

## A Different Methodologic Approach to "Ideal Weight": A Study of the Ponderal Index (PI)

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**Abstract** — It is clear from the literature that practically all of the evidence for "desirable" weight has been derived from mortality and morbidity studies. As far as we can determine this is the only attempt to establish "ideal" weight in terms of health rather than some measure of disease. There are two notable findings. First, "ideal" weight as judged by the ponderal index probably exists in a narrow range. Second, "ideal" weight as judged by this height: weight ratio is different in the sexes.

### Introduction

There is no question that weight, (expressed as an absolute measure or as an index) is a sensitive barometer of health and sickness. Apropos, several points are worthy of mention. Firstly, weight problems are exceedingly common. For example, it is generally accepted that approximately twenty percent of Americans are at least twenty percent above so-called desired weight for height according to the 1983 Metropolitan Life Tables. These individuals are recognized as being classically obese. Clearly, these numbers do not include the uncounted incidence and prevalence of marginal overweight. Secondly, most of the published information regarding "desirable" weight is derived either from *mortality* studies or specific *morbidity* analyses. Third and lastly, strikingly little information is available regarding "optimal" weight (1-5).

This report is unique in that it attempts to

analyze weight in terms of *health* rather than some measure of *disease*.

### Method of Investigation

It is fair to assume that, all other factors being equal, persons without clinical symptoms and signs are probably healthier than subjects who are symptomatic. Based on this hypothesis, 621 presumably healthy doctors and their spouses completed the Cornell Medical Index Health Questionnaire (CMI) (6). The total number of affirmative responses may be used as a measure of clinical state. Additionally, all of these subjects were graded for height and weight and their height/weight relationships. For purposes of this report, we shall be utilizing the ponderal index which is derived from the height (in inches) divided by the cubed root of the weight (in pounds). To simplify the calculations, a nomogram is now available (7). Simply put, the

**Table 1** An analysis of the Ponderal Index in a Progressively Healthier Sample of the Population. The Groups Represent Decreasing Scores on the CMI Health Questionnaire

line	groups	sample size	clinical findings range	mean	range	ponderal index mean & S.D.
1	entire sample	621	0-125	18.0	10.3-14.2	12.68 ± 0.50
2	<50	604	0- 49	16.7	10.3-14.2	12.69 ± 0.50
3	<40	576	0- 39	15.4	11.1-14.2	12.69 ± 0.49
4	<30	516	0- 29	13.3	11.1-14.2	12.70 ± 0.48
5	<20	399	0- 19	10.2	11.1-14.2	12.71 ± 0.49
6	<10	193	0- 9	6.0	11.1-14.2	12.77 ± 0.48
7	< 5	49	0- 4	2.9	12.1-13.3	12.87 ± 0.43
8	< 4	30	0- 3	2.1	12.0-13.8	12.89 ± 0.44
9	< 3	17	0- 2	1.5	12.1-13.7	12.97 ± 0.44
10	< 2	6	0- 1	0.5	12.6-13.6	13.05 ± 0.35
11	< 1	3	0	0.0	12.6-13.1	12.88 ± 0.18

lower the ponderal index (PI), the heavier is the subject; the higher the PI, the lighter.

### Results

Table 1 summarizes the findings with regard to the ponderal index. Included are the sample sizes, the ranges of affirmative scores utilizing the Cornell Medical Index Health Questionnaire along with the means for the CMI responses. Finally, shown also in Table 1 are the ranges for the indices and their means and standard deviations. For example, for the entire sample of 621 subjects, one finds a spread of CMI responses from 0 to 125 with a mean of 18.0. The PI ranges from 10.3 to 14.2 with a mean and standard deviation of  $12.68 \pm 0.50$  (line 1).

Line 2 represents a similar analysis for those subjects with <50 symptoms and signs. Hence, one finds now in this presumably healthier group only 604 subjects with a spread of CMI responses from 0 to 49 and a mean of 16.7. The PI range is still from 10.3 to 14.2 with a mean and standard deviation of  $12.69 \pm 0.50$ . In other words, there are no differences in the PI for the entire group (line 1) versus a more selected group (line 2) showing <50 clinical symptoms and signs.

As one proceeds downward from line 2 to line 11, the calculations are derived from a progressively healthier group as judged by the fact that they report systematically fewer clinical symptoms and signs.

Several points warrant particular mention. It will be noted that, as one proceeds from line 1 through line 11, the lowest PI scores (representing the heaviest individuals) seem to progressively fall out. In other words, as one builds in an

orderly fashion a healthier sample, the very heavy subjects with PIs such as 10.3 and 11.1 and so on seem to vanish. Additionally, precisely the same pattern prevails at the upper limit (the especially thin subjects). As one creates a so-called healthier group, the very high PI scores (suggesting those who are on the slight side), seem also to be eliminated.

Finally, it becomes evident from these calculations that the mean ponderal index moves in a most orderly and progressive fashion (slightly toward thinness) as one proceeds from line 1 to line 11. The only exception is line 11 and this may well be because of the small sample size of three persons. As or more importantly, the spread of values shrinks in an orderly fashion from 0.50 in line 1 to 0.18 in line 11.

### Discussion

Thus far, the evidence suggests that, as one builds as it were a progressively symptomless and signfree subject, the weight (as expressed by the ponderal index) shrinks to a relatively narrow range.

There is one other point which needs consideration, namely, the problem of sex. Clearly, it is well-established that men are generally taller and heavier than women. Accordingly, this raises the question as to whether the ponderal index corrects for this obvious clinical discrepancy or whether the "ideal" ponderal index should be significantly different for the sexes.

Table 2 summarizes the ponderal index in a progressively healthier male sample. Shown, for example, in line 1 are the data for the 351 male participants demonstrating the mean clinical

**Table 2** An Analysis of the Ponderal Index in a Progressively Healthier Male Sample

line	groups	sample size	clinical findings		ponderal index	
			range	mean	range	mean & S.D.
1	entire sample	351	0-82	15.3	11.1-14.2	12.63 ± 0.44
2	<50	347	0-45	14.7	11.1-14.2	12.63 ± 0.44
3	<40	335	0-38	13.7	11.1-14.2	12.63 ± 0.44
4	<30	312	0-29	12.2	11.1-14.2	12.64 ± 0.45
5	<20	254	0-19	9.7	11.1-14.2	12.64 ± 0.45
6	<10	133	0-9	6.0	11.1-14.2	12.70 ± 0.44
7	<5	32	0-4	3.0	12.1-13.3	12.71 ± 0.36
8	<4	18	0-3	2.2	12.1-13.2	12.65 ± 0.37
9	<3	10	0-2	1.5	12.1-13.2	12.71 ± 0.36
10	<2	3	0-1	0.3	12.6-13.0	12.77 ± 0.19
11	0	2	0	0.0	12.6-13.0	12.84 ± 0.21

score of 15.3. Shown also in this table is the range of ponderal index from 11.1 to 14.2 with a mean and standard deviation of 12.63 ± 0.44. Clearly demonstrated are the observations previously reported for the entire sample, namely, as one proceeds from line 1 to line 11, the very low and the very high ponderal index scores are eliminated. Also, the pattern shows an orderly and systematic increase in the ponderal index from 12.63 (line 1) to 12.84 (line 11). Parenthetic mention should be made that there is one exception (line 8). Also, noted in Table 2 is the more or less progressive decline in the standard deviation with one exception (line 7).

A similar analysis for the female groups (Table 3) shows essentially the findings already described for the male group.

Finally, to answer the question regarding the uniqueness of the ponderal index in terms of sex,

the data have been summarized (Table 4). It is abundantly evident that, in every instance except the very last (line 10), there is a statistically significant difference of the means (8) for the ponderal index based on sex. The only exception is line 10 and this is likely due to sample size.

**Summary and Conclusions**

The clinical problems of weight seem to be of pandemic proportions. Relatively little has been accomplished with regard to "ideal" weight. What there is in the literature deals with weight in terms of mortality and morbidity. Practically nothing has been reported with regard to weight in the so-called healthy subject. By the methodologic approach outlined in this experiment of presumably healthy doctors and their spouses, there is some suggested evidence that "ideal" weight may be within a relatively narrow range

**Table 3** An Analysis of the Ponderal Index in a Progressively Healthier Female Sample

line	groups	sample size	clinical findings		ponderal index	
			range	mean	range	mean & S.D.
1	entire sample	270	0-125	21.4	10.3-14.0	12.75 ± 0.56
2	<50	257	0-49	19.3	10.3-14.0	12.76 ± 0.55
3	<40	241	0-39	17.8	11.3-14.0	12.78 ± 0.54
4	<30	204	0-29	15.0	11.3-14.0	12.80 ± 0.52
5	<20	145	0-19	11.2	11.3-14.0	12.82 ± 0.52
6	<10	60	0-9	6.0	11.6-13.9	12.92 ± 0.52
7	<5	17	0-4	2.7	12.0-13.8	13.16 ± 0.42
8	<4	12	0-3	2.1	12.7-13.7	13.24 ± 0.28
9	<3	7	0-2	1.4	13.0-13.7	13.34 ± 0.24
10	<2	3	0-1	0.7	13.0-13.6	13.32 ± 0.26
11	0	1	0	0.0	13.0-13.0	13.00 ± 0.00

**Table 4** A Statistical Analysis of the Ponderal Index in the Male and Female Groups

line	groups	sample size	male P.I. mean & S.D.	sample size	female P.I. mean & S.D.	t
1	entire sample	351	12.63 ± 0.44	270	12.75 ± 0.56	2.907**
2	<50	347	12.63 ± 0.44	257	12.76 ± 0.56	3.102**
3	<40	335	12.63 ± 0.44	241	12.78 ± 0.54	3.556**
4	<30	312	12.64 ± 0.45	204	12.80 ± 0.52	3.608**
5	<20	254	12.64 ± 0.46	145	12.82 ± 0.52	3.463**
6	<10	133	12.70 ± 0.45	60	12.92 ± 0.52	2.833**
7	< 5	32	12.71 ± 0.36	17	13.16 ± 0.42	3.735**
8	< 4	18	12.65 ± 0.37	12	13.24 ± 0.28	4.929**
9	< 3	10	12.71 ± 0.37	7	13.34 ± 0.24	4.271**
10	< 2	3	12.77 ± 0.19	3	13.32 ± 0.26	2.918
11	0	2	12.84 ± 0.21	1	—	—

statistically significant difference between males and females \*\*p 0.01

and that it may well be different in the two sexes.

Historically, the ponderal index was the first attempt to characterize weight by means of a single number relationship. Its strengths and weaknesses have been discussed in the literature. The most current ratio is body mass index (BMI). A report to follow (9) will look at the problem discussed in this experiment in terms of this different ratio.

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