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Environmental and Occupational Risk Factors Effect to Arterial Hypertension: Correlation between Arterial Hypertension and Lead

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Abstract

The main risk factors for hypertension include smoking, the consumption of alcohol, poor dietary habits, lack of exercise, and stress. Scientists have also linked exposure to lead as a risk factor for hypertension. The goal is to assess the correlation of lead to arterial hypertension among miners of the Gobi region provinces. In the sampling we employed a random collection method with collection ratio of 1:2. One hundred miners with hypertension took part in the study. In the control group people without hypertension were assigned and they were of the same age and sex with the experimental group. Among the participants, those of working age had a high prevalence of hypertension and the disease is beginning to affect those of a younger age as well. 82% of those in the experimental group work in hard working conditions and 86% of them work for an average of 11.3 hours in noisy and dusty conditions. The increase of blood-lead content greatly depends on service length. Miners with arterial hypertension who worked for many years had a high content of lead in their blood. Lead content in the air outside of working places has a weak correlation (r = 0.3) with hypertension among those in the experimental group and was statistically significant (p = 0.007). With an increased blood-lead content, a risk for arterial hypertension (AH) increased two times (OR = 2.11 [95% CL; 1.52 - 2.94], p = 0.0001). But lead content in drinking water has an inversely associated with hypertension.

Keywords

Arterial Hypertensions, Correlation, Lead

1. Introduction

Studies of the World Health Organization shows that the main cause of death and cardiovascular disease in

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adults is hypertension [1]. The main risk factors for hypertension include smoking, the consumption of alcohol, poor dietary habits, lack of exercise, and stress [2]. Scientists have also linked exposure to lead as a risk factor hypertension. Every year, the atmosphere is harmed by human actions and the release of 3 thousand harmful substances. Each year 332.4 thousand tons of lead is released into the atmosphere. Coal, gas, and lead paint, are released in to the atmosphere through human action. Coal consists of arsenic, lead, mercury, nickel, cadmium, barium, and radium [3]. The lead level of particles in the atmosphere might influence hypertension and other cardiovascular diseases in coal workers depending on the length of their exposure to the coal (2007) [11]. Coal mining has negative effects on health. In foreign countries, there have been many studies regarding the effect of lead on hypertension, but in Mongolia, there is a lack of research in this issue. I believe it is important to conduct research on the influence of lead on hypertension and cardiovascular diseases in coal miners who have a higher rate of cardiovascular diseases than non-coal miners. In the last five years, circulatory diseases have been increasing among the population of the Gobi region; particularly in Omnogovi and Govisumber. In these regions, the rate of circulatory disease is now 568.8 per 1 thousand, which is higher than the national average (2013) [10]. This study shows that among the population of the Gobi region, the risk for cardiovascular disease is influenced by environmental factors, stress, smoking, poor dietary habits, and negative lifestyle habits.

In Mongolia, there have been many studies on the risk factors of circulatory diseases. However, there is a lack of research among the risk factors for cardiovascular diseases in the gobi region; particularly the effect of lead and other chemicals.

2. Materials and Methods

In this study, population based case controlling model, an analytic was used. For the study data analysis, SPSS 20.0 program where single and combined risk factors accounted by regressive investigation method were performed and results gained were expressed by odds ratio and 95% confidence interval (95% CI) p value.

3. Results

By random sample grouping in the casual group 34 hypertensive miners assigned whereas in the control group, 66 healthy non hypertensive of the same age were chosen. An average systolic pressure in casual group was 151.2 (±23.8) mm/Hg and diastolic pressure was 101.1 (±16.1) mm/Hg. As to age groups with an ageing morbidity rate increases and especially among the people aged 55 - 64 this rate is higher and more complicated. People of age group under 34 had arterial hypertension II, III and it shows that the disease is becoming common among younger population. Evaluated by one factor dispersion investigation, an average blood lead level in casual and control groups had a statistically significant differences ($p = 0.001$). Blood lead level of all participants was an average 5.77 μg/l (±1.83), 7.6 μg/l (±0.7) in casual group and 4.7 μg/l (±1.3) in control group. Participants of random sample group has a higher level of blood lead depending on service length ($r = 0.3$, $p = 0.005$) (**Figure 1**).

We assessed the lead level contained in air dust at and out of work places. The lead content is considered normal if it contained 0.003 mg^3 in air no more than 0.01mm^3 at work places and 0.03 mm^3 in drinking water.

During the study of the level of hypertension among mine workers, an inverse correlation was found between the level of lead in the drinking water and hypertension among miners ($r = -0.23$), with statistical significance of $p = 0.108$.

Accounted by correlation method blood lead level and service length had a weak dependence ($r = 0.347$) and statistical significance ($p = 0.015$) in a random sample group on mining place. As of working condition index was $r = 0.4$ or an average dependence that is statistical significance ($p = 0.007$) (**Figure 2**).

Correlation of arterial hypertension (AH) and blood lead content was calculated using non-parametric and Spearman ranking correlation factor. Blood lead content level had intense influence on higher diastolic and systolic pressure and a statistical authenticity ($r = 0.667$; $p = 0.0001$). Risk factors for influence of blood lead content on AH calculated by multi factors logistic regression. With an increase of blood lead content, a risk for AH increased as twice (OR = 2.11 [95% CI; 1.52 - 2.94], $p = 0.0001$) (**Figure 3**).

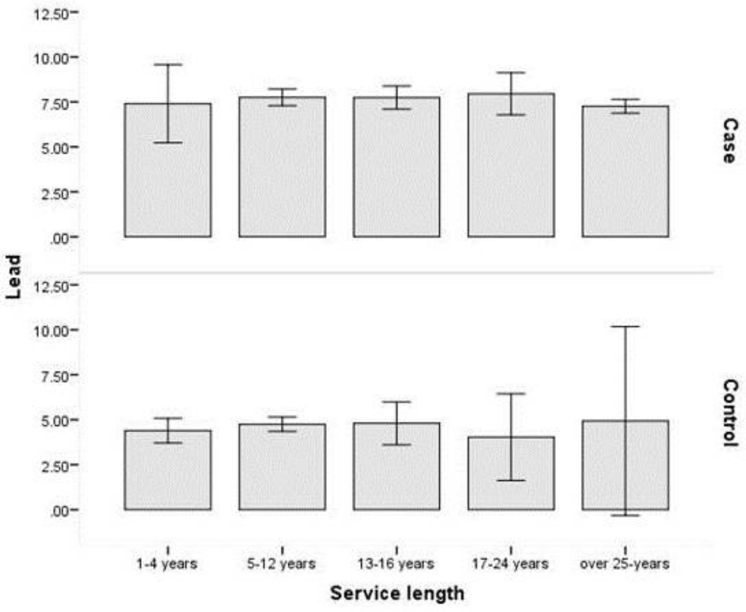

Figure 1. Service length and blood lead level.

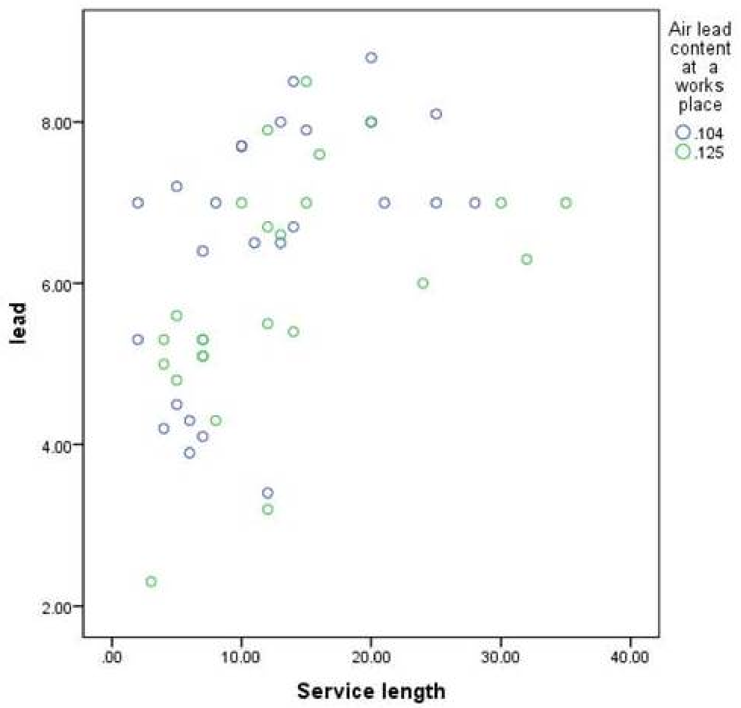

Figure 2. Correlation blood lead level of random sample group to service length air born lead content at a works place.

Because of lead influence, neurologic pathologies develop in organisms. As to health status of participants 64.7% of random sample group and 50% of control group revealed fatigue, but we did not observe any difference in statistical value (p = 0.29). 20.6% of random sample group and 40% of control group participants had a deteriorated concentration of attention (p = 0.743). As to resistance to high-frequency sound 35.3% of random sample group and 43.9% of control group participants had decreased resistance (p = 0.782) and 32.4% of ran-

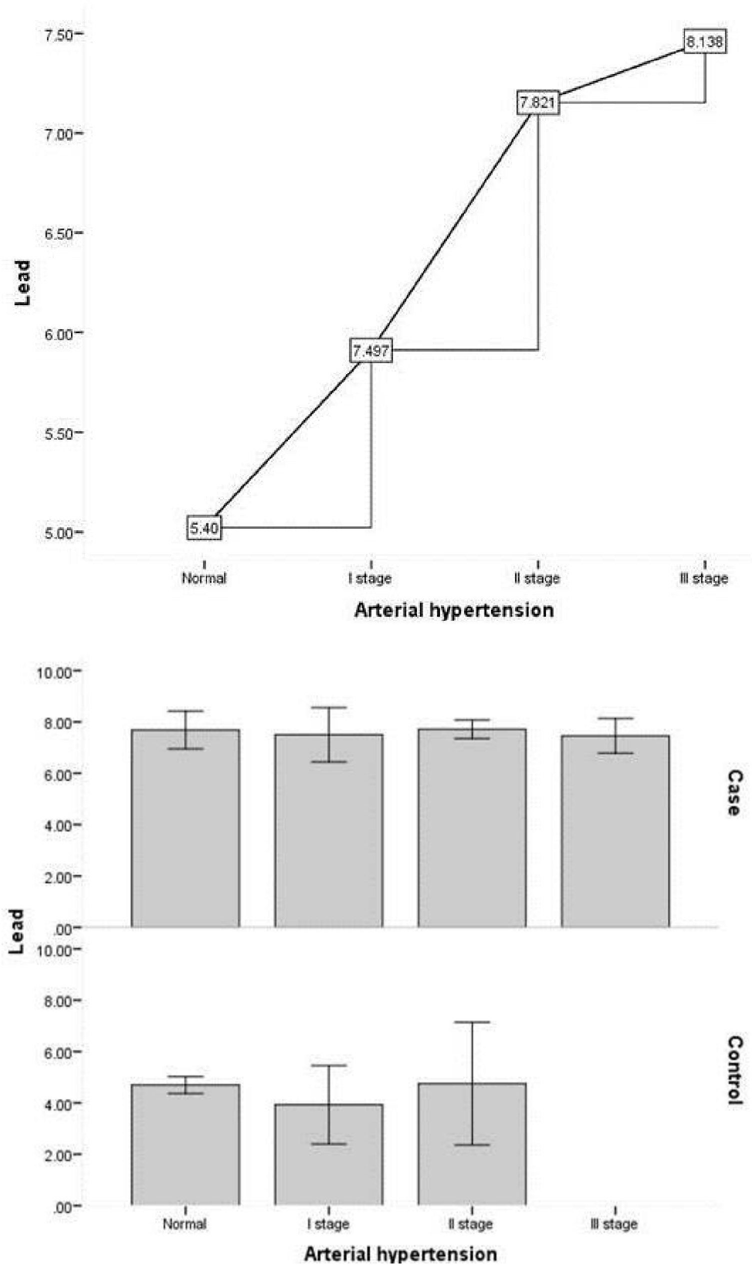

Figure 3. Arterial hypertension and blood lead dependence.

dom sample group and 34.8% of control group participants had a imbalanced motion, however it has no statistically significant (p = 0.995). But 44.1% of random sample group and 37.5% of control group participants had headache that had a difference in statistical value (p = 0.003).

Tobacco use becomes a risk factor for AH. Daily consumption of tobacco among participants of random sample group was more than 10 cigarettes than in the control group (OR = 2.09; p = 0.001). As for alcohol consumption participants of random sample group had a higher percent than in control group (OR = 2.09; p = 0.001).

We also established risk factors of working environment for AH, depending of working years. In the mine risk for AH increases 1.1 time, depending on working hour duration, the risk increases by 1.6 times whereas working condition increases the risk by 3.54 times and noise pollution increases the risk by 2.35 times.

Single factor logistic regression shows that blood lead content increases for 2.21 times depending on length of service, for the smokers of random sample group depending or blood lead content the risk, for AH increases by 1.66 times (OR = 1.66 [95%CI: 1.1 - 2.5], p = 0.013).

Depending on the lead level in the blood of selected people, the work environment is the main factor for an increased risk of hypertension. The risk factor for hypertension, depending on the work length, it increased by 1.96 (OR-1.96 [95% CI: 1.4 - 2.78], p = 0.0001). Depending on the bad and medium working conditions, the risk for hypertension is increased by 1.9 (OR = 1.9, [95% CI: 1.35 - 2.709], p = 0.0001). Depending on the work hours per day, the risk for hypertension is increased by 1.8 (OR = 1.8, [95% CI: 1.32 - 2.61], p = 0.0001). Depending on the noise level and environmental conditions, the risk of hypertension is increased by 2.01 (OR = 2.01, [95% CI: 1.4 - 2.89], p = 0.0001).

4. Discussion

Both animal and human experiments have found a relationship between the levels of lead in the blood and the development of hypertension [4]. A study by Poreba has showed that only workers with hypertension had high levels of lead in their blood, regardless of their profession. People who work in professions with high rates of exposure to lead were more at risk of developing hypertension. Scientists have found that the level of lead in the blood is a risk factor for hypertension. [5]. A study by Hu and Aro found that the levels of lead in the blood are positively associated with hypertension and that lead is the main cause of hypertension [6]. Blood tests were used to determine the levels of lead in the blood. Blood tests are the easiest way to determine lead poisoning. For the experimental group, the average blood-lead level was 6.4 ± 1.6 µg/l. The control group had an average blood-lead level of 5.1 ± 1.8 µg/l. We found a moderate correlation between blood-lead levels and hypertension. The blood-lead level was also correlated to career length. In in vivo and in vitro experiments, acute lead poisoning caused an increase in chronic hypertension, damaged the endothelin, altered the renin-angiotensin system, promoted arteriosclerosis, and increased the risk of developing cardiovascular disease [7]. In humans, high levels of lead in the blood, along with obesity, smoking, alcohol consumption, menopause, kidney disease, and poor diet, increased the risk of hypertension. In children, high levels of lead in the blood lead to an increased risk for neurological and psychological disorders. Such children are also at a higher risk for developing hypertension in the future. Animal experiments show that lead poisoning influences the production of endothelial cells and vascular smooth muscle cells and leads to hypertension. Hypertension causes inflammation, decreased hormone production, decreased calcium levels, decreased the ability of cells to absorb calcium, and increased stress. Some studied the effect of lead levels on hypertension in 8 rats. The rats received food and water containing 100 ppm of lead for 12 days. After 12 days, the average blood-lead level of the experimental group of rats was 12/4 mg/dl, higher than that of the control group with an average blood-lead level of <1 mg/dl [8]. The rats with lead poisoning showed an increase in action on the brain surface and in the small brain. However, the kidney surface remained normal while the presence of protein in the kidneys increased [9]. For workers, the levels of lead in the blood and the risk of hypertension increases with the length of time worked. If the level of lead in the blood is high, the risk of hypertension is doubled (OR = 2.11 [95% CI: 1.52 - 2.94], p = 0.0001). For the experimental group, the risk of hypertension was increased by 1.67 (OR = 1.67 [95% CI: 1.1-2.5], p = 0.013). For consumers of alcohol, the risk of hypertension is increased by 2.09 (OR = 2.09 [95% CI: 1.4-3.09], p = 0.0001).

Depending on the lead level of the blood of selected people, the work environment is the main factor for an increased risk of hypertension. The risk factor for hypertension, depending on the work length, it increased by 1.96 (OR-1.96 [95% CI: 1.4-2.78], p = 0.0001). Depending on the bad and medium working conditions, the risk for hypertension is increased by 1.9 (OR = 1.9, [95% CI: 1.35-2.709], p = 0.0001). Depending on the work hours per day, the risk for hypertension is increased by 1.8 (OR = 1.8, [95% CI: 1.32 - 2.61], p = 0.0001). Depending on the noise level and environmental conditions, the risk for hypertension is increased by 2.01 (OR = 2.01, [95% CI: 1.4-2.89], p = 0.0001).

5. Conclusions

1) Miners work for 11.1 hours in hard, noisy working environment (p = 0.001). Depending on the length of service increases a blood lead content. Evaluated by the lead content in air–born dust there is a weak correlation (r = 0.347, p = 0.015) lead contention drinking water had an inverse rate to AH

2) Higher content of blood lead alcohol and tobacco use and pointed working environment increase risks for

AH. Some results and materials of our study on hypertension and blood lead content correlation we exposed in form of posters and we invite you to see them.

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References

[1] Metoki, H., Ohkubo, T., Kikuya, M., Asayama, K., Obara, T., Hara, A., Hirose, T., Hashimoto, J., Totsune, K., Hoshi, H., Satoh, H. and Imai, Y. (2006) Prognostic Significance of Night-Time, Early Morning, and Daytime Blood Pressures on the Risk of Cerebrovascular and Cardiovascular Mortality: The Ohasama Study. *Journal of Hypertension*, **24**, 1841-1848. http://dx.doi.org/10.1097/01.hjh.0000242409.65783.fb

[2] World Health Organization (2009) Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks. World Health Organization, Geneva, 4-5.

[3] United States Affiliate of International Physicians for the Prevention of Nuclear War (1985) Coal Ash Toxics: Damaging to Human Health. Physicians for Social Responsibility.

[4] Gonick, H.C., Ding, Y., Bondy, S.C., Ni, Z. and Vaziri, N.D. (1997) Lead-Induced Hypertension: Interplay of Nitric Oxide and Reactive Oxygen Species. *Hypertension*, 1487-1492. http://dx.doi.org/10.1161/01.HYP.30.6.1487

[5] Poreba, R., Gac, P., Poreba, M., Derkacz, A., Pilecki, W., Antonowicz-Juchniewicz, J. and Andizejak, R. (2010) Relationship between Chronic Exposure to Lead, Cadmium and Manganese, Blood Pressure Values and Incidence of Arterial Hypertension. *Med Pr*, **61**, 5-14.

[6] Hu, H., Aro, A., Payton, M., Korrick, S., Sparrow, D., Weiss, S.T. and Rotnitzky, A. (1996) The Relationship of Bone and Blood Lead to Hypertension. *The Normative Aging Study*, *JAMA*, **276**, 1037-1038. http://dx.doi.org/10.1001/jama.276.13.1037

[7] Purdy, R.E., Smith, J.R., Ding, Y., Oveisi, N.D., Vazari, N.D. and Gonick, H.C. (1997) Lead Induced Hypertension Is Not Associated with Arterial Vascular Reactivity *in Vitro*. *American Journal of Hypertension*, **10**, 997-1003. http://dx.doi.org/10.1016/S0895-7061(97)00108-8

[8] Ding, Y., Gonick, H.C., Vaziri, N.D., Liang, K. and Wei, L. (2001) Lead-Induced Hypertension. III. Increased Hydroxyl Radical Production. *American Journal of Hypertension*, 169-173. http://dx.doi.org/10.1016/S0895-7061(00)01248-6

[9] Gonick, H.C., Ding, Y., Bondy, S.C., Ni, Z. and Vaziri, N.D. (1997) Lead-Induced Hypertension: Interplay of Nitric Oxide and Reactive Oxygen Species. *Hypertension*, 1487-1492. http://dx.doi.org/10.1161/01.HYP.30.6.1487

[10] Health Ministry (2013) Statistic of Health. Ulaanbaatar, 105-106.

[11] United States Department of Health Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry (2007) Toxicological Profile for Lead.