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The evaluation of environmental factors on skeletal mineralisation in children

Primary osteoporosis (OP) and osteopenia (Opn) of developmental age are more frequently diagnosed as entire system disorder of unknown etiology. They often have insidious course without apparent clinical symptoms. The risk factors of decreased skeletal mineralisation in adults are well known. They include: advanced age, female gender, white and yellow race, femoral neck fracture (9). Besides, also dietary factors (among them: low-calcium diet, decreased supply of vitamin D, smoking, increased intake of alcohol) and environmental factors, the so-called development modifiers, in other words – biocultural factors (3, 5). The group of civilization-cultural modifiers include origin, education level and inactive lifestyle. Some publications emphasize considerable influence of development modifiers on growing and maturation of children and adolescents and their peek bone mass (11).

The aim of the study was to answer the question whether the selected bio-cultural factors can have any influence on the decrease of bone mineralisation in children.

MATERIAL AND METHODS

The examination included 85 children with primary decrease of bone mineralisation, aged 6.0–17.5 years. In 31 of them osteoporosis was diagnosed and in 54/85 – osteopenia. Secondary osteoporosis was excluded on the basis of anamnesis and results of laboratory tests. Bone mineralisation was assessed by dual energy X-ray absorptiometry (DEXA) method in total body and spine programme. Osteoporosis was diagnosed for Z-score values below two and osteopenia for Z-score between minus one to minus two (2, 11). In all children the level of education and the profession of parents, cigarette smoking in mother and father (passive smoking), the number of children in the family, breast-feeding in early life and birth weight were determined using a questionnaire. Current body weight, body height and the BMI index were also determined according to the commonly recommended methods (8).

The correlation between bone mineral density and anthropometric measurements was evaluated by means of Statistica 5.0 program.

RESULTS

The level of education of mother and father and parents' smoking habits (passive smoking) in all the children are demonstrated in Table 1. In 45/85 families children were passive smokers but more frequently the smoker was the father. In the case of 63 children both parents had secondary or vocational education. Spearman R correlation coefficients (R) between total and spinal bone

mineral density and birth weight, body weight, body height and the BMI index are presented in Table 2. All correlation coefficients were positive and statistically significant ($p<0.01$).

Table 1. The level of education of mother and father and parent's cigarette smoking (passive smoking) in children with osteoporosis and osteopenia (n=85)

Education Cigarette smoking		Children with osteoporosis	Children with osteopenia	Total
Mother's education	elementary	4	3	7
	technical	8	11	19
	secondary	13	24	37
	incomplete higher	0	1	1
	university	6	15	21
Father's education	elementary	3	4	7
	technical	12	16	28
	secondary	9	19	28
	incomplete higher	0	0	0
	university	7	12	19
Mother's cigarette smoking		11	13	24
Father's cigarette smoking		15	23	38
Mother's or father's cigarette smoking		8	22	30
Mother's and father's cigarette smoking		9	6	15
Non-smoking mother		20	41	61
Non-smoking father		16	31	47
Non-smoking mother and father		14	26	40

Table 2. Spearman R correlation coefficients (R) between total and spinal bone mineral density and birthweight, body weight, body height and the BMI index

Somatic index	Total body BMD (g/cm^2)		Spine L2-L4 BMD (g/cm^2)	
	R	P	R	P
Birthwieght (n=72)	0.245593	0.037579	0.269845	0.022859
Body weight (n=75)	0.855544	0.000000	0.787734	0.000000
Body height (n=75)	0.801635	0.000000	0.807776	0.000000
BMI index (n=75)	0.7264489	0.000000	0.582914	0.000000

All correlation coefficients were statistically significant, $p<0.01$

Birth weight in 75 children and time of breast-feeding or formula feeding in all children are demonstrated in Figure 1. Only 27 children were breast-fed for a period longer than four months.

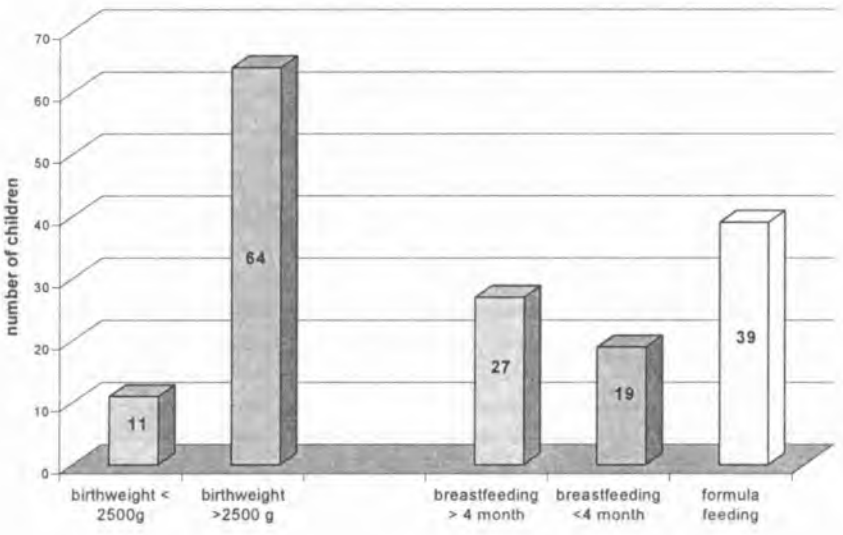

Fig. 1. Birthweight (n=75) and time of breast-feeding or formula feeding (n=85) in childern with osteoporosis and osteopenia

DISCUSSION

Bone mineral density depends on genetic, paragenetic and environmental factors (1, 3, 11, 9, 10). In our study the influence of selected environmental factors on bone mass was analysed. It was proved that bone mineral density depends on body weight and height, which is confirmed by the results of other authors (1, 3,10). Similar distinct relationship was detected between the current bone mass and birth weight in children, although M c G u i g a n et al. report that birth weight has no major importance on skeletal mineralisation (10). The other environmental factor, which may influence bone mass from babyhood, is the manner of feeding the baby. Breast-feeding is considered to be one of the most important ways in prevention of involution osteoporosis. It is emphasized that it should be regarded as the crucial factor in early prevention of this disorder (7). In our group of children with decreased bone mass 39 were formula-fed and 19 were breast-fed but shorter than four months. Both the short period of breast-feeding and formula-feeding are conducive to decreasing bone mineral density in later age. In literature it is emphasized that mother-dependent factors (including health state during pregnancy and smoking) have a strong influence on skeletal mineralisation (4, 6, 10). In our children 45 out of 85 were passive smokers, which may have negative influence on their bone mass, which is also reported in other authors' works (1).

An attempt at evaluation of the social status of the family was undertaken. It seems that in present economic situation of the Łódź region both education and occupation of parents were of lesser importance than employment possibilities. Most of the parents had secondary and vocational education, whereas the mothers were better educated than the fathers. In more than ¼ of the families at least one of the parents was unemployed. It is correlated with high unemployment rate in the Łódź province (in April 2004 it was 20.7% according to GUS data). Only in the city of Łódź there are more than 65 thousand unemployed, which constitutes 19.3% of all the active workers. It seems that the financial situation of these families may have an influence on bone mass gaining in children.

CONCLUSION

Formula feeding, exposure to cigarette smoke and family's low social status are all conducive to decreased bone mineralisation in children.

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SUMMARY

Primary osteoporosis and osteopenia of developmental age are diagnosed as systemic disorders of unknown origin. The risk factors of decrease of skeletal mineralisation in adults are well known. They include: age, sex, race, smoking, femoral neck fracture, rapid weight loss, early menopause and low bone mineral density. However, no comparable data have been found in children and adolescents. The aim of the study was to answer the question whether the selected biocultural factors can have any influence on the decrease of bone mineralisation in children. The study comprised 85 children aged 6 to 17.5 years in whom osteoporosis (31/85) and osteopenia (54/85) were diagnosed by means of densitometric examination; the interview and additional laboratory tests excluded any secondary causes of these disorders. All the patients submitted a questionnaire about their education level, occupation, parents' smoking habits, the number of children in the family and the duration of the breast-feeding period. Current body weight, body height and the BMI index were also determined according to the commonly recommended methods and the correlation between bone mineral density and anthropometric measurements was evaluated. In 63 children both parents had secondary or vocational education, and in 51 children the father was either skilled or unskilled worker. In 23 families, at least one of the parents was unemployed. Forty-five out of 85 children were exposed to passive smoking. Osteoporosis occurred more often in families with many children, although families with two children were most common. Only 27 children were breast-fed for a period longer than 4 months. The correlation between bone mineral density and anthropometric measurements were positive and statistically significant ($p<0.01$). It is

concluded that formula feeding, exposure to cigarette smoke and family's low social status are all conducive to decreased bone mineralisation in children.

Wpływ czynników środowiskowych na mineralizację kośćca u dzieci

Pierwotna osteoporoza i osteopenia wieku rozwojowego to coraz częściej rozpoznawane zaburzenie ogólnoustrojowe o nieustalonej etiologii. Powszechnie znane są czynniki ryzyka obniżonej mineralizacji kośćca u osób dorosłych. Należą do nich m. in.: wiek, płeć, rasa, palenie tytoniu, przebyte złamanie szyjki kości udowej, szybka utrata masy ciała, wczesna menopauza oraz obniżona gęstość mineralna kości. Nie znaleziono natomiast podobnych danych dotyczących dzieci i młodzieży. Celem pracy jest udzielenie odpowiedzi na pytanie, czy wybrane czynniki biokulturowe mogą mieć wpływ na obniżenie mineralizacji kośćca u dzieci. Badaniami objęto 85 dzieci w wieku od 6 do 17.5 lat, u których na podstawie badania densytometrycznego kośćca rozpoznano osteoporozę (31/85) lub osteopenię (54/85), a wywiad i wyniki badań dodatkowych wykluczyły wtórną przyczynę tych zaburzeń. U wszystkich pacjentów przeprowadzono badania ankietowe, w których pytano o poziom wykształcenia, zawód i palenie papierosów obojga rodziców oraz liczbę dzieci w rodzinie i czas karmienia naturalnego ocenianego dziecka. Oceniono także urodzeniową masę ciała, aktualną masę i wysokość ciała oraz wskaźnik BMI zgodnie z przyjętymi metodami. Wyliczono korelacje pomiędzy gęstością mineralną kości a wskaźnikami antropometrycznymi. U 63 dzieci oboje rodziców miało wykształcenie średnie lub zawodowe, a u 51 ojców wykonywany zawód mieścił się w kategorii robotnik wykwalifikowany lub niewykwalifikowany. W 23 rodzinach co najmniej jedno z rodziców nie pracowało zawodowo, natomiast w 45/85 dzieci były narażone na bierne palenie tytoniu. Osteoporozę rozpoznawano częściej w rodzinach wielodzietnych, chociaż najliczniej reprezentowane były rodziny z dwojgiem dzieci. Tylko 27 dzieci było karmionych naturalnie dłużej niż cztery miesiące. Należy wnioskować, że obniżeniu mineralizacji kośćca u dzieci sprzyjają karmienie sztuczne, narażenie na dym tytoniowy i niski status społeczny rodziny.