Lead Toxicity in Spray Painters: An Intervention with Protective Devices and KPT-4 Herbal (A Preliminary Study)

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ABSTRACT

Background: Paint and petrol handled by painters have been reported to contain lead which might enter their body to produce toxicity.

Objectives: This study investigated whether spray painting is associated with lead toxicity and whether an intervention using protective devices or KPT – 4 herbal can minimize exposure to lead and/or lead toxicity.

Methods: Fifteen spray painters were recruited for the study. Venous blood was collected from each worker for analysis of lead using inductively coupled plasma - optical emission spectrophotometer and for analysis of packed cells volume (PCV), haemoglobin, uric acid, phosphate, bilirubin, calcium, urea, creatinine, sodium, potassium, chloride, cholesterol, albumin, total protein, alkaline phosphatase (ALP), aspartate aminotranferase (AST) and alanine transaminase (ALT). This was followed by an interventional study to determine whether 6 months intervention with protective devices or KPT – 4 is associated with decreased blood lead levels and/or lead toxicity.

Results: Blood lead levels were significantly higher (P = 0.004, 485.56 verse 345.75 µg/L) in spray painters than control group. PCV, haemoglobin and ALP were significantly decreased (35.67, 12.35, 58.47 verse 43.13%, 14.58 g/dl, 81.40 iu/L respectively) while uric acid, phosphate, AST and ALT were significantly elevated (349.27, 1.64, 19.47, 15.60 verse 230.13 µmol/L, 1.09 mmol/L, 9.20 iu/L, 6.40 iu/L respectively) in exposed than unexposed workers. Intervention in spray painters with protective devices or KPT – 4 significantly reduced blood lead levels and lead toxicity.

Conclusion: Painters are exposed to lead which may compromise haematological, hepatic and renal functions but can be reverted on intervention using protective devices or KPT – 4.

Key words: Lead toxicity, spray painters, intervention

La toxicité du plomb dans la pulvérisation Peintres: Une intervention de dispositifs de protection et KPT-4 à base de plantes (Étude pilote)

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RÉSUMÉ

Contexte: la peinture et l'essence manipulé par les peintres ont été signalés à contenir du plomb qui pourraient entrer dans leur corps à produire la toxicité.

Objectifs: Cette étude a examiné si la peinture au pistolet est associée à la toxicité du plomb et si une intervention utilisant des dispositifs de protection ou KPT - 4 fines herbes peut réduire l'exposition au plomb et / ou la toxicité du plomb.

Méthodes: Quinze peintres de pulvérisation ont été recrutés pour l'étude. Le sang veineux a été recueilli à partir de chaque travailleur pour l'analyse du plomb à l'aide de plasma à couplage inductif - spectrophotomètre d'émission optique et de l'analyse du volume emballé cellules (PCV), l'hémoglobine, l'acide urique, du phosphate, de la bilirubine, de calcium, de l'urée, de la créatinine, de sodium, de potassium, chlorure , cholestérol, albumine, protéines totales, la phosphatase alcaline (ALP), aspartate aminotransférase (AST) et d'alanine transaminase (ALT). Elle a été suivie par une étude d'intervention afin de déterminer si six mois intervention de dispositifs de protection ou KPT - 4 est associée à une diminution des niveaux de plomb dans le sang et / ou la toxicité du plomb.

Résultats: les niveaux de plomb dans le sang était significativement plus élevée (P = 0.004, 485.56 verset 345.75 g / L) chez les peintres de pulvérisation que le groupe de contrôle. PCV, de l'hémoglobine et ALP ont diminué de façon significative (35.67, 12.35, 58.47 verset 43.13%, 14.58 g / dl, respectivement 81,40 UI / L), tandis que l'acide urique, de phosphate, ASAT et ALAT ont été significativement plus élevée (349.27, 1.64, 19.47, 15.60 verset 230.13 µmol/L, 1.09 mmol/L, 9.20 iu/L, 6.40 iu/L, respectivement) chez les sujets exposés que les travailleurs non exposés. Intervention dans les peintres au pistolet avec des dispositifs de protection ou KPT - 4 considérablement réduit les taux sanguins de plomb et la toxicité du plomb.

Conclusion: Peintres sont exposés au plomb qui peut compromettre hématologique, hépatique et la fonction rénale mais peuvent être revenue sur l'intervention utilisant des dispositifs de protection ou KPT - 4.

Mots clés: La toxicité du plomb, peintres au pistolet, l'intervention

INTRODUCTION

Through the ages man has continued to suffer from hazardous exposures in the work environment due to various chemicals they handle. The health of workers might therefore be affected by their type of occupation. Approximately 100,000 chemicals are currently in use worldwide and 500 new ones enter the market annually.[1] Some of these chemicals such as paints and petrol handled by painters in their various work places have been reported to contain heavy metals like lead which might enter the body to produce harmful effects.[2, 3, 4, 5] Toxicity can therefore occur due to occupational exposure of painters to lead but this is dependent on the blood lead levels.

Several chemical agents encountered in the occupational setting including arsenic, cadmium, chromium, nickel and cobalt are established carcinogens that target the lung and other organs.[6] It has also been established that occupational risk factors together with other risk factors such as life style or hereditary factors acts synergistically with smoking to attribute to cancer burden.[7] An increased incidence and death due to lung cancer has been observed in painters, an occupation that employs several million people worldwide.[8] Painters are exposed to many known and suspected toxic chemicals such as chlorinated solvents and cadmium compounds.[2, 4] Most of these are lung carcinogens through inhalation or dermal contact,[9] although the specific causative agents have not yet been identified. Exposure of many people to paints, gasoline, exhaust fumes from automobile through inhalation, oral or dermal route have caused lots of health problems.[10,11,12]

Automobile workshop environment has been found to have high prevalence rate of hepatitis B and significant ill effect on liver and kidney function.[13] The routine works of automobile workshop workers such as spray painting make them prone to long term lead and other heavy metals toxicity. Workers in automobile workshop have also been found to be anaemic due to significant decrease in haemoglobin.[13] These ill effects might be due to lack of safety measures, poor hygiene, and lack of basic health awareness.[5] Legislation on mandatory provision of personal safety protection and monitors for auto mechanics and petrol station attendants had earlier been recommended.[14] There is thus the need for such workers to be educated about the harmful effects of automobile workshop environment and proper cleaning/washing of hands in workshop environment before eating and drinking. Government should also make policies to reduce adverse effects of such environment.

In studying the acute toxicological effects of diesel and crude oil, that also contain heavy metals and benzene, in experimental animals, an increase in dose of the fuel administered into the animals caused a dose dependent decrease in haemoglobin (Hb) and packed cells volume (PCV).[15] The observed linear reductions in haematological parameters demonstrated and suggested an anaemic condition in the animals. Heavy metals and hydrocarbons in volatile organic compounds are widely used as constituents of household chemicals such as paints and fuels, and threaten health, especially of workers exposed to high concentrations.[16] Lead; a heavy metal found in both petrol and paints is one of the commonest work place toxins that produce kidney damage.[12, 17] In a study of Nigerian lead workers and control subjects, standardized urinary protein and serum uric acid determinations were shown to be reliable bioindicators of lead nephropathy.[17]High levels of lead in blood has also been reported in painting environment which has been associated with adverse effects including anaemia.[18,19]

Chelating agents such as ethylene diamine tetra acetic acid (EDTA) and penicillamine are used to reduce blood lead levels in acute lead poisoning[20] but their routine prophylactic oral use can cause problems and has no place in treatment of chronic lead poisoning. Africa is blessed with abundance of herbs/plants with claim of detoxifying activity. Herbal remedies may, therefore, proffer a solution to work place toxins due to chemical agents including lead and their use in lead exposed workers may be a desirable alternative to such prophylactic measures in situations where environmental exposure is not avoidable. Dietary garlic and bitter tea are some herbal remedies claimed to be used in preventing/managing toxicity from chemical agents during our preliminary investigation among selected workers occupationally exposed to these agents. “Kuding Plus Tea” commonly known as bitter tea is a propriety product coded KPT – 4 which is being used by some workers in Jos, Nigeria, in preventing/managing poisoning from chemical agents in the course of their work. It is a mixture of four plants namely *Folium ilicis* Kudingchae, *Radix panacis* Quinquefoli, *Folium camellis* and *Ganoderma*.[21] KPT – 4 is claimed to assist the body in promoting both function of the liver, the circulatory system and general well being; resolves toxin and inflammation and has the reputation of preventing high blood pressure without producing any serious adverse effects.[21] It is also claimed to be rich in kuding – saponin, and ganoderm amylase, various amino acids, quercetin, natural selenium, vitamin C, vitamin D, vitamin E trace

elements, polyphenol and flavones.[21] The claims have not been evaluated by National Agency of Food and Drug Administration and Control (NAFDAC).

This study investigated whether spray painting occupation in Jos Nigeria is associated with lead toxicity and whether an intervention using protective devices/other safety measures or KPT – 4 can minimize exposure to lead and/or lead toxicity.

METHODS

Study population and sampling

The sample size for the study was thirty (30) workers comprising of 15 spray painters and 15 administrative office staff. The sampling frame of the spray painters comprises all the major 95 automobile workshops in Jos, Nigeria. Every 6th workshop was selected from this frame to make a total of 15 workshops. One spray painter was randomly chosen per workshop provided he/she met inclusion/exclusion criteria of subjects for the study for a total of 15 spray painters. A total of 15 administrative office staff were also selected from the general population working with any organization (untargeted occupational group) using the same criteria of inclusion/exclusion of subjects for the study, whose work did not involve use of paint and/or petrol and they were not working in automobile workshops. The 15 administrative office workers represented the study's control subjects.

Ethics/subjects consent

The study protocol was approved by the Research and Ethics Committee in University of Jos and written informed consent to participate was provided and obtained from each subject after explaining the aim of the study and study protocol.

Study inclusion/exclusion criteria

The study included only subjects who are apparently healthy, age 18 years or above, willing to participate in the study, working regularly for not less than 6 months on the job, and male or female workers and who have consented to participate. The study excluded subjects with serious medical problems (including subjects with previous history of liver or kidney disease), who had recent x – ray diagnostic examination, on drugs likely to affect the result of analysis, smoking cigarette, already taking KPT – 4 or dietary garlic, using some protection device/other safety measures, not regular on the job, used for preliminary study or who are narcotic users. Subjects who did not consent were excluded.

Data collection

An in – depth interview using a structured questionnaire was administered to each consented subject to know among other things their age, duration of exposure (length of work in their various occupations) and also to serve as a means of inclusion/exclusion of subjects for the study. Venous blood was also collected to determine the blood lead levels, and their effects on selected biochemical markers of kidney, liver and blood function from all subjects who met the inclusion/exclusion criteria for the study. A 6-month intervention in spray painters to determine whether the use of some protective devices such as face masks, hand gloves, boots and outfits/other safety measures such as regular washing/cleaning of outfits, hands/forearms, work benches, work tools/equipments, floors and ventilation during mixing and/or spraying of paint or use of KPT – 4 can protect exposure or minimize effects of exposure to lead. The spray painters used in the interventional study were randomly divided into 3 groups each comprising of 5 subjects. Group 1 was encouraged to use protective devices/other safety measures only. Group 2 were placed on a daily regimen of 5 g KPT – 4 and recommended that they take half the dose in the morning and half in the evening before meals. Group 3 was discouraged from using protective devices/other safety measures or KPT – 4 (represented the control subjects in the interventional study). All spray painters completed the interventional study and submitted themselves for retesting of blood lead levels and their effects on selected biochemical markers of kidney, liver and blood function after 6 months.

Determination of Lead

Lead in blood was determined by inductively coupled plasma - optical - emission spectrophotometer (ICP – O – ES).[22] Ten milliliters of blood collected from each of the 30 subjects were dispensed into sterile Ethylene Diamine Tetra Acetic Acid (EDTA) bottles, agitated for 10 – 15 seconds to prevent blood clotting. 1 ml of each blood sample was placed in a Teflon microwave digestion bomb with 10 ml of concentrated nitric acid. The samples were allowed to ramp to 180 ^{0}C for 5 min, digest at 180 ^{0}C for 9.5 min, and allowed to cool down for 5 min in a MARS 5 microwave digestion system (CEM, Matthews, NC). The samples were then transferred to clean volumetric flasks, and diluted with water to 10 ml before being analyzed on a Varian 715 ES ICP – O – ES. The wavelength used for the detection and measurement of lead was 220.353 nm.

Determination of some haematological/biochemical

parameters

On whole blood samples, cyanmethaemoglobin and microhaematocrit methods were employed in determining the haemoglobin (Hb) concentration and the packed cells volume (PCV) respectively.[23] Blood samples (4 ml) from each volunteer were also dispensed in vacutainers and centrifuged at 6000 rounds per minute for 2 minutes for serum separation. Shimadzu UV – visible double beam spectrophotometer 1700 Pharma (Japan), model 56 recorder (Perkin – Elmer Corporation, Norwalk, CT 06856) was used for analysis of different biochemical indices. This included the following: uric acid, inorganic phosphorus, bilirubin, total calcium, urea, creatinine, sodium ion, potassium ion, chloride, cholesterol, albumin, total protein, alkaline phosphatase (ALP) activity, aspartate and alanine aminotranferase activities All reagents and chemicals were obtained from Cromatest Laboratories, Knickerbocker in Barcelona, Spain.

Data analysis

Data was analyzed using Statistical Package for Social Sciences (SPSS), version 16.0 for windows. One-way analysis of variance (ANOVA), independent t-test, Pearson correlation or paired t-test was used for the inferential statistic. *P* values less than 0.05 was accepted as significant for confidence intervals (CI) of 95%.

RESULTS

The age range of all the workers was 19 – 60 years (Mean 29.29 ± 0.93 years). The mean age for spray painters (SPs) was 29.27±1.81 years and 31.87±1.83 years for administrative office staff (AOS). The age distribution of study workers revealed 12 (80%) SPs and 13 (86.7%) AOS were between age ranges of 21 – 40 years old. Their duration of exposure was in the range of 0.5 – 35 years with mean duration of exposure of 8.93 ± 0.92 years. Duration of exposure relates positively with the increased blood lead levels. 46.7% of AOS were male and 100% of SPs were male.

Figure 1 presents the blood lead in both lead occupationally exposed and unexposed workers. The mean blood lead levels in all lead occupationally exposed workers were significantly (P = 0.004) higher compared with unexposed workers.

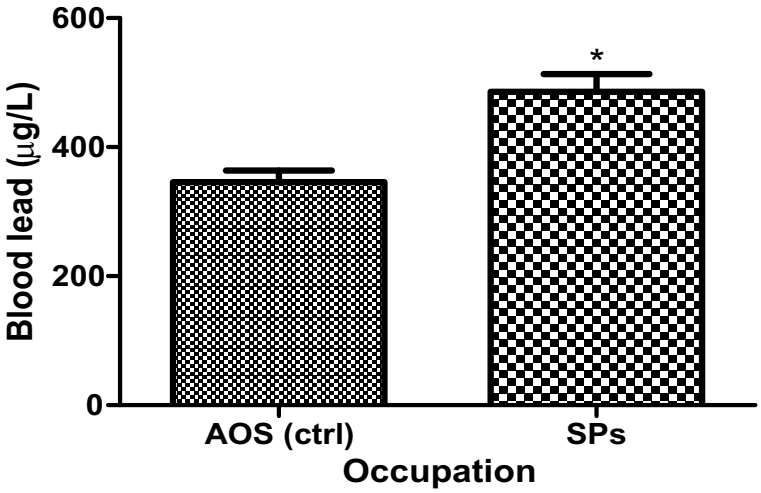

Figure 1 Blood lead levels in lead occupationally exposed and unexposed workers. SPs = spray Painters, AOS = administrative office staff. All values are means ± SEM, n = 15. $^{*}P$ = 0.004 and statistically significant when compared with the control group

Selected biomarkers of blood and liver function in the workers are presented in Table 1. PCV, Hb and ALP values were significantly decrease while AST and ALT values were significantly elevated in exposed workers when compared with the control group.

Table 1: Selected biomarkers of blood and liver function among lead occupationally exposed and unexposed workers

Selected markers of blood and liver function	SPs	AOS (control)
PCV (%)	35.67 ± 0.74*	43.13 ± 3.56
Hb (g/dl)	12.35 ± 0.24*	14.58 ± 0.19
AST (iu/L)	19.47 ± 1.48*	9.20 ± 0.57
ALT (iu/L)	15.60 ± 1.41*	6.40 ± 0.69
ALP (iu/L)	58.47 ± 4.53*	81.40 ± 5.90
Cholesterol (mmol/L)	5.07 ± 0.21	5.53 ± 0.26
Total protein (g/L)	71.07 ± 1.95	68.00 ± 1.84
Albumin (g/L)	31.40 ± 1.23	31.20 ± 0.82
Total bilirubin (µmol/L)	10.20 ± 0.00	10.20 ± 0.00
Conjugated bilirubin (µmol/L)	5.10 ± 0.00	5.10 ± 0.00

All values are means ± SEM, n = 15, * = P < 0.05 and statistically significant when compared with the control group. PCV packed cells volume; Hb haemoglobin; AST aspartate aminotransferase; ALT alanine transaminase; ALP alkaline phosphatase.

Selected biomarkers of kidney function in the workers are presented in table 2. Serum uric acid and phosphate levels were significantly elevated in exposed than unexposed workers.

Table 2: Selected biomarkers of kidney function in lead occupationally exposed and unexposed workers

Selected bio markers of kidney function	SPs	AOS (control)
Sodium (mmol/L)	136.13 ± 1.79	139.33 ± 0.82
Potassium (mmol/L)	4.23 ± 0.18	4.31 ± 0.13
Chloride (mmol/L)	100.13 ± 1.18	100.53 ± 0.77
Creatinine (µmol/L)	92.80 ± 3.62	94.80 ± 5.66
Urea (mmol/L)	4.88 ± 0.18	4.75 ± 0.18
Phosphate (mmol/L)	1.64 ± 0.03*	1.09 ± 0.03
Calcium (mmol/L)	2.23 ± 0.04	2.10 ± 0.03
Uric acid (µmol/L)	349.27 ± 21.02*	230.13 ± 6.81

All values are means ± SEM, n = 15, * = P < 0.05 and statistically significant when compared with the control group.

Table 3 presents the correlation of PCV, Hb, AST, ALT, ALP, serum phosphate and uric acid versus lead. Serum uric acid has the highest correlation which was positively and weakly correlated (r = 0.506, P < 0.01) to blood lead levels.

Table 3: Correlation of PCV, Hb, AST, ALT, ALP, serum phosphate and uric acid levels verse lead

Selected markers	R	P
PCV	- 0.452**	0.001
Hb	- 0.384**	0.001
AST	0.342**	0.003
ALT	0.347**	0.002
ALP	- 0.199	0.087
Serum phosphate	0.407**	0.001
Serum uric acid	0.506**	0.001

** Correlation is significant at the 0.01 level (2 – tailed)
R = correlation coefficient

Blood lead levels in spray painters before and after 6 months intervention with either protection device or KPT – 4 are presented in table 4. There was a statistically significant ($P < 0.05$) reduction in blood lead levels after intervention with KPT – 4 or protection device but a significant ($P < 0.05$) increase in blood lead levels in non intervened spray painters (control group).

Table 4: Blood lead levels in spray painters before and after intervention

Blood lead (µg/L)	KPT – 4	Protection device	Control
Before intervention	591.34 ± 43.97	427.92 ± 29.31	450.36 ± 32.66
After intervention	341.02 ± 21.53*	319.76 ± 27.17*	504.78 ± 32.87*

Values are means ± SEM, n = 5. * = $P < 0.05$ and statistically significant when compared before and after intervention in the different groups.

Table 5 shows the PCV, Hb, AST, ALT, ALP, serum phosphate and uric acid levels in spray painters before and after intervention with either KPT – 4 or protective devices. The group intervened with KPT – 4 showed statistically significant ($P < 0.05$) increase in PCV, Hb and ALP but significant ($P < 0.05$) reduction in AST, ALT, serum uric acid and phosphate which was in contrast to the control group that showed a significant ($P < 0.05$) reduction in PCV, Hb and ALP but significant ($P < 0.05$) increase in AST, ALT, serum phosphate and uric acid.

Table 5: PCV, Hb, AST, ALT, ALP, serum phosphate and uric acid levels in spray painters before and after intervention with either KPT – 4 or protective devices

Serum biomarkers	Before KPT-4 intervention	After KPT-4 intervention	Before Protective devices intervention	After protective devices intervention	Control before intervention	Control after intervention
PCV (%)	34.20 ± 1.02	40.40± 1.08*	36.20 ± 1.07	42.80± 1.28*	36.60± 1.66	33.00±1.14*
Hb (g/dl)	11.90 ± 0.34	13.28± 0.27*	13.02 ± 0.46	14.00 ± 0.25	12.14 ± 0.34	11.18 ± 0.10*
AST (iu/L)	19.00 ± 1.52	13.60± 1.89*	24.20 ± 2.87	12.60 ± 3.54*	15.20 ± 1.53	19.80 ± 1.50*
ALT (iu/L)	14.20 ± 1.63	10.40± 1.17*	18.60 ± 3.49	11.60 ± 3.71*	14.00 ± 1.67	20.00 ± 1.41*
ALP (iu/L)	54.40 ± 5.47	70.20± 5.08*	54.60 ± 12.66	61.40±11.05*	66.40 ± 1.21	57.20 ± 1.36*
Serum phosphate (mmol/L)	1.62 ± 0.06	1.12 ± 0.04*	1.66 ± 0.08	1.18 ± 0.06*	1.64 ± 0.04	1.76 ± 0.05*
Serum uric acid (µmol/L)	376.00±15.49	272.80±12.34*	392.80±21.28	228.20±49.63	279.00±45.39	339.60±30.61*

Values are means ± SEM, n = 5. * = P < 0.05 and statistically significant when compared before and after intervention in the different groups.

DISCUSSION

The results show that blood lead levels in occupationally lead-exposed workers were significantly (*P* = 0.004) higher than in control workers. The significant increase in blood lead levels indicates high level of exposure to lead. The high level of exposure to lead is similar to previous studies on occupational lead exposure.[24, 25] The mean blood lead levels (µg/L) of 485.56 found in spray painters in this study are consistent with the levels indicative of severe lead poisoning.[26] Blood lead levels are commonly accepted as the only practical indicator of 'internal dose'[27] but are not necessarily the best indicator of toxicity.

It was observed that workers exposed to lead were having statistically significant (P < 0.05) lower Hb, PCV and ALP values but higher AST, ALT, serum phosphate and uric acid values compared with controls. These are lead related parameters reported previously and are in agreement with these findings.[13, 15, 24] Increased serum phosphate in acute lead poisoning has been reported and is related to dysfunction of proximal renal tubules whereas elevated blood uric acid and gout have long been associated with chronic renal disease among lead industry workers.[28] The increased levels of uric acid in this study might be due to damage to renal tubules by lead. Uric acid has also been suggested as one of the antioxidants in plasma,[29] thus, its elevation in this study may be an antioxidant response to lead toxicity. The increased levels of phosphate in this study might be due to cell membrane damage from lead exposure. Lead interferes with cell membrane and may also increase cell break down.[24]

AST and ALT activities were significantly raised in exposed workers than in controls. Similar findings of elevated AST and ALT have been reported.[30] ALP activity was significantly lower in exposed workers than in controls. The decrease in activity of ALP in this study may be due to decrease in one or more structural component of ALP such as zinc in lead exposed workers. A significant decrease in ALP in lead exposed workers had earlier been found.[24] It can, therefore, be said that the liver function of exposed workers has been affected by lead. It is known that all types of liver inflammation can cause raised AST and ALT due to leakage. The elevation of AST and ALT in this study weakly correlates positively with increased blood lead levels.

The intervention study suggests that the use of either protective devices or KPT – 4 provide some protection against lead exposure and its effects. Lead is mostly inhaled or absorbed through the skin by workers thus the use of protective devices such as face masks, boots, hand gloves together with other safety measures like regular washing of outfits and ventilation during mixing or spraying of paint might have reduced the quantity of lead being inhaled or absorbed through the skin. KPT – 4 protection against lead exposure and its effects might be due to its constituents notably vitamin C which has been found to reduce blood lead levels in battery workers.[20] Vitamin C in KPT – 4 might be preventing the absorption of lead from the gastro – intestinal tract. Low dietary levels of vitamin C might increase a person's susceptibility to toxic effects of lead because it appears that lead do cause an increased utilization of ascorbic acid.[31] The pattern of decrease in blood lead levels and

the work of other researchers suggest that the drop in blood lead levels may be due to interference in the absorption of newly ingested lead. Newly entering lead may occupy some labile fraction of the blood and be the cause of transitory increases and decreases. This intervention has profound consequences even if minimizing absorption of new lead is the only effect since it is reported that only a minor fraction of airborne inhaled lead particles are retained in the respiratory tract; the remainder are cleared by ciliary action of respiratory epithelial cells and swallowed. The spray painters were placed on a regimen of KPT – 4 similar to the way the battery workers were placed on a regimen of vitamin C and zinc and followed while on this regimen for a period of 6 months.[20] In both cases, the mean blood lead levels dropped from initial levels after 6 months. There was also a significant increase in the mean haemoglobin levels with treatment in both instances but unlike the previous study, there was also a reduction in mean serum uric acid levels. Serum uric acid in the previous study is probably irreversible because it reflects permanent renal system damage. These changes were striking in view of the fact that they were achieved while the workers were on the job and constantly exposed to high levels of lead. Efforts should be made to reduce lead levels in the air but in cases where environmental exposure is unavoidable the use of protective devices/safety measures, KPT – 4 regimen or vitamin C and zinc in lead workers seems to be a desirable alternative for prophylaxis rather than chelating therapy which may have a place in treatment of acute lead poisoning but not in routine oral prophylactic use as practiced elsewhere.[20] This is because chelating agents such as EDTA and penicillamine can cause problems equal to those imposed by lead itself when used prophylactically.

It is likely that KPT – 4 may also have protective therapeutic effects (may protect against lead already absorbed, or mobilize body burden lead and cause it to be excreted); whether the proposed regimen is therapeutic or prophylactic or both remains to be determined. This study has a number of limitations. Some of the automobile workshops have only one spray painter and some none, giving a sample size that was small. It is well known that increasing the sample size is the easiest way to boost the statistical power of a test although the precision with which the data are measured also influences statistical power. The cluster sampling technique would have been more appropriate in this situation nevertheless systematic sampling was used since it is a pilot study. Hydrocarbons in volatile organic compounds just like lead are widely used as constituents of household chemicals such as paints and fuels and may threaten the health of workers exposed to high concentrations. This implies that the health implications found may not necessarily be due to lead alone. There may be imbalance in different characteristics not recorded between the groups which may have influenced the outcome of the study.

CONCLUSION

The study shows that spray painters are exposed to lead. The mean blood lead levels found in these workers in this study are consistent with the levels indicative of severe lead toxicity. Objective health implications (decreased PCV, Hb and ALP; increased AST, ALT, serum uric acid and phosphate) were associated with increased exposure to lead. Use of a detoxifying herbal product (KPT – 4) and protective devices/other safety measures were interventions found to be significant in protecting and minimizing exposure/effects to lead. Efforts should be made to reduce lead levels in the air but in cases where environmental exposure is unavoidable the use of protective devices/safety measures, KPT – 4 regimen or vitamin C and zinc in lead workers seems to be a desirable alternative for prophylaxis rather than chelating therapy which may have a place in treatment of acute lead poisoning but not in routine oral prophylactic use. This is because chelating agents such as EDTA and penicillamine can cause problems equal to those imposed by lead itself when used prophylactically.

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