SECTION THREE

DISCUSSION

CONCLUSION AND
RECOMMENDATIONS
A large variety of industries mainly in the small scale industrial sector mushrooming in India with the direct encouragement from the Government. These industries employ a few workers in a factory shed independently owned and operated and it is, therefore, these types of industries which pose the greatest problem in the organizing of occupational health service. According to Ramanathan (1973), factors that hinder the development of suitable health care systems in such industries are:

(i) the small industries are spread over an enormous area;
(ii) they frequently use a floating population of seasonal workers;
(iii) they are often genuinely ignorant of the hazards to workers; and
(iv) even when a group of such industries is concentrated in an area, their manufacturing processes and products differ so widely that a unified approach is feasible.
Present investigations embody the work done on the evaluation of occupational exposure to trace metals in some small and medium scale industries along with the studies on the background exposure i.e. assessment of the nonoccupational exposure to these metals. The background exposure has been evaluated by estimating of air, water, food, etc. and by monitoring the levels of these metals in blood and urine of the occupationally unexposed population. The findings indicate that the intake of essential elements by such population through diet and air is within the permissible ranges, though a slightly higher intake of cadmium observed here, demands a regular and extensive monitoring as a check in future. Biological monitoring indicated normal and acceptable metallic concentrations in blood and urine though variation was observed from individual to individual, which may possibly be due to the dietary factors related to socio-economic status and the surrounding environment.

Occupational exposure has been studied in a dry cell battery manufacturing unit (for manganese), in small type foundries (for lead), in a welding shop, small ferrous/nonferrous foundries and a ceramic glaze unit (for multimetal exposure).
The ambient manganese concentrations in the dry cell battery manufacturing unit were lower than TLV (U.S.A.) and MAC (U.S.S.R.) values, though, the mixing and bobbin tamping departments showed higher concentrations than the other departments. However, even at these levels, a significantly higher absorption of manganese was observed in the exposed workers which was also reflected in the excretion of manganese through urine. Nevertheless, the factory doctor did not report any case of manganese poisoning. Similarly lead poisoning or lead toxicity could not be observed among the exposed workers in type foundries, though the studies revealed significantly higher absorption of lead due to occupation in the type foundries. The absorption was related to the duration of exposure. The welders who are exposed to metal fumes in the welding operation also showed that the absorption of the metals in the occupation was related with the period of exposure and exposure was higher at the time of actual welding operation. The analyses of the measurement of the airborne metal concentrations from ten small foundries indicated that the exposure to chromium, copper and lead may present appreciable health hazards and this was confirmed by the biological
monitoring of the foundry workers, therefore it was noted that the exposed workers absorbed more chromium, nickel, copper, cadmium and lead. The glaze solution used in ceramic units contains chromium, manganese, nickel, copper, zinc, cadmium, lead, etc., and therefore, workers are exposed to all these metals at one or the other stage depending upon the type of work being done by the workers, e.g., the dippers who are almost constantly dipping their hands into the glaze solution showed higher absorption of metals than the sprayers, who are spraying the glaze solution on the ceramic articles.

The results of biological monitoring bring out another interesting observation. The concentrations of metals in blood tended to be related with the duration of exposure. This is not so for urine, which, therefore, can be regarded only as the second choice while assessing the occupational exposure through biological monitoring.

The following broad conclusions are derived from the findings.

(a) Present levels of occupational exposure to metals in the industries studied are not alarming, but the potential risk is made evident.
(b) No case of acute metal poisoning was detected.

(c) Overall exposure of the non-occupational population to trace heavy metals was in the normal range.

(d) Methodology for evaluation of hazards has been standardized and can be adopted for routine monitoring of population at risk.

It is evident from the studies that exposure of workers in different occupations to different trace metals does present a situation inviting the attention of all concerned with the welfare of the workers. The overall 'less than TLV and MAC values' should not be a reason for any complacency since even at those higher but permissible levels, significantly higher absorption of metals do occur and more so because these values (TLV/MAC) cannot be taken as valid for each and every situation and should, therefore, be best established for individual situation. In any case, measures must be taken to keep the working environment as safe as possible and to let the workers work in as near a toxicant free situation as possible. Based on the findings of the present studies, following recommendations are proposed to be made.
(i) The work-rooms should be well ventilated to have free air movement. Small scale industries like ferrous/nonferrous foundries, welding shops etc. can apply this measure easily as it involves low cost. In addition, appropriate provision of exhaust system is needed to remove the contaminant even before it enters the breathing zone, e.g., suitable exhaust system during ceramic glaze spraying operation.

(ii) All the workers with the risk of exposure to toxic metals should be provided with general and specific personal protective devices, like goggles, gloves, dust and gas masks, face masks, hood and pressure suits, ear muffe, helmeto, etc. to supplement environmental control measures.

(iii) Since workers may have to eat and drink in between the work, proper facilities should be provided for washing purposes - washing facilities should be ample and conveniently situated with hot and cold water and soap provided. The workers should be advised to take both after the day's work is over.

(iv) Proper canteen facility should be provided so that the workers are able to keep the lunch boxes away from the contaminated environment and are
also able to take their meals in such an environment.

(v) It is recommended that periodical environmental monitoring should be undertaken and whenever higher levels of metals be found in the ambient air, immediate check be made to find out the cause and remedial measures be implemented. The environmental monitoring is the dependable means by which an occupational risk can be discerned even before harmful effect actually appear in exposed workers.

(vi) The periodical biological monitoring is equally important to know the degree of intake of metals by the exposed workers. This should always be accompanied with medical surveillance to detect any health impairment at an early stage. Very often the first indication that an occupational hazard is real may be recognised only after individual workers present sign and symptoms specific to metal intoxication. Medical surveillance is important both for detection and treatment of occupational diseases, and for checking the effectiveness of the corrective measures. Periodic medical examination is a
means of detecting individual workers who are unduly susceptible to a toxic agent. This provides an opportunity to recommend a change of job before the onset of a serious or permanently disabling disease.

(vii) The workers must be made aware of the potential hazards from exposure to the metal(s) in use and their education on the subject should also emphasize due importance to personal hygiene to avoid accidental ingestion or skin absorption.

Besides the abovementioned specific recommendations for dealing with the problems of occupational exposure to trace metals, following additional suggestions are made to tackle, in general, the basic occupational health problems in small scale industries.

(i) Small-scale industries should be brought under the factory act, irrespective of the number of workers serving there;

(ii) all the workers should be covered under "Employees' State Insurance Scheme" (ESI); and

(iii) occupational health services have to be fully provided or heavily subsidized by the Government.
Therefore, an adequately planned occupational health and hygiene service must be given appropriate priority in the national interest (Nomanathan, 1970; 1977; Gupta, 1964; Chatterjee S.K., 1977 and Chakraborty, 1977).

**Suggestions for future work**

On the basis of the experience gained while carrying out the present experimental field work, the following studies suggest themselves for further investigations.

(1) Baseline data for trace metals in human environment in India:

There are very few studies, as discussed in Chapter-1, pertaining to the trace metal concentration in the human environment in India. Moreover, these studies are limited for certain metals and for restricted geographical areas. No data on ambient air concentrations, with regard to metallic contaminants, are available for the Indian cities.

Some of the findings reported here like (i) higher dietary intake of cadmium (ii) higher concentrations of nickel, cadmium and lead in blood samples collected from
the urban population with higher socio-economic status in comparison to the samples collected from the rural population with lower socio-economic status, and higher cadmium in urine of the control subjects, etc. prove the influence of the environmental factors on men. On the basis of these facts, it is recommended that countrywide investigations be made for the baseline data of human environments.

(2) To fix-up the norms for the biological samples:

It is observed that metallic concentrations in blood and urine differ widely from individual to individual. There are no data for the standard values of metals in blood, urine or biological specimen for the Indian population. For the epidemiological studies, such data are of great use.

(3) Development of biological indices for the studies on metallic exposure:

It is seen that blood is a more reliable index compared to urine for the studies on metallic exposure. Hair is used to study the toxic metal load. Sometimes, it is difficult to get such specimens, while urine can be collected from the workers with ease and without apprehensions. Therefore, biological investigations
based on urine, should be developed for the exposure studies.

(4) Development of easier techniques for the metallic determination in the environmental samples and biological specimens:

As discussed in chapter-2, there are many advanced instrumental methods of metallic determination. They are costly as such research grade instruments are hardly available in the developing countries like ours. Simple inexpensive methods should be developed to facilitate the research programme in our country. The Dip-Evon technique is a cheap, sufficiently sensitive and reliable semi-quantitative method for the metallic determinations. This technique should be developed to make quantitative assessment possible.

(5) Establishing ELVs for occupational exposure to metals in Indian conditions:

Not a single case of metallic poisoning or metallic toxicity was detected in the presented studies. High and significant absorption of metals was noted among the exposed workers as compared to control subjects. Moreover, the ambient air concentrations of metals were compared with ELV-USA and MAC-USSR values. From the different studies, it is apparent that even at higher concentrations
of notate or for that matter, at higher heat stress levels at work places or heavy dustiness at work areas, workers have not shown any manifestations and symptoms of toxicity in medical and biological investigations. This stresses the immediate need to develop our own standards, for the safe exposure levels of chemical or physical agents in the work environment, that may be applied under the prevalent environmental and working conditions in the country.

(6) Studies on the evaluation of suggested control measures:

The recommendations made in the present study include some of the control measures for minimizing the exposure to trace notate in small scale industries. Once these measures are adopted, it is recommended that further investigations be periodically made, both in terms of environmental and biological monitoring, to assess the effectiveness of control measures.