Obesity and Hypertension Among Young Adults

By NÁNDOR SZENT-GYÖRGYI, M.D.*

THE present paper deals with the results of investigations regarding the incidence of obesity and hypertension and their possible correlations among 3,508 University of Chicago students (registered in 1954). The relation of hypertension to race, climate, age, and environment among students was analyzed in a previous study.[1]

SCOPE AND MATERIAL

All cases of obesity which were considered endogenous, i.e., all cases of hormonal dysfunction (dystrophia adiposogenitalis, etc.), were excluded from the study and so were all cases of secondary (non-essential) hypertension. No one with any evidence of heart disease, kidney ailment, or hormonal dysfunction (diabetes, hyperthyroidism, etc.) was included.

The blood pressure, body weight, and height were determined at the time of the entrance examination. The student was usually recalled for re-examination of the blood pressure when it was found to be elevated at the first examination. The height (in centimeters) and weight (in kilograms) were determined without shoes and (in men) without coats. The blood pressure was considered elevated if it was 140/90 mm of mercury or above. This limit was chosen because it is the most generally accepted.[1] The reasons for the selection of this criterion have been presented elsewhere.[1]

To determine the "normal" weight, Broca's formula was used, i.e., normal weight in kilograms equals the number of centimeters of the height above 100. This formula, introduced into clinical investigation by Moritz in 1908, seems to be the simplest and most useful method. According to Glatzel[2] the values yielded by this method are useful in the age group above 35 to 40, but for younger people the values are somewhat too high.

TABLE I

Association between Obesity and Hypertension

	Hypertensive	Normotensive	Total
Obese	111	868	979
Non-obese	125	2,404	2,529
Total	236	3,272	3,508

In spite of the fact that people of different types of body build (asthenic, sthenic, or hypersthenic) have a different "normal" weight, it appears to be a safe assumption that any one with a weight in excess of that given by Broca's formula is "overweight." It is particularly true in our cases since the subjects for this study consisted of an overwhelming majority of young adults, the great majority of whom were under 30 years of age. On account of this age distribution the criteria for obesity can be made more strict than would have been possible in a survey of the general population including all age groups or the older age groups.

The criteria of obesity used in this study certainly will not include any one with a normal or subnormal weight, but may exclude a few individuals who may be considered slightly overweight by other methods, although the correspondence by this method with standard tables is quite good. For example, by Broca's method a man 6 feet (183 cm) tall is considered to have a normal weight of below 183 lb (83 kg without coat and shoes), whereas according to the commonly used Metropolitan

* Assistant Professor School of Medicine, The University of Chicago.

From the Department of Medicine and Student Health Service, School of Medicine, The University of Chicago.

Life Insurance Company "ideal weight" table[3] a man six feet tall should weigh from 152 to 185 lb (69 to 84 kg), "as ordinarily dressed with shoes." It should also be noted that although the term "obesity" is used here, the data do not exclude subjects who may be "overweight" because of an exceptionally developed muscle mass.

RESULTS

Data on obesity and hypertension among the students examined are presented in Table I. According to the criteria mentioned there were 236 hypertensive and 979 obese subjects in a total population of 3,508 students. These groups comprise 6.7 and 27.9 per cent, respectively, of the entire student sample. Among these 236 hypertensives, one hundred and eleven or 47 per cent are obese. Among the 3,272 normotensives eight hundred and sixty-eight or 26.5 per cent are obese. The incidence of obesity differs markedly between the hypertensive and normotensive groups.

Analyzing the data according to sex and birthplace (geographic origin) it appears (Table II) that 29 per cent of the young male population and 23.9 per cent of the female population is obese. There was no significant difference in the incidence of obesity among the American and among the foreign-born students.

From Table II it is quite clear, however that there is a significant difference regarding hypertension between American and foreign born. This is more striking if one analyzes the number of hypertensive subjects among non-obese students; 6.3 per cent of the American males and 2.7 per cent of the foreign-born males, 1.5 per cent of the American females and 3.7 per cent of the foreign-born females being hypertensive. No other significant difference was encountered between American and foreign-born students according to Table II.

The incidence of hypertension among non-obese American males is four times higher than among the American female students. The same is true, to a somewhat lesser degree, of the total population; however, there is no significant difference in incidence between the sexes among the foreign born.

Highly significant in the total population examined is the difference in the incidence of obesity among *normotensive* and *hypertensive* students, the ratio being 26.5 per cent to 47 per cent, respectively. Still bigger is the difference if one analyzes the occurrence of hypertension among the non-obese and obese population. Only 4.9 per cent of the non-obese students are hypertensive, but the percentage of hypertension more than doubles to 11.3 per cent among the obese.

TABLE II

Association between Obesity and Hypertension among American and Foreign-Born Males and Females

	No. of students examined	Obese in the total population		Obese among the non-hypertensive (normotensive)		Obese among the hypertensive		Hypertensive in total population		Hypertensive among non-obese		Hypertensive among obese	
	No.	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
American													
Male	2,366	691	29.2	605	27.8	86	44.5	193	8.1	107	6.3	86	12.4
Female	690	168	24.3	154	22.7	14	63.6	22	3.1	8	1.5	14	8.3
Total	3,056	859	28.1	759	26.7	100	46.5	215	7.0	115	5.2	100	11.6
Foreign born													
Male	349	98	28.0	88	26.5	10	58.8	17	4.9	7	2.7	10	10.2
Female	103	22	21.1	21	21.2	1	25.0	4	3.8	3	3.7	1	4.5
Total	452	120	26.5	109	25.2	11	52.3	21	4.6	10	3.0	11	9.1
All male	2,715	789	29.0	693	27.6	96	45.7	210	7.7	114	5.9	96	12.1
All female	793	190	23.9	175	22.8	15	57.6	26	3.2	11	1.8	15	7.8
Total	3,508	979	27.9	868*	26.5	111*	47.0	236	6.7	125*	4.9	111*	11.3

* The difference is highly significant ($P < 0.01$).

In this study, the incidence of obesity in the male population is higher than among females. It seems that younger women in a college student group are more apt to keep their weight down than do young men.

There are almost twice as many hypertensive American males (12.4 per cent) among the obese as among the non-obese (6.3 per cent). The incidence of hypertension among the young American obese males is higher by one third than among females.

The distribution of obesity according to age groups is approximately the same among the normotensive and hypertensive students. No significant difference was found on comparing the different age groups in respect to obesity and hypertension. While there is a slow increase in the rate of hypertension among the obese with increasing age, the difference is not very significant. In the age group over 40, 22.5 per cent of the obese are hypertensive; however, the small number of persons (forty) included in this age group does not permit the drawing of definite statistical conclusions. It was not possible to establish a definite tendency to develop hypertension with increasing age among the younger obese subjects.

Obesity seems to increase among the foreign born with increasing number of years spent in the United States. According to Table III 25.4 per cent of 208 foreign-born students who have spent less than one year in the United States were obese. One hundred and fifty foreign born have spent one to ten years in the United States; 26.6 per cent of them were obese. Finally, 28.7 per cent of the 94 foreign born who have resided longer than ten years in the United States were obese or "overweight."

TABLE III

Obesity among Foreign Born According to the Years Spent in America

	Total	Less than 1 yr		1–10 yr		More than 10 yr	
		No.	%	No.	%	No.	%
All foreign born	452	208	46	150	33.2	94	20.7
Obese foreign born	120	53	44.1	40	33.3	27	22.5
Percentage of obesity in year groups		25.4%		26.6%		28.7%	

TABLE IV

Incidence of Hypertension and Obesity According to Race and Sex

American born	No. of students	Obese		Hypertensive		Foreign born	No. of students	Obese		Hypertensive	
		No.	%	No.	%			No.	%	No.	%
White						European					
Male	2,297	668	29.0	184	8.0	Male	186	68	36.5	13	6.9
Female	652	160	23.1	21	3.2	Female	60	14	23.3	4	6.6
						White					
Negro						Non-European					
Male	51	18	35.1	8	15.6	Male	62	14	22.5	2	3.2
Female	31	7	22.5	1	3.2	Female	17	5	29.4	0	0
Oriental						Asiatic					
Male	16	3	17.7	1	6.2	Male	92	14	15.2	1	1
Female	6	1	16.6	0	0	Female	23	2	8.6	0	0
American Indian						African					
Male	2	2	100.0	0	0	Male	7	1	14.2	1	14.2
Female	1	0	0	0	0	Female	1	1	100.0	0	0
						South American Negro					
						Male	2	1	50.0	0	0
						Female	2	0	0	0	0

The incidence of obesity and hypertension according to race and sex among the American and foreign-born students is presented in Table IV.

It would be important to learn the incidence and the relation between obesity and hypertension in different racial groups who are living in the same environment. Unfortunately the figures presented in Table IV are not large enough to permit definite conclusions regarding this question.

TABLE V

Diastolic Pressure Values among Subjects with Systolic Pressures above 140 mm

Diastolic pressures	Below 80 mm		80–89 mm		90–99 mm		100 or more mm		
	Obese	Non-obese	Obese	Non-obese	Obese	Non-obese	Obese	Non-obese	Total
American									
Male	20	39	33	35	21	28	12	5	193
Female	1	0	5	5	6	2	3	0	22
Foreign born									
Male	1	4	5	3	2	0	1	1	17
Female	0	0	0	2	1	1	0	0	4
Total									
Male	21	43	38	38	23	28	13	6	210
Female	1	0	5	7	7	3	3	0	26
Total	22	43	43	45	30	31	16	6	236

Although the criterion of hypertension was set at 140 mm systolic pressure (see above) it is of interest to examine the distribution of diastolic pressures among obese and non-obese subjects. These data are presented in Table V. In addition it should be pointed out that there were 25 obese subjects with a diastolic pressure above 90 mm, but with a systolic pressure below 140 mm. In this study they were included as normotensives. This group consisted of 20 American males and 3 females plus 2 foreign-born males. Table VI presents additional observations on the distribution of hypertensives (divided now on the basis of diastolic pressure) among the obese.

TABLE VI

Subjects with Systolic Pressures *above* 140 mm

	Diastolic pressure below 90 mm	Diastolic pressure above 90 mm	Total
Obese	65 (58.6%)	46 (41.4%)	111
Non-obese	88 (70.4%)	37 (29.6%)	125
Total	153 (64.9%)	83 (35.1%)	236

DISCUSSION

The importance of obesity and hypertension, their influence on degenerative diseases, and effect on longevity have been emphasized by many authors. The remark of Rynearson and Gastineau[4] is quite correct: "it is easy to shrug off 'a few pounds overweight' as something of little consequence, but in so doing, the physician is ignoring what is perhaps his best chance to lengthen the life and diminish the future illness of his patient." According to Master and Jaffe[5] the death rate in obese men runs as much as 60 per cent above normal.

Levy, and associates[6] found that "transient hypertension, transient tachycardia or overweight, each by itself, increases the probability of the later development of sustained hypertension and of cardiovascular-renal disease. The presence of two of these conditions is of greater importance, in this respect, than any one alone."

According to Master *et al.*[7] "among the (hypertensive) men overweight was decidedly more frequent than it was among the general population, the ratio being 32.2 per cent to 14.8 per cent." They did not find "significant differences in the frequency of obesity among the hypertensive women and the control group." In this present study the corresponding percentages were even higher and the difference was highly significant both in the male and female population.

Moschowitz[8] found that "even in individuals within the range of normal weight, the blood pressure is in general proportionate to weight."

Davies (quoted by Schroeder[9]) found that hypertension is almost twice as frequently associated with obesity among men and women in a hospital population as would be expected by the incidence of each one alone. It is significant that in this study which deals *not* with a hospital population, but with healthy and young people, the findings bear out this statement—the corresponding figures being 26.5 per cent obese among the normotensives and 47 per cent among the hypertensives; 4.9 per cent hypertensives among the non-obese, but 11.3 per cent among the obese.

Short and Johnson[10] examined 2,858 healthy individuals and found that overweight exerts a positive influence in causing increased incidence of hypertension, but in their study the incidence of hypertension in the overweight group was generally lower than reported by other observers.

The importance of obesity is again emphasized by the fact that more than 20 per cent of the population of the United States is overweight according to recent government reports.[11]

SUMMARY

Using 140 mm Hg systolic blood pressure limit as a criterion for hypertension, and the Broca formula as the criterion for obesity in a young adult population (3,508 college students) it was found that the difference in the incidence of obesity between the normotensive and hypertensive students was statistically highly significant (26.5 per cent of the normotensives and 47 per cent of the hypertensives were obese).

The incidence of hypertension was 8.1 per cent among the American and 4.9 per cent among the foreign-born *males*. It was found that 979 or 27.9 per cent of the students (29 per cent of the males and 23.9 per cent of the females) were overweight. The incidence of hypertension was 4.9 per cent and 11.3 per cent, respectively, among the non-obese and the obese students. The difference is highly significant, there being more than twice as many hypertensives among the obese as among the non-obese. Of the obese 12.4 per cent and of the non-obese 6.3 per cent of the American males were hypertensive.

No significant difference was found in the different age groups in respect to hypertension and obesity. No increase in the incidence of hypertensive obesity was found with increasing age below the age of forty. The incidence of obesity gradually increased among foreign-born students with increasing number of years of American residency.

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