PAPERS AND ORIGINALS

Influence of body fatness in childhood on fatness in adult life

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Summary and conclusions

Comparison of skinfold thicknesses measured in childhood and again 15 years later in 318 male and 303 female subjects disclosed only a moderate relation between the two measurements. Where adult fatness could be predicted from combinations of skinfold thicknesses in childhood the accuracy in 95% of cases lay at the mean between ±8% and ±18% according to age and sex.

Introduction

Measurements of skinfold thickness give a reasonable estimate of total body fatness.[1 2] The use of skinfold measurements has brought into question the validity of indices of weight as measures of body fatness both in children[3 4] and in adults.[5 6] Recent studies have shown little relation between skinfold measurements made in infancy and repeated in childhood,[7 8] which contrasts with findings on the risk of overweight infants remaining overweight in childhood.[9 10] Estimates of the risk of overweight children remaining overweight as they grow older vary.[11 12] We report the findings of the first longitudinal study of the relevance of body fatness in childhood to body fatness in adult life as assessed from skinfold-thickness measurements.

Patients and methods

Between 1961 and 1962 members of 330 families were measured,[13] skinfold thicknesses being recorded in children aged 2-15 years. Between 1976 and 1977 as many as possible of these offspring, then aged 17-30 years, were traced and remeasured. Skinfolds were measured with a Holtain skinfold caliper at the triceps, subscapular, suprailiac, and biceps sites.[14] In a prestudy trial on 80 subjects aged 17-30 years (43 women, 37 men) the accuracy of duplicate measurements was found to be well within the 5% indicated by Edwards *et al.*[15]

The distribution of skinfold measurements was logarithmic. Log transformation of the data normalised the distribution.[15] Transformed data were used in the analyses. Regression analysis was carried out and correlation coefficients found for each individual skinfold measurement and for the four measurements combined—namely, triceps + subscapular + suprailiac + biceps (TBSS). The calculations were performed separately for male and female subjects for each year group individually (group 1), for two-year age groups (group 2), and for four-year age groups (group 3). As skinfold measurements change with age, standard deviation scores for the combined measurements in each subject were also calculated to allow the total groups to be considered together. The formula used was: score $=(x-\bar{x})/\sigma$, where x = the subject's TBSS, $\bar{x}$ = the mean TBSS of the subject's year group, and σ = the standard deviation of the mean of the variable. The means and standard deviations against which each subject was compared were the means and standard deviations for that subject's year group derived from the study population.

Where the correlations were significant residual standard deviations were used to determine the accuracy of the predictions of adult from childhood values. In normal data with a known standard deviation 1·96 standard deviations will include 95% of values, but our estimates of standard deviations are themselves subject to error based on the numbers in the samples, so that to be 95% certain of calculating the true values the limits must be widened by an amount dependent on the accuracy of the estimate of the standard deviation. We have used *t*-based intervals to estimate the number of standard deviations from the mean that will include approximately 95% of values, but recognise that the figures still very much represent a prediction at best. For the tails of the distribution (the very fat and very thin) the accuracy of the predictions will be worse than the figures we calculated.

Results

A total of 318 (90%) male and 303 (86%) female subjects were traced and remeasured. Tables I and II give the 15-year longitudinal correlation coefficients of the individual and combined skinfold thicknesses. The correlations of the standard deviation scores for the combined skinfold measurements between childhood and adult life were 0·56 for male and 0·45 for female subjects.

The accuracies of the predictions obtained from the residual standard deviations ranged at best in 95% of cases from ±10·5% to ±26·7% for individual skinfolds, and from ±8% to ±18% for combined skinfold thicknesses. By comparison adult height could be predicted in both male and female subjects from each year in childhood with estimated accuracies in 95% of cases of between ±4% and ±6%.

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TABLE I—*Fifteen-year longitudinal correlations of skinfold thicknesses in male subjects*

Age at first measurement (years)	No	Correlation coefficients				
		Triceps	Biceps	Subscapular	Suprailiac	Combined skinfolds
			Group 1			
4+	23	0·58	0·15	0·46	0·48	0·48
5+	35	0·38	0·10	0·35	0·14	0·36
6+	28	0·53	0·50	0·28	0·41	0·58
7+	24	0·53	0·42	0·85	0·72	0·65
8+	31	0·31	0·20	0·41	0·41	0·51
9+	21	0·73	0·57	0·51	0·59	0·67
10+	34	0·59	0·32	0·56	0·43	0·55
11+	21	0·41	0·11	0·51	0·64	0·61
12+	33	0·62	0·60	0·32	0·27	0·57
13+	30	0·80	0·74	0·77	0·43	0·59
14+	8	0·77	0·24	0·65	0·80	0·78
			Group 2			
2+	20	0·24	0·42	0·73	0·29	0·48
4+	58	0·47	0·16	0·43	0·39	0·48
6+	52	0·53	0·46	0·71	0·53	0·70
8+	62	0·59	0·44	0·52	0·50	0·63
10+	55	0·49	0·24	0·51	0·39	0·48
12+	63	0·67	0·67	0·60	0·38	0·56
14+	18	0·64	0·09	0·23	0·57	0·53
			Group 3			
2+	78	0·36	0·20	0·52	0·34	0·54
6+	114	0·47	0·44	0·59	0·54	0·58
10+	126	0·58	0·41	0·62	0·47	0·54

TABLE II—*Fifteen-year longitudinal correlations of skinfold thicknesses in female subjects*

Age at first measurement (years)	No	Correlation coefficients				
		Triceps	Biceps	Subscapular	Suprailiac	Combined skinfolds
			Group 1			
4+	14	0·07	0·44	0·48	0·06	0·06
5+	31	0·60	0·62	0·15	0·44	0·65
6+	33	0·32	0·24	0·18	0·20	0·24
7+	25	0·71	0·52	0·49	0·50	0·62
8+	33	0·57	0·47	0·46	0·38	0·45
9+	24	0·15	0·26	0·11	0·10	0·12
10+	38	0·33	0·51	0·46	0·44	0·46
11+	22	0·68	0·45	0·81	0·90	0·76
12+	29	0·38	0·51	0·44	0·62	0·63
13+	29	0·30	0·35	0·55	0·54	0·32
14+	8	0·21	0·40	0·22	0·27	0·51
			Group 2			
2+	17	0·62	0·21	0·30	0·14	0·14
4+	45	0·44	0·37	0·27	0·27	0·45
6+	58	0·53	0·46	0·36	0·38	0·49
8+	57	0·37	0·39	0·12	0·19	0·21
10+	60	0·53	0·49	0·80	0·64	0·65
12+	58	0·35	0·43	0·48	0·58	0·38
14+	18	0·21	0·44	0·28	0·30	0·31
			Group 3			
2+	62	0·46	0·36	0·21	0·32	0·35
6+	115	0·41	0·40	0·35	0·25	0·33
10+	126	0·40	0·46	0·53	0·49	0·50

Discussion

Our findings disclose a wide variation in the predictability of individual adult skinfold thicknesses from age to age in childhood and from site to site, with no clear pattern emerging. Analyses of the larger groups indicated a moderate degree of prediction of adult fatness from childhood values, the accuracies of predictions in the groups varying considerably. Separate analyses of the data from subjects with skinfold values in childhood over the 75th centile showed no differences from the whole group.

Combination of the four skinfold measurements used in this study as the indicator of body fatness[1] takes some account of variations in the distribution of subcutaneous fat and also shows least between-observer measurement error.[16 17] Nevertheless, some of the variation in the predictability of the individual skinfolds can probably be explained by changes in distribution of subcutaneous fat with age and some by between-observer measurement error.

We conclude that adult values of individual skinfold measurements and of combined measurements representing total body fat show considerable variation from childhood values. The accuracies of prediction of adult fatness from childhood can be made only with a poor degree of accuracy, and our figures calculated at the mean represent the situation seen in its very best light. We found, however, no evidence that obese subjects behaved in a way different from the whole group, but no doubt the accuracy of their predictions would be worse than the values given, as the standard error of a prediction is a hyperbolic function of the difference between the value from which the prediction is made and the mean of the observed sample.

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ONE HUNDRED YEARS AGO Intravenous injection of milk was performed for the first time in Ireland by Dr Robert McDonnell, one of the surgeons of Steevens's Hospital, on January 22nd. The subject of the operation was a man aged 30, who is a patient of Mr Austin Meldon, under whose care he has been, in the Dublin Provident Infirmary, since last November, suffering from enteric fever. He had profuse diarrhoea, which the ordinary remedies were incapable of permanently checking; there was also almost complete failure of the digestive powers, and he was consequently reduced to a state of such extreme exhaustion that death appeared imminent. On the suggestion of Dr Robert McDonnell, who saw the case in consultation with Dr Lyons and Mr Meldon, it was resolved to transfuse milk. Accordingly, a cow having been brought to the Infirmary, some fresh milk was procured direct from the animal, the milk being kept warm. Dr McDonnell opened the right median basilic vein, and, by means of his simple transfusion apparatus, injected nearly ten ounces of the milk. The pulse, which before the operation was barely perceptible, rose during it, and soon after became comparatively strong; but subsequently, as was also noticed in Dr Pepper's cases, there was great respiratory disturbance and capillary injection. In about two hours, these immediate effects passed away, the patient rallied wonderfully, and expressed himself as feeling comfortable and warm. At the time of writing (the sixth day after the operation), nothing could be more satisfactory than the patient's condition and progress. The diarrhoea has ceased, and his ability to digest suitable nourishment has greatly improved. We understand that Mr Meldon purposes bringing full particulars of this interesting and successful case before the Medical Society of the King and Queen's College of Physicians at an early date. (*British Medical Journal*, 1879.)