THE ASSOCIATION OF PESTICIDE EXPOSURE WITH HUMAN HEALTH

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Abstract: Pesticides have been linked to an extensive range of human health hazards, ranging from acute impacts such as headaches and nausea to chronic impacts like cancer, reproductive harm, and endocrine disruption. The present research assignment aims to systematically collect, review and evaluate epidemiological studies carried out to investigate possible links of pesticide exposure to human health.

Over the last few years a plenty of epidemiological studies investigating possible associations of pesticide exposure with adverse health effects on humans. The route of exposure to pesticides may take place via inhalation, ingestion, dermal contact or across the placenta has been recognized. The accumulation of these pesticides can cause both acute and chronic health disorders including cancer, disturbed neuro development in children, allergies, and decreased fertility, birth defects and even Parkinson's disease.

Though, for many adverse health effects that are endorsed to pesticide exposure few contradictive or uncertain studies also exist. However, those studies differ generally in sample size and in many cases duration of exposures are assumed rather than actually determined.

Therefore, in this research review article we provide a historical review of growing knowledge in health impacts of pesticides which provide a view on the lessons learned from the frequent negligence or misrepresentation of hazards. We obtained the information from, reviews, books, blogs, social media, various websites and face to face interviews from industrial, household and farm workers. Our investigation found a significant link between pesticide exposure and health effects in human. We present the outcome of the results and conclusions based on the literature review findings. The conclusions may help to improve the understanding of already acknowledged or suggested statements related with human health.

Keywords: epidemiological studies, health outcomes, pesticide exposure.

Introduction: According to the scientific report of EFSA 2014[1], there are 3 million cases of pesticide poisoning each year and up to 220,000 deaths, mainly in developing countries. There is no doubt that the use of pesticides in modern agriculture has significantly increased food productivity. But it has also significantly increased the amount of pesticides in food and in our environment which is associated with negative effects on both environment and human health. There are dozens of million cases of pesticide poisonings worldwide per annum and it is now better understood that pesticides have significant chronic health effects, including cancer, neurological effects, diabetes, respiratory diseases, fetal diseases, and genetic disorders [2]. However, these health effects are diverse depending on the amount and the type of pesticide exposure. In general, the effects are different for farmers who are directly exposed to pesticides compared to those people living in rural areas and are less directly exposed. There are also effects on consumers through pesticide residues in food [3]. More than 18,000 products in US are licensed for use, and each year more than 2 billion pounds of pesticides are applied to crops, homes, schools, parks, and forests [4]. Such extensive use of pesticides results in persistent human exposure.

The use of poisonous pesticides to control pest problems has become a common practice around the planet. Pesticides are used almost everywhere. They are not only present in agricultural fields, but also in our homes, parks, schools, buildings, forests, and roads. It is hard to find someplace where pesticides are not used. From the can of bug spray in the kitchen to the airplane our globe is filled with pesticides. Furthermore, they can be found in the air we breathe, the food we eat, and the water we drink [5].

In 1962, Rachel Carson wrote Silent Spring in 1962, in which she raised public awareness about the effects of DDT use on our health and our environment. Though, almost 52 years after Carson drew attention to the health and environmental impacts of pesticides (DDT), the use of similar dangerous pesticides has much increased [4]. And continuously there is more growing evidence that human exposure to pesticides is linked to serious health problems. However, the risk for and severity of health effects from pesticide exposure varies significantly depending on many factors, such as age and health status, the type of pesticide, and exposure conditions.

Therefore, we reviewed analyzed hundreds of research papers mainly case studies related with pesticide exposure. The conclusions may help to improve the understanding of already acknowledged or suggested statements related with human health.

Methodology: This research review paper is based on information from the fact sheets from EPA [4],

PUBMED [6], and MEDLINE [7] literature bases. Information was also obtained from Centre for Science and Environment (CCE, India) [8], web sites and articles addressing health effects of pesticides. Selected references to the articles reviewed can be found in the Appendices of the working document. Additionally, many press reports have been reviewed on a regular basis. Meetings with local farmers and experts from colleges and Vikram University, Ujjain have also been a useful source of information. Information was also obtained from blogs, research centers and other private sources.

Results and Discussion:

Acute health effects: Acute health disorders may arise in workers that handle pesticides, such as abdominal pain, dizziness, headaches, nausea, vomiting, as well as skin and eye problems [9].It is estimated that half million people are poisoned by pesticides each year in China and 500 of die [10]. Pyrethrins are neurotoxic to insecticides commonly used in common mosquito repellents. Probably it is the safest insecticide for a use in a food plant. However, now it is also known to can cause lethargy, muscle tremors, vomiting, seizures and death [11]. Toxicity of pyrethrin is usually linked with applying much more of the product than directed. Care should be taken to observe direction labels when using this substance around humans and animals. Overdose and toxicity can result in a variety of symptoms, especially in pets, including drooling, lethargy, muscle tremors, vomiting, seizures and death [12]. Our study mainly concentrated on case control and cross sectional studies. A broad and diverse range of pesticides were studied using various definitions. Our results are in line with previous studies on environmental epidemiology and in particular on pesticides.

Long term effects: Long term health effects may occur years after even minimal exposure to pesticides in the environment, or result from the pesticide residues which we ingest through our food and water.

Cancer: Numerous studies have investigated the effects of pesticide exposure on the risk of cancer. The results revealed the involvement of pesticides with various types of cancers including leukemia, lymphoma, brain, kidney and breast cancers [13]. This increased risk happens with both residential and occupational exposures. Enhanced rates of cancer have been observed among farm workers who apply these chemicals [14]. Reports shown that even if a mother is exposed to occupational exposure to pesticides during pregnancy, it is associated with an increase in her child's risk of leukemia, Wilms' tumor, and brain cancer [13], [15]. Even though increasing evidence in support of these findings, it is still incomplete because of the weakness of research methodology like small sample size, differences in age etc. The significant weak points of several epidemiological investigations of pesticide-related health effects are faced mainly in exposure appraisal and small numbers of exposed subjects.

Neurological Effects: Pesticide exposure can cause a variety of neurological health effects such as memory loss, loss of coordination, reduced speed of response to stimuli, reduced visual ability, altered or uncontrollable mood and general behavior, and reduced motor skills. These symptoms are often very slight and may not be recognized in diagnosis by the medical community [16]. Most studies of moderate pesticide exposure have found increased incidence of neurologic symptoms and changes in neurobehavioral performance, reflecting cognitive and psychomotor dysfunction. Research confirmations link pesticide exposure to deteriorated neurological outcomes [17]. The threat of budding Parkinson's disease is 70% greater in those exposed to even low levels of pesticides [11]. In some other studies it was found that both insecticides and herbicides significantly increased the risk of Parkinson's disease [18]. However, it should be noted that consistency, strength of association, and dose response were key elements of the framework utilized for evaluating epidemiologic studies. All together, the epidemiologic studies did not strongly associate any particular pesticide as being causally related to adverse neuro developmental outcomes [19].

Reproductive effects: The research data on the reproductive effects of pesticides come primarily from animal studies and population-based epidemiological studies. Exposure to pesticides at particular developmental stages of life can result an irreversible damage to organ structure and function. Among all, primary concern is the effect of exposure at during the reproductive cycle, from preconception to breast feeding. The possibility of poor birth outcomes, inborn anomalies, developmental deficits, and possibly childhood cancer are linked with pesticide exposure [17]. In the United States, increase in birth defects is associated with conceiving in the same period of the year when agrochemicals are in elevated concentrations in surface water. In Malaya and Vietnam it was found that a 50:50 mixture of 2, 4, 5-T and2, 4-D, has been associated with bad health and genetic effects in Malaya and Vietnam [20], [21]. It was also found that offspring that were at some point exposed to pesticides had a low birth weight and had developmental defects [21].Decreased egg production and embryo viability in birds associated with exposure to pesticide (atrazine) was common in animal studies. In humans, early pregnancy loss, reduced male fertility, genetic alteration in sperm, altered hormone function was observed [22]. A

number of pesticides including dibromochlorophane and 2, 4-D has been associated with impaired fertility in males [23]. Pesticide exposure resulted in reduced fertility in males, genetic alterations in sperm, a reduced number of sperm, damage to germinal epithelium and altered hormone function.

Endocrine disruptors: The Human reproduction is a sensitive bio-chemical process, directed at every step by powerful hormones. Reproductive health involves everything from the physical ability to reproduce to the many behavioral and developmental effects of sex hormones. This finely tuned system is now under threat. Certain group of pesticides mimics the structure of hormone and therefore can able to block or alter the natural system of biological signs [24]. There is also growing support that exposure to pesticides disrupts the endocrine system, causing destruction with the complex regulation of hormones. Endocrine disruption can produce infertility and a variety of birth defects and developmental defects in offspring, including hormonal imbalance and incomplete sexual development, impaired brain development, behavioral disorders, and many others. Examples of known endocrine disrupting chemicals which are present in large quantities in our environment include DDT (which still persists in abundance more than 20 years after being banned in the U.S.), lindane, atrazine, carbaryl, parathion, and many others [21].

Some pesticides when enter into the body, pass out through quickly while others are entered in our blood and tissue for years or even decades. These persistent chemicals can damage the reproductive system in a number of ways. They may cause infertility by killing or damaging the germ cells (sperm cells or eggs) [24]. Some other may cause mutations by altering the DNA that may result in birth defects or an inability to conceive. Evidences are also available that pesticides can cause "epigenic" effect which means they change the way genes are expressed [25].

Other Health Effects: A few studies have found increased risks of dermatitis and other skin disorders in those exposed [17], respiratory problems, memory disorders and depression [26]. Researchers from the National Institutes of Health (NIH) found that long time exposure may cause diabetes [27]. Another study found that linkage between specific pesticides and diabetes incidents ranged from a 20 percent to a 200 percent increase in risk. New cases of diabetes were reported by 3.4 percent of those who use low pesticide while it was 4.6 percent of those who use in high amount. Risks were greater when users of specific pesticides were compared with applicators who never applied that chemical [27].

Prevention: Many options are available to minimize the effects pesticides. The main alternatives include labor-intensive removal, applying heat, covering weeds with plastic, placing traps and lures, removing pest breeding sites, maintaining healthy soils that breed healthy, more resistant plants, cropping indigenous species that are naturally more resistant to native pests and supporting bio control agents are important[4].

Conclusions: Childhood cancers, neurological disorders, Parkinson's disease, reproductive health effects and endocrine disruptions are the major risk associated diseases with pesticide exposure. The exposure needs to be studied further in order to separate the effect of specific pesticide classes or even individual pesticides.

Our results show a very wide range of human health diseases. Among all the most prevalent outcomes are cancers and reproductive health are of major concern. However, other diseases like neurological conditions and hormone disruption are considered as highly important. Our research findings are in line with previous studies on environmental epidemiology and in particular on pesticides.

The above discussion identifies the necessity for more focused use of research studies of exposure for epidemiologic analyses. Further, the introduction and use of new tools and approaches for hypothesis testing that can improve the use of exposure science in prevention. A major restructuring of the field is not required to achieve innovation. However, additional resources for training and education are required to ensure that the potential for exposure science to play a central role in reducing and preventing excess risk within environmental/occupational health is achieved.

Recommendations:

- Effects on endocrine disorders, asthma and allergies, diabetes and obesity, are showing increased risk and should be investigated further.
- This research report concentrated on examining separately health outcomes. We suggest to go for an alternative approach which would be look for pesticide classes, subclasses or even individual pesticides across a range of outcomes. These approaches could highlight whether a pesticide class has a particular harmful effect across a variety of disease endpoints.
- Future studies will need to improve assessment of pesticide exposure in individuals and consider the role of genetic susceptibility. More studies of pesticides other than organophosphates are needed. Major unresolved issues include the relative importance of acute and chronic exposure, the effect of moderate exposure in the absence of poisoning, and the relationship of pesticide-related neurotoxicity to

- neurodegenerative disease.
- Finally, technological advances now enable us to measure in a large scale and agnostic way biomarkers of exposure.

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