

ORIGINAL ARTICLE

A Comparative Study of the Quality of Life, Depression, Anxiety and Stress in Farmers Exposed to Organophosphate Pesticides with those in a Control Group

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KEYWORDS

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ABSTRACT: The aim of this study was to compare the quality of life, depression, anxiety and stress in farmers exposed to organophosphate pesticides with those in a control group. This cross-sectional study was conducted on 67 farmers of Gheinarje village in Arak, central Iran in 2012. The case group included 35 farmers exposed to organophosphate pesticides, the control group consisted of 32 subjects who had no contact with organophosphate pesticides and were matched with the case group in terms of age, gender, and education. The assessment of the quality of life was done according to the scores obtained in SF-36 questionnaire. To assess the level of depression, anxiety and stress the Depression Anxiety Stress Scale (DASS)-42 was used. A significant difference was found between the two groups in terms of mental health and quality of life in such a way that the mental health and life quality of the farmers exposed to organophosphate pesticides were significantly lower than those of the control group were ($P < 0.05$). According to the Pearson correlation analysis there was a significant positive relationship between job history and depression as well as stress ($P < 0.05$). Chronic exposure to organophosphate pesticides can affect the psychological aspects of farmers' lives, including the quality of life, depression, anxiety and stress and may endanger their mental health. Biologic drug development and promotion of the use of protective equipment by farmers are the secure solutions to get rid of the current problems resulted from using chemical pesticides.

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INTRODUCTION

The development of industrial agriculture has resulted in increased usage of pesticides, particularly organophosphate ones. The more these pesticides are used, the higher the people's exposure to these toxins will be, with increased adverse effects on human health. Due to the changes in our lifestyles, we are constantly exposed to various chemicals. The food we eat, the water we drink, the air we breathe and the environment in which we live are all might be contaminated by toxic xenobiotics. Pesticides are among the hazardous chemicals on which our lives are depended. There are small amounts of pesticides even in human milk, drinking water, and dairy products [1].

Organophosphate compounds are among the most common causes of poisoning [2]. According to studies, the incidence of poisoning in the developing countries is 13 times higher than in the industrialized ones [3]. The developing countries consume 85% of the global production of pesticides [3]. According to WHO and the United Nations Environmental Program (UNEP) each year between four and five million cases of poisoning by insecticides, happen in agricultural workers. The incidence of poisoning has doubled in developing countries during the last 10 yrs. [4, 5]. In addition, each year about 3 million cases of poisoning by organophosphate pesticides have been reported [6, 7]. The most prevalent exposures to pesticides happen in agriculture. WHO has classified these toxins from class I (extremely toxic) to class III (slightly harmful). In fact, WHO advocates a policy prohibiting or restricting the use of class I pesticides and supports the use of a limited number of pesticides that are less damaging to the health of their users [8]. Whether used accidentally or intentionally (to commit suicide), organophosphorus compounds induce toxicity after being absorbed through skin, mucous membrane, gastrointestinal system and respiratory system. Following organophosphate poisoning four clinical phases can be seen, three acute and one chronic [9]: 1) acute cholinergic

crisis 2) intermediate syndrome 3) organophosphate induced delayed neuropathy (OPIDN), and 4) chronic organophosphate induced neuropsychiatric disorder (COPIND) (organophosphate compounds, are a wide group of chemical agents, such as insecticides (malathion, ethion, diazinon, fenthion, dichlorvos, parathion, chlorpyrifos and paraoxon) [10]. These toxins are potentially mutagenic and carcinogenic.

The main mechanism of cell and tissue destruction is exerted by the production of free radicals through the metabolism of organophosphate toxins [11-13]. These chemical agents kill insects through disrupting their nervous system. As these organophosphates have been long used as pesticides, they may cause disorders in the human brain, too [14]. The toxicity with these chemical agents is one of the problems throughout the world, especially in developing countries. Although the chemical structures of organophosphorus compounds are so vast and various, all these compounds have a common building block [15].

There is a lot of evidence regarding the negative effects of exposure to low-dose organophosphate pesticides on cognitive processes. Scientific reports regarding the effects of long term exposure to organophosphate pesticides on cognitive processes have shown the emergence of cognitive neurological disorders in proportion to the duration of the exposure [16, 17]. Organophosphate poisoning can cause neurological and behavioral effects such as depression. The potential for depression and suicide risk in developing countries, especially in rural areas and farming communities exposed to organophosphate pesticides is high [18]. Evaluating the psychological scales of quality of life, depression, anxiety and stress in the farmers with environmental and occupational exposure to organophosphate insecticides can provide appropriate treatment strategies which are of particular importance. Finally, complementary studies can help understand the type and mechanism of occupational and

environmental pollutants that are among the most important problems of modern man in order for him to take some measures to improve his individual and social health.

The aim of this study was to compare the quality of life, depression, anxiety and stress in farmers exposed to organophosphate pesticides with those in a control group.

MATERIALS AND METHODS

This cross-sectional study was conducted on 67 subjects to compare the scales of life quality, depression, anxiety and stress in farmers exposed to organophosphate pesticides with those in a control group. The case group included 35 farmers in Gheinarje village in the vicinity of the city of Arak in Markazi Province of Iran, who, according to job requirements and subsequent to spraying were exposed to organophosphate pesticides in the second half of 2012 and the control group consisted of 32 non-farmers who lived in Gheinarje village and had no contact with pesticides. They were matched with cases in terms of age, sex, and education.

From each subject a written informed consent was obtained before entering the study and all the data concerning their work history, socioeconomic status (income, education) and lifestyle (smoking, alcohol, drugs and vitamin or antioxidant supplements and diet) were collected through a questionnaire.

The study was conducted in complete accordance with the National Code of Ethics and approved by the Ethics Committee of the Islamic Azad University of Damghan Branch. In addition, each subject was individually interviewed by a trained interviewer.

The inclusion criteria were lack of exposure to other toxins and metals such as lead and zinc, no alcohol, antioxidant supplements and drug consumption, lack of chronic disease and mental illness, lack of radiation therapy, surgery and anesthesia within the previous year and the ability to answer the questions. All samples un-

derwent clinical examination to detect the symptoms of chronic diseases such as hypertension, heart problems, cancer, thyroid disorders, asthma, diabetes and anemia. The cognitive neuropsychological status of the subjects was determined by the scores obtained from the quality of life questionnaire (SF-36), as well as the ones collected from the Depression Anxiety Stress Scales both of which are of high validity and reliability.

The quality of life was assessed by using SF-36 questionnaire, already approved to be efficient in evaluating items like clinical practice and health policy, as well as in general demographic studies. SF-36 was designed in America by Sherbourne in 1992, and since then its reliability and validity has been studied in different groups of patients. The items measured by this questionnaire were not specific to any group, age, or illness and aimed at evaluating the state of health, both physical and mental, by combining the scores achieved in eight different sections. The questionnaire had 36 items, which evaluated eight health areas of vitality, physical functioning, bodily pain, general health perceptions, physical role functioning, emotional role functioning, social role functioning, and mental health. Each scale was directly transformed into a 0-100 scale on the assumption that each question carried equal weight. The lower the score the more is the disability. The higher the score the less disability i.e., a score of zero was equivalent to maximum disability and a score of 100 was equivalent to no disability. The Depression Anxiety Stress Scale (DASS)-42 was used to assess depression, anxiety and stress. This questionnaire had 42 questions. The range of responses varied from "never"(0) to "always"(3). Statistical analysis was performed using SPSS software (Chicago, IL, USA) and the descriptive statistics (mean \pm SD) and inferential *t*-test and Mann Withney U and the relationship between variables were assessed using Pearson's correlation coefficient.

RESULTS

The total number of subjects was 67 including 35 farmers exposed to pesticides and 32 controls. The age range was between 16 to 86 yrs. and most of the subjects (98.2%) were under high school diploma. The means and SD for age and experience in farmers exposed to pesticides were 44.51 ± 18.55 , 2.41 ± 1.17 and in the control group they were 41.44 ± 16.41 and 3 ± 1.73 , respectively. According to Table 2 there was a significant difference between farmers exposed to pesticides and control group in the mental health scale. The mental

health in the farmers exposed to pesticides was significantly ($P = 0.008$) lower than that of the control group and according to Table 3 between the two groups in terms of depression, anxiety and stress, there were no significant differences. According to the Pearson correlation analysis there was no significant correlation between the scales of job experience and history of spraying and that of the quality of life (Table 4). In Table 5 according to Pearson correlation analysis there was a significant positive relationship between job history, depression ($P=0.04$, $r=0.35$) and stress ($P=0.03$, $r=0.37$).

Table 1. Demographic data of farmers exposed to pesticides and control group

Variables	Farmers exposed to pesticides (N = 35)	Control group(N = 32)	P value
Age (yr)	44.51±18.55	41.44±16.41	0.5
Work experience (yr)	2.41±1.17	3 ±1.73	0.44

Table 1 Data based on Mean and standard deviation. In terms of age and experience, there was no

significant difference between the two groups.

Table 2. Comparison of the quality of life (SF-36) between farmers exposed to pesticides and control group

Variable	Farmers exposed to pesticides	Control group	P Value
General health	20.16±6.14	22.85±6.59	0.11
Physical functioning	5.66±1.34	5.85±1.55	0.62
Physical role functioning	4.46±1.16	4.64±1.22	0.57
Emotional role functioning	12.6±2.67	13.03±2.53	0.52
Bodily pain	14.96±4.74	15.39±3.46	0.69
Social role functioning	5.5±1.67	5.25±1.53	0.55
Vitality	4.7±2.15	4.96±2.31	0.65
Mental health	10.03±2.53	12.1±3.2	0.008
Total scores	77.76±10.66	84/1±9.88	0.02

Data based on mean and standard deviation There was a significant difference between the two groups in mental health scale. Mental health in the farmers exposed to pesticides was significantly ($P = 0/008$) lower than that in the control group.

Table 3. Comparison of depression, anxiety and stress in farmers exposed to pesticides with those in controls.

Variables	Farmers exposed to pesticides (N = 35)	Control group (N = 32)	P value
Depression	12.40±9.09	12.21±9.81	0.94
Anxiety	12.73±7.87	14.25±7.89	0.46
Stress	14.40±8.69	18.92±10.75	0.08
Total	39.53±34.01	45.39±26.42	0.38

Data are based on the mean and standard deviation. Between the two groups in terms of depression, anxiety and stress, there were no significant differences.

Table 4. The relationship between job history and spraying history and quality of life

Variables	Job history	Spraying history
Physical functioning	-0,04	-0.2
Physical role functioning	-0.09	0.004
Emotional role functioning	0.009	0.07
Vitality	0.13	0.01
Mental health	0.05	-0.22
Social role functioning	-0.06	0.008
Bodily pain	0.21	-0.003
General Health	-0.02	-0.07
Total	0.05	-0.22

** $P < 0.01$, * $P < 0.05$ Table 4: According to the Pearson correlation analysis there was no significant correlation between the scales of job experience and history of spraying and that of quality of life.

Table 5. The relationship between job history and history of spraying with depression, anxiety and stress

Variables	Job history	Spraying history
Depression	0.35*	0.06
Anxiety	0.15	0.02
Stress	*0.37	0.3
Total	0.31	0.15

** $P < 0.01$, * $P < 0.05$. In Table 5 according to Pearson correlation analysis there was a significant positive relationship between job history on the one hand, and depression ($P=0/04$, $r=0/35$) and stress ($P=0.03$, $r=0.37$) on the other.

DISCUSSION

In the present study, there was a significant difference in terms of mental health scale between the two groups of the farmers exposed to pesticides and the control group so that in the case group mental health was significantly lower than that of the control group. There was a significant positive correlation between the job history on the one hand and stress and depression on the other hand. The life quality in farmers exposed to organophosphate pesticides was significantly lower than that of the control group. There was no significant correlation between the scales of job history and spraying history and that of life quality. There were no significant differences between the two groups regarding the scales of depression, anxiety and stress.

According to the Pearson correlation analysis, a significant positive relationship existed between job histories

on the one hand and depression and stress on the other. Salovey and colleagues found that the exposed people suffered severe depression and anxiety [19]. Besides, organophosphates could bring about serious cognitive and behavioral disorders such as anxiety and depression [20]. In another study, increased tension, high depression, fatigue, and symptoms associated with central nervous system disorders were seen in women greenhouse workers exposed to organophosphate pesticides compared with the control group [21].

In another study, the severity of neuropathy was associated with anxiety and depression [22]. The toxicity of pesticides depends on various factors such as age, sex, state of health and the intensity and frequency of pesticide utilization. The fact that workers were differently affected by pesticides may be due to many factors such

as pesticide formulation, dose and duration of exposure to pesticides as well as their usage of proper protective equipment such as overalls, boots, masks and so on. In this study, the mental health in the farmers exposed to organophosphate pesticides was significantly lower than that of the control group. In line with the results of this study, Stephens et al. reported that farmers showed higher psychiatric disorders as assessed by General Health Questionnaire (GHQ). Moreover, these subjects had more problems in learning and memory [23].

Davies and colleagues found strong evidence proving a significant relationship between exposure to organophosphate pesticides and psychological disorders including cognitive and temperament disorders [24]. The sprayers had lower neuropsychological performance compared to the control group [25], which is consistent with the present study.

Most studies agree on the effects of organophosphate poisoning on the development of many disorders like sleep disturbance and decreased concentration, slowed processing of information, decreased psychomotor speed, memory loss, linguistic disorders, depression, anxiety and irritability [26].

Body detoxification system has a vital role in reducing the harmful effects of pesticides. However, when the toxicity level of these materials exceeds the body detoxification system capacity the person's health is threatened. In dealing with pesticides and maintaining health, diet has an important role. Vitamin C and vitamin E play a major role in the prevention of DNA damage because of their antioxidant properties [27].

It is most probable that chronic exposure to organophosphate pesticides in the workplace or in the environment can induce oxidative stress, which affects cognitive processes and in extreme cases can cause severe neuropsychological disorders. In fact, besides inhibiting acetylcholinesterase and consequently causing impaired neurological function, the organophosphate pesticides disrupt human cognitive processes through noncholinergic pathway. These pesticides attack acetyl-peptide hy-

drolase enzyme, which is involved in the process of cognition. The enzyme is more sensitive and more vulnerable to organophosphate pesticides than acetylcholinesterase. In addition to the potential effects of pesticides on the cognitive activity by acetylpeptide hydrolase enzyme, there is a relationship between cognitive disorders and antioxidant status in such a way that the increased levels of oxidative stress or antioxidant deficiency may act as a risk factor for cognitive disorders [28]. However, high blood pressure, high cholesterol and fat are also involved in the development of vascular dementia and mild cognitive impairment [29]. Neuropsychological disorders were reported in chronic exposure to organophosphate pesticides [30]. In subjects with mild cognitive impairment, damages to lipids, proteins and DNA increased (31). The exposure to organophosphates induced cognitive impairment [32]. The prevalence of neuropsychological disorders in workers exposed to organophosphates has been reported [33, 34].

Depression is associated with chronic pesticide exposure in the absence of a physician-diagnosed poisoning [35]. Association of long-term exposure and worse performance in neuropsychological functions is interpreted as evidence of a chronic effect of cumulative high exposure to organophosphates [36]. Another study showed a relationship between acute occupational poisoning with organophosphates and psychological distress including suicidal ideation [37].

Acute and chronic exposure to organophosphorus pesticide poisoning can cause delayed intoxication and behavioral changes [38] one of which is the chronic organophosphate induced neuropsychiatric disorder (COPIND). The most common symptoms of chronic neurological disease induced by organophosphorus (COPIND) include cognitive impairment as impaired memory, concentration and learning and as mood changes like anxiety, depression, psychotic symptoms, or chronic fatigue, impaired autonomic nervous system and extrapyramidal symptoms such as dystonia, rest tremors, bradykinesia, postural instability and rigidity of facial muscles (hypo-

mimia) [38, 39]. These disorders sometimes take place after one or more of the acute cholinergic clinical attacks among agricultural workers with long term, low level (LTLL) exposure to organophosphate insecticides. This chronic disorder is like the symptoms of the loss of cholinergic markers in the hippocampus and cortex which if blocked will lead to neurotoxicity and cognitive impairment [38, 39]. The limbic system that has duty for creating and understanding emotion since human consume more oxygen in this part of brain than others do. As a result, high oxygen burning up raised the defenselessness to free radicals such as ROS. In addition, free radicals will affect neurotransmitters' in addition to damaging cell structures like mitochondria. Psychological activities can be controlled by most of neurotransmitters straightly. As an example, the chemical activity, which produced from improved ROS, can reduce serotonin and this may finish in depression [40].

Several factors are involved in the development of psychological disorders and many factors such as lifestyle are most likely involved in psychological disorders of the workers. According to present study low dose chronic exposure to organophosphate pesticides can endanger individuals' physical and mental health, but severe neuropsychological disorders, which are multivariate phenomena, may be seen in the high-dose exposure. In fact, chronic exposure to organophosphate pesticides can affect cognitive processes and in extreme cases can cause severe neuropsychological disorders.

CONCLUSIONS

Chronic exposure to organophosphate pesticides can affect psychological scales such as quality of life, depression, anxiety and stress among farmers exposed to organophosphates and endanger people's mental health.

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