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Relationship of psoas width to osteoporosis

We have related the radiographic width of the psoas muscle to age, degree of osteoporosis, height, and weight, and to constitution in 234 subjects. The psoas width correlated well with age. When the subjects were grouped according to age, an association was observed between narrowing psoas width and increasing osteoporosis. Narrowing of the psoas was evident some years prior to radiographic evidence of osteoporosis.

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Muscle atrophy is an established feature of many forms of osteoporosis, and numerous studies have been undertaken to relate bone loss to muscle bulk, thickness, or weight (Chalmers & Ho 1970, Fowler 1971, Meema 1966, Meema et al. 1973). Doyle et al. (1970) compared the ash weight of the third lumbar vertebral body with the weight of the left psoas muscle at necropsy and found correlation between these variables even when body weight, age, and height were taken into account.

In the light of the above findings, we attempted to relate psoas width to age, weight, and degree of osteoporosis by radiographic methods.

Materials and methods

During a prevalence study of osteoporosis undertaken in Jerusalem, 3600 subjects were randomly picked from the voter registration list. Anteroposterior and lateral radiographs of the lumbar spine were obtained, and the latter were used for the assessment of the degree of osteoporosis. The standard criteria and grading of spinal osteoporosis were used as follows.

0. No abnormalities.
1. Borderline changes, trabecular thinning, questionable loss of bone density.
2. Definite thinning of trabeculae, vertical striation, density loss and plate accentuation.
3. Further loss of density, vertical trabeculation, end plate biconcavity wedging of a vertebral body.
4. Severe demineralization, multiple balloon discs, collapse of several vertebral bodies.

Grades 0 and 1 thus constituted no or doubtful osteoporosis while Grades 2–4 were considered as definitely porotic. The prevalence of definite osteoporosis of the spine for each age group was thus assessed and expressed as a percentage (Pogrund et al. 1977).

From the above sample, 240 subjects were selected randomly and the width of the body of the third lumbar vertebra at its waist and of the left psoas muscle at the same level were measured on an AP film (Figure 1). Six subjects were excluded because of poor radiographic visualization of the psoas muscle or because of the presence of scoliosis or other deformities of the third lumbar vertebra or spine. Our material thus comprised 117 females and 117 males, the film had been taken with a tube-film distance of 90 cm centered over L3. The psoas width related to the vertebral body width was used as a ratio. The rationale of this method was analogous to that of Doyle and associates (1970) employing size as a parameter rather

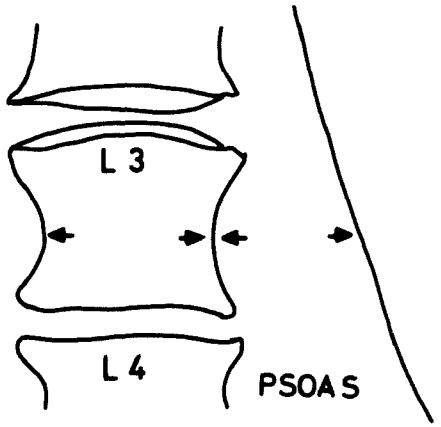

Figure 1. Radiographic measurements of the psoas width and L3 width.

than weight, the assumption being that a relationship must exist between these structures in the otherwise normal subject. We similarly noted a correlation between psoas and L3 widths in the youngest age group ($r = 0.76$, $P < 0.001$). No fractures were noted at L3 in this sample.

To reduce the errors in subjective radiographic assessment of the degree of osteoporosis and linear measurements, the radiographs were read and measured by two observers individually and subsequently checked by a third. In the event of disagreement – in 8 per cent of cases examined – the radiographs were jointly studied by two or three investigators and an agreed rating or measurement decided upon. The mean difference between the two investigators in reading psoas width was 1.7 per cent, and reading the L3 width 1.8 per cent, whereas that for two daily readings by the principal investigator was 1.9 per cent for psoas width and 1.3 per cent for the L3 width.

The weight/height ratio (W/H^2) was calculated (Florey 1970). The two-tailed Student's test was used unless stated otherwise.

Table 2. Psoas/L3 ratio[a] in relation to sex, age, and osteoporosis

Sex	Age	Osteoporosis Grade 0–1		Osteoporosis Grade 2–4
Females	55–64	0.72±0.09 (11)		0.56±0.05 (17)
	65–74	0.66±0.09 (25)		0.50±0.05 (7)
	75–84	0.65±0.08 (18)	***	0.57±0.07 (23)
Males	55–64	0.79±0.09 (13)	*	0.60±0.04 (5)
	65–74	0.75±0.10 (34)	*	0.55±0.04 (6)
	75–84	0.68±0.08 (43)	*	0.58±0.06 (8)

a (Mean±S.D.). Number of subjects in parentheses, * $P<0,05$, *** $P<0.001$.

psoas muscles and increasing osteoporosis among males and in the oldest age group among females (Table 2).

Narrowing of the psoas appeared some 10 years before osteoporosis became manifest in females, and in common with osteoporosis tended to increase with age (Figure 2).

Results

The psoas/L3 ratio of the total random sample was 0.67 ± 0.11 (mean ±S.D.). Two groups of individuals were thus formed: those with a ratio equal to or less than 0.67 and those with a ratio greater than 0.67 (Table 1).

We found no correlation between psoas width in mm and the weight/height ratio, nor was there any relationship between this ratio and the degree of osteoporosis.

The prevalence of narrower psoas muscles increased with age among females but not among males. When the three older age groups were examined separately, there was a correlation between the prevalence of narrower

Table 1. Relationship between age and psoas thickness in males and females

Psoas/L3 ratio	Age 45–54 M	45–54 F	55–64 M	55–64 F	65–74 M	65–74 F	75–84 M	75–84 F	Total
>0.67	7	13	12	7	29	12	24	8	112
<0.67	0	3	6	21	11	21	28	32	122
Total	7	16	18	28	40	33	52	40	234

$P<0.05$ (chi-square).

Discussion

Doyle et al. (1970) showed a linear relationship between the ash weight of the third lumbar

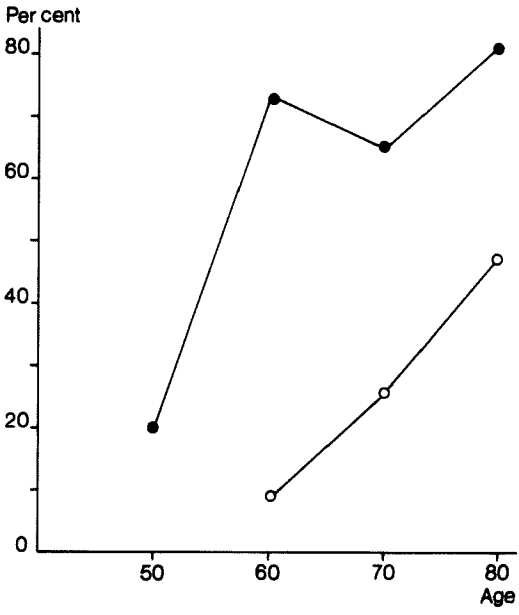

Figure 2. Frequency with age of narrow psoas muscle, ●, and osteoporosis, ○. The graph shows prevalence of the psoas/L3 width ratio <0.67 and radiographic osteoporosis Grade 2–4 in 234 random subjects, 10-year groups.

vertebra and the weight of the left psoas muscle. Our findings were similar, demonstrating correlations between osteoporosis and narrow (or less bulky) psoas muscles in both males and females.

Meema (1973), on the other hand, found a poor correlation between muscle mass and bone mineral content, and in fact, associated the presence of obesity with lesser degrees of osteoporosis rather than with differences in muscle bulk. We found no correlation between the weight/height ratio and psoas width at the level of the third lumbar vertebra, nor was there any positive or negative correlation between the degree of osteoporosis and the weight/height ratio.

Another observation in our study was the relationship of narrowing of the psoas to increasing age in females. The possibility exists that the latter is the reason for both muscle atrophy and bone atrophy. However, when different age groups were examined, there appeared to be a definite relationship between reduction in bone mass and loss of muscle width. Similarly, a decrease in muscle width in our subjects appeared to commence some 10 years before bone loss became apparent, but the two parameters then had similar trends. This would again suggest a causal relationship between reduction in muscle function and osteoporosis. Our findings conflict with those of Meema (1966), who found bone loss preceding muscle loss. Our findings were more in keeping with those of Garn (1970), who related tibial cortical thickness to muscle loss and showed that muscle appeared to atrophy more rapidly than bone. Our study suggests a more than casual association between age and muscle atrophy. We are presently engaged in a further investigation into the relationship between bone density and muscle mass to assess the effect of exercise on these parameters.

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