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NUTRITION, PHYSICAL ACTIVITY AND SKELETAL SIZE OF GIRLS AGED 16–18 YEAR

E. Morava and *Irén Somogyi*

Institute of Public Health and Epidemiology, University Medical School of Pécs, Pécs, Hungary

Abstract: The relations of some bone dimensions with the usual consumption of milk and milk products and with the level of physical activity were investigated. Schoolgirls aged 16–18 year were studied by somatometry and interviewed about nutrition and physical activity. They were groupped according to their usual intake of calcium from milk and milk products and according to their physical activity. Four groups were formed: (A) inactive, low milk consumption, (B) active, low milk consumption, (C) inactive, high milk comsumption, (D) active, high milk consumption.

The highest values of biacromial diameter, wrist diameter, humerus length were found in group D, but the maximum differences between the groups did not exceed 3.4%. In contrast, the breadth of the clavicle in group D was 6.9% larger than in group A.

The clavicular breadth corrected for skinfold thickness might be a useful indicator of skeletal size.

Key words: Nutrition, Milk consumption, Physical activity, Breadth of the clavicle, Skeletal size.

Introduction

Regular physical exercise and high intake of calcium are supposed to increase the skeletal mass and to prevent osteoporotic complications in later life (Albanese 1978, Matkovic et al. 1979, Smith et al. 1981, Speckmann 1985).

We studied the physical activity and the consumption of milk and milk products of girls aged 16–18 year and measured some anthropometric dimensions above their long bones. We tried to find out which dimension, if any, is the most sensitive to the level of physical activity and to the milk-intake of the girls.

Subjects and Methods

167 girls aged 16–18 year and attending secondary school at Pécs, Hungary were studied. They were interviewed about nutrition habits, especially about the usual intake of milk and milk products, about physical activity, health status and menarche. Girls with significant overweight were not accepted for this study (body mass index above 27).

Standard procedures as described by Cameron (1978) were used to measure body mass, height, upper arm length, biacromial width, biepicondylar-humerus and wrist diameter. The diameter of the clavicle was measured at the middle of the left clavicle on standing subjects, with shoulders slightly elevated and let forwards. The measurement was taken in the frontal vertical plane. At the same site, above the clavicle the skinfold was measured as well using Lange caliper. The breadth of the clavicle was calculated by subtracting the skinfold value from the clavicle diameter. The girls were groupped according to the usual daily intake of calcium from milk and milk products and according the to physical activity. Subjects with calcium intake above 1000 mg/day from milk and milk products were groupped into the high milk groups, the others into the low milk groups. Girls having regular sport training exceeding 4 hours a week were considered as physically active. Four groups were formed:

A) inactive, low milk consumption,
B) active, low milk consumption,
C) inactive, high milk consumption,
D) active, high milk consumption.

Results and Discussion

Table 1 shows the age distribution of the subjects in the different groups. The mean ages in the four groups were almost identical (between 16.34 and 16.50 year). The body mass and height were also similar (Table 2). Some dimensions measured above the long bones are summarized in Table 3. The group of physically active girls with high milk consumption had the highest mean values of biacromial diameter, of wrist diameter, of humerus length and of clavicle breadth. However, the inter-group differences were small. The maximum differences, expect clavicle breadth, were less than 3.4%. The difference in clavicle breadth between the low milk + low activity group and the high milk + high activity group was 6.9%.

Table 1. Age distribution of the subjects in the different groups

Age (year)	Number of persons			
	Group A	Group B	Group C	Group D
16	56	17	20	19
17	24	10	9	5
18	3	0	2	2

Table 2. Body mass, height and body mass index (BMI)* of the girls (means ± S.D.)

Groups	N	Body mass (kg)	Height (m)	BMI
A	83	55.73 ± .56	1.62 ± 0.06	21.2 ± 2.2
B	27	55.07 ± 6.85	1.62 ± 0.05	21.0 ± 2.2
C	31	54.77 ± 7.35	1.62 ± 0.07	20.9 ± 2.8
D	26	55.40 ± 6.73	1.63 ± 0.06	21.0 ± 2.2

$$*BMI = \frac{kg}{m^2}$$

Table 3. Bone dimensions in the different groups (means ± S.D.)

Measurement	Groups			
	A	B	C	D
Biacromial width (cm)	35.44 ± 1.54	35.27 ± 1.96	35.23 ± 1.31	35.77 ± 1.32
Humerus length (cm)	30.50 ± 1.63	30.45 ± 1.78	30.28 ± 1.58	30.69 ± 1.57
Humerus bicondylar width (cm)	6.14 ± 0.33	6.25 ± 0.36	6.05 ± 0.38	6.17 ± 0.21
Wrist diameter (cm)	4.97 ± 0.31	4.89 ± 0.28	4.97 ± 0.28	5.01 ± 0.24
Clavicle breadth (mm)	15.76 ± 2.37	15.85 ± 2.14	16.58 ± 3.50	16.85 ± 3.38

Anthropometry is frequently used in many areas of nutrition research including nutrition and growth, malnutrition and obesity. However, the measurement of the external

dimensions of the body has been scarcely used to study the effect of nutrition on the size or mass of the skeletal system. The only exception where external measurements are widely used for the estimation of the size of skeletal frame is the selection of the „ideal" weight for height. Some weight-height tables provide different „ideal" values for different body frames. A variety of body breadths has been suggested as measure of frame size (Frisancho and Flegel 1983, Garn et al. 1983, Himes and Bouchard 1985). In the recent Metropolitan Life Tables (1983) the skeletal mass in specified according to the bicondylar width of the humerus.

At present no low cost field method is used in the literature to study the effects of nutrition on bone mass. The techniques used for measuring bone mass are: radiography, single photon absorptiometry, dual photon absorptiometry, computerized tomography and neutron activation analysis. All these methods require special laboratory facilities, most of them are costly, and some of them involve undesirable doses of radiation as well (Cummings et al. 1985).

Osteoporosis and related fractures represent a major health problem in the developed countries. In women after climax the bone mineral content is decreasing. If bone density decreases under a certain threshold limit fractures become frequent. Women with high-density strong bones have more calcium reserves, so have a lower risk for osteoporotic complications. Thus increasing the bone mass of the teenagers serves the prevention of osteoporotic complications in later life.

Low cost and relatively simple methods are needed for large scale field studies of nutritional and other environmental factors influencing the development of the skeletal frame in teenagers. The results of our pilot study suggest that the measurement of the clavicular breadth might be a useful method for this purpose. It has been reported that the mineral content of certain long bones is positively related with their diameters in young people (Gergely et al. 1978, James 1984). Hovewer, further studies are still necessary to validate that clavicular breadth is a relevant indicator of the mass of skeletal frame in teenagers.

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Mailing address: Prof. Dr. Morava Endre
POTE Közegészségtani Intézet
Szigeti út 12. H–7643 Pécs, Hungary