

CALCIUM DEFICIT IN DIET AS RISK FACTOR FOR OSTEOPENIC SYNDROME IN PREGNANT WOMEN OF YOUNG AGE

The study features of bone tissue mineral density and their correlation with blood levels of calcium, magnesium and non-organic phosphorus in young pregnant women. Clinical and ambulatory examination of 120 pregnant women of ages 16-25 was made. Estimation of bone tissue mineral density and blood levels of calcium, phosphorus and magnesium was performed during the pregnancy stage of 12 to 28 weeks. Among young pregnant women during II trimester, rate of osteopenic syndrome amounts to 17.5%, including osteoporosis of 1.7%. Development of osteopenic syndrome is attributed to general blood calcium deficiency. Development of osteopenic syndrome in young pregnant women is associated with decreased dietary consumption of calcium (owing to exclusion of milk products). Bone tissue mineral density is directly correlated with blood plasma levels of calcium.

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Osteopenic syndrome is currently widely considered among the most common pathologic conditions in developed countries (Benevolenskaya, 2003, CRIG, 2004). It is also known to be found more frequently in females (CRIG, 2004; Melton et al., 1997).

Up until the last decades, bone tissue mineral density (BTMD) deficiency has been associated with seniors. However, a large number of recent studies indicate that osteopenia and even development of osteoporosis is often found in people of young age, and predominantly young females (Benevolenskaya, 2004; Abdurazzakov, 2001).

Majority of scientists tend to believe that bone tissue mineral density deficiency in adults, especially young adults, can be attributed to the bone metabolism disorder and disbolism of calcium, phosphorus and other elements, suffered in childhood (Gafni and Baron, 2007).

Contributing to calcium - and phosphorus-related conditions are various factors: vitamin deficiency (mainly, vitamin D3); vitamin D disbolism due to immaturity of a number of enzyme systems; insufficient dietary intake of microelements; reduction of phosphorus and calcium intestinal absorption as well as their re-absorption in kidneys; endocrinal system disorder affecting phosphorus-calcium metabolism; microelemental status deficiencies and many other factors (Demin, 2005).

Several scientists have revealed a positive connection between life-long calcium intake and bone mineral density deficiency in young adults. Matkovic et al. analyzed the correlation of calcium balance and its consumption based on a survey conducted on 519 female patients from birth to the age of 30. As a result, primary determinant of calcium balance was found to be its consumption. On adolescent stage, calcium balance was increased; positive balance values have been attained by administering over 1500 mg per day, which resulted in elevation of bone mass peak (Matkovic et al., 2005). It was found especially significant to increase calcium administration in girls and young women of ages 12-19, as the average calcium consumption for this category is known to be 900 mg per day and therefore insufficient for adequate bone mass accumulation in future (Aspris and Francis, 2008).

Pregnancy introduces additional factors leading to further decrease of bone tissue mineral density. Of those, the leading one is the increased consumption of calcium, prompting its extraction from bone reserves. Thus, potential possibility of developing osteopenic

syndrome related to insufficient consumption or assimilation in juvenile and adolescent ages can reveal itself in young women during pregnancy.

With this in mind, we have conducted a study of characteristics pertaining to the metabolism of calcium, magnesium and phosphorus as elements of highest importance in forming bone tissue in pregnant young females.

Study the features of bone tissue mineral density and their correlation to the blood levels of calcium, magnesium and inorganic phosphorus in pregnant female young adults.

Materials and methods

Clinical and ambulatory examination of 120 pregnant women of ages 16-25 (median age 21.7+/-0.4 years). Estimation of bone tissue mineral density and blood levels of calcium, phosphorus and magnesium was performed during the pregnancy stage of 12 to 28 weeks.

Bone tissue mineral density study was conducted using ultrasonic densitometer Achilles Express, Lunar-General Electric Medical Systems.

Serum Ca, Mg and nonorganic P values study was performed on a Screen Master Plus (Switzerland) biochemical electrolyte analyzer, using standard array of reagents by Roche Diagnosis (Germany), using the facilities of Pavlodar maternity hospital.

Research results and their discussion

On the first stage of research, the examined pregnant subjects underwent ultrasonic densitometry, results of which are presented in Tables 1 and 2.

TABLE 1. YOUNG PREGNANT WOMEN'S ULTRASONIC DENSITOMETRY RESULTS

DI	t-criterion	z-criterion
85.9±4.7	-0.85±0.04	-1.17±0.04

It is evident that average value of density index (DI) and t-criterion did not exhibit significant (over 1.0) decrease compared to the reference population data. Such is only registered in case of z-criterion. At the same time, Table 2 data indicate that the test group has women afflicted not only with osteopenia, but also osteoporosis.

Results indicate that the decrease of BTMD was revealed by z-criterion. We believe that this is due to availability within the test group of very young pregnant women who haven't achieved the peak of bone mass that is normally characteristic of more mature persons.

However, spotting of osteopenia and even osteoporosis by t-criterion, as the most adequate for BTMD analysis in this age group, also indicated a significant portion of deficiency cases, totaling at 17.5%.

TABLE 2. DISTRIBUTION OF EXAMINED WOMEN IN TERMS OF THE DEGREE OF BTMD DECREASE, REPRESENTED BY VARIOUS INDICATORS

Indicator	Normal BTMD (d>-1.0)		Osteopenia (d<-1.0)		Osteoporosis (d<-2.5)	
	abs.	%	abs.	%	abs.	%
DI	107	89,2	12	10,0	1	0,8
t-criterion	99	82.5	19	15.8	2	1.7
z-criterion	88	73.3	28	23.3	4	3.3

Osteoporosis was revealed in 2 cases (1.7%) which, considering the total number of young pregnant women annually treated at the national facilities, presents a significant number and serious clinical problem.

Second stage of the study involved determination of the blood levels of calcium, magnesium and non-organic phosphorus, and comparative analysis of the collected data with the BTMD indicators. Table 3 presents the blood levels of the examined minerals

TABLE 3. BLOOD LEVELS OF Ca^{2+} , Mg^{2+} AND NON-ORGANIC PHOSPHORUS IN EXAMINED PREGNANT WOMEN

Indicator	Normal BTMD ($d > -1.0$), n=99	Osteopenia ($d < -1.0$), n=19	Osteoporosis ($d < -2.5$), n=2
Plasma Ca, millimole/l	2.41±0.13	2.20±0.11	2.04±0.00*
Plasma Mg^{2+} , millimole/l	0.83±0.05	0.81±0.06	0.85±0.10
Non-organic phosphorus content (millimole/l)	1.12±0.12	1.07±0.03	1.20±0.10

Notes: * difference from indicator in control group are valid, $p < 0.05$

Concentration of general Ca in blood plasma drifted toward decrease among test groups with BTMD deficiency. Valid differences have been revealed during comparison of women group with normal BTMD and the one with osteoporosis (for 15.4%, $p < 0.05$).

As for plasma Mg^{2+} , the test registered multidirectional tendencies in groups of pregnant subjects with osteopenia and osteoporosis. Value dispersion in the osteoporosis group (comprised of only 2 subjects, however) was higher than in the osteopenia group, and, obviously, much higher than in the group with no mineral density deficiency.

Conversely, blood levels of non-organic phosphorus had a tendency to decrease in the subgroup of osteopenia sufferers, and a tendency to increase in the subgroup of osteoporosis patients. Differences in this case were inconclusive.

Examined women underwent comparative analysis of consumption of milk products, as the primary source of calcium in the region concerned, as well as mineral-vitamin complexes administration, and juxtaposed that to the BTMD deficiency. Results are presented in Table 4.

TABLE 4. COMPARATIVE ANALYSIS OF BTMD DEFICIENCY AGAINST DIETARY ADMINISTRATION OF MILK PRODUCTS AND ADDITIONAL CALCIUM SOURCES ANAMNESIS (T-CRITERION)

Anamnesis data	Normal BTMD ($d > -1.0$), n=99		Osteopenia ($d < -1.0$), n=19		Osteoporosis ($d < -2.5$), n=2	
	abs.	%	abs.	%	abs.	%
Regular consumption of milk and milk products	93	93.9±2.4	10	52.6±11.5*	1	50.0±35.4
Infrequent or nonexistent consumption of milk and milk products; no nutritional correction.	2	2.0± 1.4	7	36.8±11.1*	1	50.0±35.4
Infrequent or nonexistent consumption of milk and milk products, with nutritional correction	4	4.0± 2.0	2	10.5±7.0	0	0.0

Table 4 data indicate that normal BTMD was validly revealed primarily in women who regularly consumed milk or milk products throughout their lives. At the same time, conclusive difference from the normal BTMD group was exhibited by women who refrained from milk and milk products consumption and nutritional correction. Osteopenia among those was revealed in (36.8±11.8)%, which is 18 times greater than in the normal BTMD group ($p < 0.05$).

Due to the small number of pregnant women afflicted osteoporosis, conclusive differences for the BTMD indicators against other groups were not registered.

Results of correlational analysis of blood levels of calcium, magnesium and non-organic phosphorus against BTMD indicator are rendered in Table 5.

TABLE 5. VALUES OBTAINED DURING CORRELATION OF BLOOD LEVELS OF BIVALENT METALS WITH BTMD PARAMETERS IN PREGNANT SUBJECTS OF YOUNG AGE

Indicator	DI		t-criterion		z-criterion	
	r	p	r	p	r	P
Plasma Ca, mmole/l	0.49	<0.05	0.55	<0.05	0.38	<0.05
Plasma Mg ²⁺ , mmole/l	0.29	<0.05	-0.03	>0.05	0.17	>0.05
Non-organic phosphorus content (mmole/l)	0.37	<0.05	-0.15	>0.05	0.20	>0.05

It is evident that there were significant and statistically valid correlations for total plasma levels of calcium against the BTMD parameters which were positive in all three cases.

As for plasma levels of Mg²⁺ and non-organic phosphorus, statistically valid positive correlations were revealed only in terms of DI ($p < 0.05$).

Data acquired during research thus allow one to form the following conclusions:

1. Among young pregnant women during II trimester, rate of osteopenic syndrome amounts to 17.5%, including osteoporosis of 1.7%;
2. Development of osteopenic syndrome is attributed to general blood calcium deficiency;
3. Development of osteopenic syndrome in young pregnant women is associated with decreased dietary consumption of calcium (owing to exclusion of milk products);
4. Bone tissue mineral density is directly correlated with blood plasma levels of calcium.

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