

**Research Article****Safety Behaviors related to Health and its Perceived Environmental Factors  
among Greenhouse Spray Workers, Jiroft, Iran**

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**ABSTRACT**

In spite of the apparently high enhancement in production of agricultural products by application of pesticides, these substances cause inevitable effects on human health and environment.

Therefore, the present research aimed to study the safety behaviors related to health and its perceived environmental factors among greenhouse spray workers of Jiroft, Iran. This cross sectional study with a descriptive- correlation approach was conducted on 229 spray workers of Jiroft greenhouses. Proportional stratified random sampling was applied for data collection. Data (obtained by a researcher-made questionnaire) included demographic variables, behavioral factors affecting workers' health, and its perceived environmental factors. The questionnaire's validity and reliability were confirmed. Data were then analyzed by SPSS software 24, descriptive, and analytical tests were further carried out in the significance level of 0.05. The most protective equipment was glove (16.6%, *always* option). Regarding protective and health principles, washing face and hands after spray was the most frequently used behavior (86%). Numbers of greenhouse workers with spray as their main job. Application of safety equipment which prevents the occurrence of hazards through skin contact and breathing were underutilized. Observance of important behaviors such as not spilling pesticide residuals in the environment as well as paying attention to notifications and recommendations on pesticides' labels had low percentage. Therefore, conducting educational interventions and promoting social health are recommended to prevent health problems in spray workers, their family members, and others, environment, as well as users of greenhouse crops.

**Keywords:** Safety, behaviors, Spray workers, Behavior, Environmental, Greenhouse

**INTRODUCTION:**

Pesticides threaten human health and the environment [1]. Individuals who are in contact with pesticides due to their jobs' nature are highly exposed to risks of different cancers [2]. Pesticides cause acute poisoning or several problems [3]. such as Parkinson, [4]. weakness of immune system, affection to pulmonary, pancreas, kidney, colon, rectum, leukemia, bladder, prostate,

brain, skin cancers, respiration disorders [5]. congenital malformation, fetal death, growth abnormalities [6]. and increased cancer risk in children (whether the child or his/her family are exposed to pesticides) [7].

Every year, around 25 million agricultural workers are poisoned by pesticides throughout the world [8]. In a study conducted by national

institute of occupational health, it was reported that the poisoning rate of workers in the USA is 39.9 times higher than all other jobs and industries (the rate of poisoning in agricultural workers is 53.6% while it is 1.4% in non-agricultural workers) [9].

Greenhouse workers encounter many risks due to the limited space of greenhouse, high temperature and humidity, growth of different fungi and pests, use of high amounts of different pesticides in greenhouse [10], and absorption of pesticides by skin due to wearing improper and light clothes [4]. In spite of their frequent exposure to different types of dangerous pesticides, workers and farmers do not frequently use personal equipment (gloves, special clothes, and mask); they also do not observe health principles while applying pesticides [7]. In a study, 42% of farmers never used personal equipment [11] and in another case, just lower than 20% of farmers applied mask, proper clothes, and gloves at the time of spray [12]. In the study conducted by Quandt, all workers stated that pesticides should be touched and smelled; if pesticides are not recognized by senses, they are not original pesticides [13].

Aghilinejad also reported that only 25% of farmers noticed information on pesticides' labels, 55% of farmers left pesticides' containers in the environment while just 27% of them fired or buried them [14]. Therefore, new and efficient interventions are required to reduce farmers and workers' exposure to detrimental factors [15]. In order to design such interventions, it is necessary to focus on important risk factors of diseases and occupational events in this population [16, 17]. These factors are divided into behavioral and environmental factors [18]. Behavioral factors are those that strongly influence individuals' health, e.g., not using mask while spraying. Environmental factors are social and physical components that are out of control, that if corrected, will support behavioral change and influence on health outcomes (for instance, application of impermissible pesticides, or when

workers are forced to mix some strong pesticides for greenhouse spray) [19, 20].

Kakaie stated that 86.2% of occupational events are caused by behavioral factors [21]. In the study carried out by Broucke, education and the number of workers were considered as non-behavioral risk factors. Also, pesticides were introduced as the most important behavioral risk factor for damages. In his study, use of unsafe pesticides had the highest rank among all risk factors [16]. Regarding the high number of greenhouses in Jiroft and since no study has ever been conducted on behavioral and environmental factors affecting spray workers' health in Jiroft greenhouses, the current study aimed to examine safety behaviors related to health and its perceived environmental factors among spray workers of Jiroft greenhouses.

## **MATERIALS AND METHODS:**

This is a cross sectional study with a descriptive-correlation approach. It targets at studying safety behaviors related to health and its perceived environmental factors on 229 workers of Jiroft greenhouses in 2016.

### **2.1. Research setting and selection of participants under study**

Jiroft city is located in south of Kerman with three climate types of moderate, cold and dry, as well as warm and humid. It is one of the important agricultural regions of Kerman and Iran. Different types of agricultural crops especially kitchen-garden crops are cultivated in greenhouses due to their weather conditions. Greenhouses are mostly cultivated in warm and humid regions during autumn, winter, and spring (especially in central parts and Esmaili district). Inclusion criteria for the greenhouse workers included at least two years of work experience in greenhouses, at least one year of experience in greenhouse spraying, and living in the region under study. Workers who have not sprayed greenhouses and did not live in the region were excluded from the study. Proportional stratified random sampling was applied; ten health-treatment centers located in central part and Ismailieh district of Jiroft were

considered as ten stratifications. To reach the favorable sample size of 229 participants, proportional to the number of greenhouses in each stratification and by taking into account the inclusion criteria, one worker was selected from each greenhouse and entered the study.

## 2.2. Ethical considerations

The study's goals and instructions were provided to participants, then they were ensured about information confidentiality and asked to complete the informed consent. In addition, the current research was approved by ethical committee of Yazd Medical Science University, Iran, with ethical code No. IR.SSU.SPH.REC.1394.60.

## 2.3. Data collection instrument and methodology

Data were collected by a researcher-made questionnaire. Since a high number of workers were illiterate, many questions were asked orally and recorded by questioners. The questionnaire included two parts. The first part considered demographic (8 items) and background information (6 items). Demographic questions include age, marital status, education level, monthly income, work experience in greenhouse, duration of spraying, number of sprays per year, and history of poisoning due to exposure to pesticides. Background questions consisted of whether working in greenhouse is the worker's main job, number of workers in greenhouse, area of the greenhouse, whether the worker's family members are working in the same greenhouse, whether the worker's close relatives are working in the same greenhouse, as well as the type of product cultivated in the greenhouse.

The second part of questions dealt with safety behaviors related to health and perceived environmental factors affecting workers' health. Questions of safety behaviors related to health were totally 30 (scores ranged from 30 to 150). A Likert's five point scale was applied ranging from never to always. The questions included use of personal equipment (8 items with scores ranged from 8 to 40) with titles such as use of mask, gloves, overalls, goggles, helmet, mask, when

mixing pesticides and spraying. Questions on "*avoiding risks that endanger users' pesticide*" (ten items with scores ranging from 10 to 50) include subjects such as controlling sprayers' holes and leaks, avoiding to breathe pesticides, not spraying in warm weather, not spraying during wind blow, avoiding to eat, drink, or smoke when spraying, removing nutrients from places where spraying is conducted, not touching eyes, nose, or mouth while spraying, not spraying the greenhouse when other workers are working, and not spraying in presence of children. Questions of "*observance of protective and health principles*" (12 items with scores from 12 to 60) included subjects such as considering dangerous notifications and signs on pesticides labels before spraying, paying attention to pesticide manufacturer's instructions on applying the pesticide before spraying, gathering pesticide containers with caution and transferring them to proper places, stop spraying in case of observing poisoning symptoms and refer to doctor immediately, mixing pesticides with special devices than manually, observing safety principles when lifting pesticide bags and manual sprayers (Regarding the question "*Do you observe safety principles in lifting pesticide bags and manual sprayers?*" (The well trained interviewer briefly explained safety principles of lifting pesticide bags and manual sprayers. Then, participants were asked whether they observe these principles while lifting pesticide bags), ensuring about the greenhouse proper ventilation before reentrance after using pesticides, washing face and hands with soap and water after spraying, not spilling pesticide residuals in water streams, and not reusing pesticide cans. Questions of "*perceived environmental factors*" included 6 items with a 5-point Likert scale (from 6 to 30) ranging from always to never. The questions were: employer's good behavior causes me to observe safety instructions in greenhouse; the employer does not provide personal equipment for workers and I do not know how to learn the required safety principles; improper environment of greenhouse

causes me not to breathe well; old sprayers expose me more to pesticides; as well as there is no first aid box and antidote in greenhouse where I am working. Questionnaire's Validity was confirmed by content validity indices (CVI and CVR) and expert panels' opinions (8 people). The values obtained for CVR were 0.98, 0.99, 0.99, and 0.98 respectively for use of personal protective equipment, avoidance of risks that endangers pesticides' user's, observance of health and protective principles, as well as perceived environmental factors. Values obtained for CVI were 0.87, 0.91, 0.89, and 0.80 for use of personal protective equipment, avoidance of risks that endangers pesticides' users, observance of health and protective principles, perceived environmental factors, respectively. Internal consistency test was applied to measure questionnaire's reliability. Cronbach's alpha for environmental factors, use of personal protective equipment, avoidance of risks that endangers pesticides' users, pesticides and observance of health and protective principles was respectively 0.76, 0.83, 0.85, and 0.84.

**2.4. Data analysis**

Data were analyzed through SPSS software Version 24. Descriptive statistical tests were used to describe demographic-background variables and to answer behavioral factors' questions. ANOVA was then applied to measure the relationship between some demographic-background variables and mean scores of safety

behaviors. Pearson correlation test was also conducted to measure the correlation between some demographic-background variables, perceived environmental factors, and safety behaviors. Moreover, linear regression was applied to determine predictors of safety behaviors related to workers' health.

**RESULTS:**

All participants were male greenhouse workers in the age range of 19-70 years with the mean of 36.88±11.24. Most participants were married (86.5%), 41.5% were illiterate, 41.9% had the educational degree of diploma or below diploma, and 16.6% had associate or higher degrees. had 61.6% of them a monthly income of less than one million Toomans and 57.2% of them had work experience of less than 5 years in greenhouse. were 61.6% of them spraying in greenhouses less than two years. Among workers under study, 11.8% stated that they sprayed in greenhouse less than 10 times, 21% reported that they sprayed between 10 to 20 times, 20.5% indicated between 21 to 30 times of spraying, and 46.7% stated that they sprayed greenhouse more than 30 times. In addition, 47.6% reported that they were poisoned by pesticides. Among participants, 16.6% indicated that they always use gloves while 14% of them used mask before spraying. And 33.6% reported use of mask when mixing pesticides (table 1).

[Table 1]. Participants' responses on "application of personal protective equipment"

Statements	Never		Seldom		Often		usually		Always	
	N	%	N	%	N	%	N	%	N	%
I use mask before spraying	40	17.5	35	15.3	45	19.7	77	33.6	32	14
I wear gloves before spraying	61	26.6	47	20.5	41	17.9	42	18.3	38	16.6
I use overall before spraying	99	43.2	46	20.1	34	14.8	33	14.4	17	7.4
I wear goggles before spraying	46	20.1	35	15.3	45	19.7	78	34.1	25	10.9
I use proper helmet before spraying	225	98.3	0	0	0	0	0	0	4	1.7
I wear brogan before spraying	219	95.6	2	0.9	2	0.9	6	2.6	0	0
I use proper mask when mixing pesticides	45	19.7	35	15.3	46	20.1	78	34.1	25	10.9
I use gloves when mixing pesticides	95	41.5	48	21	36	15.7	33	14.4	17	7.4

The highest percentage of positive behaviors to avoid risks that endanger pesticide users was eating and drinking avoidance during spraying (97.8%, "always" option), avoidance to touch mouth, nose, and eyes by hands was the next frequent behavior (93.9%, always option). (Table 2).

[Table 2]. Participants’ responses on “avoidance of risks that endanger pesticides’ users”

Statements	Never		Seldom		Often		usually		Always	
	N	%	N	%	N	%	N	%	N	%
I will control sprayer’s holes and seals when regulating its pressure in order to ensure about leaks	20	8.7	22	9.6	50	21.8	15	6.6	122	53.3
I avoid breathing pesticides because of their poisonous dangerous gases	2	0.9	4	1.7	4	1.7	28	12.2	191	83.4
I do not spray in warm weather at mid-day	0	0	0	0	39	17	53	23.1	137	59.8
I do not spray during wind blow	27	11.8	25	10.9	35	15.3	42	18.3	100	43.7
I avoid eating and drinking during spraying	0	0	0	0	0	0	5	2.2	224	97.8
I avoid smoking during spraying	0	0	2	0.9	2	0.9	20	8.7	205	89.9
I remove nutrients from places that are going to be sprayed before spraying	0	0	0	0	4	1.7	17	7.4	208	90.8
I avoid touching eyes, nose, and mouth by hands during spraying	0	0	0	0	4	1.7	10	4.4	215	93.9
I do not allow anybody to work in greenhouse when I am spraying	12	5.2	14	6.1	28	12.2	33	14.4	142	62
I do not spray in presence of children	0	0	0	0	10	4.4	21	9.2	198	86.5

The highest percentage of positive behaviors related to observance of health and protective principles belonged to *washing hands and face*

*after spraying* (86%, *always* option) followed by *mixing pesticides with special equipment* (81.7%, *always* option). (Table 3).

[Table 3]. Participants’ responses on “observance of health and protective principles”

Statements	Never		Seldom		Often		usually		Always	
	N	%	N	%	N	%	N	%	N	%
I pay attention to notifications and signs on pesticides’ labels before spraying	79	34.5	46	20.1	42	18.3	43	18.8	19	8.3
I pay attention to manufacturer’s instructions about how to use pesticides before spraying	88	38.4	56	24.5	39	17	26	11.4	20	8.7
I collect and remove pesticide containers appropriately with caution	0	0	0	0	4	1.7	108	47.2	117	51.1
I will stop spraying in the case of observing symptoms such as dizziness, nausea, vomit, headache, dyspnea and I will visit doctor	0	0	54	23.6	61	26.6	77	33.6	37	16.2
I will mix pesticides by special equipment rather than my hands	0	0	0	0	16	7	26	11.4	187	81.7
I observe safety principles when lifting pesticide bags and manual sprayers	157	68.6	64	27.9	8	3.5	0	0	0	0
I check the greenhouse for proper ventilation after using pesticides and before reentering to greenhouse	78	34.1	35	15.3	46	20.1	45	19.7	25	10.9
I will wash my hands and face with water and soap after spraying	0	0	0	0	4	1.7	28	12.2	197	86
I will change my clothes after spraying	86	37.6	73	31.9	18	7.9	17	7.4	35	15.3
I will take a shower after spraying	56	24.5	34	14.8	44	19.2	72	31.4	23	10
I do not spill pesticide residuals in water streams and to the surrounding environment	51	22.3	35	15.3	46	20.1	38	16.6	59	25.8
I do not keep pesticide cans for other uses	75	32.8	83	36.2	36	15.7	15	6.6	20	8.7

Among perceived environmental factors, the highest score was related to *good behavior of employer* (39.7% option “*always*”) while the lowest score was related to *workers’ personal protective equipment provided by employer* (0%, *always* option) (table 4).

[Table 4]. Participants’ responses on “perceived environmental factors”

Statements	Never		Seldom		Often		usually		Always	
	N	%	N	%	N	%	N	%	N	%
Good behavior of employer causes me to observe safety in greenhouse	59	25.8	16	7	49	21.4	14	6.1	91	39.7
The employer gives me personal protective equipment	208	90.8	9	3.9	11	4.8	1	0.4	0	0
I do not know how to learn safety issues about working in greenhouse	33	14.4	175	76.4	8	3.5	9	3.9	4	1.7
Improper structure of greenhouse causes more exposure to pesticides	59	25.8	0	0	35	15.3	19	8.3	117	50.7
Old sprayers cause more exposure to pesticides	38	16.6	39	17	51	22.3	2	0.9	99	43.2
There is no first aid box and antidote in the greenhouse where I am working	13	5.7	0	0	0	0	0	0	216	94.3

In the current study, significant correlation between age, work experience in greenhouse, number of sprays in cultivation season, number of greenhouse workers, area of greenhouse, behavior of employer, having personal protective equipment, total mean of perceived environmental factors, and safety behaviors (Table 5).

[Table 5]. Correlation among demographic variables, background variables, perceived environmental factors, and safety behaviors related to participants’ health (n= 229).

Variables		Age	Work experience	Spraying experience	Number of sprays in cultivation season	Number of greenhouse workers	Area of greenhouse
Behavioral factors	r= 0.144* p= 0.029	r= 0.097 p= 0.142	r= 0.190** p= 0.004	r= 0.139* p= 0.036	r= 0.289** p= 0.001	r= 0.794** p= 0.001	r= 0.770** p= 0.001
Variables	Behavior of employer	Having personal protective equipment	know how to learn the required safety principles	Greenhouse Environment	Sprayers status	First aid box and antidote in greenhouse	Total mean score of perceived environmental factors
Behavioral factors	r= 0.182** p= 0.006	r= 0.287** p= 0.001	r= 0.099 p= 0.135	r= 0.055 p= 0.404	r= 0.007 p= 0.921	r= 0.071 p= 0.285	r= 0.197** p= 0.003

There was a significant relationship among occupational poisoning, working in greenhouse as the main job, participants' family members working in the same greenhouse, and safety behaviors (table 6).

[Table 6]. Relationship between demographic and background variables as well as safety behaviors of participants’ health (n= 229).

Variable		Mean	SD	F	P
Marital status	Married	100.66	9.92	2.07	0.105
	Single	104.64	9.60		
	Widowed	104.40	15.05		
	Divorced	116	0		
Education level	Illiterate	99.98	10.13	8.15	0.001
	Diploma and lower	99.69	9.71		
	Associate	108.60	8.22		
	Bachelor	107.80	7.48		
History of poisoning	Yes	97.11	8.78	51.7	0.001
	No	105.78	9.46		
Working in greenhouse as main job	Yes	91.63	5.67	188.70	0.001

	No	106.01	7.20		
Family members working in the same greenhouse	Yes	98.72	4.56	109.143	0.001
	No	114.29	8.82		
Close relatives working in the same greenhouse	Yes	100.91	9.91	0.832	0.363
	No	102.36	10.62		
Type of product almost cultivated in the greenhouse	Cucumber	101.52	9.55	0.511	0.728
	Tomato	100.94	10.57		
	Eggplant	98.31	11.77		
	Strawberry	101.84	8.42		
	Other	102.64	13.31		

Number of greenhouse workers, working in greenhouse as main job, participants' family members working in the same greenhouse, academic literacy, and good behavior of employer were the most important predictors of workers' safety behaviors in the current study. These factors predicted 73.2% of changes in workers' safety behaviors.

[Table 7]. Behavior predictors (stepwise) related to participants' health

Variable	B	SE	Beta	P	F	R <sup>2</sup>
Constant (a)	70.580	1.708		0.001	121.915	0.732
Number of greenhouse workers	6.202	0.629	0.485	0.001		
Working in greenhouse as main job	6.793	0.916	0.318	0.001		
Family members working in the same greenhouse	4.802	1.153	0.176	0.001		
Academic literacy	0.956	0.415	0.082	0.022		
Employer's Behavior	0.437	0.218	0.071	0.046		

**DISCUSSION**

The current study aimed to investigate safety behaviors related to health and its perceived environmental factors among greenhouse spray workers in 2016. The most important method to avoid pesticides' contamination is application of personal protective equipment [22]. An effective method to reduce workers' exposure to pesticides is to use proper clothes and safety equipment when mixing, loading pesticides, and spray pesticides [23]. Results of the study conducted by Dasgupta showed that although absolute amounts of pesticide did not increase poisoning rate, 1% increase in high risk pesticides increased poisoning rate 3.9%. However, increase of protective equipment reduced poisoning to 44.3% [24]. Pesticides mostly enter human body via skin, breath, and digestion [25]. In the present study, only 16.6% of workers used gloves before spraying, 7.4% used gloves when mixing pesticides, 7.4% used overall and trousers. It was also observed that 14% of workers used mask before spraying and 10.9% applied mask while

mixing pesticides. In the study conducted by Gomes, 35% of workers used gloves [26]. In the study carried out by Ghasemi, 33% of Fars greenhouse keepers used mask and 14.3% used protective clothes [27]. In the study of Hines, participants applied plastic gloves (68% when mixing pesticides and 59% during spraying) and mask (45% when mixing pesticides and 36% during spraying) as the most abundant protective equipment against pesticides [28]. Results achieved by different studies are controversial in this field but they all agree on that only low percentages of greenhouse workers use safety equipment in their workplace. Therefore, according to Macfarlane, education is the most important intervention for increasing application of personal protective equipment and reduction of exposure risks to pesticides [29]. In addition to use personal protective equipment, workers exposed to pesticides should avoid some risks that may threaten their health, environment, and other people. Regarding avoidance of risks that endanger pesticides users' health, workers who observed this behavior were more than users of

the other two dimensions. The most frequently used strategy was eating and drinking avoidance during spraying (97.8% *always* option), while the least one was associated with not spraying during wind blow (43.7% *always* option).

Concerning the fact that poisoning with pesticides rarely occurs through digestion [25], most participants (97.8%) stated eating and drinking avoidance, also 89.9% indicated smoking avoidance during spraying. 90.8% removed nutrients from places where spraying was supposed to be conducted. 93.9% stated that they always avoided touching eyes, mouth, and nose by hands during spraying.

The above mentioned cases were more favorable than other dimensions of safety behaviors in current study. Less observed cases were: spray avoidance during wind blow (43.7%), holes and seals control when regulating sprayer's pressure for ensuring about leaks (53.3%), not spraying in warm weather at mid-day (59.8%), not allowing other individuals to work in greenhouse during spraying (62%), stop spraying in presence of children (86.5%, *always* option). If the above issues are not observed, poisoning will occur via skin or breathing resulting in complications in spraying workers or other individuals. In the study conducted by Ghasemi, 92.3% of participants always avoided eating and drinking and 83.5% avoided smoking during spraying (27). In the study of Gomes, 63% of workers drank water during spraying and 46% ate food (26). In the study carried out by Ghasemi, 98.5% of greenhouse owners prevented children to enter the greenhouse during spraying [27]. Extreme use of pesticides has multiple detrimental effects on human health and environment (directly and indirectly) [30]. Important factors in improper application of pesticides include lack of monitoring over pesticide productions, non-standard pesticide sales, and abundance of pesticides in the market. [31] Therefore, workers and farmers should consider a set of protective principles to protect environment, their own, and others' health. In the current study, protective and sanitary principle mostly observed by pesticides'

workers was *washing hands and face with soap and water* after spraying (86%, *always* option) which was followed by *mixing pesticides by special equipment rather than hands* (81.7%). While behaviors such as "*observance of safety principles when lifting pesticide bags and manual sprayers*" (0%, "*always*" option) can prevent occupational accidents, paying attention to danger notifications and signs on pesticide's label before spraying (8.3%, *always* option), paying attention to manufacturers' instructions about how to use pesticide before spraying (8.7%), not keeping pesticide cans for other uses (8.7%), collecting pesticide residual containers with caution and removing them properly (51.1%, *always* option) will prevent injury to worker, his family, environment, crops, and consumers of greenhouse crops. Taking shower after spraying (10%), ensuring about proper ventilation in the greenhouse after spraying and before reentering the greenhouse (10.9%), changing clothes after spraying (15.3%), stopping the spray immediately after observance of poisoning symptoms such as dizziness, nausea, vomit, headache, and dyspnea, and visiting the doctor (16.2%) were not observed regularly and permanently which cause injury to spraying worker and his family members. In the study conducted by Hines, 77% of pesticide users did not wash their hands after mixing pesticides (28). In the study conducted by Ghasemi, 20.9% of greenhouse keepers washed their hands after spraying, 33% read the information on pesticide's label, 27.5% paid attention to danger notifications and signs on pesticide containers, and 36.7% entered the greenhouse after making sure about proper ventilation. [27] In the study of Aghilinejad, 25% of farmers claimed that they read the information on pesticides' labels.

Although all pesticide containers should have danger notification labels on them, farmers pay less attention to them because of illiteracy and lack of education [31]. Therefore, this issue may have led workers of the present study not to pay attention to pesticides' labels and not to observe health and protective principles while using



pesticides. In this study, 51.1% of workers stated that they always collected pesticide containers and buried them properly, however, in the studies carried out by Ghasemi and Aghilinejad 11.2% and 27% of participants were reported respectively for this case [27]. Gomes indicated that 83% of participants changed their clothes after spraying and 83% took a shower [26]. Therefore, it is necessary to study several environmental factors that influence protective behaviors of workers in addition to behavioral factors. One of the most important factors is the employer's expectations and behavior.

If employers support safety behaviors, workers' will show more positive safety behaviors. Among workers under study, 100 workers stated that their employers did not provide personal protective equipment for them, 5.7% reported that there was no first aid box and antipode in their workplace.

Further, 43.2% and 50.7% of workers respectively believed that old sprayers and improper structure of greenhouse cause more exposure to pesticides. 25.8% of workers mentioned that improper behavior of employer caused them not to observe safety instructions. 1.7% stated that they did not know how to learn safety issues related to greenhouse. Thus, employer's support for observance of safety principles, avoidance of risks that endanger pesticide users, use of personal protective equipment, and on time referral to doctor in occurrence of unpleasant events are important factors because workers' lack of understanding about acute poisoning symptoms causes them not to take medical treatments. Moreover, workers may do not report poisoning due to fear of being punished by employer [9].

Availability of equipment required for workers' protection against toxic effects of pesticides will increase workers' intention to observe safety principles. In the study conducted by Levesque, workers who had access to warm and cold water for bathing observed safety behaviors against pesticide 13.6 times more than others. Additionally, workers who had soap for washing

hands observed safety behaviors against pesticide 7.8 times more than others. Consequently, improvement of job conditions determines observance of safety behavior and use of personal protective equipment by workers while applying pesticides [9]. In the present study, there was a significant correlation among age, work experience in greenhouse, number of sprays in cultivation season, number of greenhouse workers, greenhouse's size, employer's behavior, preparing personal protective equipment, total mean score of perceived environmental factors, and safety behaviors. Also, there was a significant relationship among education level, occupational poisoning history, choosing greenhouse as the main workplace, worker's family members working in the same greenhouse, and safety behavior. Both Ibrahim [32] and Khan [33] reported a significant relationship between age and farmers' behavior. In the study conducted by Khan, [33] there was a positive relationship between education level and behavior, while the relationship between income and behavior was negative. No relationship was found between the farm's size and workers' behavior. Ibrahim [32] noted that there was a significant relationship between education and behavior. In the current study, there was a significant correlation between use of personal protective equipment and poisoning resulted from exposure to pesticides ( $r = 0.403^{**}$ ,  $p = 0.001$ ). Feola reported a significant relationship between problems and accidents resulted from exposure to pesticides and use of personal protective equipment [34].

In the study conducted by Khan, there was a relationship between unpleasant events during mixing pesticides or spraying and use of personal protective equipment [33].

In the recent study, the most important predictors of workers' safety behaviors include number of greenhouse workers, Working in greenhouse as main job, worker's family members working in the same greenhouse, academic literacy, and good behavior of employer. Such factors predicted totally 73.2% of changes in

participants' safety behaviors. Unlike the present research, in the study carried out by Broucke, education and number of workers (as risk factors) led to unpleasant events among participants [16]. In the study conducted by Okoffo, factors such as farmer's age and experience, farm size, and education were effective on application of personal protective equipment [35].

Denkyirah reported that age, education level, and agricultural experience were the most important factors affecting farmers' decision on using pesticides [36]. Among limitations of the study, self-report method of data collection on behavioral and environmental factors can be mentioned since it is not sufficiently accurate. , Although, this method was applied because it was impossible to observe behavior of workers.

## CONCLUSION

Results of the present study indicate that investigation of different behavioral and environmental factors affecting safety behaviors of workers in agricultural product greenhouses is crucial.

Therefore, greenhouse workers and owners should be trained about application of personal protective equipment, avoidance of risks that endanger pesticides users, observance of health and protective principles, avoidance of behaviors that endanger health of workers' family members, other people, environment, and consumers of greenhouse products, provision of personal protective equipment, reconstruction and standardization of greenhouses to take effective steps in improving workers, other people, environment, and consumers of greenhouse products' health.

Intervention studies through planning and behavioral models on efficiency of education and other non-educational measures are recommended to promote safety behaviors of greenhouse keepers.

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