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IMPACT OF PESTICIDE EXPOSURE ON THE RESIDENTS OF DISTRICT SHOPIAN, KASHMIR, INDIA – A GEO-MEDICAL INTERPRETATION

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1. Abstract:

Vast majority of the population in the study area are engaged in horticulture sector and that particular region is also called Apple Bowl of the state. It is the main source of income of the residents of the area. While pesticides help in increasing fruit production, inappropriate pesticide storage practice and inadequate protective measures frequently causes accidental poisoning among farmers. The present paper attempted to assess the impact of pesticides on the residents of district Shopian- a geo-medical interpretation.A cross-sectional questionnaire based study was conducted in the district of Shopian, J & K, India toaddress the study objective. Data analysis was performed by using descriptive statistical methods: Frequency,percentage, mean, standard deviation.In the present study insecticides (58%) was the most commonly used pesticide followed by fungicides (22%), herbicides (10%), rodenticide (5%),nematicides (3%) and molluscicides (2%). The farmers used to storepesticides mostly in storerooms (50%) followed by cowsheds (26%). During spraying of pesticides, farmersexperienced headache (26.4%) followed by nausea (22.4%), burning/itching eyes (9.8%), fatigue (7%),cough (2%), %), running/burning nose (4.6%), muscle cramps (3%), diarrhea/stomach pain (3.6%), salivation (1.6%) & no symptoms (16.4%). Regarding the personal protective measures taken by the farmers for spraying, covering nose &mouth (27%), wash after spray (25.2%), cover all body (6.2%) and no protection was the most common with (37.4%). When asked about suggested actions to be taken if anybody becomes sick following exposure to pesticides, 72% of farmers prefer consulting a doctor. The study suggested that farmers of study area were exposed to highly hazardouspesticides, with insufficient protection. In this situation, educational and training interventions on pesticide handling and safety precautions are urgently needed.

Keywords: Farmer, Cross-sectional, Horticulture sector, Hazardous, Pesticide

2. Introduction:

Pesticides constitute any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. They can also serve as plant regulators, defoliants, or desiccants [1].Occupational health hazards are well known. The widespread use of pesticides in the agricultural industry to control the insects, pests and fungus and to enhance the crop and fruit production is recognized as a major chemical health hazard for the orchard workers, residentsand children by the direct contact and by polluting the aerial, soil and water environment. The residual concentrations of these toxic chemicals in the farm workers lead to a variety of neurological dysfunctions [2& 3].Worldwide, pesticide use has resulted in different cases of acute and chronic poisoning, with effects of varying hazard on human health, from mild effects to death [4]. In many cases, farmers face great risks of exposure due to the use of toxic chemicals that are banned, incorrect application techniques, poorly maintained or totally inappropriate spraying equipment, inadequate storage practices, and often the reuse of old pesticide containers for food, poor use of personal protection equipment(PPE) and other safety measures due to lack of knowledge [5]. Various human health related concerns are associated with pesticides, ranging from short term impacts such as headaches and nausea to chronic impacts, such as various cancers, birth defects, infertility, and endocrine disruption [6]. Children, in particular, are more endanger by short-term and chronic exposure to pesticides. Furthermore, excessive use of pesticides may lead to the destruction of biodiversity, secondary pest outbreaks destruction of non-target species, soil, water, and air contamination [7].Pesticides and agrochemicals, in general, became an important component of worldwide agriculture systemsduring the last century, allowing for a noticeable increase in crop yields and food production [8]. In 1962, Rachel Carson published the book “Silent Spring”, in which she mentioned problems that could arise from the indiscriminate use of pesticides. This book inspired widespread concern about the impact of pesticides on the human health and the environment. In the 1970s, pest resistance emerged which, combined with influence of the book “Silent Spring” and accumulated evidence on the effects of pesticides culminated in banning of the use of DDT in the United States in 1972. Thereafter, other countries discontinued the use of DDT, as well [9]. According to the principles of integrated pest management themonitoring of pesticide residues is essential in order to predict theproper concentrations and number of applications of pesticidesneeded and to determine the pre-harvest interval. The application of the principles of integrated pest management and goodagricultural practices resulted in a reduction of pesticide usagewith the tendency to reduce the most environmental dangerouspesticides [10].Many pesticides used in all societies have been associated with toxicity to human [11] and others are suspected to be carcinogenic, mutagenic, and endocrine disruptors [12]. A World Bank [13] report estimates that 355,000 people worldwide die each year from unintentional pesticide poisoning. An older, but authoritative study [14] estimates that there are possibly one million cases of serious unintentional pesticide poisonings each year. Parental body burden of organochlorine pesticides such as DDT, DDE, HCH, HCB and

endosulfan are also associated with a range of congenital defects including neural tube defects, undescended testicles, cryptorchidism, extra nipple in males, and cretinism [15,16,17,18,19, & 20]

The pesticide economy of India is more export-oriented in nature. The growth rate of domestic consumption of pesticides, however, over different decades has shown wide fluctuations, though the overall trend is negative (2.48%).While analyzing the trend of pesticide consumption in 29 states and Union Territories (UTs) of India for the period 2000 to 2013, a positive growth trend has been observed in 17 states/UTs. The positive growth has been observed highest in Jammu & Kashmir, Andaman & Nicobar Islands and Tripura. Uttar Pradesh, Maharashtra, Andhra Pradesh, Punjab and Haryana are the states that accounted for 70 per cent of total pesticide consumption. The use-intensity has been found highest in Jammu and Kashmir, followed by Punjab and Haryana [21].The abundant use of pesticides in our orchards are warming signals that we should reduce the chemical use and adopt biological methods of controlling agricultural enemies before our environment is contaminated Nature has bestowed Kashmir rich bio-diversity and some incredible fruit crops which are barely found in rest of world. Apple, almond , walnut, cheery, apricot etc are abundantly grown in Kashmir as cash crops because of the fertile lands, favourable climate and natural waterresources allows the valley to grow these fruit crops. To reduce loss due to pest attacks and diseases, the fruit growers use almost every types of pesticides namely; synthetic Pyrethroids, Endosulphan, Chloropyrephos, Carbaryl, Demicron, Quinalphos, Monocrotophos etc and fungicides namely; Dithane, Mencozeb, Carboxin, Captan etc often these are sprayed without proper care. Pesticides and fungicides have unintended fall out on the natural population especially on birds. During the apple season, many birds of various species die every year[22].Kashmir study reveals the highest incidence of primary brain cancer in the geographic areas of Baramulla (Sopore), Anantnag, Budgam, Shopian and Kupwara which comprises most of the orchard areas of Kashmir [23].

3. Study Area:

District Shopian is situated at 33°43' North Latitude and 74°49'east longitude at an altitude of 6731ft or 2146 mts above the mean sea level. It is categorized as Northern Western Himalayan Region agro-ecological sub-region by ICAR (Indian Council of Agricultural Research); cold humid Agro-Climatic Zone by Planning Commission and Humid Western Himalayan Region by NARP. The district receives 658.10mm average rainfall in 60 rainy days. Geographical area of the district is 36.834(000ha)/368.34 Sq.km in which 25.186(000ha)/251.86 Sq.km are cultivable, 0.249(000ha)/2.49 Sq.km under forest and 4.543(000ha)/45 Sq.km under non-agriculture use. 33.260(000ha)/332.6 Sq.km or 90% of the major Soils of the District are Clay to clay loam and 3.600(000ha)/36 Sq.km or 10% soils are Sandy Loam. Major farming activity of the farmers in this district is Apple cultivation, which is cultivated on an area of 19.770(000ha)/197.7 Sq.km. Paddy, Oilseed and maize(rain fed) are major field crops, cultivated on an area of 0.556(000ha)/5.56Sq.km, 3.649(000ha)/36.49Sq.km and 1.479(000ha)/14.79Sq.km respectively [24 & 25] . Shopian district came into

existence in 2007 and was carved out of the Pulwama district. The population is 2.66 lacs including 15% of ST population as per census 2011. About 95% of the population lives in its rural areas. Presently the District Shopian having two Assembly Constituencies consists of nine Tehsils, eight CD Blocks, One Municipal Committee with 13 Wards, 43 Patwar Halqas & 231 inhabited villages. Shopian is a historical town, and has gained importance from the time of Mughal rulers. It was previously known as 'Sheen-e-van' meaning 'forest of snow'. Shopian was one out of six Wazarat Headquarters in Kashmir from 1872-1892 A.D. The District is situated in the laps of foot Hills of Pirpanchal range and most of its area is Hilly Terrain. It is at a distance of 51 km from city Srinagar & 20 km from Pulwama. Shopian has been an ancient Town of Kashmir, which among other factors in the past has historical importance, since it is situated on the ancient imperial road commonly known as Mughal Road. It has decades of old road connectivity with Anantnag as well as Kulgam. The district is known as "Apple Bowl" of the state as it is famous for Horticulture Sector.

4. Material&Methods:

Cross-sectional study was conducted in the district of Shopian (Jammu & Kashmir) India to analyze data from a sample population at a specific period so that toassess the prevalence of a condition and its distribution within a population. Through this method we can also evaluates the association of disease with pesticide exposure populace of the study area. It is the best way to determine prevalence and exposure proportion rate in the population. The source population included farmers of the district whom they are used pesticides in the horticulture sector and other different agricultural purposes. The number of farmers to be included in the study (participants) was determined using single population proportion formula.

$$n=\frac{(Za/2)2\,p(1-p)}{(d)2}$$

Where, (*Z*a/2) is critical value of normal distribution. At 95% of confidence level a=0.05. We can easily see that Z*0.05/2 = 1.96 (Reliability coefficient).

n = Sample size

Since no previous survey or data is available so we assume p= 50% i.e. 50% of the farmers had a low level of perceptions and beliefs on risks and hazards of pesticides use.

d = assumed marginal error (5%),

n = (1.96)2 (0.5) (0.5)/ (0.05)2 = 384

20% non-response rate was added to the final sample size. Accordingly, *n* = 384 + 20/100 (384) =384 + 76.8 = 460.8. For better results, we took an additional for nearest hundred. Thus, a total of 500 farmers were collected for further analysis during the study period.

The farmers who used these pesticides were approached to collect information. They were explained about objectives of the study following which written consent was obtained from them. The farmers who consented into

the study were asked to fill up a pre-designed questionnaire written in vernacular language. The questionnaire included questions related to: Basic demographic information (age, sex, education), names of pesticides commonly used by them in the spraying season, place in the household where they store the pesticide, personal protective measures taken by the farmers while spraying, symptoms experienced by the farmers during/after spraying and suggested actions taken by the farmers if somebody becomes sick following exposure to pesticides. The filled up questionnaires were checked for completeness and analyzed.

The returned questionnaires were checked for completeness of data and then analyzed in computer by using Statistical Package for Social Sciences (SPSS) software. Data analysis was performed by using descriptive statistical methods: Frequency, percentage, Mean, standard deviation (SD).

5. Results:

In the present study, it was found that age of 80% of farmers interviewed lie between 20 to 50 years of age with mean = 38.4 & SD = 8.6 with absolute male dominance (90%). The educational status of them was poor with only 30% illiterates. Details of demographic characteristics of study participants are provided in *Table X*. Insecticides (58%) were the most commonly used pesticide followed by fungicide (22%), herbicides (10%), rodenticide (5%) and nematicides (3%), and molluscicides (2%). Regarding the storage of pesticides, storerooms was most common place of storage (50%) followed by cowshed (26%). The farmers also stored the pesticides in places such as bathrooms (16.6%), residential houses (7.4%) where their families were unknowingly exposed to their toxic effects. During spraying of pesticides, headache (26.4%) was the most common symptom experienced by farmers followed by nausea/vomiting (22.4%); burning/itching eyes (9.8%), fatigue (7%), cough (5.2%), running/burning nose (4.6%), muscle cramps (3%), diarrhea/stomach pain (3.6%), salivation (1.6%) & no symptoms (16.4%) shown in the *Table Z.* Regarding the personal protective measures taken by the farmers for spraying, covering nose &mouth (27%), wash after spray (25.2%), cover all body (6.2%) and no protection was the most common with (37.4%) shown in *Table Y*.When asked about suggested actions to be taken if anybody became sick following exposure to pesticides, 72% of farmers prefer consulting a doctor.

***Table X*: Demographic profile of farmers who participated in the study.**

Parameters	***No. of Farmers***	***Percentage***
Sex		
Male	450	90
Female	50	10
Educational Status	***Respondents***	***Percentage***
Illiterate	150	30

Literate	170	34
Secondary level	100	20
Higher secondary	80	16

Source: Compiled from field study, 2018

Table Y: Pesticides use Patternamong Farmers.

Response of the Questionnaire n = 500		
Storage practices	***No. of Respondents***	***Percentage***
• Storeroom	250	50
• Cowshed	130	26
• Bathroom	83	13.6
• Residential House	37	7.4
Personal protective measures	***No. of Respondents***	***Percentage***
• Cover nose and mouth	135	27
• No protection	187	37.4
• Wash after spray	126	25.2
• Cover all body	31	6.2
• Cover eyes	21	4.2

Source: Compiled from field study, 2018

***Table Z*: Signs and Symptoms of illness among Study population of Farmers.**

Health Hazard Risk	n = 500	Percentage
Headache	132	26.4
Nausea/Vomiting	112	22.4
Burning/Stinging/Itching eyes	49	9.8
Fatigue	35	07
Cough/ Shortness of Breath	26	5.2
Running/Burning nose	23	4.6
Muscle weakness/Muscle cramps	15	03
Diarrhea/Stomach pain	18	3.6
Excessive Salivation	08	1.6
No symptoms	82	16.4

Source: Compiled from field study, 2018

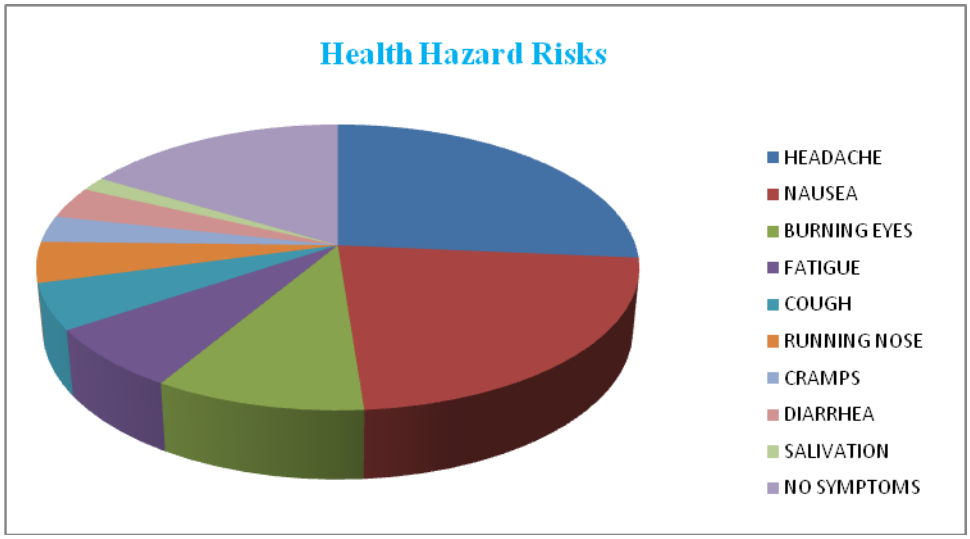

Fig 1: Health Hazard Risks

6. Discussion:

The present study documented the serious consequences of the indiscriminate use of pesticides for the health of orchard farmers of Shopian, Kashmir, India. The study aimed primarily to raise farmer's awareness of the seriousness of the pesticide poisoning occurring in the study area. Most farmers in our study were not aware of the health hazards of the inappropriate handling of pesticides. The use of cotton cloth as protective clothing was common among them. Studies show that wet cotton clothing and cotton masks in fact increase the person's personal absorption rate of pesticides [26]. The practice of chewing or smoking, eating or drinking while spraying is also hazardous to health. This may also indicate that the farmers were symptomatic enough to self-medicate during a pesticide- spraying session. But many are unwilling to follow the necessary precautions, attributing their reluctance to non-availability and high cost of personal protection products, and the prevailing hot and humid weather conditions. These reasons were similar to those reported from other developing countries such as Indonesia [27].WHO [28] periodically publishes list of hazardous chemicals, which sets out a classification system to distinguish between the more and the less hazardous forms of selected pesticides based on acute risk to human health (that is the risk of single or multiple exposures over a relatively short period of time). It takes into consideration the toxicity of the technical active substance and also describes methods for the classification of formulations.

Combining two or more pesticides, many of which are duplicates (different trade names but the same common name and thus the same active ingredient) should be discouraged. This could result in a dangerous concoction, because mixing of pesticides can alter their chemical properties, thereby increasing their detrimental effects. The combination of use of hazardous pesticides and the absence of appropriate precautions is detrimental to farmers' health [29]. Farmers sometimes return to the fields for work less than 24 hours after the application of pesticides. The continuation of pesticide spraying and other farming activities concurrently in the field can lead to direct exposure to pesticides, as they may still be dispersed in air [27]. Some 20.17% of the women in our study reported that they continued to work while pesticides were being sprayed. Such exposure could cause a variety of reproductive health problems in women of reproductive age. This unexpected though direct exposure to pesticides due to women's proximity to the source of exposure needs to be studied further. This aspect of women's being prone to various avenues of exposure has been highlighted in the study done among the cotton growers of India by [30].

Young people seem to be engaged in pesticide spraying more than the older people, which may be due to possible attrition of the elderly workforce. Higher-than-normal prevalence of reduced vision among these farmers could be associated with prolonged exposures to pesticides in the present study. The present findings are in accordance with the previous literature by [31] that the farmers in this study experienced a variety of signs and symptoms related to pesticide exposures. Among populations, the prevalence of signs and symptoms related to pesticide exposure was higher among the farmers involved in spraying. The higher percentage of some signs and symptoms among the non-sprayers could be due to their direct exposure to pesticide or due to previous exposure to pesticides. In contrast, the higher prevalence of some signs and symptoms among non-sprayers could have been due to their direct exposures to pesticides or due to previous exposures to pesticides.

7. Conclusion:

The study revealed that most of the orchard farmers of Shopian, Kashmir and their family members were exposed to highly hazardous pesticides, with insufficient protection and did not follow instructions while spraying and exhibited some unsafe practices while using the pesticides. Mostly the orchard farmers in the study area had a low level of knowledge regarding pesticide use. In particular, the farm workers seemed to be unaware of real pesticide risks and they lacked safety education.In this situation, educational and training interventions on pesticide handling and safety precautions are urgently needed in order to change the existing situation. Governmental interventions and efforts, such as restrictions on hazardous pesticides, monitoring of labels and enforcement of good agricultural practices are needed to decrease pesticide exposure of farmers and population of the study area in general. Farmers need to use bio-pesticides instead of synthetic pesticides and also encourage organic farming. There should be promotion of integrated pest management approach among the orchardists in the Apple Bowl of Kashmir.

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