

Incidence of Obesity and Overweight Among Honolulu Police and Firemen

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OVERWEIGHT and obesity are considered major public health problems in the United States. Although no causal relationship has been proved, the penalty of overweight and obesity is reflected in increased mortality rates from disorders such as diabetes and cardiovascular disease and liver and gallbladder diseases (1-3).

The terms overweight and obesity are often used interchangeably, but the terms are not synonymous, nor do the conditions necessarily occur simultaneously. The most common clinical criterion for evaluating body weight is the height-weight table, and overweight is determined as weight in excess of a standard of heights and weights. Classification of obesity requires an estimate of body fatness. Of the methods available, measurements of body skinfolds provide a simple and reasonably good clinical estimate of the degree of body fatness (4,5).

The purpose of this study was to determine the incidence of overweight and obesity among policemen and firemen in Honolulu, Hawaii. Weight in relation to height and triceps skin-

fold data were used as criteria for evaluation. The study was done in conjunction with the Mayor's Council on Health for the city and county of Honolulu. The objective was to provide baseline data for evaluation of physical fitness of city employees and to point out areas of need in improving health and work performance.

Method

Height, weight, and triceps skinfold measurements were taken at the 1968 annual examination of 619 firemen and 552 policemen from Honolulu. These data along with ethnic backgrounds of the men were obtained through the office of the county physician at Maluhia Hospital. Because the available figures did not include retrospective data on the men, a sample of all men hired between 1962 and 1967 was selected for further study. Available records were screened for height, weight, and triceps skinfold measurements following each man from year of employment to 1968. Female employees and men whose records were incomplete were omitted from the study. The final sample comprised 434 men.

The men's body weight and height were measured without shoes and clothing. Skinfold measurements were made at the back of the upper arm over the triceps using a Lange caliper which exerts a pressure of 10 gm. per sq. mm. (6). All measurements were made by one physician.

Desirable weights for the policemen and firemen in the study were based on the National

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Research Council table of desirable weights, which for adults is considered to be the weight normally achieved at least by age 25 (7). Clinical obesity was determined using the table provided by Seltzer and Mayer (8).

Results

Mean height, weight, and skinfold measurements of 1,171 Honolulu policemen and firemen examined in 1968 are shown in table 1. Policemen were taller and heavier than firemen and had significantly larger triceps skinfolds ($P=0.05$). Weight-height ratios, however, were not significantly different for the two groups.

Because of the racial distribution in Hawaii, policemen and firemen were separated by ethnic group to determine if ethnic distribution could account for differences observed between the two service groups. Three ethnic groups were evaluated. Part-Hawaiians include men with any Hawaiian forebears. The other groups were Caucasians and Orientals (Japanese, Chinese, Korean, and Filipino).

Mean weight and mean skinfold measurements were significantly greater for part-Hawaiians and Caucasians than for Orientals. There was no significant difference in height, weight, or skinfold measurements between part-

Hawaiians and Caucasians. When ethnic groups were separated further by occupation, part-Hawaiians and Caucasians still had higher body weights and larger skinfolds than their Oriental counterparts within each occupational group. Further, differences observed between occupational groups persisted for each ethnic group. Thus, part-Hawaiian, Caucasian, and Oriental policemen were significantly heavier and had larger skinfolds than firemen of the same ethnic group.

In order to evaluate the extent of overweight, individual weights were compared with desirable weight for height recommended by the National Research Council (7) using the highest allowable weight for height as a base. No attempt was made to evaluate body structure. Men were rated as clinically obese when skinfold measurements were higher than limits described by Seltzer and Mayer (8). As shown in table 2 the incidence of overweight was somewhat greater among policemen than among firemen, but the difference was not significant by the chi-square test. Further, the incidence of overweight was consistently higher among part-Hawaiians and Caucasians than among Orientals. The differences observed again were somewhat higher for policemen than firemen of corresponding ethnic groups.

Table 1. Height, weight, and skinfold measurements of Honolulu policemen and firemen, by occupation, ethnic group, and occupation-ethnic group, 1968

Classification	Number examined	Age (years)		Height (inches)		Weight (pounds)		Skinfold (mm.)		Weight-height (ratio)	
		Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Occupation:											
Policemen.....	552	1 35	10	1 71	2	1 188	23	1 19	3	2.7	0.31
Firemen.....	619	1 37	9	1 69	2	1 177	21	1 18	2	2.6	.27
Ethnic group:											
Part-Hawaiian.....	692	1 35	10	1 70	2	1 186	23	1 19	3	2.7	.30
Caucasian.....	196	1 35	10	1 71	2	1 184	24	1 19	3	2.6	.32
Oriental.....	283	1 39	9	1 69	2	1 171	17	1 17	2	2.5	.22
Occupation-ethnic:											
Policemen:											
Part-Hawaiian....	311	33	10	71	2	1 192	24	1 20	4	2.7	.33
Caucasian.....	117	34	10	71	2	1 190	23	1 19	3	2.7	.31
Oriental.....	124	38	10	70	2	1 178	18	1 18	2	2.5	.24
Firemen:											
Part-Hawaiian....	381	37	9	69	2	1 181	20	1 18	3	2.6	.27
Caucasian.....	79	36	10	70	2	1 176	24	1 18	3	2.5	.31
Oriental.....	159	39	9	68	2	1 166	15	1 17	1	2.4	.19

¹ Significant at the $P=0.05$ level.

NOTE: S.D. means standard deviation.

The incidence of clinical obesity, however, was significantly higher among policemen than firemen and among part-Hawaiians and Caucasians as compared with Orientals ($P=0.05$). The effect of occupation on the incidence of obesity again was clearly demonstrated by the

low incidence of clinical obesity among firemen of the three ethnic groups as compared with policemen of the same ethnic group. For example, the extremely low incidence of obesity among Orientals was due entirely to obesity among Oriental policemen because no Oriental

Table 2. Comparison of overweight and obesity by occupation, ethnic group, and by occupation-ethnic group, Honolulu policemen and firemen, 1968

Classification	Overweight			Obese	
	Mean pounds	Number	Percent	Number	Percent
Occupation:					
Policemen.....	22	389	70.5	103	¹ 18.7
Firemen.....	17	404	65.3	31	¹ 5.0
Ethnic group:					
Part-Hawaiian.....	21	507	¹ 73.3	95	¹ 13.7
Caucasian.....	20	128	¹ 65.3	33	¹ 16.8
Oriental.....	13	158	¹ 55.8	6	2.1
Occupation-ethnic:					
Policemen:					
Part-Hawaiian.....	24	235	75.6	70	¹ 22.5
Caucasian.....	21	81	69.2	27	¹ 23.1
Oriental.....	15	73	58.9	6	4.8
Firemen:					
Part-Hawaiian.....	18	272	71.4	25	¹ 6.6
Caucasian.....	17	47	59.5	6	¹ 7.6
Oriental.....	11	85	53.5		

¹ Significant at the $P=0.05$ level.

Table 3. Heights and weights of policemen and firemen hired 1962-67 from year of hiring to 1968

Number	Age (years)		Height (inches)		Weight (pounds)													
					1962		1963		1964		1965		1966		1967		1968	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Policemen																		
13-----	28	3	70	2	170	19	178	17	178	18	178	19	181	15	185	16	188	17
33-----	28	3	71	2			¹ 179	20	¹ 181	17	¹ 182	17	¹ 191	20	¹ 192	19	¹ 195	22
29-----	27	2	71	2					177	25	177	23	181	28	¹ 189	33	¹ 192	33
28-----	25	3	71	1							176	19	179	18	¹ 182	17	¹ 187	20
58-----	26	3	71	2									178	25	179	21	185	21
76-----	25	5	71	2											173	22	175	20
Firemen																		
13-----	31	2	71	2	170	21	173	20	176	21	176	19	180	22	180	23	180	20
66-----	31	3	70	2			¹ 167	17	¹ 170	17	¹ 170	16	¹ 172	17	¹ 174	17	¹ 174	17
69-----	30	3	70	2					170	20	170	16	172	17	¹ 173	18	¹ 174	19
32-----	29	3	71	2							171	22	170	21	¹ 171	18	¹ 174	20
11-----	26	3	71	2									173	23	172	16	173	18
5-----	26	3	71	2											175	12	179	10

¹ Significant at the $P=0.05$ level.

NOTE: S.D. means standard deviation.

firemen had skinfolds large enough to be rated as evidence of obesity.

These data suggested that occupational differences may affect the incidence of overweight and obesity among policemen and firemen. However, the fact could not be ignored that the men may have already been overweight and clinically obese when selected. Therefore, a study was made of the mean weight for each occupational group hired between 1962 and 1967 to observe if policemen are heavier and more clinically obese than firemen because of either selection standards of the two services or occupational differences.

As shown in table 3 no difference was found between mean weight when the men were employed except in 1963, when the mean weight of the policemen at the time of hiring was significantly greater than that of firemen. Mean weight increased after hiring for both policemen and firemen, and the differences in the two groups hired in 1963 persisted to 1968. By 1968 mean weight was significantly higher among policemen than among firemen for those hired in 1963, 1964, and 1965. Weights in 1968 were somewhat higher for policemen hired in 1962 and 1966 than for firemen hired in these same years also, but the difference was not significant. There was very little difference in weight of policemen and firemen hired in 1967.

In order to clarify whether hiring practices or occupational differences affect the incidence of overweight among the two occupational groups, the number of men who were overweight in 1968 was compared with the number who were overweight when hired. No difference was found in the incidence of overweight between occupational groups at hiring, but more policemen than firemen were overweight in 1968 (table 4). Although the results were not statistically significant, the incidence of overweight increased for each group.

Another comparison was made to determine changes in weight following employment for all men without regard to weight status at hiring. As shown in table 4 more policemen than firemen gained 5 pounds or more from time of employment to 1968 as compared with firemen, but the difference was not statistically significant by the chi-square test. Further, more firemen than

Table 4. Incidence of overweight and change in weight status, by occupation, Honolulu policemen and firemen, 1962-68

Status	Policemen		Firemen	
	Number (N=237)	Per- cent	Number (N=197)	Per- cent
Overweight when hired.....	107	45	83	42
Overweight in 1968..	151	64	109	55
No change in weight by 1968...	69	29	79	40
Lost 5 pounds or more by 1968....	24	10	25	13
Gained 5 pounds or more by 1968....	144	61	93	47

Table 5. Weight increase among Honolulu policemen and firemen from year hired, 1962-65 to 1968, by occupation

Occupation and date hired	Number hired	Gained 5 pounds or more		Mean gain (pounds)
		Number	Percent	
Policemen:				
1962.....	13	10	77	23.4
1963.....	25	25	76	¹ 21.0
1964.....	21	21	72	¹ 20.3
1965.....	18	18	64	¹ 18.5
Firemen:				
1962.....	13	8	62	16.3
1963.....	66	34	52	¹ 12.3
1964.....	69	31	45	¹ 13.6
1965.....	32	13	41	¹ 10.8

¹ Significant at the $P=0.05$ level.

policemen were able to maintain their weight. Only a small portion of both occupational groups lost weight, and the difference between the two occupational groups was negligible. Therefore, after the men are hired, more policemen than firemen tend to gain weight and in contrast, more firemen are able to stabilize their weight.

The mean gain in weight was then determined for the men who gained 5 pounds or more from the time they were hired to 1968 and for each occupational group from 1962 to 1968. In 1963, 1964, and 1965 the mean weight gained was significantly greater for policemen than firemen (table 5). The difference in weight gain for men hired in 1962 was of borderline significance, which probably is indicative of an insufficient number of subjects. A similar problem in sample

size did not allow a statistical evaluation of mean weight gain after 1965, but the trend of greater weight gain among policemen occurred after 1965.

Since it has been recognized that ethnic background may be an influencing factor, the effect of the ethnic distribution on mean weight gain was evaluated. The data on mean weight gain among ethnic groups showed that part-Hawaiians gained significantly more weight than Orientals (table 6). However, the ethnic groups among the policemen gained more weight than the corresponding ethnic groups among the firemen. Part-Hawaiian and Caucasian policemen

were shown by the *t*-test to have a significantly greater weight gain than part-Hawaiian and Caucasian firemen ($P=0.05$). No significant difference was found among Oriental policemen and firemen, but this could be expected because there was no significance between the Oriental groups in the earlier data.

In order to determine if changes occurred in body fat, an analysis was made of skinfold measurements. Triceps skinfold measurements, unfortunately, were not included in the medical examinations of the men until 1965, and complete records for everyone were available only after 1966. A comparison of the triceps skinfold data for men hired in 1966 and 1967 showed that more policemen than firemen were clinically obese at hiring (table 7). However, the difference was not statistically significant. By 1968 the proportion of obese policemen and firemen was somewhat less for both groups. Although significantly more policemen than firemen were clinically obese in 1968, it must be pointed out that only 15 firemen were hired during this period as compared with 124 policemen.

A further evaluation was made of triceps skinfold measurements to determine if differences occurred between the number of men who had increased, decreased, or maintained skinfold measurements. As shown in table 7 skinfolds of more policemen than firemen increased; this difference was statistically significant by the chi-square test ($P=0.05$). Conversely, skinfolds of more firemen than policemen decreased significantly ($P=0.05$). More firemen than policemen also maintained their initial triceps skinfold measurements, but the difference was of borderline significance.

Discussion

The data in this study demonstrate the well-known difference between overweight and obesity. According to a height-weight standard, a large proportion of men were overweight. However, only a small percentage of this group was classified as obese. For example, 70 percent of the policemen were overweight, but only 19 percent were obese; 65 percent of the firemen were overweight, but only 5 percent were obese. It may be that the estimates of overweight are somewhat high since no consideration was given to individual body build (9). Conversely,

Table 6. Weight increase of Honolulu policemen and firemen from employment to 1968, by ethnic group and occupation-ethnic group

Classification	Number	Weight gain (5 pounds or more)		Mean gain (pounds)
		Number	Percent	
Ethnic group:				
Part-Hawaiian	228	125	55	¹ 16.3
Caucasian	89	53	60	15.0
Oriental	126	59	47	¹ 13.1
Policemen:				
Part-Hawaiian	109	68	62	¹ 19.0
Caucasian	59	39	66	¹ 16.7
Oriental	78	37	47	13.1
Firemen:				
Part-Hawaiian	119	57	48	¹ 13.0
Caucasian	30	14	47	¹ 10.1
Oriental	48	22	46	13.2

¹ Significant at the $P=0.05$ level.

Table 7. Incidence of obesity among Honolulu policemen and firemen when hired and change in skinfold, 1966-68

Status	Policemen		Firemen	
	Number (N=124)	Percent	Number (N=15)	Percent
Obese when hired	59	48	5	33
Obese in 1968	52	42	2	13
No change in skinfold	45	36	8	53
Decrease in skinfold	14	¹ 11	5	¹ 3
Increase in skinfold	65	¹ 52	2	¹ 13

¹ Significant at the $P=0.05$ level.

whether some men classified as overweight (or normal weight) were carrying more body fat than desirable for good health cannot be evaluated from these data. Bassett and Schroffner (10), for example, refer to a "non-overweight adiposity" in middle-aged Chinese men in Hawaii.

The results indicate a difference among ethnic groups with more part-Hawaiians and Caucasians judged overweight and obese than Orientals. This difference remains even after the ethnic groups are classified by occupation. Although the ethnic composition of either occupation could affect the incidence of overweight and obesity, there was a fairly even distribution of the three ethnic groups among the policemen and firemen. The ethnic factor, therefore, could not explain why policemen are more obese than firemen. Apparently occupational differences are more important than ethnic factors among this sample.

A study in detail of the subsample of men hired between 1962 and 1968 showed that differences in weight between policemen and firemen occurred primarily after the men entered the service. Once policemen were admitted to the service, their mean weight increased more than that of firemen. Moreover, weight increase appeared to occur more rapidly among policemen. Although the incidence of overweight was not significantly different between the two groups at time of hiring or in 1968, more policemen than firemen tended to gain weight. These data suggest a greater trend toward weight gain among policemen following admission to service even though they had not yet become overweight at the time of the study.

The results from skinfold data are more difficult to evaluate but suggest a similar trend. The incidence of clinical obesity was higher, although not significantly, among policemen than firemen when they were hired. More obesity among police recruits indicates the possible influence of differences in hiring practices between the two services. However, a significantly larger number of policemen had increased skinfold measurements following hiring, and significantly more firemen had decreased skinfolds.

Even though these data are statistically significant, the small sample of firemen suggests that the results be interpreted with caution. Fur-

ther, the use of triceps skinfold as a sole measure of obesity is not without hazards. Malina (11) has reported that considerable variation in triceps skinfold is associated with age, sex, ethnic group, and geographic location.

Apparently, however, the general tendency is for more policemen than firemen to gain weight and body fat following admission to the service. Occupational differences, therefore, appear to be important determinants in the incidence of obesity among the total sample of policemen and firemen. Whatever differences exist between overweight and obese policemen and firemen at the time of hiring are accentuated by the occupational factor.

Studies of persons in different occupational groups indicate that the incidence of overweight and obesity is influenced by physical activity. In a study of coronary heart disease, Heady (12) found by using skinfold measurements that London bus conductors are thinner than bus drivers. The ponderal index also showed conductors to be lighter for their height than drivers. However, the diets of the two occupational groups were similar and therefore, the extra activity of collecting fares on the double-deck bus appears to be the advantage conductors have over the relatively sedentary drivers.

Keys and Brozek (13) using arm and subscapular skinfold measurements studied groups of men differing in the intensity of their habitual physical work and found the more active men to be leaner and the more sedentary men more frequently classified as fat by skinfold measurements. Mayer and co-workers (14) found that below a certain level of activity adult men do not reduce their food intakes proportionately to caloric expenditure and, as a result, obesity develops. Other workers (15, 16) have reported obese subjects to be less active than subjects of normal weight. Although presently there is no direct evidence of differences in activity among policemen and firemen in this study, the data imply that occupational activities have a major influence on body weight and composition in the two groups of men.

Summary

A study of height, weight, and triceps measurements of 1,171 policemen and firemen in Honolulu indicated that a number of policemen

and firemen were overweight in comparison with a table of desirable weights. Policemen were heavier than firemen, and significantly more policemen than firemen were clinically obese by the standards developed by Seltzer and Mayer.

The incidence of overweight and obesity was higher among part-Hawaiians and Caucasians than among Orientals. However, when policeman and firemen were compared by ethnic group, the incidence of overweight and obesity was higher among part-Hawaiian, Caucasian, and Oriental policemen than their counterparts among the firemen.

Weight gain among part-Hawaiians and Caucasians hired between 1962 and 1967 was greater than for Orientals. Mean weight gain was greater also for each ethnic group of policemen than for corresponding groups among firemen. These data suggest that ethnic differences are not the influencing factor in this sample and that occupational differences are more significant.

Further evaluation of changes in weight for each group hired between 1962 and 1967 indicated that differences in mean weight occur after the men enter the two services and not at the time they are hired. Once hired, a larger proportion of policemen than firemen increase their weight and triceps skinfold, and this increase is greater among policemen than firemen. Although not all the men became overweight by height-weight standards or clinically obese by triceps skinfold standards, significantly more policemen than firemen gained weight and body fat following admission to service.

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