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ASSESSMENT OF LOSS OF HEIGHT IN ELDERLY WOMEN

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Loss of height with advancing years in women most commonly reflects the development of osteoporosis of the vertebral column. Moreover, height measurement from young adult life is often not available for making this judgement about a particular woman. Unless affected by fracture or Paget's disease of bone, alteration in hip length with age is unlikely. We have therefore examined the relationship between height and hip length in young adult Caucasian Australian women and used this to predict earlier 'maximal height' from hip length in elderly Caucasian Australian women. The equation used was maximal height = a + b hip length ($r = 0.65$, $n = 36$, $P < 0.0001$) where values for a and b were taken from the sample of young women, (a = 1.096 b = 1.185) and applied to the older women. The difference between 'maximal height' and 'observed height' then provided an estimate of 'loss of height'. For a representative sample of ambulant institutionalized elderly women aged 85 ± 6.47 years, (mean ± s.d.) range 70–98 years, the loss of height was 0.15 ± 0.07 m (mean ± s.d.), range 0–0.27 m. For such groups of women there should be value in knowing maximal height and loss of height at least in so far as assessment of lean body mass, adiposity (as BMI or weight (kg)/height(m)^2) and osteoporosis are concerned.

A knowledge of maximal height attained in adult life would often be of value in the assessment of elderly women. In the absence of records of height in young adult life, some way of predicting maximal height from contemporary data is required. Mitchell & Lipscitz (1982) have validated the use of arm length (acromium to wrist) and Chumlea *et al.* (1984, 1985) and Muncie *et al.* (1987) knee-height as alternatives to height. However, it is not always practical to use these methods with disabled subjects and other approaches are required.

We have taken the opportunity to examine the relationship between height and hip length (anterior superior iliac spine to knee joint space) in young adult women tertiary students (aged 18–29 years). Long bones, such as the femur, do not alter in length with age (Trotter & Gleser, 1951). These measurements have been used to predict 'maximal height' from hip length in elderly women (aged 70 years or more). The difference between maximal and observed heights allowed calculation of 'loss of height'. Loss of height may have several components, but the major one for the majority of women can be expected to be osteoporosis (Heaney, 1986) (Fig. 1).

Subjects and methods

We recruited 36 healthy young Caucasian women university students from an available 54 students from the nutrition and dietetic programme. In addition, a representative sample of ambulant elderly women aged 70–98 years was selected

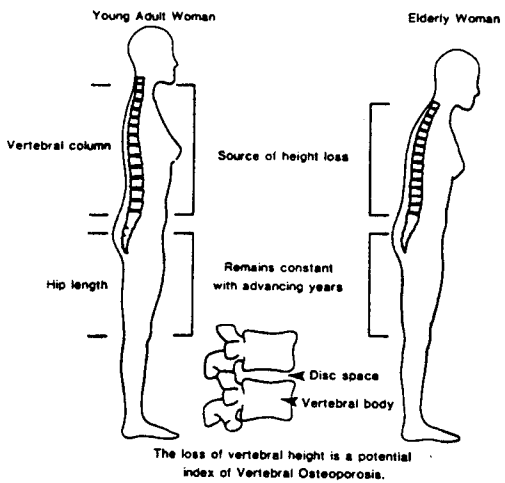

Fig. 1. *Source of height loss in elderly women.*

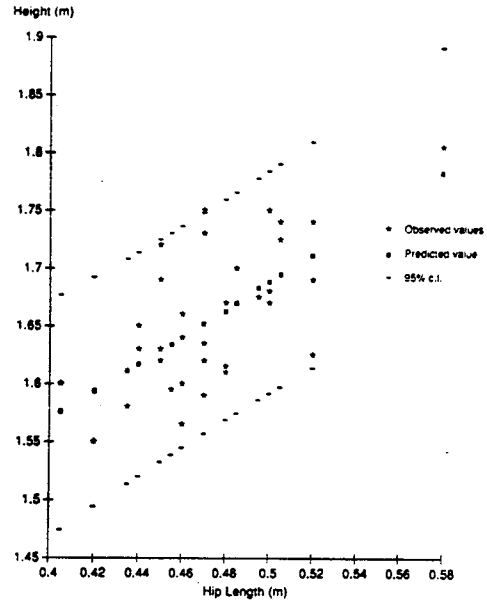

Fig. 2. *Relationship between height and hip length among 36 young adult women born in the 1960s.* $y = 1.096 + 1.185x$; $r = 0.65$; $P < 0.001$.

from a major institution for their care in the Australian State of Victoria.

All subjects had height measured, without shoes, to the nearest cm. Hip length was measured whilst recumbent on a hard flat surface, from anterior superior iliac spine to knee joint space, to the nearest 0.5 cm, using a flexible steel tape on the right side. All measurements were the average of three consecutive readings.

Simple regression analysis was used where appropriate. Significance level was set at 5 per cent. Confidence limits (c.l.) were used for the height-hip length relationship in young women.

Results

The relationship between height and hip length for young healthy women is shown in Fig. 2. This provided the equation height = a+b hip length to predict height from hip length.

The distributions of height/hip length ratios are shown in Figs 3A and 3B. There was a shift to a lower ratio in elderly women.

Using the equation from young women, each elderly woman studied then had maximal height estimated and loss of height calculated from the difference between maximal height and observed height (Table). The loss of height was 0.14 ± 0.07 m (mean ± s.d.).

The relationship between predicted maximal height and observed height is

Table. *Anthropometric characteristics and derivation of loss of height in 54 elderly women*

Variable	*Minimum*	*Maximum*	*Mean*	*s.d.*
Age, years	72	99	85	6.47
Weight, kg	36.0	76.5	55.5	10.72
Height, m	1.38	1.68	1.52	0.07
BMI, kg/m^2	15.00	35.20	24.11	4.45
Hip length, m	0.39	0.58	0.47	0.04
Maximum height, m	1.56	1.79	1.66	0.04
Loss of height, m	0.00	0.27	0.14	0.07
Loss of height, %	0.00	1.60	9.00	4.00

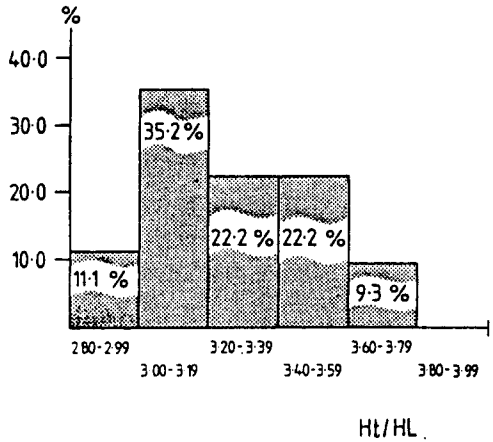

Fig. 3A. *Distribution of height/hip length in 36 young women.*

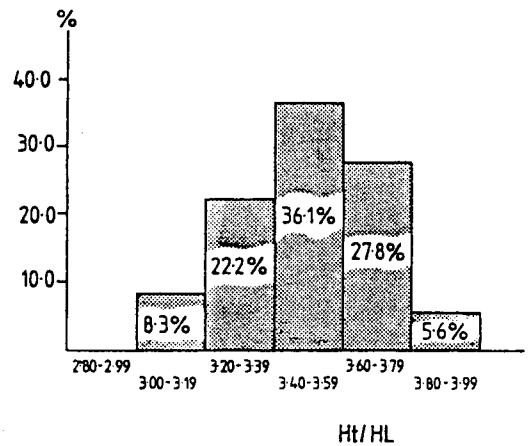

Fig. 3B. *Distribution of height/hip length in 54 elderly women.*

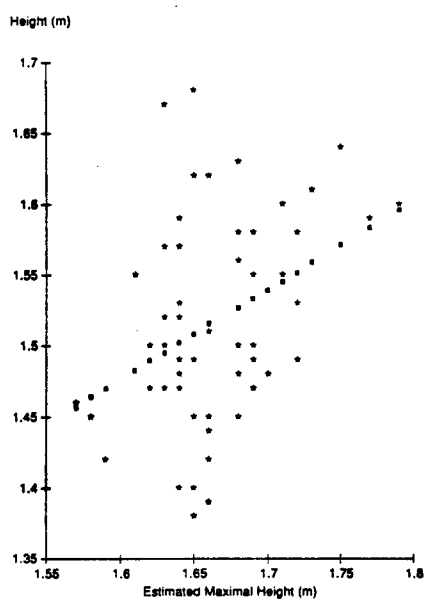

Fig. 4. *Relationship between observed height(*) and estimated maximal height (■) in 54 elderly women.* $y = 0.52 + 0.60x$; r = 0.362; $P < 0.0072$.

shown in Fig. 4. This relationship allows a consideration of the biological dependence of the observed height in elderly women on maximal height, derived from hip length in the same women; it is not compounded by mathematical derivation of one variable from the other. Since r is 0.36, the variance in observed height in elderly women accounted for by maximal height in earlier life is 13 per cent. On the other hand, percentage loss of height is not dependent on maximal height (r = 0.0375, $n = 54$, $P > 0.05$).

Discussion

Although there is a secular trend for height to increase by about 1 cm per decade (Tanner, 1962; Backwin & McLaughlen, 1964), this presumably resides in change in long bone length and will not alter any relationship between stature and hip length.

Where physical disability or loss of limb makes anthropometry difficult, alternative measures to assess stature, other than height, are desirable. The option of using hip length in later life to predict what height would have been in young adult life might well be applied to arm length (Mitchell & Lipschitz, 1985) and knee height (Chumlea *et al.*, 1984, 1985; Muncie *et al.*, 1987). An evaluation of these three methods in the one study or combinations of the limb measurements to improve predictive power would undoubtedly be worthwhile.

As far as loss of height as an index of osteoporosis is concerned, we see the need

to relate it to more direct indices of bone density for validation.

Whenever height is used in the nutritional assessment of elderly people, whether as a basis of calculation for lean body mass or adiposity (Wahlqvist & Flint, 1981), attention should be given to the value of estimating maximal height.

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