Study on Health Effects of Disassembling Imported Electrical Equipment

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Pollution of heavy metals (Deng 2001; Chen et al, 2001; Zeng et al, 2001; Yang et al, 2000) is a big problem in the environment concerns. This has done much harm to human. Recently some studies have been carried out by several research groups (Chang et al, 2000; Li et al, 1999; Borella et al, 1991; Deng 1991). this show that excessive heavy metals pose a great danger to the human body by presenting strong propagation resistance, obstructing normal embryonic development and affecting normal growth of children. The wastes from disassembling imported electrical materials that often contain high concentrations of heavy metals, which could be a threat to the environment and human health (Shen et al,2000; Wang et al,1997; Faller et al, 2001). To study the influence of this pollution on human health, investigations and epidemiological survey were carried out in a polluted area (Town A) and a controlled area (Town B). The values of hematology, serum enzyme, immune level, lymphocyte micronucleus and alkali resistibility of children's skin were measured among 60 disassembling workers (contact group) and 60 residents in Town A (control group 1), and 60 residents in Town B (control group 2). We found that: (1) the concentrations of hematology and serum enzyme in subjects of all the 3 groups were at normal level; (2) The average level of saliva IgA and platelets in subjects from Town A were significantly lower than those in Town B (P<0.01); and (3) the average lymphocyte micronucleus level of children from Town A was 1.43 ‰. These results indicate that pollutants from disassembling imported electrical equipment have some influence on blood biochemical indexes of people in the polluted area, which should be taken seriously.

MATERIALS AND METHODS

The investigation was carried out in two towns (named Town A and B). Town A has about 20 small to medium-size disassembling workshops which are open to air, consequently, this town is considered to be polluted. Town B, which is about 50 miles away from town A, does not have heavy metal pollutants and is thus assumed to be unpolluted. 60 disassembling workers (contact group) and 60

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residents who had never done disassembling work (control group 1) were selected from town A. Another control group (control group 2) of 60 residents chosen from Town B. In addition, 30 children from age 8 to 14 were selected as a group from Town A with the same number of children from Town B acting as a control group. Among these groups, hematology, serum enzyme, immune level, alkali resistibility of children's skin and lymphocyte micronucleus level were determined with the methods described in the following sections.

Hematology including Hb, WBC, W-SCR, W-LCR, PLT was tested with an automatic blood counter (Counter JT-IR) (Xiao 1994). An automatic analysis instrument (Toshiba TBA-30FR) was used to test serum enzyme samples containing GPT, GOT, y-GT, AKP. The immune level, which includes SigG, IgG, IgM and IgA (Qi 1996), was measured with an enzyme target instrument (DYNATECH MR4100).

To observe the protective condition of children's skin, a method proposed by Yao (1998) was applied to determine the alkali resistibility. 3 drops of NaOH solution (0.5M) were dripped to the middle of subjects' forearm every other 3cm. After that the forearm was immediately covered with a glass pane, which assured that the skin was permeated with the alkali liquid completely. If a red rash appeared after ten minutes This indicated a positive reaction, a second drop was applied. The same reaction may happen if the protective skin is affected by air pollutants such as SO_2. However, it should be remembered that it is normal to observe a positive reaction after the third drop.

To test the lymphocyte micronucleus level, 0.1mL blood sample was taken from every selected person. The blood sample was then centrifuged and the resulted lymph cell liquid was dried to obtain a flake. In this way three flakes were prepared from each blood sample, which were consequently dyed with Giemsa. The flakes were finally tested with an electronic microscope to obtain the lymphocyte micronucleus level.

RESULTS AND DISCUSSION

Figure 1 shows the sex distribution of the investigated persons. As can be seen in the figure, there are more males than females in the contact group, because most disassembling workers were male. A fact to mention is that their living habits are almost the same in different places.

The test results for Hb, WBC, W-SCR, W-LCR and PLT are shown in Table 1. As can be seen in this table, the concentration of hematology was in the normal range for all groups (contact group and control group 1&2). For the contact group, there was no indication of higher Hb and WBC or lower PLT than the normal range.However, the Hb content was different between the contact group and the
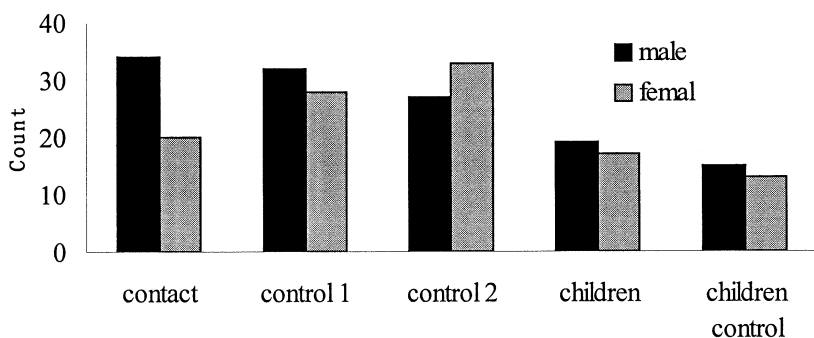
Figure 1. The sex poroportion of each group

Table 1. Statistics analysis of the value of hematology of each group

Project	Contact Group n=54	Control Group1 n=61	Control Group2 n=60	Children Group n=36	Children Control n=26	Standard (China)
Hb (g/L)	138.1± 18.4	131.1± 15.5	132.3± 13.7	128.6± 9.4	126.0± 10.4	110-150
WBC ($\times 10^9$)	5.7±1.5	5.6±1.3	5.8±0.2	5.1±1.0	5.7±1.2*	4.0-10.0
WSCR (%)	0.41± 0.09	0.40± 0.10	0.43± 0.09	0.47± 0.07	0.49± 0.07	0.20-0.40
WLCR (%)	0.59± 0.09	0.60± 0.10	0.57± 0.09	0.53± 0.07	0.51± 0.07	0.55-0.75
WSCC ($\times 10^9$)	2.3± 0.78	2.2± 0.71	2.5± 0.60	2.4± 0.60	2.89± 0.48*	0.8-4.0
WLCC ($\times 10^9$)	3.41± 1.10	3.4± 1.30	3.4± 1.10	2.7± 0.70	3.0± 0.90	2.0-7.0
PLT (g/L)	173.2± 38.3	160.2± 40.8	206± 54.4**	214.8± 38.0	227.3± 46.6	100-300

*P<0.05, **P<0.01

controls, which may be due to the different sex proportions between the contact and control groups. The PLT concentration of the contact group was lower than that of the control group 2 even though both were in the normal range. Similarly, the PLT level of children selected from Town A were also lower than that of Town B. The WBC concentration of children in Town A was apparently much lower than that of the control. Thus we may conclude that the disassembling people's PLT concentration was generally lower. This indicates that the health was affected by the pollution to some extent.

In order to test whether the disassembling imported electrical equipments were harmful to the liver, we tested the serum enzyme samples taken from the selected groups.

Table 2 shows the results of this test, from which we can see that there were no apparent difference in concentrations of GPT, GOT, y-GT and AKP among the contact group, control group 1 and control group 2. However, it was found that individuals with higher level of GPT and GOT have a higher probability of getting acute hepatitis. The AKP level of people in Town A is a little lower than that of Town B, but both are in the normal range.

Table 2. Statistics analysis of serum enzyme of each group

Project	Contact Group n=54	Control group1 n=61	Control Group2 n=60	Children Group n=36	Children Control n=26	Standard (China)
GPT (u/L)	19.8± 12.8	18.8± 16.1	19.9± 14.7	11.1± 4.5	12.8± 5.5	<35
GOT (u/L)	16.0± 8.1	16.4± 10.4	19.1± 14.6	17.6± 4.8	20.1± 6.7	<40
y-GT (u/L)	20.0± 13.7	17.5± 12.8	18.9± 19.0	12.2± 11.0	12.2± 2.6	<25
AKP	54.8± 10.7	55.7± 16.8	67.7± 21.1**	129.8± 37.3	124.0± 38.7	<200

*P<0.05, **P<0.01

Table 3. Statistics analysis of immune level of each group

Project	Contact Group n=54	Control Group1 n=61	Control Group2 n=60	Children Group n=36	Children Control n=26	Standard Zhejiang
SigA (ug/ml)	315.7± 151.3	353.6± 184.7	402.9± 212.6*	196.5± 104.2	268.6± 102.5**	314
IgA (ug/ml)	normal value	0.7-3.3		2.1±1.1	2.1±1.4	0.7-3.30
IgG (ug/ml)		8.0-16.0		6.3±3.0	6.3±4.6	8.0-16.0
IgM (ug/ml)		0.5-2.2		2.4±1.2	2.4±1.3	0.7-2.20

*P<0.05, **P<0.01

Radiate immune method was used to determine saliva IgA level and the results are shown in Table 3. We can see from this table that the IgA concentration of the people in Town A was lower than that in Town B. However, infectious diseases

such as flu or parotitis had not been found in this investigation, nor had abnormal throat appearance in physical examinations. Thus it is very likely that the distinctive protective immune had been affected to some extent in this area.

Table 4 shows the results of alkali resistibility test of children's skin. It can be seen that the proportion of alkali resistibility weakened is much higher in Town A than in Town B, indicating a possible negative influence from disassembling pollutants. This should be taken seriously.

Table 4. Results of alkali resistibility of children's skin

Place	Num. of People	Num. of Weakened	%	Num. of Fine	%
The very town	32	7	21.9	25	78.1
Neighbor town	25	2	8.0	23	92.0

Table 5. Results of microkernel rate test

age	male	female	total	microkiernel rate(‰)
Children	8	6	14	1.43±0.65
20-30	13	7	20	1.15±0.38
31-40	10	12	22	1.70±0.48
41-50	12	8	20	2.17±0.59
51-	11	1	12	2.73±1.73
total	46	28	74	
microkiernelrate(‰)	1.91±0.94	1.54±0.58		1.77±0.84

*Normal microkiernel rate of Zhejiang: 0-1.5‰

Cell genetics may be altered by environmental pollution, which is mainly shown as chromosome mutation or gene mutation. Lymphocyte micronucleus level reflects chromosome section of organism cell under the influence of mutation materials, which indirectly indicates the condition of chromosome aberration. For normal people, the mutation rate is relatively constant, though it may go up as age increases. Some persons from both Town A and Town B were selected to do the lymphocyte micronucleus level test and the results were shown in Table 5. The sex and age distribution of the tested people was similar to that of the residents in Town A. The results indicate that the average lymphocyte micronucleus level is a little higher than that of the normal adults' (0-1.5‰). The children's lymphocyte micronucleus level was at the upper limit of the average even though it did not exceed the normal range. Therefore this test implies that disassembling electrical equipments may influence the human cell directly or indirectly, which consequently would affect the human health.

In general, our studies show that disassembling imported electrical equipment has some negative influence on human health. More specifically, it could change some blood biochemical indexes of people in the polluted area. It was found that the PLT level of the residents in polluted area was lower than that of unpolluted area. The average lymphocyte micronucleus level of residents (both adults and children) in polluted area was higher than that in unpolluted area and this level was already at the upper limit of the normal range for children. Non-distinctive immune test showed that both adults and children's saliva IgA as well as the alkali resistibility of children's skin were weakened in the polluted area. From these results it may be concluded that disassembling import electrical equipment can damage the distinctive immunity to some degree. It is thus suggested that monitoring and administrating of disassembling import electrical equipments should be strengthened in the future. It is also advisable to improve the health monitor system of the disassembling workers and children to detect early indication of negative health influence. Further research is needed to gain deeper understanding of how disassembling electrical equipments influences human health.

REFERENCES

Deng LF(2001) Physiological effects of zinc on human body. J XiAn Unit Univ 4:91-93

Chen ZL，Mo PL，Qiu RL (2001) Biological damage of soil cadmium pollution and its control. Environ Prot Sci　27:37-39

Zeng ZH，Zeng XP (2001) The form of iron on human health in ground water. Guizhou Environ Prot Sci 7:17-24

Yang ZX，Liu SQ (2000) The effect of compound pollution of heavy metals on rape. J Hebei Agric Univ 23:27-30

Chang XX，Wen CH，Wang FX (2000) Effect of heavy metal pollution on human health and sustainable dvelopment. Yunnan Environ Sci 19:59-61

Li HB，Qi P，Yao XP，Wang XH (1999) The study development of lead on human health. Environ Herald 1:32-35

Borella P，Ni CB (1991) Accumulation of cadmium, nickel,chromium and lead on human lymph cells. Foreign Medi Sci 12:25-27

Deng ZR (1991) Heavy mental pollution on human health. Environ Health 12:26-27

Shen DS，Zhu YM (2000) Study on the Leaching of pollutants in solid from disassembling import electrical equipment. Acta Sci Circum 3:382-384

Wang GQ，Li W(1997) Discuss the importance of the environmental risk

assessment of the import solid wastes. Guizhou Environ. Prot Sci Tech 2: 39-40

Faller H, Ott G, Wurster U (2001) Exposure to hazardous substances during the recycling of old clectrical/electrinic devices? Gefahrst Reinh 61: 175-180

Xiao XX (1994) Radiation immune analysis. Tongji University Press, Shanghai, China

Qi RD (1996) Study on diagnosis. People's Medical Publishing House, Beijing, China

Yao ZQ (1998) Environment and hygiene. People's Medical Publishing House, Beijing, China