that vital capacity in adults varies with the surface area more closely than with any other standard tried. It was not our object to determine the truth of this relation in normal children, but it came out in our work. Peabody¹ has demonstrated the importance of the reduction in vital capacity as an index of the tendency to dyspnea in cardiac disease and has emphasized the importance of vital capacity determinations in diagnosis, prognosis and treatment of vital capacity. It is our primary object to confirm, with regard to children, Peabody's observations in adults, but naturally the vital capacity of normal children had first to be determined. We have made a number of measurements in children in the Heart Clinic of the Children's Hospital, and these we shall publish in a later communication.

METHOD USED

We used for all our determinations the Standard spirometer, made by the Narragansett Machine Co., Providence, R. I. With individual sterilized mouthpieces, each child was coached to take the fullest possible inspiration and then to put forth his best effort in making the maximum expiration. No determination was considered satisfactory unless two determinations came within a margin of 20 c.c. Vital capacity is, of course, the maximum expiration, but we felt that each determination should be checked; two measurements differing more than 20 c.c. from one another would be open to the criticism that the higher figure was

* Received for publication, Feb. 22, 1921.

1. Peabody, F. W., and Wentworth, J. A.: Clinical Studies of the Respiration. IV, Arch. Int. Medicine **20**:443 (Oct.) 1917.

2. West, H. F.: Clinical Studies of the Respiration. VI, Arch. Int. Med. **25**:231 (March) 1920.

due to two expirations instead of one expiration, or that the lower figure was due to a poor try. In a number of cases we have determinations in the same children at intervals of a week, repeated at seven or eight successive periods, and these results were practically constant. Proper coaching of the children and experience are of the greatest importance in securing reliable results. Children below seven years do not cooperate well.

SOURCES OF OUR MATERIAL

Boys between 8 and 15 years of age and girls between 7 and 13 years, inclusive, of the class of people who would attend an outpatient clinic, of various nationalities—Syrian, Irish, American, Italian and Jewish—were measured. These measurements were made in the outpatient departments of the Children's Hospital and of the Boston Floating Hospital, at a boys' club, at an orphan asylum, and at two settlement houses. Each child was examined physically to rule out any children with cardiac or pulmonary disease. Each child was weighed stripped, and measured as to height without shoes. The number of children accepted was 413 boys and girls. Of these, sixty-three were excluded on account of inability to cooperate on account of age. There remained 350 cases, 266 boys and eighty-four girls.

We used the revised tables of Wood³ for our standard for weights and for heights. The weights as given by Wood include indoor clothes, and since our children were all weighed stripped, it was necessary in determining those cases below normal weight for height, to deduct a certain percentage of the total weight to allow for this factor. In the tables published by Dr. J. L. Morse,⁴ 7 per cent. of the total weight for boys is allowed for indoor clothes, and 8 per cent. for girls. For convenience, we allowed 7.5 per cent. for both boys and girls. It is held by Emerson and Manny⁵ that the zone of health, as allowed for by Wood, that is, the difference between the obese and the malnourished, is too narrow. A more reasonable zone would allow the deduction of 7 per cent. from the average weight, to include children to this extent under weight for height. These could still be considered normal. For convenience we used the factor 7.5 per cent., making a total deduction of 15 per cent. to be made from the figures of Wood. It may be pointed out that 7.5 per cent. is too much to allow as a reduction from the figures of Wood because this would put the lower boundary of the zone of health below that of Emerson and Manny, even though Wood's curve follows very closely that of Boas and Burk, set forward six months by Emerson and Manny and used by them as

3. Wood, T. D.: Right Height and Weight for Boys and for Girls. Child Health Organization.

4. Morse, J. L.: Case Histories in Pediatrics.

5. Emerson, W. R. P., and Manny, F. A.: Weight and Height in Relation to Malnutrition. *Arch. Pediat.* **37**:468 (Aug.) 1920.

TABLE 1.—VITAL CAPACITY, WEIGHT AND SURFACE AREAS OF BOYS

Height, Inches	Age, Years	Weight, Pounds	Vital Capacity, C.c.	Surface Area, Sq. M.
69.8	15	132	2,220	1.75 DB
67	13	76*	1,300	1.218 †
66.9	13	79.6*	1,260	1.258
66.6	14	138.8	2,220	1.73 DB
65.1	15	115.2*	1,920	1.56 DB
65	15	129	2,200	1.65 DB
64.8	14	119.5	2,260	1.60 DB
64.4	14	110.2	2,100	1.51 DB
63.4	14	125.7	2,180	1.60 DB
63	15	93	1,600	1.40 DB
63	13	121	1,900	1.56 DB
63	13	88*	1,960	1.342
62.9	15	98.6	1,600	1.43 DB
62.7	15	101	1,800	1.44 DB
62.6	14	102.7	1,340	1.44 DB
62.6	12	97	1,680	1.42 DB
62.2	15	90	1,300	1.35 DB
62	15	91	1,400	1.36 DB
61	15	92	1,300	1.35 DB
61	14	102.8	1,800	1.38 DB
61	14	96	1,400	1.39 DB
61	13	103	1,680	1.43 DB
60.5	13	94	1,160	1.37 DB
60.5	13	100	1,120	1.42 DB
60.5	13	94	1,420	1.37 DB
60.5	11	95	720	1.38 DB
60.4	14	101.4	1,380	1.39 DB
60.2	13	100	1,600	1.39 DB
60	13	97	1,380	1.37 DB
60	15	89	1,400	1.32 DB
59.7	14	85.6*	1,400	1.320
59.7	13	87.5	1,160	1.338
59.6	14	108	1,340	1.43 DB
59.4	13	85	1,240	1.313
59.4	13	90	1,480	1.32 DB
59.4	14	86.1	1,560	1.323
59.4	15	88.7	1,600	1.31 DB
59.3	15	93.6*	2,240	1.33 DB
59.2	13	87.5	1,500	1.338
59.2	15	108.5*	1,500	1.43 DB
59	14	75	1,100	1.209
59	13	93	1,320	1.33 DB
59	13	73*	1,520	1.187
59	12	89	1,440	1.31 DB
58.9	14	88.1	1,660	1.345
58.8	15	85.3	900	1.316
58.6	13	87.3	1,500	1.336
58.5	14	88	1,560	1.342
58.5	13	84	1,600	1.302
58.5	13	79.7*	1,400	1.253
58.5	12	77.1*	1,220	1.232
58.4	14	90.1	1,360	1.28 DB
58.3	11	82.7	1,080	1.288
58.1	13	86.5	1,340	1.327
58.1	13	80.7	1,220	1.267
58.1	12	75.5*	1,280	1.213
58	13	79*	1,540	1.251
58	13	96.5	1,360	1.33 DB
58	13	82.9	1,560	1.290
58	13	88	1,580	1.342
58	13	71*	1,120	1.166
57.9	15	95.8*	1,260	1.21 DB
57.8	13	82.5	1,400	1.286
57.7	13	85.5	1,500	1.318
57.6	13	84.9	1,420	1.311
57.6	12	83	1,300	1.293
57.5	14	73.5*	1,020	1.192
57.5	13	78*	1,200	1.239
57.5	12	85.7	1,400	1.320
57.3	14	76.7*	1,360	1.225
57.3	12	70.8*	1,080	1.163
57.2	10	73.4*	1,220	1.192
57.1	13	67.2*	1,140	1.122
57.1	14	81.1	1,260	1.274
57	14	90	1,220	1.27 DB
57	13	95	1,440	1.30 DB
57	13	92	1,340	1.28 DB
57	13	83	1,320	1.293
56.9	14	79.1	1,100	1.254
56.8	13	74.5*	1,020	1.202
56.7	13	71.1*	1,100	1.168
56.5	15	79.5*	1,420	1.256
56.5	14	83.5*	800	1.297
56.5	13	81.2	1,100	1.274
56.5	13	73.8*	1,320	1.197
56.5	12	75*	1,100	1.209
56.5	12	69*	840	1.141
56.4	12	80.4	1,440	1.265
56.1	12	86.5	1,120	1.327

* Denotes those cases falling below 7.5 per cent. normal weight for height.

† All surface areas, except those marked DB, are from Benedict and Talbot. DB denotes Dubois and Dubois.

TABLE 1.—VITAL CAPACITY, WEIGHT AND SURFACE
AREAS OF BOYS—(Continued)

Height, Inches	Age, Years	Weight, Pounds	Vital Capacity, C.c.	Surface Area, Sq. M.
56.1	11	80.3	1,220	1,263
56	15	82.3	1,280	1,283
56	13	76	1,420	1,218
56	13	75.6	1,080	1,216
56	13	73*	1,200	1,187
56	12	75	1,400	1,209
56	12	73*	1,880	1,187
56	12	76	1,120	1,218
56	12	69*	600	1,141
56	11	71*	1,130	1,166
55.9	11	90	1,220	1,26 DB
55.8	12	80.3	1,100	1,263
55.8	12	66.9*	1,140	1,117
55.8	12	62.7*	1,200	1,070
55.7	13	73.7	1,300	1,195
55.6	12	77.3	1,300	1,232
55.5	13	75.5	1,200	1,213
55.5	11	85.7	1,580	1,320
55.5	10	67.2*	1,080	1,122
55.4	14	76.1	1,046	1,220
55.4	12	65.1*	1,200	1,100
55.4	11	71.5	1,100	1,171
55.4	11	70.2	1,200	1,156
55.3	11	67.5*	1,120	1,124
55.3	11	72	1,440	1,175
55.1	12	73.1	1,140	1,190
55.1	11	77.6	1,240	1,237
55.1	11	70	1,180	1,154
55.1	10	65.6*	1,360	1,105
55	12	69*	1,300	1,141
55	12	65*	1,360	1,098
55	12	66*	1,200	1,107
55	12	67.7*	840	1,126
55	12	74	1,280	1,197
55	12	72.5	1,020	1,180
55	11	74	1,060	1,197
55	11	63*	1,100	1,075
55	11	67.5*	1,120	1,124
55	11	73	1,250	1,187
55	11	70	1,400	1,154
55	10	70	1,140	1,154
54.9	13	76.5	1,200	1,223
54.8	11	68.6*	1,000	1,136
54.8	11	70.8	1,200	1,163
54.7	12	72.3	900	1,178
54.7	12	71.5	1,000	1,171
54.7	10	64.6*	820	1,093
54.7	10	67.5*	1,120	1,124
54.7	9	60.1	1,000	1,144
54.7	11	63.3*	1,240	1,078
54.6	13	68.2*	1,260	1,131
54.5	13	73.5	1,150	1,192
54.5	12	59.1*	1,020	1,032
54.4	12	66.5*	1,040	1,112
54.4	10	67.4	880	1,124
54.2	11	66.6	1,040	1,114
54	12	64*	1,100	1,086
54	12	68.3	1,100	1,131
54	12	72	1,300	1,175
54	12	69	1,120	1,141
54	12	64*	1,160	1,086
54	12	69	1,120	1,141
54	11	75	1,240	1,209
54	11	80	1,300	1,260
54	10	64*	1,080	1,086
54	13	69	1,000	1,141
54	9	68.7	700	1,136
53.8	13	66.7*	1,140	1,114
53.7	12	66*	1,140	1,107
53.7	11	64.4*	1,280	1,090
53.7	13	67*	1,200	1,119
53.6	13	60*	960	1,040
53.5	13	66*	840	1,107
53.5	14	70.3	1,200	1,156
53.5	12	66*	1,200	1,107
53.5	12	67.5	1,200	1,124
53.4	11	66.9	1,000	1,117
53.2	10	69.2	1,140	1,144
53	12	66	1,040	1,107
53	12	68	1,270	1,129
53	12	77	1,000	1,230
53	12	68.6	1,080	1,136
53	12	60*	1,120	1,040
53	11	63*	940	1,075
53	11	80	1,120	1,260
53	11	78	1,260	1,239
53	11	65	1,120	1,098
53	11	63.3*	1,060	1,078

* Denotes those cases falling below 7.5 per cent. normal weight for height.

† All surface areas, except those marked DB, are from Benedict and Talbot. DB denotes Dubois and Dubois.

TABLE 1.—VITAL CAPACITY, WEIGHT AND SURFACE
AREAS OF BOYS—(Continued)

Height, Inches	Age, Years	Weight, Pounds	Vital Capacity, C.c.	Surface Area, Sq. M.
53	11	68	1,140	1.129
53	10	63	1,000	1.075
52.8	10	70.5	1,260	1.159
52.7	10	68.3	1,100	1.131
52.7	12	58.1	1,160	1.019
52.6	13	68	1,200	1.129
52.6	11	67.9	1,200	1.129
52.5	10	60.5*	800	1.045
52.4	10	66	1,060	1.107
52.4	9	56.5*	1,200	0.988
52.2	13	59.2*	1,140	1.082
52.2	10	66.8	920	1.117
52.1	11	66.5	1,000	1.112
52.1	8	53	900	0.934
52	12	63	620	1.075
52	12	61*	840	1.062
52	12	58*	980	1.016
52	11	58*	1,020	1.016
52	11	59*	920	1.029
52	11	68	1,000	1.129
52	11	70.5	1,100	1.159
52	10	63	1,000	1.075
52	10	63.6	1,000	1.083
52	10	65	1,240	1.066
52	10	62	940	1.062
52	10	77	860	1.230
51.9	9	61	940	1.062
51.8	12	68.1	1,060	1.131
51.8	11	63.6	1,020	1.083
51.7	9	50.4*	1,100	0.903
51.6	9	54.3*	880	0.947
51.6	10	61	820	1.062
51.5	13	61.5*	1,100	1.067
51.4	12	55.6*	1,040	0.973
51.3	12	86	840	1.323
51.1	8	59.8	900	1.040
51	12	66	800	1.107
51	11	58*	1,020	1.016
51	11	51*	1,020	0.911
51	11	61	780	1.052
51	10	57.6*	960	1.014
51	10	56	980	0.978
51	10	60.5	1,100	1.045
51	10	61	660	1.052
51	9	65	1,100	1.098
50.7	11	56.8*	900	0.996
50.6	11	59.5	920	1.035
50.5	11	58*	1,000	1.016
50.5	9	52.2	980	0.924
50.5	9	60	1,000	1.040
50.4	9	58.2	940	1.019
50.3	11	57.4	1,020	1.011
50	12	58.1	750	1.019
50	12	65	1,000	1.066
50	11	72	920	1.175
50	10	62	720	1.062
50	10	57	800	1.003
50	10	59	900	1.029
50	9	55*	1,100	0.958
49.9	11	53.5*	860	0.939
49.8	9	61.8	900	1.062
49.7	11	56.4*	820	0.988
49.4	9	55.2	980	0.963
49.3	8	52.3	800	0.924
49	12	58*	820	1.016
49	11	48*	840	0.871
49	10	50.5*	860	0.903
49	10	58	800	1.016
49	9	54.6	820	0.952
49	8	51.9	820	0.921
48.7	10	49*	800	0.884
48.6	10	55.3	900	0.963
48.5	9	49*	620	0.884
48.5	10	61	1,100	1.062
48.5	10	60.8	720	1.050
48.4	9	57	800	1.003
48.3	8	48.3	600	0.873
48.2	9	52.2*	820	0.924
48.1	10	51.1	680	0.913
48	10	47*	720	0.860
47.6	8	45.3*	800	0.839
47.5	8	53*	760	0.934
47.2	8	46.6*	540	0.855
47	10	48.5*	800	0.876
46.7	8	48	640	0.871
46.7	8	46.1*	820	0.850
46.7	8	52.1	620	0.924
46.2	9	50.7	820	0.906
46.1	8	49	720	0.884

* Denotes those cases falling below 7.5 per cent. normal weight for height.

† All surface areas, except those marked DB, are from Benedict and Talbot. DB denotes Dubois and Dubois.

TABLE 2.—WEIGHT, VITAL CAPACITY AND SURFACE AREA OF GIRLS

Height, Inches	Age, Years	Weight, Pounds	Vital Capacity, C.c.	Surface Area, Sq. M.
59.5	13	97.3*	1,380	1.37 DB
59.3	12	99	1,300	1.37 DB
59	13	83*	1,280	1.248†
59	12	74.8*	960	1.158
58.8	12	92	1,320	1.32 DB
58.8	11	83	1,300	1.248
58.3	12	90.3	1,320	1.29 DB
58	13	88	1,220	1.295
58	13	100.5	1,060	1.37 DB
57.8	12	82	1,360	1.237
57.8	10	80.5	1,160	1.221
57.5	12	86	1,040	1.277
57	13	79.5	1,240	1.212
57	13	79	1,100	1.207
57	13	93	1,100	1.3 DB
57	11	81.5	1,240	1.233
57	7	46.5*	840	0.845
56.5	12	75*	1,280	1.166
56.5	11	76	1,180	1.176
56.3	9	76.5	960	1.178
56	11	73.6	960	1.153
56	10	48.3*	1,000	0.966
55	12	71	980	1.125
55	12	68*	920	1.080
55	10	62*	920	1.026
55	9	68.5	1,080	1.095
54.8	10	85	1,120	1.268
54	13	69.5	1,200	1.107
53.5	12	67.5	1,000	1.085
53.5	12	61*	1,000	1.016
53.5	11	66	780	1.069
53.3	10	61.5	1,060	1.021
53	9	61.5	960	1.021
53	12	66.8	740	1.078
52.5	7	59.5*	900	0.999
52.5	12	60.3*	1,120	1.006
52	13	70*	920	1.114
52	12	70.5	840	1.119
52	11	67.5	1,040	1.085
51.8	10	63	860	1.038
51	9	70	920	1.114
51	9	54*	800	0.936
50.5	12	56*	940	0.969
50	11	57	840	0.971
50	11	62	920	1.026
50	11	50*	740	0.890
50	10	60.5	720	1.009
50	10	58.5	740	0.986
50	10	57.5	860	0.976
50	9	51*	840	0.903
49.5	10	53*	560	0.926
49.1	9	50*	720	0.890
49	11	83.3	1,180	1.25
49	10	50*	700	0.890
49	10	57	840	0.971
49	9	55.5	760	0.954
49	8	47.5*	540	0.858
48.5	7	46.3	660	0.840
48.3	10	52.3	700	0.916
48.3	9	48.5*	940	0.869
48	10	58.3	720	0.984
48	10	48*	740	0.863
48	8	47.6*	540	0.861
48	7	46	480	0.835
48	7	56.3	660	0.961
47.8	8	50	500	0.890
47.5	10	55.3	640	0.951
47.5	7	43.5	820	0.787
47	9	53	420	0.926
47	9	50	540	0.890
46.5	7	45.3	760	0.820
46	8	50.5	960	0.895
46	8	51	760	0.903
46	7	47	740	0.858
46	7	48	640	0.803
45.8	8	48	760	0.863
45	8	52	720	0.913
44.8	8	47.5	700	0.858
44.5	8	52	600	0.913
44	7	43	680	0.782
44	7	43	500	0.782
43.5	7	46.3	540	0.840
43.3	7	46.3	660	0.840
43	7	42.5	680	0.774

* Denotes those cases falling below 7.5 per cent. normal weight for height.

† All surface areas, except those marked DB, are from Benedict and Talbot. DB denotes Dubois and Dubois.

their basis. As it happened, the vital capacity of normal children and of children below normal weight for height differed very little. Those cases falling below 7.5 per cent. weight for height are marked with an asterisk.

TABLE 3.—VITAL CAPACITY OF LUNGS FOR BOYS

Group	Number Studied	Height, Inches	Average Vital Capacity, C.c.	Surface Area, Square Meters	Number Within 20% of Normal Vital Capacity	Number Falling Below 80% Average Vital Capacity	Highest Vital Capacity	Lowest Vital Capacity
I	8 4*	63-69.8	2,080 1,610	1,600 1,344	7 4	1 0	2,220 1,960	1,600 1,260
Total Average	12 ...		1,845	1,514				
II	50 16*	57-63	1,390 1,343	1,338 1,233	46 15	4 1	1,800 2,240	720 1,020
Total Average	66 ...		1,366	1,313				
III	87 57*	51-57	1,100 1,091	1,157 1,093	79 49	8 8	1,580 1,420	620 600
Total Average	144 ...		1,095	1,132				
IV	27 17*	46-51	840 814	0.988 0.917	24 15	3 2	1,100 1,100	600 540
Total Average	44 ...		827	0.961				

* Denotes those cases falling below 7.5 per cent. normal weight for height.

TABLE 4.—VITAL CAPACITY OF LUNGS FOR GIRLS

Group	Number Studied	Height, Inches	Average Vital Capacity, C.c.	Surface Area, Square Meters	Number Within 20% of Normal Vital Capacity	Number Falling Below 80% Average Vital Capacity	Highest Vital Capacity	Lowest Vital Capacity
I	26 8*	50.5-53	1,120 1,025	1,204 1,052	24 8	2 0	1,380 1,280	740 840
Total Average	34 ...		1,072	1,168				
II	22 14*	53-47	759 786	0.976 0.900	18 11	4 3	1,180 1,120	420 540
Total Average	36 ...		773	0.938				
III	14	47-43	693	0.849	12	2	960	500

* Denotes those cases falling below 7.5 per cent. normal weight for height.

The tables used for surface area are the work of Benedict and Talbot⁶ who kindly allowed us to use these tables before publication.⁷ For the heavier children we used the chart of Dubois and Dubois.⁸

6. Talbot, F., and Benedict, F. G.: The Metabolism and Growth from Birth to Puberty, Carnegie Institution, Washington; Publication 302.

7. These figures are available now in Carnegie Publication No. 302.

8. Dubois, D., and Dubois, E. F.: Arch. Int. Med. **17**:863 (June) 1916.

Our readings of the vital capacity for boys and girls are shown in Tables 1 and 2. These readings were divided into four groups for boys and three groups for girls (Tables 3 and 4). The difference in the height between the shortest and tallest children in the case of boys was 23.8 inches and of the girls 16.5 inches. Accordingly, we allowed six inches roughly for each group. It will be noticed that the first group for boys is a little over six inches and the last group for boys is a little under six inches. The third group of girls is from 43 to 47.1 inches, a division made necessary by the small number of girls of the shortest height.

In each group the average vital capacity is given first for children of normal height and weight. Below this figure the vital capacity is given for those falling below 7.5 per cent. of the average weight for height.

The next column is the average surface area for each group. The figures for surface area are given in square meters and those for vital capacity in cubic centimeters. In order to compare the two, the vital capacity can be read in litres.

TABLE 5.—SUMMARY AND RATIO OF VITAL CAPACITY TO SURFACE AREA

	Average Vital Capacity, Liters (A)	Surface Area, Square Meters (B)	Ratio: Vital Capacity to Surface Area (A ÷ B)
Boys:			
Group I.....	1.8	1.5	1.2
Group II.....	1.4	1.3	1.1
Group III.....	1.1	1.1	1.0
Group IV.....	0.8	1.0	0.8
Girls:			
Group I.....	1.1	1.2	0.9
Group II.....	0.8	0.9	0.7
Group III.....	0.7	0.9	0.6

For the second group of boys, which contained next to the largest number, the vital capacity in liters would be 1.4, and the surface area 1.3 square meters. For the third group, which contained the largest number of boys, the vital capacity in liters was 1.1, and the surface area 1.1 square meters. These two groups show very markedly the close relationship between vital capacity and surface area. Even in the first group with comparatively few determinations the vital capacity was 1.8 liters and the surface area 1.5 square meters.

The next column in the tables gives the number of cases in which the vital capacity fell below 20 per cent. of the average for this group: a variation of 10 per cent. in adults is considered normal. Children, as a rule, are more difficult to handle and are usually harder to make cooperate, so that they vary more from the average than adults. A variation of 20 per cent. includes most of the cases.

The next column in the tables gives the number of cases in which vital capacity fell below 20 per cent. of the average for this group.

The next column gives the number below 80 per cent. of the average; not 80 per cent. below, but below 80 per cent. of the average.

In pathologic conditions there is a fall in vital capacity. From our determinations the fall should amount to more than 20 per cent. of the average to be considered significant.

The highest and lowest vital capacity is given for each group. This shows a wide variation of about 20 per cent. from the average.

A.—When vital capacity and surface area are identical theoretically.
B.—Experimental Curve.

Group 1 of the girls gave an average vital capacity of 1.1 liters and a surface area of 1.2 square meters. Group II of the girls gave an average vital capacity of 0.8 liters and a surface area of 0.9 square meters.

In Table 5 we have summarized the vital capacity in liters, the surface area in square meters, and the ratio of vital capacity to surface

area for each group—first of boys, then of girls. Group I of our girls, our best group of girls, showed a vital capacity of 1 liter to 0.9 of a square meter of surface area; and our best group of boys, Group III, showed a vital capacity of 1 liter to 1 square meter of surface area.

Although the normal children and those falling below 7.5 per cent. of normal were considered separately, the vital capacity showed very little variation; in fact, they corresponded very closely, except in the first group of boys, which was a very small one.

On a graph, a line was drawn arbitrarily to make the vital capacity and surface area correspond exactly. We then plotted our actual figures and found that they came very close to this arbitrary line.

CONCLUSIONS

1. A very close relationship was found between vital capacity and surface area in children.
2. There is practically no difference between children considered in the tables for normal weight for height and those falling 7.5 per cent. below the normal.
3. The determinations of vital capacity for girls were on the whole much lower than those for boys, but the same relation held between vital capacity and surface area.
4. Determinations of vital capacity below seven years of age are unreliable.