

## PREVALENCE OF OVERWEIGHT AND OBESITY AMONG ADULT SUBJECTS OF AN URBAN AFRICAN POPULATION SAMPLE

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In a strict sense obesity can be defined as an excess of body fat relative to the amount of non-adipose tissue in the individual. In clinical practice it is not infrequently equated with overweight. Moderate depositions of fat can occur in the individual who is not overweight and muscular hypertrophy may cause an appreciable increase in weight with only a minimum accumulation of adipose tissue in the body (Welham and Behnke, 1942).

When fat collections are gross, reliance can be placed on a diagnosis derived from a direct clinical appraisal of the subject. The distinction between overweight and obesity is not often so easy, and different criteria have been used by many authors in obtaining cut-off points on weights and weight-for-height charts at which overweight in the individual subject becomes obesity (Moore, Stunkard, and Srole, 1962; Strang, 1964; Davidson, 1966; Silverstone, Gordon, and Stunkard, 1969).

Although various research techniques have been described for the measurement of the amount of adipose tissue in the body (see Brožek and Keys, 1950), most of these are unsuitable for epidemiological studies or even for the routine clinical assessment of the individual subject. From the practical point of view, the simplest indices of adiposity are the ratio of observed to standard weights (Billewicz, Kemsley, and Thomson, 1962) and the measurement of the skin-fold thickness at specified parts of the body (Brožek, Kihlberg, Taylor, and Keys, 1963).

The present study defines the prevalence of overweight and obesity among a sample of adult Africans living in Lagos, the capital of the Federal Republic of Nigeria.

### DESCRIPTION OF SAMPLES AND METHODS OF STUDY

Five areas randomly selected from among 30 blocks used for an onward going demographic survey of the Lagos population were studied. These areas gave a sample which was very closely representative of the entire population of the metropolitan area and included respondents from the main ethnic groupings of the Federation.

Subjects in a defined age group, 15-64 years, who were known to be the more permanent residents of these areas were examined. They were measured for height without shoes, standing erect and with the gaze horizontal. Weights were recorded with the subjects clad in minimum clothing. In a study of a sixth area of these Metropolitan sample blocks, in addition to the collection of heights and weights data, records of skin-fold thickness were also made on subjects aged 10 years and above. These latter measurements were taken over the right triceps area using the Harpenden calipers, as described by Tanner and Whitehouse (1962). The mean of three caliper readings was taken for each subject. All measurements of height, weight and skin-fold thickness were made by the author alone except in the case of three female inmates of a purdah household.

### CRITERIA FOR DIAGNOSIS OF OVERWEIGHT AND OBESITY

In the absence of any standard weight-for-height tables for the adult population in Nigeria, the weights of the subjects of this study were referred to the widely used standards given for adult American subjects (Society of Actuaries, 1959; Metropolitan Life Insurance Company, 1959). These standards are probably not directly applicable to this population but are nevertheless useful as a general reference and means of comparison.

The American subjects were weighed in indoor clothing and were measured for height wearing shoes. Correction for these was made by allowing 10 lb. and 6 lb. (4.5 kg. and 2.7 kg.) for male and female clothing respectively and 1 in. and 1½ in. (25 mm. and 38 mm.) for foot wear. Data on the subjects of this study were reduced to nude weights by subtracting 2 lb. and 4 lb. (0.9 kg. and 1.8 kg.) respectively for male and female clothing. These values were the average correction factors established during the field study on a smaller number of subjects selected randomly. A few of the subjects

whose heights were below those given in the reference tables were excluded from analysis.

For the definition of overweight, the more commonly employed criterion of 10% above the standard weight was accepted. Different levels of overweight were considered for the diagnosis of obesity. At a cut-off level of 20% above the reference average weights, it was felt that the diagnosis of obesity in this population would be clinically acceptable. For the purposes of comparison with data on other population groups, however, the proportions of subjects whose weights exceeded various percentage levels above the ideal weights for men and women of average frame given in the Metropolitan Life Insurance Company, 1959, tables are also presented. When comparing groups of subjects, the chi-square test was applied to determine the significance of the differences observed. A conventional level of  $P < 0.05$  was taken as significant.

### RESULTS

Table 1 gives the age and sex composition of the subjects of the first five areas considered in this study. There were 935 subjects, 451 males and 484 females. The female total excluded the 25 pregnant respondents of the sample. None of the subjects examined was ill.

Eleven males and eight females were excluded because they were too short for assessment on the average weights tables. The means and standard deviations by age groups for males and females are

TABLE I  
AGE AND SEX COMPOSITION OF SUBJECTS EXAMINED

Age Group (years)	Males		Females	
	No. of Subjects	%	No. of Subjects	%
15-24	158	35.0	163 (11) <sup>1</sup>	33.7
25-34	120	26.6	151 (10) <sup>1</sup>	31.2
35-44	84	18.6	94 (4) <sup>1</sup>	19.4
45-54	60	13.3	45	9.3
55-64	29	6.4	31	6.4
Total	451		484 (25) <sup>1</sup>	

<sup>1</sup>Pregnant subjects

shown in Table II. The ideal weights tables concerned subjects aged 25 years and above, and three males in the age group 35-44 years could not be assessed by standards for this age group.

TABLE III  
INCIDENCE OF OVERWEIGHT AND OBESITY BASED ON COMPARISON WITH AMERICAN AVERAGE WEIGHTS TABLES

Age Group (years)	Males			Females		
	No. of Subjects	% Over-weight	% Obese	No. of Subjects	% Over-weight	% Obese
15-24	148	2.0	0.7	157	17.2	5.7
25-34	120	1.7	0.8	150	30.0	17.3
35-44	84	9.6	7.2	93	34.4	23.7
45-54	59	6.8	3.4	45	20.0	11.2
55-64	29	6.9	—	31	41.9	29.0
Total	440	4.3	3.1	476	26.5	14.9

TABLE II  
MEANS AND STANDARD DEVIATIONS OF HEIGHT (IN.) AND WEIGHT (LB.), BY AGE AND SEX

Age Group (years)	Males					Females				
	No. of subjects	Height		Weight		No. of subjects	Height		Weight	
		Mean	SD	Mean	SD		Mean	SD	Mean	SD
15-24	148	65.7	2.7	123.0	6.8	157	61.9	4.3	112.6	15.8
25-34	120	66.9	3.9	133.3	17.4	150	62.4	2.3	127.5	26.8
35-44	84	66.3	2.7	140.5	25.5	93	62.8	4.2	139.8	40.0
45-54	59	66.1	2.6	142.4	23.5	45	62.5	2.4	135.0	23.8
55-65	29	67.7	2.3	143.3	22.5	31	62.4	2.1	147.8	35.4

TABLE IV  
PROPORTIONS OF SUBJECTS BY AGE GROUPS AT VARIOUS PERCENTAGE LEVELS OF IDEAL WEIGHTS

Age Group (years)	Males							Females						
	No. of Subjects	Proportions at % Levels of Ideal Weight						No. of Subjects	Proportions at % Levels of Ideal Weight					
		> 100	110	115	120	125	130+		> 100	110	115	120	125	130
25-34	120	14.2	3.3	1.7	1.7	0.8	0.8	150	49.3	32.7	25.3	22.0	14.7	12.0
35-44	81	27.2	13.6	9.9	8.6	8.6	7.4	93	68.8	50.5	44.1	33.3	29.0	23.7
45-54	59	40.7	20.3	15.3	6.8	5.1	3.4	45	68.9	40.0	37.8	22.2	20.0	17.8
55-64	29	31.0	20.7	17.2	3.4	3.4	—	31	71.0	58.1	58.1	51.6	41.9	38.7
Total	289	24.9	11.4	8.3	4.8	4.2	3.1	319	59.9	41.1	35.7	28.2	22.3	18.8

Tables III and IV show the results obtained when the data of the subjects were referred to the American average and ideal weights standards.

**MALES**

Of the males, 4.3% were overweight and 3.1% were regarded as obese on the average weights tables. The highest incidences of overweight and obesity were found in the age group 35-44 years. There was no significant difference in the incidences of overweight and obesity between males in the age groups 15-24 years and 25-34 years. Overweight was as common in males aged 45-54 years as in males aged 55-64 years. By these standards, there were no obese subjects among the 29 subjects aged 55-64 years.

Of the 289 males aged 25-64 years, 24.9% exceeded their ideal weights, but only 3.1% weighed 30% or more above their desirable weights. There was close correspondence in the proportions of subjects in the different age groups who were 30% or more above their ideal weights and those who were 20% or more above the average weights given for their heights and ages.

**FEMALES**

The percentage overall and age-specific rates of overweight were significantly higher in females than in males and, except in the two older age groups, obesity was commoner among females than males.

Although the highest rates of overweight obesity were found among the 55-64 years female subjects, the incidences in this age group were not significantly different from those recorded for female subjects aged 25-44 years. Also, although the lowest percentage incidences were recorded among the youngest females, the rates in the 15-24 year age group were not significantly different from those recorded among subjects aged 45-54 years.

One hundred and ninety-one of the 319 females aged 25-64 years exceeded their ideal weights, and 18.8% were 30% or more above these weights. These values are much in excess of those of the males. Unlike the males the females showed a low correlation between the proportions in the different age groups who were 30% or more above their ideal weights and those whose weights were 20% or more above their standard or average weights.

**SKIN-FOLD THICKNESS**

The cumulative frequency distribution of the skin-fold measurements of the 193 subjects (102 males and 91 females) in the age group of 10 years and above examined in the sixth survey block is presented in Table V. In men, the values obtained

**TABLE V**  
DISTRIBUTION OF ARM SKIN-FOLD MEASUREMENTS

Interval (mm.)	Males (n = 102)				Females (n = 91)			
	No. of Subjects	Cumulative Frequency		No. of Subjects	Cumulative Frequency			
		No.	%		No.	%		
0-4.9	10	10	9.8	0	0	0		
5-9.9	70	80	78.4	12	12	13.2		
10-14.9	13	93	91.2	39	51	56.0		
15-19.9	4	97	95.1	23	74	81.3		
20-24.9	2	99	97.1	11	85	93.4		
25-29.9	3	102	100	1	86	94.5		
30-34.9	—	—	—	1	87	95.6		
35-39.9	—	—	—	1	88	96.7		
40 and above	—	—	—	3	91	100		

ranged from 4 to 27.8 mm. Skin-fold thickness in three of the female subjects exceeded the measuring limits of the calipers. The lowest reading among females was 6.3 mm. and the highest recorded value was 38 mm. The 50th percentile among males was 7.2 mm. and among females it was 13.6 mm.

**TABLE VI**  
MEANS AND STANDARD DEVIATIONS OF TRICEPS SKIN-FOLD MEASUREMENTS, BY AGE GROUP

Age Group (years)	Males			Females		
	No.	Mean	SD	No.	Mean	SD
15-24	21	8.2	2.3	25	14.2	3.7
25-34	35	7.8	1.7	32	15.8	5.8
35-44	22	10.8	4.1	11	15.8	8.0
45-54	8	10.9	5.7	8	17.8	3.7
55-64	8	9.3	6.7	5	12.2	3.2

Table VI shows the means and standard deviations of the measurements for subjects aged 15 years and above. Mean values in females were higher than those in males.

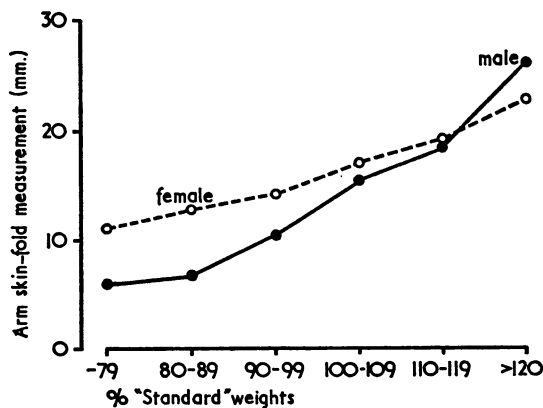


FIGURE 1: Mean triceps skin-fold measurement by sex and percentage 'standard' weights.

The figure shows the relationship of skin-fold thickness to body weight expressed as percentages of the American average weights.

When the female values were compared with those of the males, it was found that females who were normal or below their average weights had significantly more subcutaneous fat than males at the same percentage of standard weight. It appeared, however, that as males and females became overweight and obese, subcutaneous fat contributed progressively to a similar extent among both sexes in producing the excess weight. The numbers of subjects in the overweight and obese classes were rather small, and much larger samples will be required to validate this latter finding.

#### DISCUSSION

In Africa where nutritional problems and disorders abound, emphasis has been placed on under-nutrition and starvation. Over-nutrition as another example of malnutrition has not been investigated to any extent.

Two surveys were conducted recently among randomly selected African subjects in South Africa (Slome, Gampel, Abramson, and Scotch, 1960; Jackson, Goldberg, Marine, and Vinik, 1968). Slome and his colleagues referred the weights of their subjects to the earlier actuarial tables (Association of Life Insurance Medical Directors and Actuarial Society of America, 1912). They found obesity, taken as 125% or more of these U.S. standard weights, to be commoner in females than in males. The overall incidence of obesity among their 325 subjects aged 20 years and above was 27.7%, a figure which is higher than, though not strictly comparable to, 6.9% obtained on the Lagos subjects of similar age at 125% on the 1959 actuarial tables.

Among the 600 adult Bantu subjects screened by Jackson and his colleagues during a glycosuria survey in Cape Town, 37% were 15% or more above the ideal weights for their height and sex as given in the Metropolitan Life Insurance Company 1959 tables. On these tables, 22.7% of the 608 Nigerian subjects aged 25 years and above were 15% or more overweight. Fifty per cent of the females and 7% of the male Bantu subjects were obese by this overweight level. These figures compare with the 35.7% and 8.3% for females and males in the present study. Obesity and overweight appear to be commoner in the Bantus than in the Nigerian subjects.

There have been few systematic attempts at the epidemiological study of obesity using random population samples of adequate size even in the socially advanced countries. Moore *et al.* (1962)

surveyed a random sample of adult white American subjects aged 20-59 years in a residential area of New York City. Of the 690 male subjects of the sample, 57.6% were 15% or more overweight on the desirable weights tables of the Metropolitan Life Insurance Company and 42.1% of the 969 females of the sample were 21% or more above their ideal weights. Obesity levels were chosen by these authors as 29% or more overweight for males and 37% or more for females. Thus defined, 24.1% of the men and 17.1% of the women were obese.

A more recent survey conducted by Silverstone *et al.* (1969) among 329 randomly selected subjects aged 20-59 years living in the London area showed that 37% of the men and 49% of the women were 20% or more overweight on the ideal weight tables.

Among subjects aged 25-59 years in the Lagos sample, 8% of the men were 15% or more overweight, 4.7% of the males and 27.6% of the females were 20% or more overweight. Only 3.6% of the males were 29% or more overweight, and 12.2% of the females were 37% or more above their ideal weights.

Thus overweight and obesity are less frequent among the Nigerian subjects of the present sample than in similarly randomly selected samples of British and American populations.

The subjects examined in the sixth area can be regarded as a random but small sample of the population of the suburbs of the Federal Territory of Lagos. Their data for skin-fold thickness confirmed the earlier findings among selected Nigerian subjects (Republic of Nigeria Nutrition Survey, 1965) that women have significantly larger subcutaneous adipose collections than males and that, as they exceeded their expected weights, both males and females progressively increased their subcutaneous fat depots. From their results, however, the Nutrition team concluded without valid evidence that the excess weight in males was due to an increase in both muscle mass and subcutaneous fat. The results of the present study among randomly selected subjects appeared to indicate a contrary view, but further studies on larger samples of overweight and obese subjects would be needed to validate the conclusions of the present study.

#### SUMMARY

The adult population of six randomly selected sample blocks in the urban area of Lagos, the Federal Capital of Nigeria, was studied for the incidence of overweight and obesity defined on American weight-for-height standards.

Obesity was not as common as in studies conducted among random samples of subjects in Lon-

don or New York or even among adult African population samples in urban areas of South Africa.

For purposes of comparison with future studies among other racial groups, data are also presented for different levels of percentage overweight on the widely used American tables of desirable weights.

Males were less frequently overweight and obese than females and in general showed lesser amounts of subcutaneous fat.

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#### REFERENCES

- ASSOCIATION OF LIFE INSURANCE MEDICAL DIRECTORS AND ACTUARIAL SOCIETY OF AMERICA (1912). *Medico-Actuarial Mortality Investigation*. Vol. 1, New York.
- BILLEWICZ, W. Z., KEMSLEY, W. F. F., and THOMSON, A. M. (1962). Indices of adiposity. *Brit. J. prev. soc. Med.*, **16**, 183.
- BROŹEK, J., and KEYS, A. (1950). Evaluation of leanness-fatness in man: a survey of methods. *Nutr. Abstr. Rev.*, **20**, 247.
- , KIHLEBERG, J. K., TAYLOR, H. L., and KEYS, A. (1963). Skinfold distributions in middle-aged American men: A contribution to norms of leanness-fatness. *Ann. N. Y. Acad. Sci.*, **110**, 492.
- DAVIDSON, S. (1966). 'Obesity' in *The Principles and Practice of Medicine*. Ed. Davidson, S. 8th ed., p. 454. E. & S. Livingstone, London and Edinburgh.
- JACKSON, W. P. U., GOLDBERG, M. D., MARINE, N., and VINIK, A. I. (1968). Effectiveness, reproducibility and weight-relation of screening-tests for diabetes. *Lancet*, **2**, 1101.
- METROPOLITAN LIFE INSURANCE COMPANY (1959). New weight standards for men and women. *Statist. Bull., Metrop. Life Insur. Co.*, **40**, Nov.-Dec., p. 1.
- MOORE, M. E., STUNKARD, A., and SROLE, L. (1962). Obesity, social class, and mental illness. *J. Amer. med. Ass.*, **181**, 962.
- REPUBLIC OF NIGERIA NUTRITION SURVEY (1965). A report by the Nutrition Section, Office of International Research, National Institutes of Health. U.S. Department of Health, Education and Welfare. Publ. Hlth. Series, p. 148.
- SILVERSTONE, J. T., GORDON, R. P., and STUNKARD, A. J. (1969). Social factors in obesity in London. *Practitioner*, **202**, 682.
- SLOME, C., GAMPEL, B., ABRAMSON, J. H., and SCOTCH, N. (1960). Weight, height and skinfold thickness of Zulu adults in Durban. *S. Afr. med. J.*, **34**, 505.
- SOCIETY OF ACTUARIES (1959). *Build and Blood Pressure Study*. Vol. I, p. 16. Chicago.
- STRANG, J. M. (1964). 'Obesity' in *Diseases of Metabolism*. Ed. Duncan, G. G., 5th ed., p. 703. W. B. Saunders, Philadelphia and London.
- TANNER, J. M., and WHITEHOUSE, R. H. (1962). Standards for subcutaneous fat in British children. *Brit. med. J.*, **1**, 446.
- WELHAM, W. C., and BEHNKE, A. R. (1942). The specific gravity of healthy men. *J. Amer. med. Ass.*, **118**, 498.