ASIA PACIFIC JOURNAL of MEDICAL TOXICOLOGY
APJMT 4;3 http://apjmt.mums.ac.ir September 2015

EDITORIAL

Socially Responsive Toxicology; Looking Outside the Windows of Medical Wards: A Tale of Lead Exposure

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The disability-adjusted life years (DALYs) associated with a disease refers to the number of years lived with a disability (YLD) and years of life lost (YLL), i.e., premature death as a result of the disease. The sum of YLD and YLL is thus an apt indicator of the overall burden of the disease (1,2). YLD is calculated by multiplying the number of incident cases of a disease in the population by the average duration of the disease and a weighting factor that reflects the severity of the impact of the disease (disability weight or DW). DW is reported on a scale from 0 (perfect health) to 1 (dead). DWs have been estimated for many health conditions including poisoning. The DW of poisoning for 0 to 14-year-old children is 0.611 and for people above 14 years of years is 0.608 (2). In Iran, poisoning was ranked 21st in terms of its contribution to YLL in 2010. When YLD is considered; however, acute poisoning, which is mainly related to admission in medical toxicology wards, was not a major contributor (3).

There is increasing evidence that at levels of exposure that do not produce acute toxicity, heavy metals can affect public health. So-called "low level" exposures to lead and manganese have been linked to low intelligence scores and hyperactivity in children (4-7). Lead exposure alone accounts for 0.6% of the total global burden of diseases (8). There is no known "safe" level of lead exposure. It damages the developing brain and nervous system and adversely affects the immune, reproductive, hematopoietic and cardiovascular systems (9). These effects are observed at blood lead levels far below the threshold for acute lead poisoning for which chelation therapy is indicated in children (≥ 45 μg/dL). The disease burden of low level chronic exposures to chemicals is considerably higher than that of acute overdoses (4,5,10).

Lead-induced IQ loss is not a disease, but intellectual disability (IQ below 70 points) is. Assuming IQ is normally distributed with a mean (± SD) of 100 (± 15) points (11), it is possible to calculate the number of people in a population whose IQ score would fall below 70 as a result of lead exposure (Figure 1) (12). Although the calculations are complex, 1.59% of population can be expected to fall into IQ of 70 to 73.5 (11,12). These are the individuals at risk for suffering from IQ reduction to less than 70 as a result of lead exposure and thus meeting the diagnostic criteria for intellectual disability. This is equal to 0.42 cases of intellectual disability per 100 people from known non-congenital causes, out of total rate of intellectual disability of 2.27 cases per 100 people (12).

Lead exposure is preventable. A cost-benefit study from the United States found that for every $1 US spent to reduce lead hazards, there is a benefit of $17-221 US or a net lifetime saving of $181-269 billion US (13). Hence, the cost-benefit

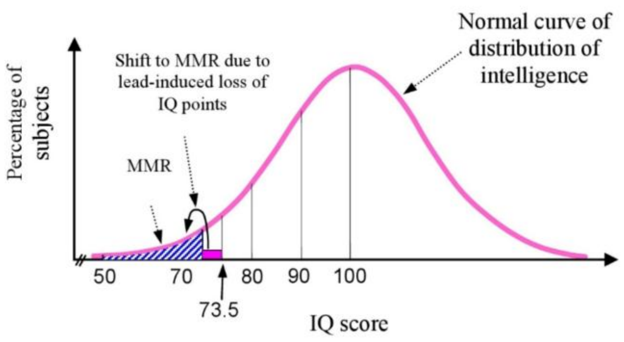

Figure 1. Shift to mild mental retardation (MMR) due to lead-induced IQ loss. Demonstration of the percentage of subjects who falls between 70 and 73.5 points, i.e. the intervals of IQ loss related to the background lead exposure (Adapted from: Fewtrell et al. (11))

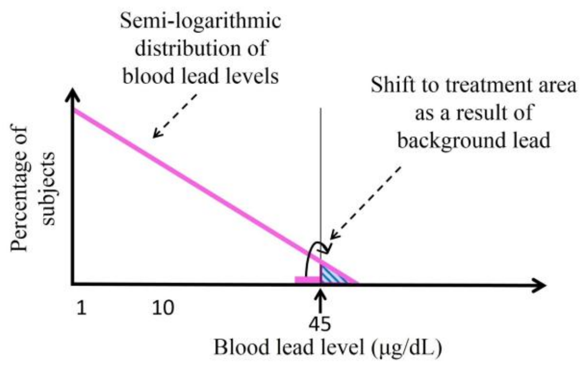

Figure 2. Positively skewed distribution of blood lead levels (BLL) in the population. Demonstration of the percentage of subjects who falls between 35 to 45 µg/L BLL, i.e. the intervals of BLL related to the background lead exposure

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of this preventive measure is even superior to vaccination (8). It is also possible to estimate the contribution of environmental lead exposure to the overall blood lead level (BLL) in occupational poisonings in which chelation therapy is needed (i.e. children ≥ 45 μg/dL) (Figure 2). As the distribution of BLL is skewed (very few cases are above the treatment line among general population due to occupational exposure), any shift of this distribution to over ≥ 45 μg/dL as a result of background lead would include a limited number of cases.

Although reducing the number of individuals whose BLL exceeds the level at which chelation therapy is required would yield cost savings, it is much smaller than the savings that would be expected as a result of reducing the lead-related IQ loss in the general population, which affects many more people (Figure 2). Similar arguments could be made in regard to other measures that should be taken in cases with high BLL, including follow-up blood lead monitoring, neurodevelopmental monitoring, abdominal X ray, other laboratory works and recommended education.

While lead exposure has declined in developed countries in the past decades, it is still a common public health threat in developing countries including Asian countries. It is expected that the burden will remain high in developing countries where rapid increases in industrialization are in process and regulatory standards are weakly enforced. The World Health Organization has estimated that 10% of children worldwide have a BLL greater than 20 μg/dL, given that 99% of these were children from developing countries (12). Hence, the magnitude of this problem in many Asian countries is likely to be large.

Acute toxicities can be managed effectively; however, potential interventions for low dose toxic exposures are scarce. At least for now, it is not pragmatic to advise people to avoid their environment. "Clinical" toxicology practice and research mainly focuses on medical toxicology wards (14,15). Intervening at the population level to reduce exposures to toxicant will yield greater social benefits, however (16). Therefore, designing community-oriented toxicological interventions should be encouraged (17).

Conflict of interest: None to be declared

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