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**O.E. Loskutov,
E.M. Biletska,
V.V. Kalinicheva,
N.M. Onul,
D.A. Sinegubov**

CLINICAL AND HYGIENIC ASSESSMENT OF BONE MINERAL DENSITY IN POPULATION OF ECOLOGICALLY CONTRASTING TERRITORIES

SE «Dnipropetrovsk medical academy of Health Ministry of Ukraine»

Department of General Hygiene

Department of Traumatology and Orthopedics

V. Vernadsky str., 9, Dnipro, 49044, Ukraine

ДЗ «Дніпропетровська медична академія МОЗ України»

кафедра загальної гігієни

(зав. – д. мед. н., проф., Е.М. Білецька)

кафедра травматології та ортопедії

(зав. – академік НАМН України, проф. О.Є. Лоскутов)

вул. В. Вернадського, 9, Дніпро, 49044, Україна

e-mail: dsma@dsma.dp.ua

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Ключевые слова: костная ткань, остеопения, загрязнение окружающей среды

Abstract. Clinical and hygienic assessment of bone mineral density in population of ecologically contrasting territories. Loskutov O.E., Biletska E.M., Kalinicheva V.V., Onul N.M., Sinegubov D.A. Disorder of the relationship between biotic and abiotic elements against the background of anthropogenic stress on the human body affects the course of bone remodeling. It is bone tissue in the human body that has the greatest cumulative properties with respect to many xenobiotics, lead in particular. The accumulation of lead in the bone leads to the replacement of calcium ions by ions of the abiotic element and causes further changes in the bone structure: inhibition of growth processes, decreased density, the development of osteopenia and osteoporosis. In the article, a comparative hygienic analysis of bone mineral density levels (according to T-score) in industrial (n=68) and control (n=70) areas was conducted. The T-score, calculated at the LI-LIV level obtained by the method of dual-energy X-ray absorptiometry was used and was evaluated according to the recommendations of the WHO. The formation of a homogeneous sample of persons for the study was conducted according to the place of residence, age, sex, absence of diseases and regular intake of drugs which lead to a decrease in bone mass. Summarizing the results, it should be noted that the population of Dnipro city has a more negative and significant decrease in the bone mineral density (according to the T-score) compared to the same values of the control areas – 2.15-4.6 times and Ukraine's – 1.39-4.21 times. According to WHO recommendations, T-score indices for residents of industrial territory indicate to the presence of osteopenia, while among residents of the control area the norm for this indicator is noted. Consequently, there is an effect of man-made, pollution of the environment including lead on the level of bone mineral density in the industrial city, which contributes to the development of osteoporotic changes in the population.

Реферат. Клинико-гигиеническая оценка минеральной плотности костной ткани у населения экологически контрастных территорий. Лоскутов А.Е., Белецкая Э.Н., Калинин В.В., Онул Н.М., Синегубов Д.А. Нарушение взаимоотношений между биотическими и абиотическими элементами на фоне антропогенной нагрузки на организм человека влияет на ход костного ремоделирования. Именно костная ткань в организме человека имеет наибольшие кумулятивные свойства по отношению ко многим ксенобиотикам, в частности к свинцу. Накопление свинца в кости приводит к замене ионов кальция на ионы абиотического элемента, вызывает дальнейшие изменения структуры кости: угнетение ростовых процессов, снижение плотности, развитие остеопении и остеопороза. В статье проведен сравнительный гигиенический анализ уровней минеральной плотности кости (по T-критерию) у жителей промышленной (n=68) и контрольной (n=70) территорий. Использовали автоматически рассчитанный на уровне LI-LIV T-критерий, полученный методом двуэнергетической рентгеновской абсорбциометрии и оценивали его в соответствии с рекомендациями ВОЗ. Формирование однородной выборки лиц для исследования проводилось согласно месту жительства, возрасту, полу, отсутствию заболеваний и регулярного приема лекарственных средств, ведущих к снижению костной массы. Суммируя полученные результаты, следует отметить, что население г. Днепр

имеет более отрицательное и существенное снижение уровня минеральной плотности костной ткани (по T-критерию) по сравнению с аналогичными значениями контрольных территорий – в 2,15-4,6 раза и Украины – в 1,39-4,21 раза. Согласно рекомендациям ВОЗ, показатели T-критериев для жителей промышленной территории свидетельствуют о наличии у них остеопении, в то время как среди жителей контрольной территории отмечается норма по данному показателю. Следовательно, имеет место влияние техногенного, и в т.ч. свинцового, загрязнения окружающей среды на уровень минеральной плотности кости жителей промышленного города, что способствует развитию остеопорозных изменений среди населения.

Dissociation between biotic and abiotic elements against the background of anthropogenic load on the human body affects the course of bone remodeling [8]. It is the bone tissue in the human body that has the greatest cumulative properties in relation to many xenobiotics, in particular to lead [8]. Accumulation of lead in the bone leads to the replacement of calcium ions by ions of the abiotic element, which causes further changes in bone structure: inhibition of growth processes, decreased density, the development of osteopenia and osteoporosis [5].

Asymptomatic decrease in bone mineral density (BMD) is a risk of increasing the prevalence of fractures and mortality among the population [3]. From the standpoint of preventive medicine, prenosological diagnosis of osteopenic conditions is extremely important. Among the methods available today, dual-energy X-ray absorptiometry (DXA) is the most widely used and considered the "gold standard" in diagnostic methods of bone loss [4].

Thus, the aim of our study was to identify the impact of man-made environmental pollution on the reduction of bone mineral density (according to the T-test) of the residents of industrial areas.

MATERIALS AND METHODS OF RESEARCH

The paper presents the results of a comparative hygienic assessment of BMD levels (according to the T-criterion) of residents of industrial and control areas. Persons living in the industrial city of Dnipro were included into the experimental group (n=68).

The control group (n=70) included persons living in the cities of Dnipropetrovsk region with minor man-made pollution. Data were copied from densitometric studies on the basis of the Municipal Institution "Dnipropetrovsk Regional Clinical Hospital named after I.I. Mechnikov».

The formation of a homogeneous sample of persons for the study was carried out according to the requirements for epidemiological studies: place of residence not less than 5 years, age (22 to 64 years), sex, absence of diseases, bad habits, occupational hazards and regular medications taking, leading to a decrease in bone mass during 2011-2017.

We used automatically calculated T-test at the level of LI-LIV and evaluated it in accordance with WHO recommendations [6].

Statistical processing of the results was performed using standard methods of variational statistics [1] using the licensed software product STATISTICA 6.1 (StatSoftInc., Serial NAGAR909E415822FA). The results are presented as means (± SD).

RESULTS AND DISCUSSION

The results of the analyzed densitometric studies show that the value of BMD (by T-test) among the studied contingent on average ranged from -2.44±0.241 to -0.53±0.427 for men and from -1.98±0.134 to -0.89±0.209 – for women, respectively (Table).

Indices of the T-test of residents of Dnipropetrovsk region distributed according to the place of residence, M±m

Population (gender, place of residence)	T-score	Conclusion according WHO recommendations [6]
Men (Dnipro city)	-2.44±0.241*	osteopenia
Women (Dnipro city)	-1.98±0.134*	osteopenia
Men (control territory)	-0.53±0.427	within norm
Women (control territory)	-0.89±0.209	within norm

Note. * – p<0,01 compared to control territory.



The average T-criterion in men of Dnipro was 2.44 ± 0.241 , which is 4.6 times ($p < 0.01$) lower compared to men in the control group (-0.53 ± 0.427). Thus, there is every reason to believe that men in Dnipro have indices of osteopenia that approach

osteoporosis (Fig. 1), because according to the WHO [6] the value of the T-criterion of -2.5 and below corresponds to osteoporosis. At the same time, among the residents of the control area, the BMD (according to the T-test) is within the norm.

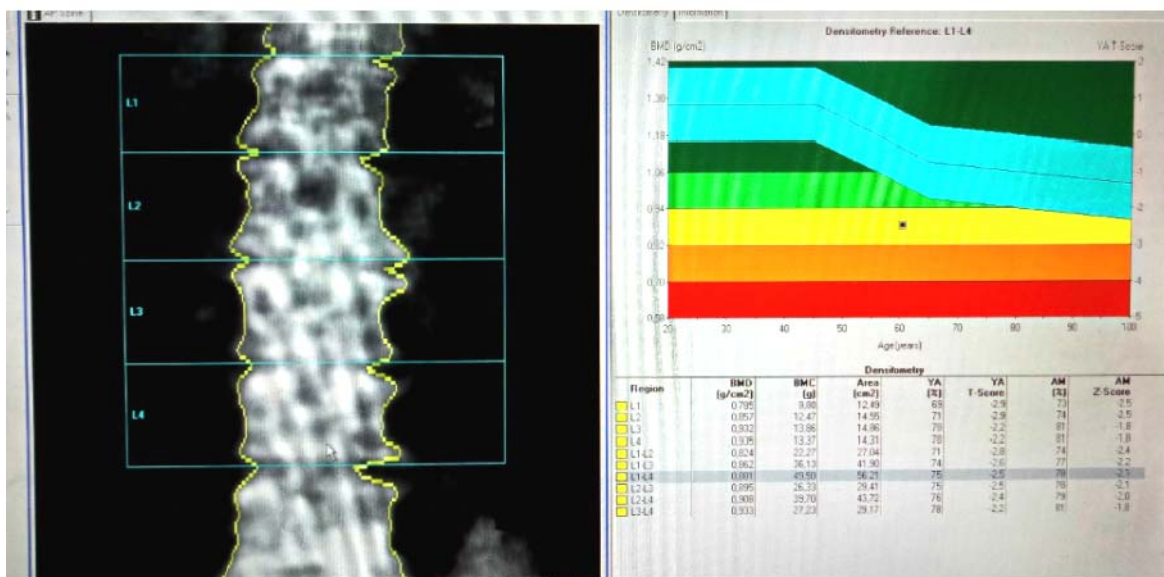


Fig. 1. Example of densitometry result of female patient V., osteopenia (by T-criterion, according to WHO [6])

According to the results of our study, T-criterion in the male population of Dnipro is 1.39 times lower compared to its average level (-1.75) in men in Ukraine [2]. In the residents of the control area, we found that T-criterion is 3.3 times higher than the average Ukrainian for men [2].

In female-residents of Dnipro, the average value of T-criterion was found at the level of 1.91 ± 0.134 , which corresponds to osteopenia, and 2.15 times ($p < 0.01$) lower than in the control area, in which the value of T-criterion corresponds to the norm (Fig. 2), being -0.89 ± 0.209 .

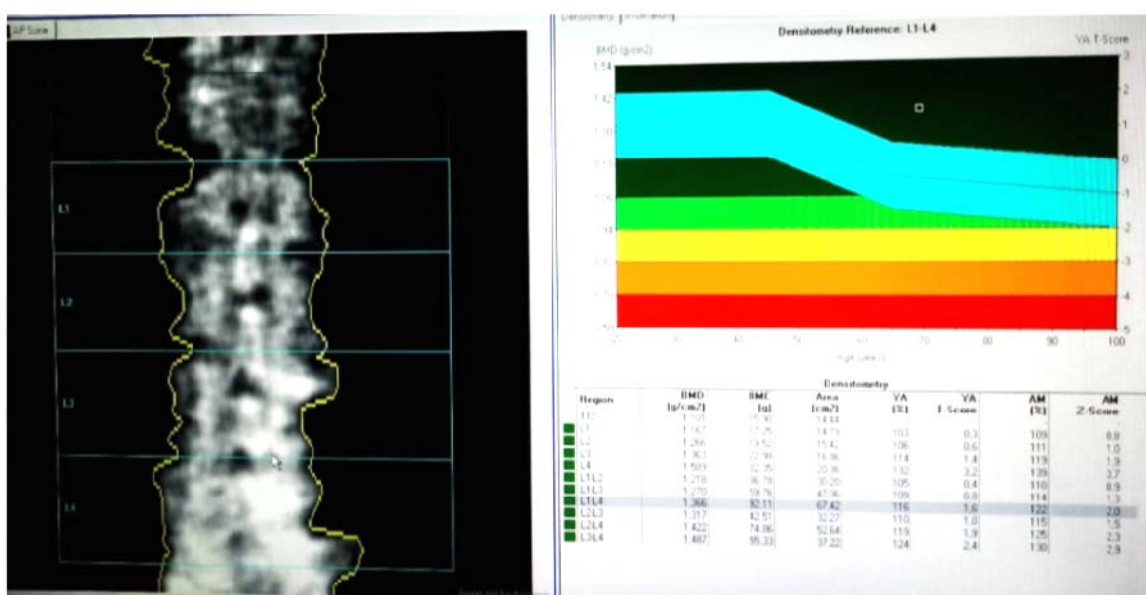


Fig. 2. Example of densitometry result of female patient B., norm, (by T-criterion, according to WHO [6])

According to our data, in women of Dnipro city and those of the control area, the T-test is 4.21 times and 1.13 times lower compared to its average level (-0.47) in women of Ukraine [7].

CONCLUSION

Summarizing the obtained results, it should be noted that the population of Dnipro has a more negative and significant decrease in the level of bone mineral density (by T-test) compared to similar values of control areas – by 2.15-4.6 times and Ukraine – by 1.39-4.21 times. According to the WHO recommendations, the values of T-criteria for the residents of the industrial area indicate the

presence of osteopenia, while the residents of the control area has normal values of the latter. Thus, on the basis of the obtained data it is possible to assume the influence of technogenic pollution on the level of BMD in the inhabitants of the industrial city, which promotes the development of osteoporotic changes among the population. For the final conclusion, it is necessary to apply deeper research methods and take into account other factors of influence, which is a prospect for our further research.

Conflict of interest. The authors declare no conflict of interest.

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