THE PHYSIQUE OF OXFORD UNDERGRADUATES

RELATIONSHIP WITH WEIGHT VARIATION, SCHOOLING AND HABITS

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In earlier reports on the physique of Oxford undergraduates attending the pilot student health service from 1947 to 1950 emphasis was laid on body shape. Parnell (1952) pointed out the tendency for centrally placed Sheldonian somatotypes, that is those with more balanced mid-range body proportions, to occur more frequently in the Oxford sample than in American universities, a tendency incidentally which advances further according to the level of university performance attained. Tanner (1952) emphasized the tendency for Oxford students to show less mesomorphy, that is muscle and bone development, than American students but he reports a comment from Sheldon himself that the distribution at Harvard resembled the Oxford distribution more closely. This approach, by the analysis of body shape, to the problem of physical characteristics accompanying academic selection is of particular interest, but in calculating the somatotype, height is deliberately ignored by being placed as the denominator of all the body proportions employed. Height, however, is an index of body size, as opposed to body shape, and has an importance of its own. This report concerns observations on Oxford undergraduates in which more attention is paid to body size, and particular attention also to variation of weight during university residence.

One of the earliest observations made in the pilot survey (Parnell, 1948) was the significant difference in the heights and weights of men who arrived at the university from different kinds of school. Men from private and public schools were on the average more than 1 in. taller and about 5 lb. heavier than those from government-aided primary and secondary schools. A more detailed analysis by Bailey (1951), who employed samples of men who had attended the Cambridge University Health Service, confirms the tendency. The actual differences in weight at Cambridge were not quite so large as those at Oxford, but as Bailey pointed out his sample from the highest fee-paying schools were slightly younger when they arrived at the university. That such differences existed between university students and some other sections of the community was already known. Cathcart, Hughes & Chalmers (1935) had compared the average height and weight of students with members of the armed forces, and with employed and unemployed workmen. School medical officers knew well that such differences existed between particular schools where heights and weights were studied in relation to social or economic grading of the homes from which students came. Reports to this effect were made by Huws-Jones (1938), and more recently confirmed by Hammond (1953). The present survey shows the existence of similar differences within the age group of young men at Oxford. Similar differences were also shown among American

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students by Diehl (1933). These differences suggest that some kind of selection is operating, whether this is self-selection or selection by circumstance, including the current educational system.

Who then is being selected? Is the student more heavily endowed genetically that he grows taller and heavier? Is it because he has lived in a better environment, been better fed, better housed, sent to bed earlier and suffered less illness to handicap growth? Has he played more games, suffered or enjoyed more physical training? Or is it a combination of all these and possibly other environmental factors too?

Table 1. *Mean heights and weights of young men aged* 17–19 *years at Oxford University* 1947–50 *and in each social class* 1941–4, *together with those for schoolboys*

Height (in.)					Weight (lb.)				
No.	Name	Mean	S.E.	S.D.	No.	Name	Mean	S.E.	S.D.
182	Ex-boarding schools	70·70	± 0·17	2·34	182	Ex-boarding schools	152·95	± 1·08	14·60
55	Ex-private day schools	69·75	± 0·30	2·21	55	Ex-private day schools	152·05	± 2·66	19·75
100	Schoolboys	69·68	± 0·24	2·40	148	Ex-government-aided day schools	148·60	± 1·24	15·16
148	Ex-government-aided day schools	69·45	± 0·19	2·29	100	Schoolboys	141·88	± 1·50	15·00
232	Social class I	69·20	± 0·17	2·66	232	Social class I	139·40	± 1·05	16·10
195	Social class II	69·06	± 0·19	2·66	195	Social class II	135·66	± 1·06	14·76
3270	Social class III	67·48	± 0·05	2·68	466	Social class IV	129·91	± 0·73	15·75
466	Social class IV	67·20	± 0·12	2·62	3270	Social class III	129·45	± 0·27	15·72
514	Social class V	67·02	± 0·13	2·90	514	Social class V	128·12	± 0·73	16·55

Table 1 gives the average heights and weights of undergraduates, and compares them with various groups of the same age in the general community. The figures for each social class in the general community are taken from the civilian Medical Board records of 18-year-old men from Northamptonshire. Figures for all Northamptonshire are very close to those for the whole country as can be seen in Martin's (1949) analysis of over 91,000 records of 20-year-old men called to medical boards under the Militia Act in 1939. Their average height was $67{\cdot}50 \pm 0{\cdot}009$ in. and average weight $135{\cdot}75 \pm 0{\cdot}055$ lb.

The points of interest are these. First, there is the economic grading both within the university and separately within the general community. Secondly, there is the arresting fact that the shortest and lightest undergraduate group is yet as tall and actually 9 lb. heavier than the highest social level in the general community. This fact will vex environmentalists who may seek to explain these socio-economic differences in height and weight in terms of nutrition or other social class privilege, for it confronts them with the awkward question as to what priority would enable the ex-elementary or secondary school man to be better fed than say the children of professional men outside the university. Without in any way denying that environmental influence can be important, it seems that in the problem now under review, another and overpowering influence, probably of genetic origin, may be at work accounting for the large group differences in height and weight. There is further evidence to support this view.

Schuster (1911) recorded the height and weight of 959 Oxford undergraduates, which may be compared with current measurements (see table 2). Correction for the difference in mean age of the two groups would tend to lessen such discrepancy as exists in height since according to Morant (1950) growth ceases at about twenty-one years, and it would also nullify the apparent difference of about 4 lb. in weight

Table 2. *Mean heights and weights of Oxford undergraduates in* 1908–10 *and* 1947–50

Observer	No. observed	Average age (years)	Average height (in.)	Average weight (lb.)
1908–10 Schuster*	959	19·6	69·49–0·08	151·94–0·53
1947–50 Parnell	498	21·6	69·99–0·11	148·40–0·80

* Schuster's series were measured fully clothed without footwear. He gave probable errors, but standard errors are given above according to modern practice, as calculated by Bailey from Schuster's data. If it is assumed that the clothes without footwear weighed on the average about 8 lb., then recent undergraduates would appear to be about 4 lb. heavier than their predecessors of 1908–10. They are, however, 2 years older.

Table 3. *A comparison of the mean heights and weights of the commoner Oxford somatotypes with Sheldon's findings in the United States*

Somatotype	No. Oxford	Mean height (in.) U.S.	Mean height (in.) Oxford	Mean weight (lb.) U.S.	Mean weight (lb.) Oxford
225	9	69·0	71·6	123–	135–
235	14	70·2	72·9+	132	148
244	7	68·6	71·0	131	140
325	5	69·3	72·2	127	150
334	34	68·5	70·2	131	142
335	18	70·4+	72·0	136	149
343	64	67·8	69·3	136	146
344	40	69·1	71·6	138	156
353	20	68·8	69·2	149	153
433	5	67·3	67·2–	133	139
434	17	69·1	70·2	141	151
442	33	66·8	68·9	140	157
443	38	68·3	69·4	143	151
444	5	69·9	70·2	149	150
451	8	65·3–	67·6	140	162
452	8	67·8	68·3	153	153
453	5	69·8	70·6	159	168
532	7	67·0	69·7	147	172
541	6	65·6	68·7	153	169
542	6	67·6	70·2	162+	176+

between 1908 and 1910 when Schuster took his measurements and 1947–50. The most remarkable feature appears to be the small amount of change in four decades, and it is appropriate to ask whether environment has changed so little during this period? Why has the changing social cross-section of the university, accompanied by increasing financial awards, resulted in no alteration in height and weight? Has less food at upper social levels in recent years exactly counterbalanced better nutrition at lower economic levels? Or is there an alternative explanation?

Further evidence is obtained from the average measurements of individual somatotypes in America and at Oxford. The data for this comparison is found in Table 3. Almost without exception it may be seen that the Oxford men are taller and heavier than the American students of similar somatotype. They are certainly slightly older (mean age 21·3 years) but the differences in height and weight are not small, amounting in half the number to more than 2 in. and in thirteen of the commoner somatotypes to more than 10 lb. To explain this on the basis of nutrition would necessitate the suggestion that food was much better and more plentiful in the United Kingdom than in the United States during the years in question. Such a suggestion would be hard to accept.

Table 4. *Percentage distribution of weight variation by sex*

	290 men (%)	171 women (%)
Gain (lb.)		
30–34	0·3	0·6
25–29	0·3	—
20–24	1·7	—
15–19	3·8	2·3
10–14	9·3	3·5
5–9	26·6	26·9
0–4	29·0	31·0
Loss (lb.)		
1–4	21·8	21·1
5–9	5·5	12·3
10–14	1·0	1·2
15–19	0·3	0·6
20–24	0·3	0·6

If, however, it is accepted that the major differences encountered in students' physique are the result of progressive selection of those with higher genetic endowment,* then the evidence falls into the line with that at the other end of the scale where mentally defective children are found to be smaller than normal children. To conclude that genetic endowment is likely to be the more important influence controlling the physical accompaniments of academic selection seems reasonable.

Weight variation during university residence

Discussion may now turn to records of weight variation taking place during university residence. The time of collecting data was conditioned by the annual routine overhaul. This did not allow such changes as seasonal variation to be adequately covered and, because the ex-military service group were older, evidence of the effect on weight of military training as distinct from age is small. In spite of this, evidence was gained on several points of interest, including the frequency distribution of weight gain and loss. An answer can be given to the following questions. Who gained weight, and who lost weight? Since ex-government-aided school men were behind in weight and stature on arrival at the university, did they

* A good deal less than 1 % of young men born in the United Kingdom reach Oxford or Cambridge.

subsequently gain more, or did the others maintain their lead when all shared common diet for at least 24 weeks in the year? Lastly, what evidence was there of the effect of tobacco and sport?

During their first year more women than men lost weight, and a significantly higher proportion of men gained 10 lb. or more (see Table 4). Is this due to some difference in dietary standards at men's and women's colleges? Does the stress of new surroundings and competition lie more heavily on the women, or do men mature physically later than women and consequently grow more after the age of eighteen? Are the younger women still losing what they sometimes describe as 'puppy fat'? Lastly, the older ex-servicemen might conceivably gain weight if university life came as an emotional relief after military service, but this possibility is immediately seen to be unsupported by analysis of weight changes associated

Table 5. *Percentage distribution of weight gainers and losers by age and sex*

	Men			Women		
Age group ...	17–19	20–22	23+	17–18	19	20+
n ...	81	128	81	54	69	48
	(%)	(%)	(%)	(%)	(%)	(%)
Gain (lb.)						
20+	3·7	1·5	2·5	—	1·4	—
10–19	19·8	10·2	11·1	9·3	4·3	4·2
0–9	64·2	53·1	50·6	53·7	65·2	52·1
Loss (lb.)						
1–9	12·3	32·8	33·3	35·2	26·1	41·7
10–19	—	2·3	1·2	1·9	1·4	2·10
20+	—	—	1·2	—	1·4	—

with age. Most of the men over twenty years of age were ex-servicemen and they actually gained weight less often than younger men in their first year at university (see Table 5). Older women undergraduates also show a smaller proportion gaining weight, but the difference is not significant statistically, and the distribution is uneven compared with men in that the middle group of 19-year-olds gained more often than the earlier and later groups. On the whole, the decline of weight gain with age, more especially in the men where it was significant, may be said to favour the explanation that growth is stopping, but the possibility of the sex difference being due to nutrition cannot be excluded on the evidence so far.

The next analysis given in Table 6 shows the proportion gaining and losing weight according to schools previously attended as well as by their military service. This table confirms what has already been suspected from the analysis by age that younger men, that is non-service men, more often gain weight at the university than ex-servicemen, and this is so whatever their economic grading or previous history in the shape of schools attended.

The second point, and one of particular interest in view of perennial complaints by boys about the standard of feeding in boarding schools, is that the ex-boarder less often gained weight than the ex-day boy once he had reached the university. At the university they shared the same diet for 24 weeks in their first year, and if

the difference were due to nutritional causes, surely the nutritional advantage if any, associated with a wealthier home during vacations, would favour the ex-boarder.

When those who attended elementary and secondary schools are contrasted with those from private and public schools, the greatest proportion gaining weight comes uniformly from the less wealthy homes. Of course it may be suggested that college food is so much better than food at home that those from less wealthy homes catch up their leeway at the university. How many undergraduates would think this explanation most probable is doubtful.

Table 6. *The percentage gaining and losing weight according to schools and military service*

Schools attended	Ex-servicemen				Non-service				All (241) men			
	Gaining		Losing		Gaining		Losing		Gaining		Losing	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Day	72	65·5	38	34·5	59	86·8	9	13·2	131	73·5	47	26·5
Boarding	38	61·3	24	38·7	20	66·6	10	33·3	58	63·0	34	37·0
Elementary	49	76·6	15	23·4	34	87·2	5	12·8	83	80·6	20	19·4
Secondary	43	69·4	19	30·6	46	90·2	5	9·8	89	78·8	24	21·2
Private	53	68·0	25	32·0	30	77·0	9	23·0	83	71·0	34	29·0
Public	62	64·6	34	35·4	32	76·2	10	23·8	94	68·1	44	31·9

Table 7. *Average weight gain in lb. during* 1 *year's residence according to endomorphy rating*

Endomorphy rating ...	2	2½	3	3½	4	4½	5	5½+
n	12	22	67	83	43	27	12	7
Average gain (lb.)	2·1	3·2	4·2	4·8	6·1	6·7	11·3	7·1

Evidence that the differences in weight were nutritional in origin seems weak; thus the need arises to look for another and more acceptable explanation. Can this be found in variation of growth and maturation associated with constitutional type? In Table 7 the average weight gain during the first year is given according to somatotype rating in endomorphy based on photographic appearance. There is a steady increase in the amount of weight gained in association with the degree of endomorphy, with the one exception that the gain shown by the most endomorphic group begins to diminish, but two of this small sample were actually on reducing diets!

In order to explain the difference in the proportion of weight gainers and losers from various schools by means of constitutional type ex-government-aided school men must show higher endomorphy ratings than ex-private boarding boys. This is seen to be so in Table 8 for as many as twenty out of ninety-one ex-private boarders (i.e. 22 %) had low ratings in endomorphy (2½ or less) in contrast to only nine out of 118 (i.e. 7·6 %) from government schools. This difference is significant. (Diff. ÷ S.E. diff. = 2·9.) Among those with higher ratings of four or more in endomorphy, there is once again a higher proportion from government schools, although it does not reach a significant level. The sum of evidence suggests that the differences in

proportion of weight gainers and losers may be explained by the particular somatotype recruitment from different types of school. This explanation, which is in keeping with the earlier findings reported here, seems more acceptable on the whole than attempted explanation by different standards of feeding.

Some progress has now been made towards identifying weight gainers by their constitution, and it is interesting to record here that among the 101 endopenes (men with endomorphy rated at 3 or less) only four, and they were central types, gained as much as 1 stone (14 lb.) or more during the year. In other areas of the somatotype chart such prominent weight gainers amounted to 20·5 % of thirty-nine endomorphic-ectomorphs, 15 % of sixty endomorphic-mesomorphs, and 16 % of fifty-six endomorphs.

Having advanced this far towards the identification of weight gainers and having come to the conclusion that constitutional form of growth and maturation explains the gains encountered better than nutritional differences, the next question to be considered is: Who lost weight and why?

Table 8. *Distribution of endomorphy ratings by type of schooling*

Endomorphy rating ...	1½	2	2½	3	3½	4	4½	5	5½	6	Total
Ex-government-aided schools	0	4	5	38	23	31	8	8	0	1	118
Ex-private boarding schools	1	11	8	18	20	21	7	4	0	1	91

Loss of weight and psychological upset

There were eleven men who lost 10 lb. or more in weight. Of these two lost intentionally on account of obesity, one lost following jaundice and one during a stay in hospital for a surgical operation. In one no cause was found. In the remaining six there was evidence of associated psychological or other stress, two were married and had to cope with prolonged family illness in addition to their work, two were under treatment for insomnia and depression, one was receiving psychiatric treatment for an emotional tangle connected with private aims in opposition to his family, the sixth was a difficult person who had been invalided from the forces and was undecided about his work until his faculty was changed. In all, there were eight out of eleven in whom conscious or subconscious psychological causes were operating, while in two only, the cases of jaundice and surgical operation, was 'organic' disease the chief feature. It is worth noting that two men actually gained weight during the year while they were developing pulmonary tuberculosis. Where routine annual radiography is employed to improve the chances of early diagnosis this may well be a more common experience than loss of weight. The traditional association of tuberculosis with loss of weight derives from hospital and other experience of advanced cases.

Among eleven women who lost 10 lb. or more one was on a reducing diet, and in five no cause was found, they appeared to remain in good health and it must be remembered in this connexion that in the table of gain and loss by age and sex, more women than men lost weight. In the five remaining subjects there were unmistakable signs of psychological disturbance lasting several months.

Sport and tobacco as causes of weight change

Change in weight of oneself or friends is a common enough topic of conversation, and while rowing is often accused of leading to a middle-aged spread, smoking is sometimes blamed for loss of weight. Both suggestions ignore the important preliminary question as to what sort of person plays games or smokes, and would he, whether he plays and smokes or not, be the sort of person who in the ordinary course of life would gain weight.

Sport

Table 9 compares the primary somatotype dominance of sixty-six men who participated in a prominent way in sport with thirty-five men who took little or no part at all. A much larger proportion of sports players are evidently mesomorphs, and the figures further suggest that the majority (74·3 %) with suitably

Table 9. *Primary somatotype dominance of games players and non-players*

	Endomorphs		Mesomorphs		Ectomorphs		Total	
	n	%	*n*	%	*n*	%	*n*	%
Prominent part in sport	7	10·6	49	74·3	10	15·1	66	100
Little or no sport	7	20·0	12	34·3	16	45·7	35	100

mesomorphic physique do in fact play games, whereas among those who take little part the required physique is more usually lacking. Special handicaps such as poor sight or defects arising from past illness may also operate as they did in eight of the twelve non-playing mesomorphs, four of whom had visual acuity of 6/36 or worse.

With such large constitutional differences present between players and non-players it seemed unlikely with the number available that, after allowing for constitution, any difference in their capacity to gain weight would be demonstrated in a clear and significant way as due to sport. Actually 67 % of sixty-seven footballers gained weight during their first year's residence, 72 % of 125 taking the lightest forms of physical exercise, and 79 % of seventy rowing men. These differences are not significant on the samples available, but neither are their constitutional differences in endomorphy although these show a similar trend. The mean endomorphic rating was 3·46 in footballers, 3·49 in those taking little or no exercise, and 3·50 in rowing men. In short, there is much evidence about the contrast in physique of those who play games and those who do not, but there is nothing here to confirm that playing itself either keeps down the weight of the footballer, or on the contrary increases the weight of rowing men.

Tobacco

With tobacco there is once more evidence of comparative constitutional addiction among endomorphs and endomorphic-mesomorphs, with abstention among those who are more ectomorphic. Table 10 gives the percentage distribution of those gaining and losing weight according to body build and smoking habits. In both body types there was a slightly higher proportion of non-smokers gaining weight, but the difference is not significant. The proportion of weight gainers and losers

differs to a greater extent by somatotype than it does by smoking, and this difference is significant. Robert Louis Stevenson gave it as a golden rule that no woman should marry a teetotaller or a man who does not smoke. At first sight it seems he was stressing the importance of smoking, but a woman marries a man, not his tobacco, and life with him may be the more comfortable as well as satisfying, if he happens to combine average endomorphy with his mesomorphy, and average tolerance with his strength. Such a man also gains weight in the ordinary course of events and, as the table indicates, his chance of natural gain in weight exceeds the likelihood of loss by smoking.

Table 10. *Percentage distribution of those gaining and losing weight, by body type and smoking habits*

	Endomorphs and endomorphic-mesomorphs		Ectomorphs and ectomorphic-mesomorphs	
	Smokers	Non-smokers	Smokers	Non-smokers
Total number ...	54	66	30	65
Gain in weight (%)	72·3	75·7	56·7	67·7
Loss in weight (%)	27·7	24·3	43·3	32·3
	100%	100%	100%	100%

CONCLUSIONS

1. Men from private and public schools were on the average about 1 in. taller and 5 lb. heavier than those from government-aided primary and secondary schools.

2. A similar socio-economic grading occurs in the general community.

3. The shortest and lightest undergraduate group is as tall and actually heavier than the highest social class level reached in the general community.

4. Compared with 1908–10 there is little evidence of change in height and weight of Oxford men in spite of great alteration in the social cross-section of the university.

5. Oxford undergraduates are substantially taller and heavier than the American students of identical somatotype reported by Sheldon, Stevens & Tucker (1940). The differences in height and weight amount in half the number to more than 2 in. and in thirteen of the commoner somatotypes to more than 10 lb. The differences are unlikely to be due to age alone.

6. The differences encountered are probably associated with progressive selection of men with high genetic endowment.

Weight variation

7. The percentage distribution of men and women gaining or losing weight during their first year of residence at the university is given. More women than men lost weight.

8. The proportion of men gaining weight diminishes as age increases and the cause is considered more likely to be associated with constitutional differences in cessation of growth, than it is to be of nutritional origin.

9. Non-military service men more often gained weight than ex-service men. This was so whatever their history of schools attended.

10. The ex-boarder less often gained weight than the ex-day boy after reaching the university.

Weight gain

11. Gain in weight is related directly to the constitutional rating in endomorphy based on photographic inspection on arrival at the university.

12. Significantly more ex-boarding schoolboys had low endomorphy ratings than among the men from government-aided schools.

13. The difference in weight gained by men from different schools may be explained by differences in somatotype recruitment from the schools concerned.

14. The lowest proportion of prominent weight gainers was found among endopenes, that is men rated three or less in endomorphy.

Weight loss

15. Among twenty-two students losing 10 lb. or more in weight, three were losing intentionally on a reducing diet. Among the remainder moderate or severe psychological stress and upset were recognized in six of nine men and five of ten women.

Sport and tobacco

16. There is strong evidence that the habits of playing games and of smoking are related to somatotype. Weight gain and loss is related to the physique of men who smoke or take part in sport. There was no evidence that sport or smoking are commonly responsible by themselves for more than comparatively small changes in weight.

Dr Josephine Webb, who has been engaged on a study of medical board records, kindly gave me the figures for height and weight of young men in each social class.

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