



Received: 22 September 2015
Accepted: 10 February 2016
Published: 09 March 2016

*Corresponding author: Muhammad Sarwar, Department of Entomology, Nuclear Institute for Food & Agriculture (NIFA), Tarnab, Peshawar, Pakistan
E-mail: drmsarwar64@yahoo.com

Reviewing editor:
Albert Lee, The Chinese University of Hong Kong, Hong Kong

Additional information is available at the end of the article

PUBLIC HEALTH | REVIEW ARTICLE

Indoor risks of pesticide uses are significantly linked to hazards of the family members

Muhammad Sarwar^{1*}

Abstract: In this review article are described different ways in which pesticides may disrupt human's body system, various functions, and in particular of children, men, and women exposures. Pesticides are of vital importance in fight against crop diseases, for production and storage of food, and widely used for pest control in agriculture, gardening, homes, and soil treatment. Most common factors contributing to illness are excessive insecticide application, failure to wash pesticide-treated bedding, and inadequate notification of pesticide application. Majority of insecticide exposures are to pyrethroids, pyrethrins, or many others, and most frequently reported health-impacted outcomes are neurologic symptoms including headache and dizziness, respiratory symptoms including upper respiratory tract pain and irritation and dyspnea, and gastrointestinal symptoms including nausea and vomiting. Some pesticides may interfere with male and female hormonal functions, which may lead to negative effects on reproductive system through disruption of hormonal balance necessary for proper body functioning. Previous studies primarily focused on interference with estrogen and androgen receptor; however, hormonal function may be disrupted in many more ways through pesticide exposure. Parental exposure to pesticides has been linked with birth defects in children, and studies suggest that



Muhammad Sarwar

ABOUT THE AUTHOR

Muhammad Sarwar, Principal Scientist, is going through his twenty-fifth year of service experience in a research-orientated Department of Agriculture and Pakistan Atomic Energy Commission. He has 203 research work publications in national (61) and foreign journals (142) with suitable impact factor. He has received the Award of Higher Education Commission of Pakistan, "Post-Doctoral Scholarship", 2006, on the basis of merit for research work at Institute of Plant Protection, Chinese Academy of Agricultural Sciences, Beijing, China. Zoological Society of Pakistan in recognition of research contributions presented Gold Medal-2010 on March 2, 2010. Granted Research Productivity Award-2011, by Pakistan Council for Science and Technology. Included in list of Higher Education Commission of Pakistan as approved Supervisor. Completed "Basic Management course" organized by Pakistan Institute of Engineering & Applied Sciences, Islamabad, held from 31 January to 18 February 2011 and has acquired different national and international (Beijing, Bangkok, Vienna and Havana) trainings.

PUBLIC INTEREST STATEMENT

Pesticides are chemicals that are used to kill or control pests which include insects and rodents, in addition to bacteria, fungi, and other organisms. Products used on lawns and gardens that drift or are tracked inside the house may be found, especially in the air within homes. The exposure to pesticides may result in irritation to eye, nose, and throat; damage to central nervous system and kidney; and increased risk of cancer. Symptoms due to pesticides exposure may include headache, dizziness, muscular weakness, and nausea. If chemicals are necessary to be used, use only recommended amounts, mix or dilute pesticides outdoors or in an isolated well-ventilated area, apply to unoccupied areas, and dispose of unwanted pesticides safely to minimize human exposure. Always consider to use alternative methods other than pesticides, follow the label instructions carefully, use the least possible amount, and seek urgent medical attention in case of pesticide poisoning.

pesticides may compromise the immune system of infants and children. Every effort should be made to limit children, men, and women exposures to pesticides including educating of public about effective vector management. Furthermore, house holders should have to take into account that dose, timing, and duration of exposure are critical to the ability of a pesticide to cause harmful effects.

Subjects: Environmental Health; Physical Chemistry; Public Health - Medical Sociology

Keywords: pesticide; risk; hazard; infestation; toxicity; public safety

1. Introduction

Insecticides are products of chemical or biological origin that are used to control insects. They include ovicides, larvicides, and adulticides used against the eggs, larvae, and adults of insects, respectively, and are used in agriculture, medicine, industry, and the household. Insecticides are believed to be the major factors behind the increase in agricultural productivity and healthy against vectors. Control of insects by insecticides may result from killing the pests or otherwise preventing these from engaging in behaviors deemed destructive. The current study adds to the health concerns that pesticides could contribute to the development of children and adults. It certainly seems prudent to limit the exposure of children or anyone to these agents, especially in indoor locations (Sarwar & Salman, 2015; Ware & Whitacre, 2004).

The risk of developing blood cancers such as leukemia and lymphoma increases significantly in children exposed to pesticides indoors, which a recent meta-analysis has shown. A correlation between pesticide exposure and childhood brain tumors has also been observed. Children who are exposed to indoor insecticides by either breathing in or eating them are more likely to be diagnosed with the two types of above-stated blood cancers, which are among the most common childhood cancers. Also observed is a positive but not statistically significant association between childhood home pesticide or herbicide exposure and childhood brain tumors. The research looked at children's exposure to three types of pesticides, indoor insecticides, outdoor insecticides, and herbicides, determined through parent interviews. Chemicals that are used in the manufacture of child's car seats contained substances that are potentially toxic to a child in his/her developmental years. The toxic chemicals highlighted included arsenic, bromine, chlorine, lead, and other heavy metals tested in the study using gas chromatography or mass spectrometry. The ecology found that car seats tested contained hazardous halogenated flame retardants, and more than half contained non-halogenated organophosphate flame retardants, some of which are hazardous as well. The research shows that some car seats contain more harmful chemicals than others. Repeated exposures to the chemicals found in the car seats have consistently been linked to thyroid problems, learning and memory impairment, decreased fertility, and cancer. Scientists are particularly concerned about what happens when a child spends hours in a car seat when that car seat is exposed to heat and UV-rays, because heat can accelerate the release of chemicals from products into the environment (Irvine, 1998; Mark, Brancaccio, Soter, & Cohen, 1999).

Scientists have also discovered that flame retardant chemicals added to the seat materials are not bound to the car seat, posing a risk that infants, toddlers, and children can inhale, ingest, or absorb the chemicals through the skin over time. This study reminds us that the lack of regulation of chemicals in vehicles and vehicle components, like children's car seats, has resulted in vehicle interiors having some of the highest levels of hazardous chemicals including flame retardants. Children exposed to insecticides at home may have a slightly increased risk of developing leukemia or lymphoma. The analysis of studies done, found that children exposed to indoor insecticides have an elevated risk of developing the blood cancers. There is also a weaker link between exposure to weed killers and the risk of leukemia. The findings, reported that by limiting babies and children exposures to chemical pesticides, especially the indoor insect killers, is linked to leukemia and lymphoma. Childhood cancers leukemia and lymphoma are two types of blood cancer among the most common

childhood cancers, but unlike adult cancers, which arise after decades of lifestyle choices. But as the new review shows, a number of studies have found an association between pesticides and certain childhood cancers. Moreover, it is biologically plausible that the chemicals could contribute to cancer in certain vulnerable children. Adults should always be cautious about exposing the children to any toxic chemicals, which just makes sense. For the study, it has been pooled the results that overall, children who are not exposed to any indoor insecticides are less percent likely to have leukemia or lymphoma, while outdoor insecticides are not linked to the cancers, and kids exposed to weed killers, meanwhile, have percent higher risk of leukemia found. Those figures might sound alarming, and it is important to keep them in perspective, still it is a risk factor that can be avoided and therein it is important to get this information out to parents. If indoor pests are a problem, and there are nonchemical options for controlling, like denying bugs any food sources and using baits or traps, then it is very decent. But children can also be exposed to pesticides outside of the home such as in schools, parks, or playgrounds, so it also makes sense to limit pesticide use in those places too (Davis, Brownson, & Garcia, 1992; Leiss & Savitz, 1995; Zahm, 1997).

2. Human health issues

In most cases, pesticides are designed to kill pests, and many pesticides used indoor can also pose risks to peoples. However, in many cases the amount of pesticide peoples are likely to be exposed to is too small to pose a risk. The risks associated with given pesticides or pesticide products depend on the toxicity of the compound and the probability of exposure. For determining risk, one must consider both the toxicity and hazard of the pesticide and the likelihood of exposure. For example, a low level of exposure to a very toxic pesticide may be no more dangerous than a high level of exposure to a relatively low-toxicity pesticide (Sarwar & Sattar, 2016).

2.1. Pesticides and children

Two behavioral traits associated with children's exposure to pesticides include their hand to mouth behavior, which increase their ingestion of any toxic chemical in dust or soil, and their likelihood of playing close to the ground. Both of these behaviors increase children's exposure to toxins in dust, soil, and carpets, as well as to toxins that form low-lying layers in the air such as certain pesticides (Landrigan, 2001). Previous research has suggested that the use of pesticides may affect children's health more than adult's health. Children may be particularly vulnerable because their immune systems are still developing, and therefore may provide less protection than adult immune systems. Their bodies may also be less able to detoxify and excrete pesticides than those of adults. Studies have also shown that children have experienced acute toxic effects on their respiratory, gastrointestinal, nervous, and endocrine systems as a result of exposure to pesticides at home or school (Nelson, 1998). Children may present with a different clinical picture from adults. Hypotonia, lethargy, seizures, and coma are more common presenting symptoms in children than in adults, and children rarely present with the classic cholinergic signs of salivation, lacrimation, diaphoresis, bradycardia, or fasciculations (Lifshitz, Shahak, & Sofer, 1999).

According to a new analysis of previous studies, children who have been exposed to certain pesticides used in homes may have an increased risk of childhood diseases. In the analysis, researchers looked at various studies examining the potential link between exposure to residential pesticides and childhood cancers. They found that children who have been exposed to indoor insecticides are 47 percent more likely to be diagnosed with childhood leukemia than those who have never been exposed. They are also 43 percent more likely to be diagnosed with childhood lymphoma. It is important to remember that pesticides are designed and manufactured to kill organisms, and parents should avoid using these chemicals in the vicinity of their kids, and in places where the kids spend a lot of time (Zahm & Ward, 1998).

Organophosphates and carbamates are toxic to the nervous system, and some of the pyrethroids are believed to be toxic to the reproductive system and disruptive to endocrine function. A recent study suggests that endosulfan exposures may delay sexual maturity and interfere with sex hormone synthesis in male children (Clark et al., 2002; Narayana, Narayan, & D'Souza, 2004). Because

the use of pesticides is increasing, public health policies should be developed to minimize childhood exposure to pesticides in the home according to the new analysis. Meanwhile, parents, teachers, and doctors should learn about common types of pesticides and labeling information, and be aware of the potential health effects of those chemicals newly added. When there are children in the home, it is necessary to make sure that all pesticides are stored out of their reach and do not store any highly toxic pesticides in the home, especially agricultural pesticides. Whenever, any object including clothing, containers, or equipment, become contaminated with pesticides, discard it or clean it thoroughly and separately. Always do not leave any pesticide contaminated object in areas where children might come into contact with them (Frazier, 2007).

2.2. Men exposure to pesticides

Peoples of any age with asthma or other chronic diseases may be more likely than healthy individuals to get sick after pesticide exposure. Some individuals are also more sensitive to the odor or other irritant effects of certain pesticides. Peoples who use pesticides in their homes may also be overexposed and become ill, especially if they do not carefully follow the directions on the product label. Many pesticides penetrate to the skin and cause systemic exposure. Acute illness and death have been reported from percutaneous absorption of pesticides, particularly through damaged skin and dermatitis is the second most common occupational disease. Rates in the agricultural industry are the highest of any industrial sector and pesticide-related skin conditions represent between 15 and 25% of pesticide illness reports. Skin reactions can involve any skin area, including areas covered by clothing, particularly if the pesticide contacts through the clothing and soaks. However, exposed areas, such as arms, hands, face, and neck are most commonly affected (Larsen, Giwerzman, Spanò, & Bonde, 1998; Paulsen, 1998).

Adults occupationally exposed to organophosphate or organochlorine pesticides are found to have increased frequency and severity of respiratory infections such as tonsillitis, pharyngitis, and bronchitis. These workers also showed diminished neutrophil response related to duration of exposure to pesticides including impaired phagocytosis, respiratory burst, and adhesion. A substantial amount of research has been conducted to associate occupational exposure to pesticides with fertility problems in men. One reason may be that exposure to pesticides is higher among men, because men usually apply pesticides. Low sperm concentration, reduced motility, and abnormal morphology of sperm are the dominant causes of subfertility. Male subfertility is generally expressed as a reduced ability of the female partner to get pregnant. Because of their high performance and low toxicity, pyrethroid insecticides are widely used in place of organochlorine insecticides both in agriculture and in the home. Recent research indicates that pyrethroid insecticides can reduce sperm count and motility, cause deformity of the sperm head, increase the count of abnormal sperm, damage sperm DNA, and induce its aneuploidy rate, as well as affect sex hormone levels and produce reproductive toxicity (Meeker, Barr, & Hauser, 2008).

2.3. Pesticides and women

Significant exposure to pesticides is a concern for adults, children, and, particularly, expectant mothers. Garden insects, fleas, mosquitoes, ants, and cockroaches are just some of the reasons that women commonly spray pesticides around their homes. Pesticides and insecticides contain chemicals that are used to attack the nervous system of the insects and cause them to die. During the first trimester of pregnancy, the nervous system is rapidly developing in baby, so definitely it is necessary to avoid any type of contact with pesticides during this time (Abell, Juul, & Bonde, 2000; Liu, Gold, Lasley, & Johnson, 2004). Numerous case reports and case series present various combined severe congenital anomalies following occupational or accidental exposure of pregnant women to pesticides. Modest increase in cancers of the nose and nasal cavity is reported among workers exposed to phenoxy herbicides and chlorophenols. A greater than two fold increase in lung cancer (adjusted for smoking) has been observed among structural pest-control workers. Excess cancer of the sinusal cavities and lungs has been found among women working in agricultural settings. Among women occupationally exposed to pesticides, one study observed an increased incidence of bladder

cancer (Hjalgrim, Frisch, Begtrup, & Melbye, 1996; McDuffie, 1994; Mirza, Sarwar, Sarwar, Khalid & Sarwar, 2015; Sarwar, Mirza, Sarwar, Khalid & Sarwar, 2015).

Some studies primarily focused on interference with the estrogen and androgen receptor, but the hormonal function may be disrupted in many more ways through pesticide exposure that may disrupt the hormonal function of the female reproductive system and in particular the ovarian cycle. Disruption can occur in all stages of hormonal regulation like hormone synthesis, hormone release and storage, hormone transport and clearance, hormone receptor recognition and binding, hormone post-recept or activation, the thyroid function, and the central nervous system. These mechanisms are described for effects of pesticide exposure *in vitro* and on experimental animals *in vivo*. For the latter, potential effects of endocrine disrupting pesticides on the female reproductive system, i.e. modulation of hormone concentrations, ovarian cycle irregularities, and impaired fertility, are also reviewed. In epidemiological studies, exposure to pesticides has been associated with menstrual cycle disturbances, reduced fertility, prolonged time to pregnancy, spontaneous abortion, stillbirths, and developmental defects, which may or may not be due to disruption of the female hormonal function. Because pesticides comprise a large number of distinct substances with dissimilar structures and diverse toxicity, it is most likely that several of the above-mentioned mechanisms are involved in the pathophysiological pathways explaining the role of pesticide exposure in ovarian cycle disturbances, ultimately leading to fertility problems and other reproductive effects. In future research, information on the ways in which pesticides may disrupt the hormonal function as described in this review, can be used to generate specific hypotheses for studies on the effects of pesticides on the ovarian cycle, both in toxicological and epidemiological settings (Bretveld, Thomas, Scheepers, Zielhuis, & Roeleveld, 2006).

2.3. Epidemiological impacts of pesticide on human

After an exhaustive and comprehensive search of scientific publications, it is identified that there are epidemiologic associations between pesticide exposure and diverse health outcomes. The entire spectrum of health outcomes related to pesticide exposure shows a very wide spectrum including 24 major disease categories. Few environmental exposures have been associated with such a wide range of outcomes, and the most prevalent outcomes are cancers and mother and child health outcomes. But, other disease categories have also received considerable attention such as neurological conditions and reproductive diseases. In addition, exposure simultaneously to multiple agents is common which may introduce further bias in the results. For example, occupational exposure to pesticides is likely to coexist with exposure to benzene, heavy metals, solvents, suspended particulate matter, etc. all of which have adverse health outcomes. Beyond definition of exposure, the definition of clinical outcomes displayed large variability in eligible epidemiological studies, which can further cause the variability in results (Ntzani, Chondrogiorgi, Ntritsos, Evangelou, & Tzoulaki, 2013).

3. Safety from pesticides

Some of the journals have reported that three out of every four women are exposed to pesticides around the home. They also observed that pregnant women exposed to household gardening pesticides have a modest risk to increase for oral clefts, neural tube defects, heart defects, and limb defects. Women living within 1/3 km of agricultural crops have the same modest risk increase for neural tube defects. The children who are exposed to indoor pesticides are at an elevated risk of leukemia and the risk is increased during the first three months of pregnancy and when professional pest control services are used in the home. Some of the journals have reported an association between agricultural pesticides and birth defects, pregnancy complications, and miscarriage. The safest rule of thumb is that pregnant women should avoid to pesticide exposures whenever possible. Some studies indicate that the greatest risk of exposure to pesticides is during the first three to eight weeks of the first trimester when the neural tube development is occurring. If it is discovered that female is pregnant and lives near an agricultural area where pesticides are being used, it is advised to re-move herself to avoid exposure to these chemicals (Collins, Burrows, & Wilan, 1995; Idrovo et al., 2005).

4. Techniques to diminish toxins at homes

New parents and expectant in particular, need practical advice to help the family members to safeguard their children from health risks such as learning and behavioral disorders, asthma, cancer, and certain birth defects that researchers have linked to toxic chemicals found in and around the homes. Below is helpful information related to pesticide or insecticide uses that the health and environmental experts have issued as the best ways to reduce five common sources of toxins associated with health risks in homes (Erdman, 2003; Sarwar, 2015a, 2015b, 2015c, 2015d, 2015e; Thomas, Kihiczak, & Schwartz, 2004; Wang, Gibb, & Bennett, 2009).

4.1. Dust regularly

The house dust is a major source of children's exposures to toxic substances including pesticides and lead, which even at very low levels is known to be harmful to the developing brain. One of the main sources of children's exposure to toxic substances, house dust can be kept away with weekly vacuuming or wet cleaning, as well as dusting with a damp cloth. It is recommended such cleaning twice a week in the house having a crawling child. Dry dusting is not advised because it circulates the dust back into the air. Additionally, taking off shoes for everyone at the door can minimize the amount of dirt and potentially harmful chemicals brought into the home. Getting rid of clutter and storing toys in closed containers can also help to reduce dust levels.

4.2. Green cleaning

This is recommended switching to simple and nontoxic cleaners such as baking soda can be used to scrub sinks and tubs, while vinegar mixed with water works well for most surfaces, including windows and floors. The researchers say that bleach is not needed for most cleaning tasks and that air fresheners should be avoided. For laundry, choose fragrance-free detergents and avoid using dryer sheets, because fragrances in these products can contain potentially harmful chemicals. For dry clean only items, locate a cleaner that uses nontoxic methods.

4.3. Right renovation

The home renovation schemes pose a threat to children and pregnant women, as contaminant-laden renovation dust and toxic fumes from paints, caulking, and glues can cause neurological damage. All renovation areas should be sealed off from the rest of the home by plastic sheeting and duct tape, and heating and cooling vents should be closed. Controlling all dust is especially important in homes built many years ago, because their renovation dust can contain high levels of lead. Careful dust breaking is essential during and after any renovation or repair project, and children and pregnant women should stay away from any areas being renovated to avoid being exposed to potentially harmful substances, whereas for painting, select less toxic paints, finishes, and glues.

4.4. Picking plastics carefully

Many of the adverse effects of pesticides depend upon the packaging containers and their suitable discard could minimize exposure to these chemicals and the undesirable effects of exposure on human health. Make sure to read the warning labels on all pesticide and insecticide packages before handling and using. It is advised for ignoring of pesticides labels and never placing plastic containers or plastic wraps in the microwave, because harmful chemicals can leach from the plastic into food and drinks. Food should be stored in glass or ceramic containers rather than plastic, and consumers should eat fresh and frozen foods whenever possible to reduce their exposure to a chemical used in the lining of most food and drink cans. It is also advised to parents to avoid buying teething toys, bibs, bath toys, shower curtains, and other items that contain PVC, which is a type of soft plastic commonly known as vinyl. These items can contain harmful chemicals called phthalates, which are banned from being used in children's toys, and it is advised discarding of older toys and teethingers made of this soft plastic.

4.5. Minimizing of toxic materials

Human's toxicity to insecticides may be influenced by any surfactant or adjuvant used and the sublethal effects of many agricultural chemicals can cause serious problems. On the other hand, even

the most toxic chemical can be used safely if it is used properly, for example, mercury, a metal that is toxic to the brain, is prominent in certain types of fish and shellfish, including tuna and swordfish. The experts recommend choosing fish low in mercury, such as Atlantic mackerel, herring, rainbow trout, wild or canned salmon, and tilapia. Light varieties of canned tuna are lower in mercury than albacore or white tuna. The experts state that pregnant women, women who may become pregnant, nursing mothers, and young children can eat up to 12 oz of fish that are low in mercury a week. Ask local authorities about whether it is safe to eat fish caught by family or friends in the local lakes, rivers, and coastal areas.

4.6. Organic and natural pesticides

Almost all toxins used in pesticides are compounds that are naturally present in some plants. Although they sound healthier, all chemicals, including natural chemicals, have the potential to cause harm if they are not properly handled according to the regulations and also considering the public concerns about residues in food and drinking water. Least toxic insecticides that are labeled as natural or organic are necessarily harmless to humans, many quite safe to use and less toxic in contrast to broad spectrum conventional pesticides. These could contribute to reduction of the adverse effects of pesticides on human health and home environment, and all these may sound difficult, but seem to be a promising way for sufficient supply of safety against harmful chemicals within a viable system (Hina, Sarwar, & Lohar, 2015; Sarwar, 2012, 2013; Sarwar & Sattar, 2012; Sarwar, Ashfaq, Ahmad, & Randhawa, 2013). Below is helpful information related to pesticide or insecticide uses:

Do not fright if it is realized that somebody has been exposed to a pesticide because any real risk comes from long-term or intense exposure. When someone just treated the pet for fleas or lice and exposed himself to a pesticide, then the risks to baby are small. The safest plan is to avoid using pesticides or insecticides in home, on pets, or in the garden during pregnancy. Especially avoid them during the first trimester when the baby's neural tube and nervous system are developing. However, if there must be treatment to home, pet, or garden for pesticides, follow these guidelines to decrease the likelihood of exposure, wherein there should have someone else to apply the pesticides. Leave the area for the amount of time indicated on the pesticide package, remove food, dishes, and utensils from the area before the pesticide is used, wash the area where food is normally prepared following any application of pesticides in the home, open the windows and allow the house to ventilate after the treatment is completed, and wear protective clothing when gardening to prevent contact with plants that have pesticide on them. When a pesticide comes in contact with skin, is inhaled or swallowed, try to have the pesticide container immediately when called for Physician (Romero, Potter, Potter, & Haynes, 2007).

Raising alarm over the use of pesticides indoors, a new study has found increased risk of leukemia and lymphoma in children. According to researchers, it has been found that indoor pesticides use is linked with more percent increased risk (47%) of leukemia and 43% increased risk of lymphoma. The risk calculation is made in the study using a meta-analysis of previous studies. Exposure to residential indoor insecticides but not outdoor insecticides during childhood is significantly associated with an increased risk of childhood cancers, but not childhood brain tumors. The study does not find any connection between increased risk of cancer and outdoor use of pesticides. A small risk increase is associated with herbicide use outdoors. Childhood cancer is considered rare but in the past few decades the rate of incidents is said to have increased, with vast improvement in cure and survival rates. Additional research is needed to confirm the association between residential indoor pesticide exposures and childhood cancers. Meanwhile, preventive measures should be considered to reduce children's exposure to pesticides at home. Farmers who work with pesticides, even without major mishaps, have a greater risk of neurological problems. According to a study of farmers, researchers have looked at a host of symptoms, ranging from headache and fatigue to memory loss and motor problems. The more pesticides the farmers used in their lives, the greater the risk even if they have not used them recently (Khalid, Sarwar, Sarwar, & Sarwar, 2015; Sarwar, Sarwar, Khalid & Sarwar, 2015).

5. Responsibility of health professionals

The health professionals can reduce pesticide exposure by informing patients about the risks of pesticide exposure and discourage to use of many pesticides in the home and garden and on pets, particularly in homes with small children or pregnant women; learn about pesticides used in local schools, hospitals, day care centers, parks, and playgrounds, and push to eliminate the use of hazardous pesticides in these environments, and work for strict regulation or phase-out of aerial spraying of chemical pesticides. Overall, home pesticide use is associated with a statistically significant risk in all examined childhood cancers, including neuroblastoma and tumor. Researchers also examined studies involving outdoor pesticides, such as outdoor insecticides, herbicides, and fungicides, but the results are much less consistent. There is a statistically significant association between exposure to herbicides and all types of childhood cancer combined, as well as childhood leukemia specifically. However, there is no statistically significant association between outdoor pesticides or outdoor insecticides and childhood cancer. It is emphasized the role that both clinicians and the community could play in helping to protect children from exposure. Pediatricians ought to remind the parents with young kids to try not to use pesticides in their household and if kids go to a daycare or school that uses lots of pesticides, parents may need to talk to the schools to see if there is a better alternative without using chemicals-based treatment. The most important message is that these exposures can be minimized, because public does not have to use pesticides in places where kids and adults spend so much time (Mughal, Sarwar, & Sarwar, 2015; Sarwar, Sarwar, & Sarwar, 2014; Sarwar, Sarwar, & Sarwar, 2015).

6. Conclusion

Pesticides are not one common substance, but comprise a large number of substances with dissimilar structures and diverse toxicity which may act through different mechanisms. Sometimes insect populations and infestations are seen at increasing trend in homes which are often treated with insecticides, but insecticide resistance is a problem and excessive use of insecticides can raise potential for human toxicity. Therefore, it is most likely that not just one but several of the above-mentioned mechanisms are involved in the pathophysiological pathways explaining the role of pesticide exposure in gonads cycle disturbances ultimately leading to fertility problems and other reproduction toxic effects. An effective strategy for dealing with pesticide contamination in the home environment has to commence with an assessment of the extent of the problem, however, monitoring programs for pesticides are scarce, particularly in developing countries. Likewise, integrated vector management (IVM)-based vector control is encouraged, however, strengthened coordination, intersectoral collaboration, and institutional and technical capacity for entomological monitoring and evaluations, including enforcement of appropriate legislation are crucial. Furthermore, more research is needed in order to characterize the cumulative and synergistic effects of these pesticides, as well as, the interaction among those contaminants and other pollutants. To be successful, in combating vector-borne diseases, vector-control programs should have the legal authority to perform surveillance and control activities, employ qualified staff, and have a stable and adequate source of revenue. The IPM programs use current, comprehensive information on the biology of vectors and their interactions with the environment. This information, in combination with available pest-control methods, is used to manage vector populations by the most economical means and with the least possible hazard to people's property and the environment. In addition, evaluation of IPM programs is important to ensure their efficacy in reducing vector populations and mitigating human health risks. For intendance, IPM is initiated to overcome the shortfalls associated with indiscriminate application of pesticides. Pesticide application alone is not effective in controlling mosquito populations because it is difficult to get the pesticide into the habitat of the mosquitoes due to weather conditions (rain, wind) or changes in adult mosquito activity. In fact, mosquitoes can build resistance if pesticides are overused, and aside from their ineffectiveness, pesticides can have long-term ecological, environmental, and human or animal health impacts. Although few cases of illnesses associated with insecticides used to control public health insects have been reported, recommendations to prevent this problem from escalating include educating the public about effective vector management. In future research, information on the ways in which pesticides may disrupt hormonal function as described in this article, can be used to generate specific hypotheses for

studies on the effects of pesticides on body both in toxicological and epidemiological settings. The researchers encourage non-chemical indoor control measures; therefore, in an IPM approach to vectors control, pesticides play part as overall pest control device.

Funding

The author received no direct funding for this research.

Competing interest

The author declares no competing interest.

Author details

Muhammad Sarwar¹
E-mail: drmsarwar64@yahoo.com

¹ Department of Entomology, Nuclear Institute for Food & Agriculture (NIFA), Tarnab, Peshawar, Pakistan.

Citation information

Cite this article as: Indoor risks of pesticide uses are significantly linked to hazards of the family members, Muhammad Sarwar, *Cogent Medicine* (2016), 3: 1155373.

References

- Abell, A., Juul, S., & Bonde, J. P. (2000). Time to pregnancy among female greenhouse workers. *Scandinavian Journal of Work, Environment & Health*, 26, 131–136. <http://dx.doi.org/10.5271/sjweh.522>
- Bretveld, R. W., Thomas, C. M. G., Scheepers, P. T. J., Zielhuis, G. A., & Roeleveld, N. (2006). Pesticide exposure: the hormonal function of the female reproductive system disrupted? *Reproductive Biology and Endocrinology*, 4(30), 1–14.
- Clark, G., Garry, V., Burroughs, B., Holland, S., Chu, M., & Brown, D. (2002). Endocrine disruptors. Relationships between exposure to dioxin-like chemicals, testosterone levels, and sex of the children of pesticide applicators. *Organohalogen Compounds*, 56, 73–76.
- Collins, J. A., Burrows, E. A., & Wilan, A. R. (1995). The prognosis for live birth among untreated infertile couples. *Fertility and Sterility*, 64, 22–28.
- Davis, J. R., Brownson, R. C., & Garcia, R. (1992). Family pesticide use in the home, garden, orchard, and yard. *Archives of Environmental Contamination and Toxicology*, 22, 260–266.
- Erdman, A. R. (2003). Pesticides- insecticides. In R. C. Dart (Ed.), *Medical toxicology* (3rd ed., pp. 1487–1492). Philadelphia, PA: Lippincott Williams & Wilkins.
- Frazier, L. M. (2007). Reproductive disorders associated with pesticide exposure. *Journal of Agromedicine*, 12, 27–37. http://dx.doi.org/10.1300/J096v12n01_04
- Hina, H. K., Sarwar, M., & Lohar, M. K. (2015). Repellence activity of plant oils against red flour beetle *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae) in wheat. *International Journal of Animal Biology*, 1, 86–92.
- Hjalgrim, H., Frisch, M., Begtrup, K., & Melbye, M. (1996). Recent increase in the incidence of non-Hodgkin's lymphoma among young men and women in Denmark. *British Journal of Cancer*, 73, 951–954. <http://dx.doi.org/10.1038/bjc.1996.170>
- Idrovo, A. J., Sanin, L. H., Cole, D., Chavarro, J., Cáceres, H., Narváez, J., & Restrepo, M. (2005). Time to first pregnancy among women working in agricultural production. *International Archives of Occupational and Environmental Health*, 78, 493–500. <http://dx.doi.org/10.1007/s00420-005-0615-9>
- Irvine, D. S. (1998). Epidemiology and aetiology of male infertility. *Human Reproduction*, 13, 33–44. http://dx.doi.org/10.1093/humrep/13.suppl_1.33
- Khalid, M. T., Sarwar, M. F., Sarwar, M. H., & Sarwar, M. (2015). Current role of physiotherapy in response to changing healthcare needs of the society. *International Journal of Education and Information Technology*, 1, 105–110.
- Landrigan, P. J. (2001). Pesticides and PCBs: Does the evidence show that they threaten children's health? *Contemporary Pediatrics*, 18, 110–111.
- Larsen, S. B., Giwercman, A., Spanò, M., & Bonde, J. P. (1998). A longitudinal study of semen quality in pesticide spraying Danish farmers. *Reproductive Toxicology*, 12, 581–589. [http://dx.doi.org/10.1016/S0890-6238\(98\)00047-1](http://dx.doi.org/10.1016/S0890-6238(98)00047-1)
- Leiss, J. K., & Savitz, D. A. (1995). Home pesticide use and childhood cancer: a case-control study. *American Journal of Public Health*, 85, 249–252. <http://dx.doi.org/10.2105/AJPH.85.2.249>
- Lifshitz, M., Shahak, E., & Sofer, S. (1999). Carbamate and organophosphate poisoning in young children. *Pediatric Emergency care*, 15, 102–103. <http://dx.doi.org/10.1097/00006565-199904000-00006>
- Liu, Y., Gold, E. B., Lasley, B. L., & Johnson, W. O. (2004). Factors affecting menstrual cycle characteristics. *American Journal of Epidemiology*, 160, 131–140. <http://dx.doi.org/10.1093/aje/kwh188>
- Mark, K. A., Branaccio, R. R., Soter, N. A., & Cohen, D. E. (1999). Allergic contact and photoallergic contact dermatitis to plant and pesticide allergen. *Arch. Dermatol.*, 135, 67–70.
- McDuffie, H. H. (1994). Women at work: Agriculture and pesticides. *Journal of Occupational and Environmental Medicine*, 36, 1240–1246. <http://dx.doi.org/10.1097/00043764-199411000-00012>
- Meeker, J. D., Barr, D. B., & Hauser, R. (2008). Human semen quality and sperm DNA damage in relation to urinary metabolites of pyrethroid insecticides. *Human Reproduction*, 23, 1932–1940. <http://dx.doi.org/10.1093/humrep/den242>
- Mirza, B., Sarwar, M. H., Sarwar, M. F., Khalid, M. T., & Sarwar, M. (2015). An overview of recommendations for women's physical activity effecting on health, knowledge, attitudes and behaviour. *International Journal of Bioinformatics and Biomedical Engineering*, 1, 366–371.
- Mughal, A. R., Sarwar, M. H., & Sarwar, M. (2015). Exploring the causes, diagnosis, symptoms, risk factors, treatments and prevention of rheumatic fever. *Journal of Pharmacy and Pharmaceutical Sciences*, 3(1), 1–8.
- Narayana, K., Narayan, P., & D'Souza, U. J. (2004). Is our drinking water a slow poison? *Indian Journal of Medical Sciences*, 58, 528–530.
- Nelson, F. (1998). The five worst environmental health threats to children's health. *Journal of Environmental Health*, 60, 46–46.
- Ntzani, E. E., Chondrogiorgi, M., Ntritsos, G., Evangelou, E., & Tzoulaki, I. (2013). *Literature review on epidemiological studies linking exposure to pesticides and health effects* (EFSA supporting publication 2013: EN-497, 159 p.). European Food Safety Authority.
- Paulsen, E. (1998). Occupational dermatitis in Danish gardeners and greenhouse workers. *Contact Dermatitis*, 38, 14–19. <http://dx.doi.org/10.1111/cod.1998.38.issue-1>
- Romero, A., Potter, M. F., Potter, D. A., & Haynes, K. F. (2007). Insecticide resistance in the bed bug: A factor in the pest's sudden resurgence? *Journal of Medical Entomology*, 44, 175–178.
- Sarwar, M. (2012). Competency of natural and synthetic chemicals in controlling gram pod borer, *Helicoverpa armigera* (Hubner) on chickpea crop. *International Journal of Agricultural Sciences*, 2, 132–135.
- Sarwar, M. (2013). The inhibitory properties of organic pest control agents against aphid (Aphididae: Homoptera) on Canola *Brassica napus* L. (Brassicaceae) Under field

- environment. *International Journal of Scientific Research in Environmental Sciences*, 1, 195–201.
- Sarwar, M. (2015a). The killer chemicals as controller of agriculture insect pests: The conventional insecticides. *International Journal of Chemical and Biomolecular Science*, 1, 141–147.
- Sarwar, M. (2015b). The killer chemicals for control of agriculture insect pests: The botanical insecticides. *International Journal of Chemical and Biomolecular Science*, 1, 123–128.
- Sarwar, M. (2015c). The dangers of pesticides associated with public health and preventing of the risks. *International Journal of Bioinformatics and Biomedical Engineering*, 1, 130–136.
- Sarwar, M. (2015d). Usage of biorational pesticides with novel modes of action, mechanism and application in crop protection. *International Journal of Materials Chemistry and Physics*, 1, 156–162.
- Sarwar, M. (2015e). Commonly available commercial insecticide formulations and their applications in the field. *International Journal of Materials Chemistry and Physics*, 1, 116–123.
- Sarwar, M., Ashfaq, M., Ahmad, A., & Randhawa, M. A. M. (2013). Assessing the potential of assorted plant powders on survival of *Caloglyphus* grain mite (Acari: Acaridae) in wheat grain. *International Journal of Agricultural Science and Bioresource Engineering Research*, 2(1), 1–6.
- Sarwar, M. H., Mirza, B., Sarwar, M. F., Khalid, M. T., & Sarwar, M. (2015). Snapshot of scientific evidence for remunerations of physical activity on public well-being in different settings and contexts. *American Journal of Clinical Neurology and Neurosurgery*, 1, 182–188.
- Sarwar, M., & Salman, M. (2015). Overall notable health challenges about the toxicity of pesticides concerning to end users. *International Journal of Bioinformatics and Biomedical Engineering*, 1, 323–330.
- Sarwar, M., & Sattar, M. (2012). Appraisal of different plant products against *Trogoderma granarium* Everts to protect stored wheat- A laboratory comparison. *The Nucleus*, 49, 65–69.
- Sarwar, M., & Sattar, M. (2016). An analysis of comparative efficacies of various insecticides on the densities of important insect pests and the natural enemies of cotton, *Gossypium hirsutum* L. *Pakistan Journal of Zoology*, 48, 131–136.
- Sarwar, M. H., Sarwar, M. F., & Sarwar, M. (2014). Understanding the significance of medical education for health care of community around the globe. *International Journal of Innovation and Research in Educational Sciences*, 1, 149–152.
- Sarwar, M. F., Sarwar, M. H., & Sarwar, M. (2015). Understanding some of the best practices for discipline of health education to the public on the sphere. *International Journal of Innovation and Research in Educational Sciences*, 2(1), 1–4.
- Sarwar, M. H., Sarwar, M. F., Khalid, M. T., & Sarwar, M. (2015). Effects of eating the balance food and diet to protect human health and prevent diseases. *American Journal of Circuits, Systems and Signal Processing*, 1, 99–104.
- Thomas, I., Kihiczak, G. G., & Schwartz, R. A. (2004). Bedbug bites: A review. *International Journal of Dermatology*, 43, 430–433. <http://dx.doi.org/10.1111/ijd.2004.43.issue-6>
- Wang, C., Gibb, T., & Bennett, G. W. (2009). Evaluation of two least toxic integrated pest management programs for managing bed bugs (Heteroptera: Cimicidae) with discussion of a bed bug intercepting device. *Journal of Medical Entomology*, 46, 566–571. <http://dx.doi.org/10.1603/033.046.0322>
- Ware, G. W., & Whitacre, D. M. (2004). *The pesticide book* (6th ed., 496 p.). Willoughby, OH: Meister Media Worldwide.
- Zahm, S. H. (1997). Mortality study of pesticide applicators and other employees of a lawn care service company. *Journal of Occupational & Environmental Medicine*, 39, 1055–1067. <http://dx.doi.org/10.1097/00043764-199711000-00006>
- Zahm, S. H., & Ward, M. H. (1998). Pesticides and childhood cancer. *Environmental Health Perspectives*, 106, 893–908. <http://dx.doi.org/10.1289/ehp.98106893>



© 2016 The Author(s). This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.

You are free to:

Share — copy and redistribute the material in any medium or format

Adapt — remix, transform, and build upon the material for any purpose, even commercially.

The licensor cannot revoke these freedoms as long as you follow the license terms.

Under the following terms:

Attribution — You must give appropriate credit, provide a link to the license, and indicate if changes were made.

You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

No additional restrictions

You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.



Cogent Medicine (ISSN: 2331-205X) is published by Cogent OA, part of Taylor & Francis Group.

Publishing with Cogent OA ensures:

- Immediate, universal access to your article on publication
- High visibility and discoverability via the Cogent OA website as well as Taylor & Francis Online
- Download and citation statistics for your article
- Rapid online publication
- Input from, and dialog with, expert editors and editorial boards
- Retention of full copyright of your article
- Guaranteed legacy preservation of your article
- Discounts and waivers for authors in developing regions

Submit your manuscript to a Cogent OA journal at www.CogentOA.com

