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LINKING PESTICIDE EXPOSURE WITH COVID-19 AMONG AGRICULTURAL PROFESSIONALS IN PERSPECTIVES OF IMMUNITY AND SAFETY: A REVIEW

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ABSTRACT

Pesticides are commonly used in our agro-ecosystems for controlling the insect pests, diseases and weeds. They are harmful for the people's immune system. There is an important role of pesticides in our food chain and health systems. Unsafe use of pesticides in pandemic situation caused by COVID-19 may lead to reduction of immunity level in individuals exposed to sub lethal doses of pesticides. Arial sprays of pesticides are reported to be carcinogenic especially for those workers who are directly exposed to pesticides. Strengthened immune system is the first wall of safety against COVID-19. Peoples must consider the safe use of pesticides when they are thinking to strength their immune system. Off drifts of pesticides are suggested to be avoided for a better chance to survive in pandemic.

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INTRODUCTION

As the situation of lockdown persists across the world, Pakistan is no exception where exponential increase in confirmed COVID-19 cases has been seen during the peak pandemic months. Smart lockdown was suggested by the Government of Pakistan, after lifting the complete lockdown. Staying home is the last strategy to slow down the spread of novel coronavirus. Relaxation from the duties has been granted to many professionals and workers for their safety while in some other sectors, workers have been expelled from their jobs due to continuous drop in business. At the same time, agriculture professionals, pesticide sector frontiers, pesticide dealers and law enforcement agencies and farmers are out there in the field for continuing the supply of agricultural inputs and maintaining the supply chains. There is general shortage of personal protection equipment (PPE) for agriculture professionals and pesticide sector workers, due to which they are getting exposed to COVID-19. Several agriculture professionals and pesticide dealers and inspectors are deceased in this pandemic. In perspective of aforementioned situation and unavailability of medical facilities in Pakistan, herd immunity is the only way of survival for general public. Herd immunity is almost based on the immunity level of individuals facing the exposure to novel coronavirus. The survival of infected people is also based on their immunity level (Randolph and Barreiro, 2020). There are many factors lowering the immunity level including many diseases, anxiety, depression and use of pesticides in our homes, fields and offices against insect pests, diseases, weeds and urban pests. These pesticides are causing the immunodeficiency in exposed individuals which resultantly become more susceptible to COVID-19 (Gangemi et al., 2016).

This article will provide information about pesticide uses in our daily life and their impacts on exposed ones. These efforts are made to raise awareness among the agriculture professionals, urban pest control agencies, field workers and pesticide sector workers regarding

safe use of pesticides and avoiding pesticide use as much as possible through adaptation of integrated pest management (IPM) and ecological pest management (EPM) (Ahmad et al., 2020). This will also helpful the policy makers to take necessary measure for the safety of agriculture professional against COVID-19.

Data collection: In this review article, information was collected from the research papers, case studies and different database search engines. The facts were compared with pesticide and immune system deficiencies specially reported as one of the causes of causalities in coronavirus pandemic irrespective of the gender and the country of origin.

Pesticides and immune system: The immune system of our body is working as first line of defense against many microorganisms (viruses, bacteria, parasites) and other pathogens invading human body. Strong immune system can defend body systems against these invaders while weak immune system may lead to serious health disorders (Aktar et al., 2009). Farmers in Pakistan mostly rely on the use of pesticides for controlling the insect pests, weeds and diseases irrespective of their harmful effects on the human health, environment and natural biodiversity. The concept of IPM and EPM is poorly understood and there is lack of training mechanism for farmers and pesticide workers in this regard (Ahmad et al., 2020). Many farm workers and agriculture professionals are exposed to pesticide drifts or fumes in closed areas like shops and houses. The pesticide concentration in the air, duration exposed, and group of pesticide being used may differ in their severity of alteration but alteration in humoral cytokine is always observed (Gangemi et al., 2016). All the patients with these disorders are also susceptible for COVID-19. The insecticide induced immunosuppression can lead to predisposition of infectious diseases. The health disorders are directly correlated with the exposure to pesticides indicating an alarming situation for workers in this sector as exposed people may exponentially spread coronavirus pandemic (Dallaire et al., 2004; Dewailly et al., 2000; Sunyer et al., 2010).

Mondal et al. (2009) studied the effects of acetamiprid on immune system of wistar rats through oral administration and results revealed significant decrease in total leukocyte count and relative lymphocyte count in rats. The same pattern was observed in histopathological examination of spleen which confirmed that acetamiprid inhalation is responsible for suppressing of the antibody formation by lymphocytes. Injudicious use of acetamiprid in agriculture farms and to control urban pests may lead to inhalation by human beings. Resultantly, immunity could be suppressed. Many other pesticides used in agriculture are also reported to suppress the immunity in human including pyrethroids, organophosphates and chlorine-based insecticides (Galloway and Handy, 2003; Kumar et al., 2002; Prater, 2002). These insecticides are commonly used for cotton pests. The mechanism of action of pesticides in humans may be different in response to different groups of pesticides but ultimate results include increased susceptibility to infectious diseases. The suppression of immune system will depend on exposure duration and sublethal doses of pesticides (Kacmar et al., 1999; Mokarizadeh et al., 2015) described the adverse effects of pesticides on humans. These effects could be for a specific time or on permanent basis. It is alarming for the food workers and pesticide sector workers including pesticide dealers and inspectors.

Pesticides have hazardous effects on human health including changes in reproductive system, chronic disorders and immune system. Functional disorders of immune system are reported in the individuals exposed to pesticides. Pesticide induced immunosuppression is positively corelated with spread of infectious diseases. The loss of immune system is responsible for cardiac diseases, diabetes, Parkinson's disease and cancer. Immunotoxin effects exerted by pesticides greatly interfere with human immune system leading to susceptibility for infectious diseases (Barnett and Rodgers, 1994; Luebke, 2002).

There are several factors affecting the human health and immune system including gender, age, group of pesticide, dosage, duration of exposure, lifestyle and daily work routine with dietary values (Dietert, 2011; Saadi and Abdollahi, 2012). Mostly animals have shown immune disfunction when they are exposed to higher dosage and for long durations. However, repetitive sublethal doses have also shown similar affects (Corsini et al., 2013). Lee and Choi (2020) reported that many diseases are interlinked with pesticide and immune system including asthma, cancer, organ diseases, respiratory diseases and many others. Immunotoxicity of various pesticides was reported on T and B cells of our immune system supporting the spread of infectious diseases. Farm workers exposed to pesticides were

reported as patients of infectious diseases in respiratory tract (Hermanowicz and Kossman, 1984; Vial et al., 1996). Mora and Schickler (2020) and Nalwanga and Ssempebwa (2011) reported the association between pesticide exposure and disease of chronic bronchitis. These short impacts of pesticides (i.e. insecticides, weedicides and fungicides) on human health is discussed below:

Insecticides: In USA, aldicarb residues are reported in potato samples for residual effects of pesticides. Aldicarb was also reported to have effect on immune system. Organochlorines are reported to increase the IgM serum level and the same was decreased in patients exposed to carbamates (Aguilar-Garduño et al., 2013). Studies have also confirmed that infants can face disturbance in cytokine levels and predisposition of leukopenia if mother has exposed to organochlorine insecticides causing breathing problems (Corsini et al., 2013; Schaalan et al., 2012).

Organophosphates are reported to weaken the immune system in case of acute toxicity and enhanced immune dysfunction has been observed after sublethal doses. Direct damage to lymphoid and immunocytes has been reported in vertebrates and invertebrates after exposure to high dosage of organophosphates (Galloway and Handy, 2003; Tomizawa and Casida, 2005). This group of pesticides may be responsible for reduction of autoantibodies and causing breathing problems during infectious diseases through inhibition of cell cytotoxicity (Corsini et al., 2013; Li, 2007). Workers handling the organophosphate pesticides are also reported to have increased cell respiratory burst and macrophage activation. Similar effects were reported in malathion induced patients.

Weedicides: Like other pesticides, weedicides are also reported to have adverse effects on human health and environment. Continuous exposure to atrazine has shown adverse effects on immune system of targeted rats (Rooney et al., 2003; Rowe et al., 2008). In humans, addition of atrazine caused inhibition of cytokine production whilst blocking of lytic granules has also been reported (Hooghe et al., 2000; Rowe et al., 2007). Potti and Sehgal (2005) reported that glyphosate, a widely used nonselective weedicide, is responsible for cancer development in exposed farm workers and consumers. Propanil (3, 4-dichloropropionanilide), a known weed killer was also reported as cause of thymic atrophy and injurious for the developing T and B cells in immune system. Respiratory infections were reported after burst of macrophages (Salazar et al., 2008; Ustyugova et al., 2007). Chen et al. (2018) has reported health hazardous effects of Tribenuron-methyle on health of other vertebrates and invertebrates. Oxidative stress was induced in living organisms and cellulose activity was also inhibited.

Fungicides: Fungicides are excessively used in controlled agriculture for reduction of pathogenic attacks by various fungi from seed treatment to the post-harvest management (Muhammad et al., 2019). Immunologic processes are disturbed after exposure to triflumizole, imibenconazole, imazalil, tetraconazole and hexaconazole i.e. lymph node development. Immunotoxic effects of mancozeb were reported by Descotes (1988) and immune potentiation and immunosuppressive activity was observed. Increase in leukocyte count was caused by the exposure of mancozeb and immune modulating effects were noted (Corsini et al., 2013; Queiroz et al., 1998). Mostly fungicides have harmful effects on eyes, skin and inflammatory parts of the human body. These have been reported for adverse effects on NK cells resultantly lowering the immunity against infectious diseases (Caldas et al., 2001; Colosio et al., 1991; Lee and Choi, 2020; Taylor et al., 2005; Wilson et al., 2004).

Safety of Farm workers, Pesticide Sector Employees and Dealers: Although, hazardous effects of pesticides are unlimited and comparatively difficult to investigate in terms of immune dysfunction at grass root level but there is urgent need to take precautionary steps for avoiding the immunity loss of agriculture force including farm workers, pesticides dealers, pesticide inspectors, extension workers and other employees in this sector. Developing countries like India and Pakistan are at high risk during pandemic situation of COVID-19. There is urgent need to develop applicable and effective pesticide risk communication tools (Rother, 2008). The clear message for avoiding the exposures to pesticide and mitigation of their harmful effects through precautionary measures should be spread among all stakeholders of pesticide affected community. Health hazardous effects of pesticides including occupational asthma, chronic pulmonary diseases, decreased lung function, chest pain, coughing and wheezing may be avoided through measures given below

Exposure to pesticides must be reduced as first line of defense against COVID-19.

N-95 masks should be compulsory farm equipment during handling the pesticides related activities.

Adjustment of pest management practices with reduced use of pesticides up to all possible limits.

Anyone who handles or assists with the application of pesticides is required to use filtering masks.

Provision of necessary PPE to workers closely exposed to pesticides and their fumes according to the toxicity class of pesticide, type and duration of exposure either in outdoor or indoor.

CONCLUSION

It is concluded that farm workers, food growers, pesticide handling and selling agents, extension workers and pesticide quality control workers are on high risk during COVID-19 pandemic due to direct and indirect exposure to pesticide contents. Unwanted entry of pesticide contents into food chain is resulting in lowering the immunity or immunity loss in humans and animals against infectious diseases and their secondary infections. Farm workers are already suffering poor health and they have no reasonable access to quality health facilities. Often, they are exposed to the poisonous chemicals which have negative impacts on immune system. Organophosphates, commonly used insecticides in cotton and sugarcane are capable to weaken the immune system in many ways. Prevailing conditions may put these people on higher risk of COVID-19 in Pakistan. Our soils are contaminated with weedicides and water has arsenic contaminations, air has pesticides residues and indoor places are also contaminated due to urban pest control. Farmers and agriculture professionals are not equipped with any PPEs from provincial or federal governments. In these compromised situations, agriculture professionals, field workers and pesticides dealing people, with weak immune system, must avoid any exposure to pesticides and their employers should relieve them with paid leave during pandemic situation.

Author Contribution

All the authors have contributed to collect the literature and write-up process.

Conflict of interest

The authors declare no conflict of interest.

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Abbreviations

IPM (Integrated pest management); EPM (Ecological pest management); PCP (Pentachlorophenol); NK cells (Natural killer cells); T cells (thymus cells); B cells (bone marrow- or bursa-derived cells).

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