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הסתדרות מדיצינית הדסה
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August 31, 2000

PPC/CDIE/DI.
U.S. Agency for International Development
Room 6.07-154; RRB
Washington, D.C. 20523-6701

Re: FINAL REPORT of Grant Number: TA-MOU-95-CA015-025 entitled: "The Effect of Prenatal Lead Exposure on Neurobehavioral Development: A Survey in Tshimkent, Kazakhstan".

Dear Sir / Madame,

Enclosed is a copy of our final report with a set of Tables and Figures.

In behalf of all co-investigators I would like to express our gratitude to the US-AID for the support which enabled us to carry out this project.

Sincerely,

Y. Amitai

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FINAL REPORT (August 2000)
Covering period: 1996-1999
Submitted to the U.S. Agency for International Development; Bureau for Global Programs, Field Support and Research; Center for Economic Growth

TITLE: "THE EFFECT OF PRENATAL LEAD EXPOSURE ON NEUROBEHAVIORAL DEVELOPMENT: A SURVEY IN POLLUTED AREA IN TSHIMKENT, KAZAKHSTAN"

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Grant Number: TA-MOU-95-CA015-025
Grant Project Officer: David W. Mulenex / Boaz Ayalon, American Embassy, Tel Aviv
Project Duration: January 1, 1996 - November 30, 1999 (extended)

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3. EXECUTIVE SUMMARY

At the initial stage of the study the P I (YA) and one of the collaborators (MK) visited the project field site at Kazakhstan to make the following arrangements interview and arrange contracts with the project staff. train local staff in recognition, clinical management and protocols of childhood lead poisoning. Arrange the logistics of blood sample collection, storage and transport. Thousands of test tubes, disposable syringes and needles and a complete kit of Bayley were purchased and transported from Israel to Tshimkent. Study protocols and Bayley questionnaires were translated to Russian Two Pediatric Neurologists (AT and OR) were trained in performing the test

At the first stage of the project, we have faced several problems: there were major difficulties in transporting blood samples to Israel posed by the custom authorities in Kazakhstan and Uzbekistan (shipment was done through the Tashkent airport), despite support letters and statements from the American Embassy at Tel Aviv This caused delays of several weeks Blood samples were damaged by excessive transport time and high ambient temperatures. We had to discard over 100 samples due to clots. To compensate for that we had to recruit more newborns. Thus, the study was started again with selection of a new cohort of newborns in June-August 1997. This report includes data on the definitive study population after completion of recruitment, examination and proper blood sampling and handling of samples. We have reported on this delay in our report of July 10, 1998.

Another difficulty aroused at the six months follow up (winter 1997/8), when only 87 of the original 156 children from Group A were available for follow up. because the families of other 69 infants have left the city for the winter. At 12 months and 18 months 128 and 142 children respectively, from Group A were available for follow up, after proper arrangements were done.

During our visit in Thimkent we have realized that there was no proper equipment for assay of BLL in this city, so management of patients was based on reports of BLL from the laboratory in Israel.

Throughout the study we had to overcome language barriers. The participation of MK and his follow up visits in Tshimkent, facilitated the communication

Another difficulty aroused in purchasing DMSA for the 23 children who needed chelation therapy at the age of 6 months.

Summary of the project: As predicted, we have found high environmental lead pollution (in air and soil) near the lead plant, and gradual reduction of lead concentrations with increasing distance from the plant. Likewise, there were higher BLL in subjects in Group A in comparison with Group B at all stages; prenatal (maternal, at birth), neonatal (umbilical cord blood), and at the age of 6, 12, and 18 months Also, BLL were gradually lower in newborns, as a function of the distance from the plant. Specific data are reported in the Result section. The mean Mental Developmental Index (MDI) was significantly lower in infants from Group A, compared with those from Group B at the age of 6 months and 18 months.

We have identified 23 infants (14 or 26%) in Group A, and 9 or 6% in Group B) with Class III lead poisoning (range of BLL: 20.7-40.0 ug/dL) All these infants have received one course of chelation with oral DMSA with marked reduction of BLL None of the infants had symptomatic lead poisoning.

Project Accomplishments: Despite some unexpected difficulties we were able to complete the project. Overall, our assumptions about excessive lead exposure in infants near the lead plant proved true. The severity of prenatal lead exposure was smaller than predicted, however the identification of 23 infants with Class III lead poisoning is worrisome. These infants underwent chelation, but ongoing clinical service of children with lead poisoning requires

laboratory equipment for BLL assay on site in the city of Tshimkent Awareness to environmental lead pollution has been raised in the local population and skills in recognition and management of lead poisoning were developed in the local medical staff in Tshimkent who participated in the project

RESEARCH OBJECTIVES:

Lead poisoning is quite frequent among children in the US and many other countries, and may result in impaired cognitive development, particularly in young children (1) Lead crosses placenta and prenatal lead exposure, assessed by maternal blood lead level (BLL) at birth and umbilical cord blood lead level (UCBLL) impairs neurobehavioral development of infants (2-4).

Bellinger et al. have demonstrated a significant impairment in cognitive functions at 1-2 years of age in a cohort of infants with UCBLL > 10 ug/dL (mean of 14.6 ug/dL) (2). Deitrich et al. observed a reduction in Bayley Mental Developmental Index (MDI) at the ages of 3 and 6 months in infants with mild elevations of UCBLL (3). Since prenatal lead exposure has been recognized as potentially harmful to the developing brain, it has been extensively studied. Although there are no good data on lead exposure in the USSR, lead exposure from industrial and environmental pollution and housing conditions in East Europe and the ex-USSR is probably worse than in the US (5). To the best of our knowledge there are no reports on prenatal lead exposure from the ex-USSR.

A potential industrial source of lead pollution exists in Tshimkent, Kazakhstan, a city with about 600.000 inhabitants. A lead plant which served the USSR military industry till 1990 is located at the south-west border of the town. It employed up to 15.000

workers, about 30% of them were women The plant has cut down its production and its manpower to about 4 000 after the year 1990, but in view of the persistence of lead in the environment, lead remains an environmental hazard Nevertheless, environmental lead exposure has not been previously reported in infants in this area

Specific Objectives 1. We undertook a study to evaluate the extent of prenatal lead exposure in newborns in the Tshimkent area residing near the lead plant and 2. The effect of prenatal lead exposure on neurobehavioral development, between birth and 18 months of age, in comparison with a control group.

General Objectives: 1. To increase the awareness of the public and local authorities in Kazakhstan to the problem of environmental lead pollution. 2 To introduce the concepts of the modern approach to management of pediatric lead poisoning to the local medical community in Tshimkent and provide them with training and experience in handling such a problem.

Support of other organizations· This project was enabled by cooperation of several Institutions in Kazakhstan (Tshimkent, Alma Ati) and Israel (Jerusalem and Tel Hashomer). Additionally, we have received assistance from the American Embassy in Tel Aviv (in solving buerocratic problems with the local authorities in Kazakhstan and Uzbekistan), from the New Jersey Poison Information Center, NJ, USA (in receiving DMSA for chelation) and from the Hebrew University Jerusalem (in statistical analysis).

METHODS AND RESULTS:

ENVIRONMENTAL LEAD POLLUTION IN THE TSHIMKENT AREA:

Environmental lead pollution in the region was evaluated at the initiation of the study, and 6, 12 and 18 months later Measurements were done by one of us (V K). Lead concentration was measured in air and soil (at the earth surface and at 15 cms depth). Air and soil were sampled adjacent to the lead plant (distance 0), and at 1, 2, 3, 5 and 10 kms eastwards from the plant, in the direction of the city Data are reported in Table 1 and 2 Data on the prevailing wind directions in the area, provided by the local meteorology service in Tshimkent, are illustrated in Figure 1.

PATIENTS AND METHODS:

Mothers of 156 newborns residing <3 kms from the lead plant, who were born during July-August 1997 were consecutively selected to form Group A. Newborns born at multiple deliveries or born prematurely were excluded. Similarly, 175 control mothers and their newborns residing >3 kms away from the plant born during the same time were consecutively selected for the control group (Group B). Interviews were done with mothers in both groups and their newborns were examined. Maternal blood samples (prenatal) and umbilical cord blood (neonatal) samples were collected at delivery. Venous blood samples were drawn for Complete blood count (CBC), and ALAD activity. Hemoglobin (Hb), hematocrit (htc) was done by standard methods. Assay of aminolevulinic acid dehydratase (ALAD) enzymatic activity was done by colorimetric reaction measured by spectrophotometric absorption on fresh blood samples, at the Chemical Laboratory at the Rented First Aid Hospital in Tshimkent. Aliquots of blood samples were kept in 4^0C and transported to the Toxicology Laboratory of the Sheba Medical Center, Tel Hashomer Israel where they BLL were

determined by the atomic absorption spectrometry equiped with a graphite furance system and Ziman background correction and zinc protoporphyrin (ZPP) by spectrofluorometry

Neurobehavioral development was assessed at 6, 12 and 18 months using the Bayley MDI motor and mental scores (The Psychological Corporation, Harcourt Brace & Company, San Antonio, Second Edition, 1993) translated to Russian, and provided by pediatricians trained to perform the tests

STATISTICAL ANALYSIS:

Comparison between non-categoric parameters of patients in the two groups were done by the two tailed t test. P values < 0.05 are considered significant. Pearson correlation was used for correlations.

RESULTS:

The highest concentrations were measured adjacent to the lead plant (1388 mg/kg. And 1395 mg/kg at the earth surface, in the summer of 1997 and 1998, respectively), with decreasing concentrations as the distance from the plant increased. Lead concentrations were quite similar at 15 cm. Depth. Likewise, the highest lead concentrations in air were found in proximity to the lead plant.

DEMOGRAPHIC CHARACTERISTICS OF PATIENTS

Demographic characteristics of mothers in the two groups are presented in Table 3. The ethnicity, expressed as Russian (Christian) and Asian (Muslim) origin and education (years of schooling) were similar between groups. There was a higher rate of unemployed mothers in Group A, and higher proportions of families lived in old (> 15 years) and painted houses. The number of previous pregnancies and

the birth order of children in the study were similar between groups There was a slightly higher proportion of mothers with past history of spontaneous abortions

BIRTH WEIGHT, LENGTH AND HEAD CIRCUMFERENCE

Data on anthropometric measurements of infants in both groups at birth are listed in Table 4 Newborns of Group A were significantly smaller in all three parameters, weight, length and head circumference in comparison with infants of group B Differences between the children in the two groups were attenuated over the time, with the exception of length, which was significantly longer in children in Group B at the age of 18 months.

BLOOD LEAD LEVELS (BLL), HEMOGLOBIN, ZINC PROTOPORPHYRIN (ZPP) AND AMINOLEVULINIC ACID DEHYDRATASE (ALAD) IN MOTHER AND NEWBORNS AT BIRTH:

Data on BLL, hemoglobin, ZPP and ALAD of newborns (Umbilical cord) and the follow up tests at 6, 12. and 18 months of children in Group A and B are given in Table 5. Mothers of infants in Group A had higher BLL than mothers in Group B (5.34$\pm$3.9ug./dL and 4.54$\pm$2.5ug./dL respectively, p=0.025). Umbilical cord BLL were also higher in newborns in Group A than in Group B (4.99$\pm$3.8ug/dL and 3.74$\pm$2.4ug/dL respectively, p=0.0003) There was a statistically significant correlation between BLL in mother-newborn pairs in Group A (R^2= 0.68, Figure 2), and in Group B (R^2= 0.31, Figure 3).

There were no statistically significant differences in the other parameters between mothers in both groups, as well as between their newborns. Hemoglobin levels in

umbilical cord BLL decreased with distance from the plant By contrast, hemoglobin levels in umbilical cord blood increased with distance (Figure 4) There were no differences in the mean ZPP and ALAD between the groups

In newborns with UCBLL >11ug/dL) ALAD activity was lower, and inversely related with UCBLL This correlation was stronger, as UCBLL increased (Table 6)

Mean scores of Bayley Motor and Mental Developmental: (reported in Table 7). At six months of age Mental Developmental Index (MDI) of infants in Group A were slightly lower than controls (M= 106.9 and 108 2, respectively, p=0.09) At 18 months of age the difference between the mean MDI of children in the two groups was significant at a P value of 0 001, the mean difference was 1.9 points (lower in Group A). There was an uneven distribution of children with MDI < 2 S.D. with 12% of children in Group A, and only 4% of children in Group B

When infants in both groups were combined, at the age of 6 months, the MDI of infants with cord BLL > 20ug/dL (n=23) was significantly lower than those with cord BLL <20ug/dL (n= 238) (106.0 and 107 5, respectively, p=0.00024).

Motor Developmental Index were significantly lower in Group A only at the age of 18 months (p=0.03).

In trying to explain the Mental Developmental Index at 18 months we have found a negative regression between Umbilical cord BLL (UCBLL) and MDI at 18 months, with the following equation:

Mental Developmental Index at 18 months = 102.65 - 0.086 X UCBLL (Ug/dL)

Finally, we have identified 23 infants (14 or 26%) in Group A, and 9 or 6% in Group B) with Class III lead poisoning (range of BLL: 20.7-40.0 ug/dL). All these infants had received one course of chelation with oral DMSA with marked reduction of BLL None of the infants had symptomatic lead poisoning.

6. IMPACT RELEVANCE AND TECHNOLOGY TRANSFER

The relevance and usefulness of our finding in Kazakhstan are at three levels

1. Exploring, defining and reporting on environmental lead pollution from an industrial source, that has not been reported earlier, before the political change in the Soviet Union took place
2. Increasing the awareness of the public, local authorities and the medical community to this problem
3. Providing a group of physicians, nurses and laboratory staff in Tshimkent with some experience in the modern approach to medical management of children with lead exposure and lead poisoning.

The results of our project require further activities in routine handling of this problem. The identification of 23 children with class III lead poisoning (6) at the age of 6 months is significant These infants were mostly living within 3 kms of the lead plant, where the incidence was 26% in this sample (!) This calls for action.

A larger scale trial is justified. There may be hundreds or thousands of more infants with slead poisoning in the city of Tshimkent. These 23 infants were recruited from a small cohort of newborns born in two communities within two months (July-August 1997). It might be only the tip of an iceberg

However, at the present the medical community in Tshimkent is not equipped with the basic facilities to carry over this activity. The major problem is lack of equipment to perform blood lead assays. Modern equipment is expensive, however there are portable inexpensive tools for field studies of blood lead levels, which could be used for this purpose. We left the medical group with some experience, but not with equipment, which was not a part of the budget.

7. PROJECT ACTIVITY / OUTPUTS

We met with the medical and laboratory staff in Tshimkent before starting the study, for logistic arrangements, interviewing and contracting staff, and providing them with materials, laboratory supplies, and teaching

Dr Koifman travelled to Kazakhstan a few more times to facilitate communication, and supervision.

We are preparing two manuscripts for scientific publication Copies will be send to the USAID upon completion.

8. PROJECT PRODUCTIVITY:

We have accomplished most of the goals. Exploring the problem of environmental lead exposure, and introducing experience and training of modern management of childhood lead poisoning to the local medical community. There were limitations in providing optimal management by the US or Israeli standards, due to lack of equipment for lead assay in site, and severe problems in shipment of blood samples to Israel. This caused severe delays, so that prompt response to high lead levels could not be done, as well as frequent follow up lead levels, as required.

9. FUTURE WORK

Future work is required. An establishment of a routine clinical service: i.e. a lead clinic to screen, diagnose and treat children with lead poisoning is badly needed.

This requires additional budget, mainly for equipment, as well as 2-3 salaries, which is unexpensive in Tshimkent.

10. LITERUTURE CITED

1. Amitai Y, Hryhorczuk D Lead poisoning In Strange et al Eds Pediatric Emergency Medicine. McGraw-Hill pub Pp 548-51 1996

2 Bellinger D, Leviton A, Waternaux C, Needelman H, Rabinowitz M Longitudinal analysis of prenatal and postnatal lead exposure and early cognitive development. NEJM 1987. 316· 1037-43

3. Dietrich KN, Kraft KM, Bornschein RL et Al. Low-level fetal lead exposure effect on neurobehavioral development in early infancy Pediatrics 1987· 80: 721-30.

4. McMichael AJ, Baghurst PA, Wigg NR et al. Port Pierie cohort study: environmental exposure to lead and children's ability at the age of four years. NEJM 1988: 319: 468-75.

5. Emerson T. Lead and your kids: Lead is the Number 1 environmental threat to the young, public-health officials say, but America has been slow to respond – and Europe was slower. Newsweek, July 1992

6. Shannon MW. Lead. In Haddad LM, Shannon MW, Winchester JF Clinical Management of Poisoning and Drug Overdose. 3rd Edition WB Saunders, Co. Philadelphia 1998

APPENDIX: 7 TABLES

5 FIGURES

TABLE 1: Lead concentrations in air, at various distances from the lead plant

	0 km	1 km	2 km	3 km	5 km	10 km	(mg/m3)
08-09 97	0.0006	0.0006	0.0006	0.0003	0.0003	0.0003	
01-02 98	0.0011	0.0011	0.0006	0.0006	0.0006	0.0003	
07-08 98	0.0011	0.0006	0.0006	0.0006	0.0003	0.0003	
01-02 99	0.0011	0.0006	0.0006	0.0006	0.0006	0.0003	

TABLE 2: Lead concentrations in soil at various distances from the lead plant

	0 km	1 km	2 km	3 km	5 km	10 km	mg/kg, earth level
08-09 97	1388	390	214	127	36	20	
01-02 98	1216	327	174	117	35	19	
07-08 98	1395	398	226	133	41	20	
01-02 99	1220	333	208	115	37	18	

	0 km	1 km	2 km	3 km	5 km	10 km	mg/kg, - 15 cms
08-09 97	1376	354	205	118	23	18	
01-02 98	1248	334	178	105	20	17	
07-08 98	1390	357	214	129	27	18	
01-02 99	1226	321	181	119	22	16	

TABLE 3: Comparison of demographic characteristics of patients within 3 kms. from the lead plant (Group A) and the Control Group (Group B)

		Group A (n=156)	Group B (n=175)
Ethnicity of the mothers (%):	Muslims	86	89
	Russians	14	11
Mothers' education (%):	Secondary (12 yrs)	91	89
	High (University)	9	11
Mothers' occupation (%):	worker	4	2
	clerk	8	30
	unemployed	88	68
Type of residence (%):	new (< 15 year)	38	65
	old (> 15 years)	62	35
	painted (other than white)	26	2
	not painted	74	98
Number of previous pregnancies (mean)		2.52	2.47
Mothers with previous abortions (%):		14	19
Birth order (mean)		2.3	2.2

TABLE 4: Weight, length and head circumference of infants in Group A and B at birth, and at age 6, 12, 18 months

	Group A	Group B	P-value
At birth	(n=156)	(n=175)	
Weight (gms.) (Mean ± SD)	3065 (520)	3377 (437)	0.00003
Length (cms.) (Mean ± SD)	51.9 (3.2)	53.4 (3.1)	0.00001
Head Circumference (Mean ± SD)	33.7 (1.6)	35.2 (2.2)	0.007
At 6 months	(n=87)	(n=150)	
Weight (gms.) (Mean)	7339	7640	
Length (cms.) (Mean)	65.4	65.6	
Head Circumference (Mean)	40.3	41.0	
At 12 months	(n=128)	(n=174)	
Weight (gms.) (Mean)	10347	10353	
Length (cms.) (Mean)	74.3	74.6	
Head Circumference (Mean)	46.3	47.1	
At 18 months	(n=142)	(n=174)	
Weight (gms.) (Mean ± SD)	11311 (521)	11585 (645)	0.015
Length (cms.) (Mean ± SD)	79.8 (3.8)	82.5 (3.2)	0.00001
Head Circumference (Mean ± SD)	49.8 (0.7)	49.0 (0.8)	

TABLE 5: **Blood lead levels (BLL), Hemoglobin, Aminolevulinic Acid Dehydratase (ALA-D), and Zinc Protoporphyrin (ZPP) of infants in Group A and B at birth, and at age 6, 12, 18 months**

	Group A	Group B	P-value
At birth	(n=156)	(n=175)	
Blood Lead Level (Ug/dL) (Mean ± SD)	4.99 ± 3.8	3.74 ± 2.4	0.0003
Hemoglobin (Gr/dL) (Mean ± SD)	13.1 ± 2.1	13.5 ± 2.2	0.034
ALA-D activity (units) (Mean ± SD)	695 ± 193	693 ± 197	0.45
ZPP (Ug/dL) (Mean ± SD)	66.7 ± 31.4	65.4 ± 30.0	0.27
At 6 months	(n=87)	(n=150)	
Blood Lead Level (Ug/dL) (Mean ± SD)	14.1 ± 12.7	7.45 ± 4.83	0.001
Hemoglobin (Gr/dL) (Mean ± SD)	10.4 ± 1.6	12.1 ± 11.1	0.001
ALA-D activity (units) (Mean ± SD)	766 ± 220	910 ± 247	0.001
ZPP (Ug/dL) (Mean ± SD)	91.6 ± 84.7	80.7 ± 43.2	0.13
At 12 months	(n=128)	(n=174)	
Blood Lead Level (Ug/dL) (Mean ± SD)	8.33 ± 6.53	7.64 ± 4.08	0.14
Hemoglobin (Gr/dL) (Mean ± SD)	11.1 ± 1.6	12.2 ± 1.7	0.001
ALA-D activity (units) (Mean ± SD)	845 ± 234	973 ± 221	0.001
ZPP (Ug/dL) (Mean ± SD)	145 ± 155	96 ± 108	0.02
At 18 months	(n=142)	(n=174)	
Blood Lead Level (Ug/dL) (Mean ± SD)	5.41 ± 4.18	4.60 ± 3.10	0.028
Hemoglobin (Gr/dL) (Mean ± SD)	11.4 ± 0.89	11.9 ± 1.6	0.001
ALA-D activity (units) (Mean ± SD)	898 ± 202	1032 ± 180	0.001
ZPP (Ug/dL) (Mean ± SD)	67.2 ± 39.2	59.9 ± 26.6	0.031

TABLE 6: Inverse correlation between Umbilical Cord Blood Lead Levels (UCBLL) and Aminolevulinic Acid Dehydratase (ALA-D) activity in 30 newborns, combined from Groups A & B with UCBLL > 7 Ug/dL. As UCBLL increase, the inverse correlation is more significant.

UCBLL	CORRELATION (r) WITH ALA-D ACTIVITY
> 7 Ug/dL	- 0.0285
> 8 Ug/dL	- 0.1791
> 9 Ug/dL	- 0.2739
> 10 Ug/dL	- 0.1352
> 11 Ug/dL	- 0.2950
> 12 Ug/dL	- 0.3475
> 13 Ug/dL	- 0.7310
> 14 Ug/dL	- 0.7830

B

TABLE 7: Bayley Mental and Motor Developmental scores of infants in Group A and B at age 6, 12, 18 months

	Group A	Group B	P-value
At 6 months	(n=86)	(n=175)	
Mental Developmental Index (Mean±SD)	106.8 ± 8.2	108.2 ± 5.8	0.089
Motor Developmental Index (Mean±SD)	110.1 ± 9.9	109.6 ± 7.6	0.33
At 12 months	(n=128)	(n=174)	
Mental Developmental Index (Mean±SD)	112.3	113.1	
Motor Developmental Index (Mean±SD)	108.6	108.9	
At 18 months	(n=142)	(n=174)	
Mental Developmental Index (Mean±SD)	101.0 ± 2.7	102.9 ± 2.2	0.001
Motor Developmental Index (Mean±SD)	108.9 ±3.7	110.1 ± 6.6	0.03

FIGURE 1: SCHEME OF TSHIMKENT CITY, LEAD PLANT AND PREVAILING WIND DIRECTIONS

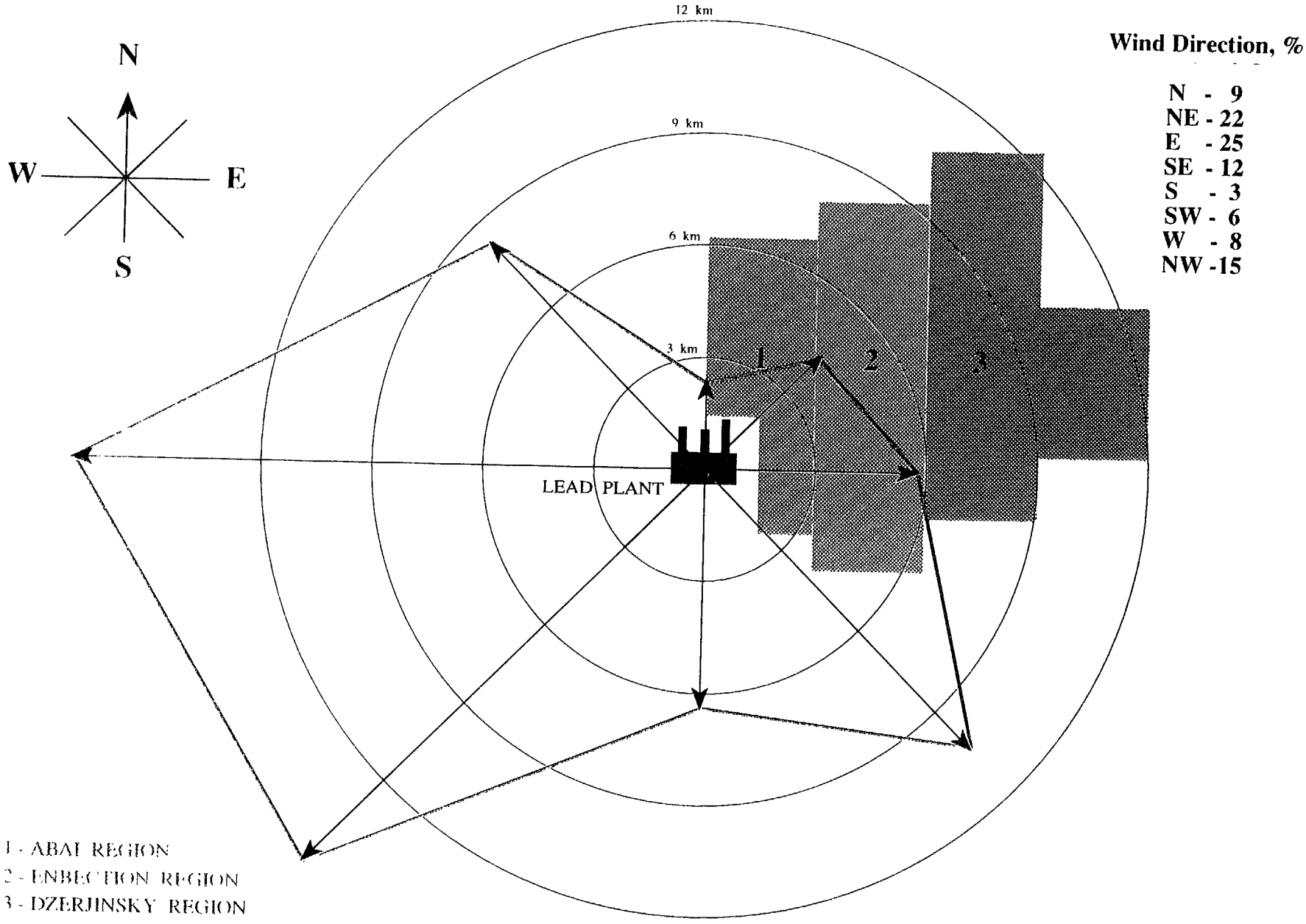


FIGURE 2: Correlation between Blood Lead Levels in mother - newborns pairs in Group A ($R^2 = 0.68$)

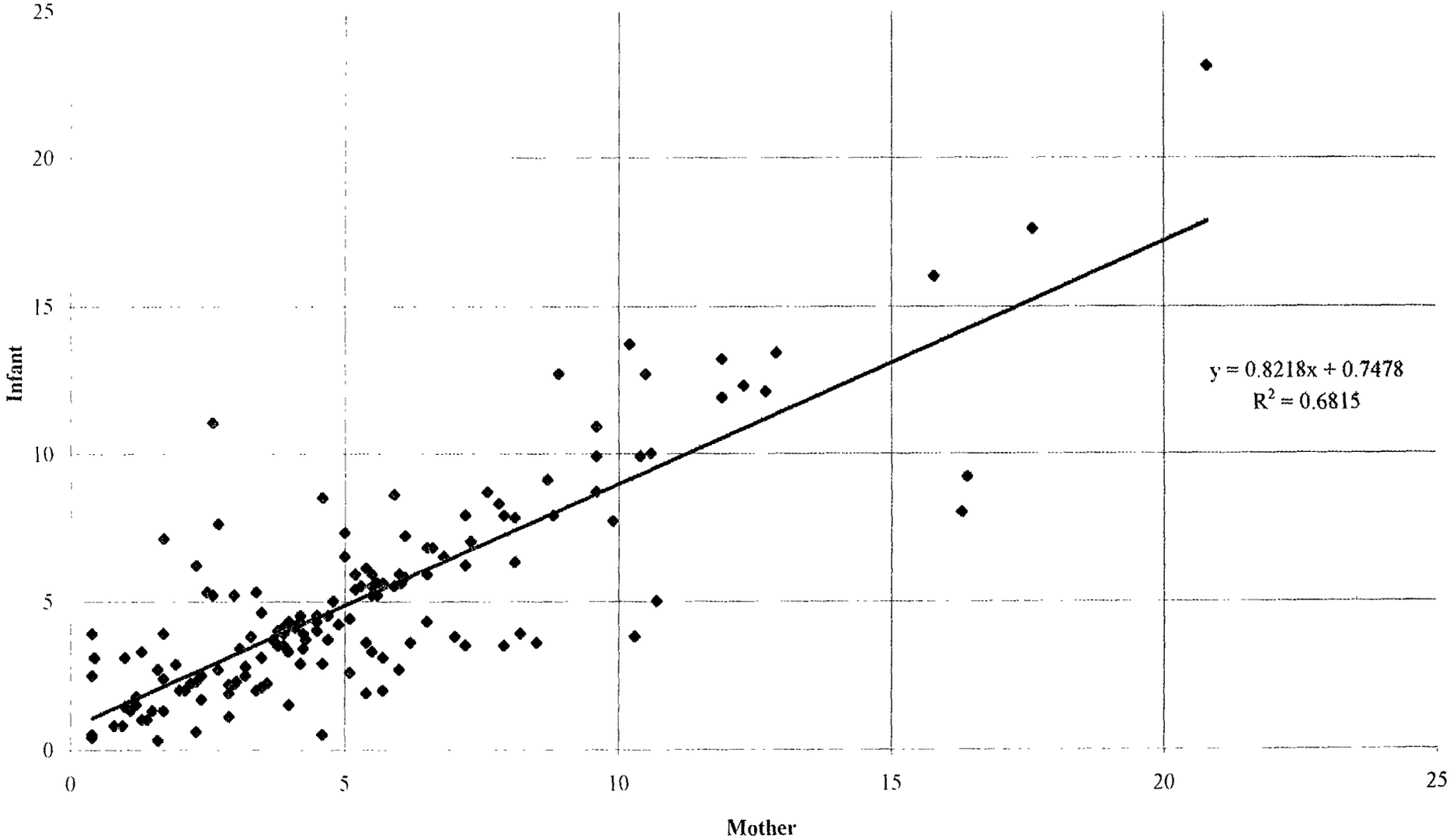


FIGURE 3: Correlation between Blood Lead Levels in mother - newborns pairs in Group B ($R^2 = 0.31$)

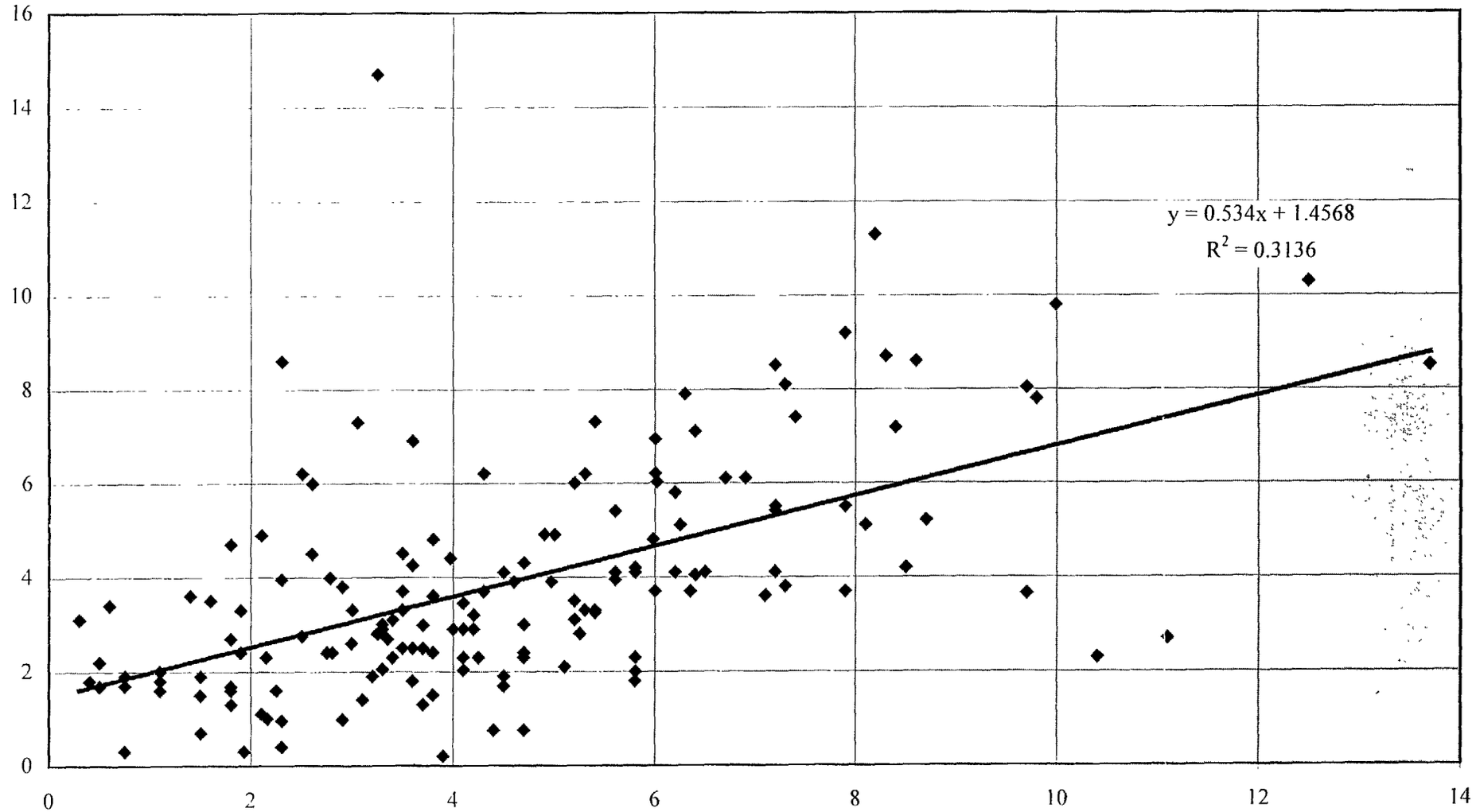


FIGURE 4: **The blood parameters by the distance from the plant (infants at birth)**

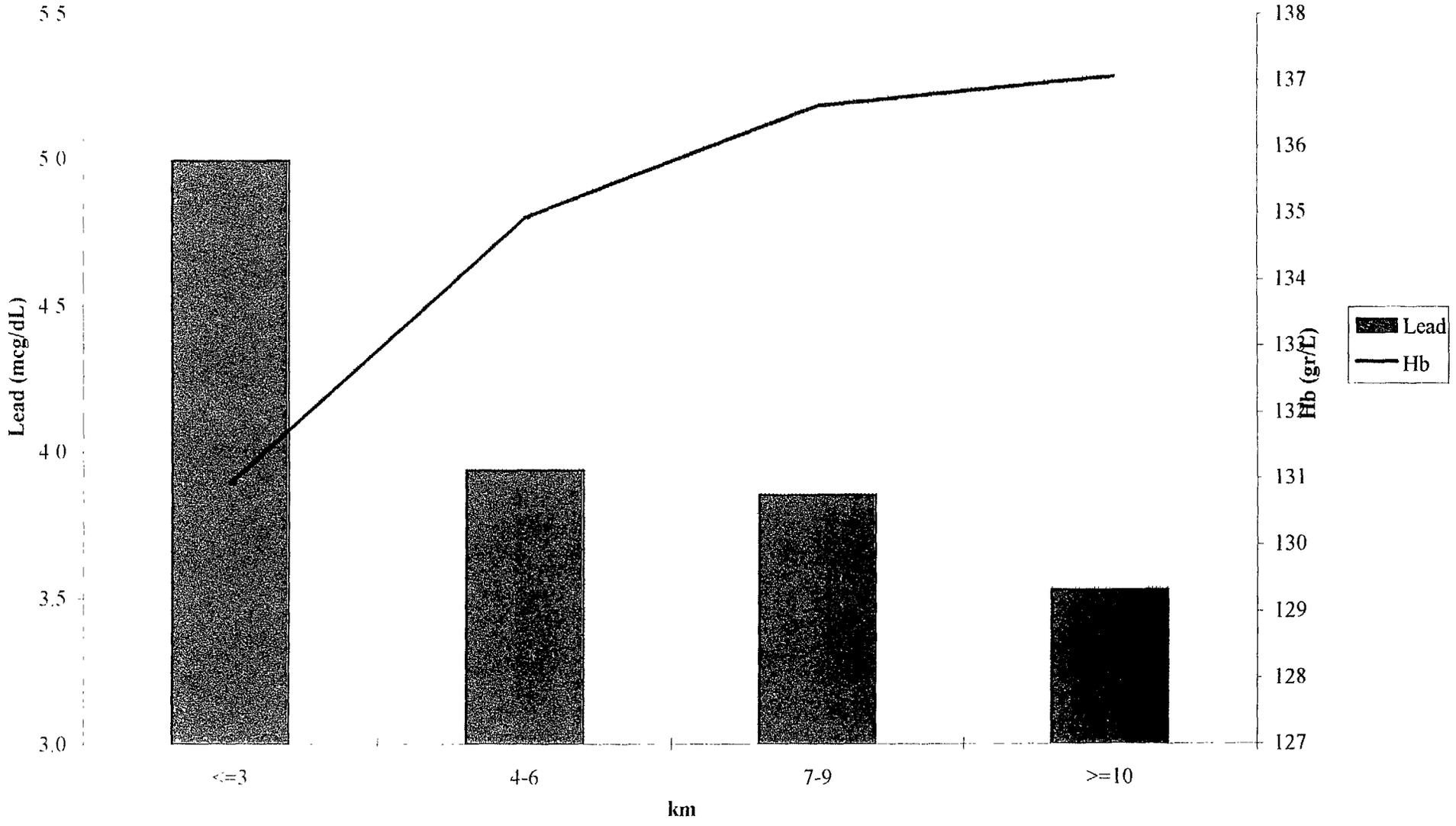
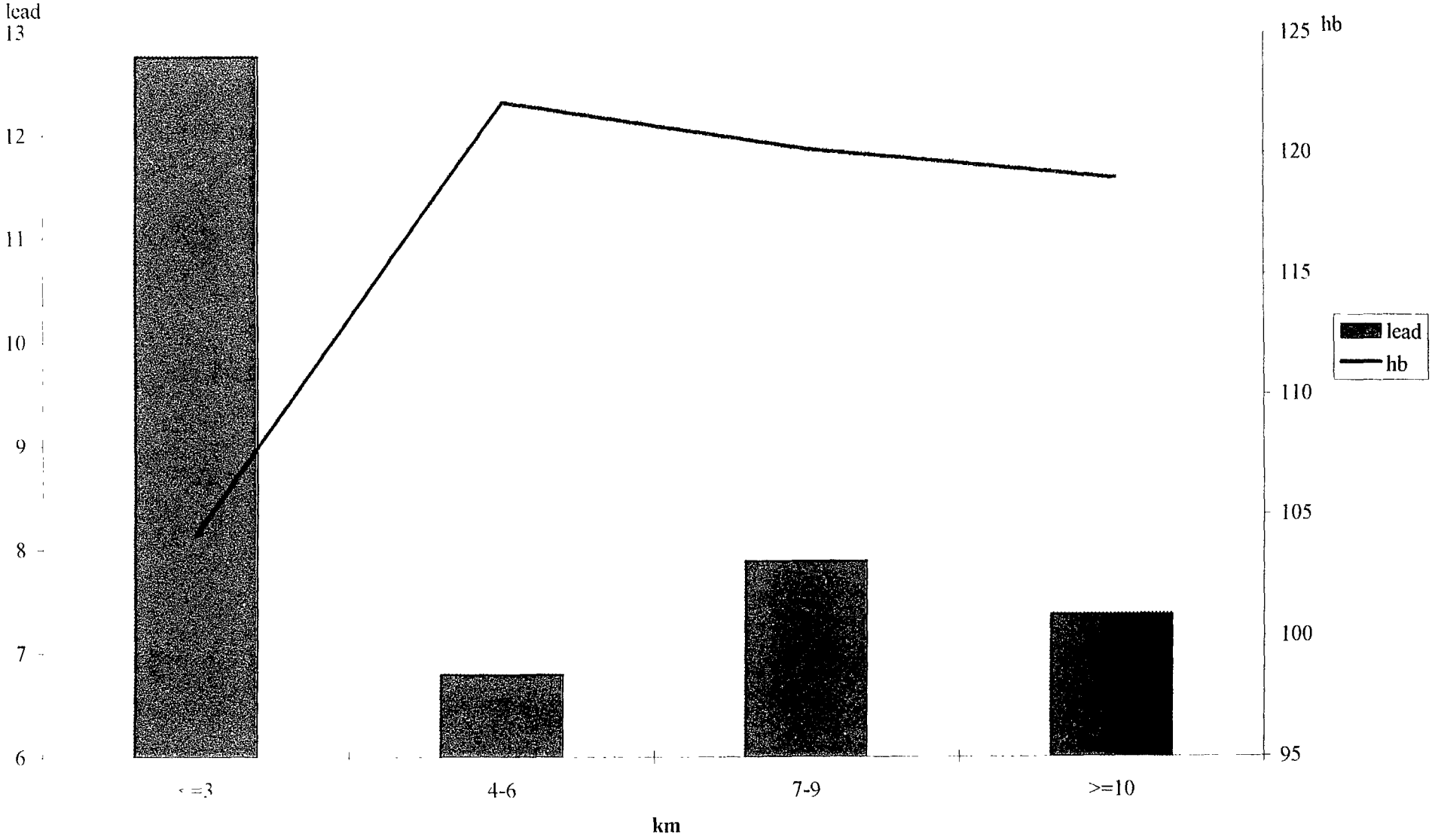


FIGURE 5: The blood parameters at 6 months by the distance from the plant



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