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Review Article

Health and Environmental Effects of Organochlorine Pesticides in Developing Countries

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Introduction

Organochlorine pesticide (OCP) was first synthesized in 1884, however, its use became evident during the 2nd World war when it was used as an insecticide in controlling various vector borne diseases such as malaria and typhus [1]. The post war era saw OCP being used extensively in the agricultural sector as a potent pesticide in addition to its use in indoor residual sprays (IRS) for vector control [1]. The adverse effects on human health and environment caused by OCP led to an international call for its ban in late 1960s [2]. Though this ban was implemented in most developed countries, OCP is still widely used in developing countries because of its low cost, easy availability and effectiveness as pesticides and vector control [2]. India alone uses over 88,000 metric tons of pesticide annually out of which 70% constitutes of OCP [3]. The persistent use of OCP in developing countries could be due to the belief that the immediate benefits brought by the pesticide in saving human lives from vector borne diseases is far important than the long-term consequences caused by it. This paper aims to explore the various health and environmental impacts that are attributed to OCP use.

OCP Effects on Health and Environment

OCP and Human Health

It is estimated by WHO that globally 3 million new cases of pesticide poisoning occur yearly with more than 10 percent deaths [3]. Dichloro diphenyl tri choloethane (DDT), a form of OCP is still the most common pesticide used in many developing countries. OCP is a stable compound that is easily soluble in fats and saturated oils, insoluble in water and has a very long shelf life making it last longer in the environment creating a prolonged and persistent threat to the ecosystem [1]. Although OCP was banned in China in 1983, considerable amounts of the chemical can still be found in the environment even today [4]. OCP has an ability to constantly accumulate without disintegration in the fats and the adipose tissues of the human body over a period of time, therefore, even minimal exposure continuously over time may still result into potential health problems [5]. The exposure to OCP can be through various routes. It may be high transient direct exposure in farmers, workers involved in OCP production, supply and IRS spraying or indirect exposure to people through drinking water, food, air or contact [3]. It is reported that approximately 25 million agricultural workers are exposed to pesticide poisoning globally [6]. The toxicity of OCP depends upon the human doses and time. In case of doses around 280mg/ kg people get acute toxicity such as nausea, vomiting, convulsions, fatigue, flu like symptoms whereas chronic exposures affect various organ systems such as liver, kidney, nerves and immunity resulting into cancers, neurologic symptoms, infertility, and other diseases [1].

OCP causes cancer in people living and working in areas where it is widely used as pesticides. Malwa village, where OCP is used extensively as pesticides in cotton farming reported 46% of the total 34,430 cancer deaths in the whole state of Punjab in India [3]. A common form of cancer directly associated to OCP is the non-Hodgkin's disease which occurs in children and adults [4]. OCP has also been associated with increased incidences of pancreatic and liver cancer. It is reported that workers working in OCP manufacturing companies and farms have a four to five-fold increased risk of getting pancreatic cancer they had a significant risk of liver cancer [7]. OCP is also associated with strong neurologic reactions. It has become evident that continuous exposure to OCP over a period of time increases the risk of Parkinson's disease [8]. Adults aged over 50 years living in or around a farm where OCP is still used are more susceptible to this disease. [8] Parkinson's disease is a major threat in developing countries where majority of settlements are besides agricultural farms. Neurologic symptoms such as elevated levels of stress, anger, and even depression have been reported in OCP exposed workers [6].

Due to their higher body fat percentage coupled with the strong lipophilic nature of chemical, females are more vulnerable to OCP toxicity [7]. A study in China revealed considerable amount of OCP not only in maternal milk and blood but even in the umbilical cord among women [4]. Mothers residing in areas of Kwazulu, South Africa where OCP is used for malaria control had higher OCP levels in their breast milk (15.83mg/kg) as compared to 0.69mg/kg in the non-exposed [9]. However, a study in Kenya in the late nineties reported the presence of OCP in breast milk in samples collected from even non-farmer urban mothers which explains the possibility of its indirect spread [9]. OCP levels in mothers will have a direct impact on children whether it is a fetus or a breastfeeding child. OCP can cause an imbalance in the estrogen- progesterone level during pregnancy leading to preterm babies [7]. The fact that OCP is permeable through the placenta adds further impetus to the evidence that it can impair the growth and development of the fetus [10,11].

OCP and Environment

It is believed that almost 90% of OCP volatizes within a couple of days after spraying [12]. Suspended OCP after sprays disperse over considerable distances apart from the targeted area resulting in contamination of air, soil and non-target plants [12]. Proper disposal of industrial and municipal wastes is also a major concern in developing countries. High levels of OCP was observed in dumping site samples collected between 1999 and 2001 in India, Vietnam and Cambodia [13]. With this environment it is understandable how OCP affects animals such as insects and birds. Considerable OCP residues were also found in samples of lamb, beef and chicken meat and even eggs in Jordan [14]. Another major threat to the environment is the contamination of surface water because of OCP sprays. This surface water not only seeps through but is also washed during monsoon to reach reservoirs such as lakes rivers and oceans [12]. OCP collected in water reservoirs does not dissolve and possess a constant threat to the aquatic life. Mussels collected from the oceans bordering China, Cambodia, India, Korea, Malaysia, Philippines, and Vietnam showed traces of OCP when examined [15]. Even mussel samples collected from the Egyptian Red Sea showed high levels of OCP [16]. In countries like India, China and Bangladesh where fish is consumed in large quantities this is quite significant. In China alone the average fish consumption values stand at 34.19g/day in urban areas while it is at 12.3g/day for the rural residents and the consumption of fish and sea food is even higher among pregnant women [4]. The health threat mostly comes from the fatty oils of the fish meat which contain the highest concentration of OCP [17].

Another major problem associated with OCP is the contamination of the ground water due to its permeability through the soil during rainfall [12]. The level of OCP increases in areas where IRS is conducted regularly. This ground water which is the major source of drinking water in developing countries acts as reservoirs for these chemicals. OCP was present in 58% of the drinking water samples collected from various hand pumps in Bhopal, India [12]. Similarly, reservoir area in Guangtang, China showed traces of OCP which would be detrimental considering the fact that this reservoir is a future source of drinking water supply for Beijing [18].

Where the use of pesticides can be beneficial for agriculture over a transient period, on a long run it decreases the quality of the topsoil [19]. Continuous treatment of soil with pesticides has been found to deplete the necessary soil microorganisms such as Triclopyr, Mycorrrhizal fungi that transform the atmospheric nitrogen into nitrates and ammonia into nitrites. These nitrous compounds are essential nutrients for some leguminous plants such as beans [12]. Soil samples collected from Czech Republic, China and Ghana showed considerable amounts of OCP [20-22].

Conclusion

It is evident that OCP use is a major health and environmental issue in developing countries. The current use of this chemical adds up to the already existing residues in the environment from the past. If not controlled, use of OCP will have serious ramifications in the future. There is a definite need to find similar, safer, effective and cheaper alternatives to OCP when it comes to pesticides. This has to be accompanied by health education to farmers and workers involved in its use because there are still people who are not aware of the consequence of OCP use and are at direct risk of severe diseases.

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