RELATIONSHIP BETWEEN FARMERS' KNOWLEDGE OF AND ATTITUDES TOWARDS PESTICIDE USE AND THEIR SOCIODEMOGRAPHIC CHARACTERISTICS: A CROSS-SECTIONAL STUDY FROM NORTHWESTERN TURKEY

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ABSTRACT

Background. The determination of farmers' knowledge of and attitudes towards pesticide use is very important in terms of preventing pesticide use-related short- and long-term damages.

Objective. This study was aimed at investigating the relationship between the sociodemographic characteristics of farmers in Karacabey District of Bursa, a province in northwest Turkey, and their knowledge of and attitudes towards pesticide use.

Material and methods. This cross-sectional study was conducted in Karacabey district between December 2018 and April 2019. The sample size was calculated as 1924 using the Epi info program by assuming the prevalence as 50%, type I error as 5%, standard deviation as 3% and design effect as 2. The dependent variable of the study was the farmers' knowledge of and attitudes towards pesticide use whereas the independent variables were their sociodemographic characteristics. The relationship between the dependent and independent variables was analyzed using the chi-square test and binary logistic regression model.

Results. The mean score the participants obtained from the Knowledge and Attitude Index was 12.8±2.8 and the median value was 13. While 49.5% of the participating farmers obtained a score lower than the median, 51.5% of them obtained a score equal to or above the median. While advanced age increased the possibility of getting a low score from the Knowledge and Attitude Index 2.7 times, not being married increased it 35.7 times, not getting formal education increased it 30.1 times, living in a non-crowded household increased it 2.1 times, and low income (2000 Turkish liras equal to ≤$310 according to April 2019 exchange rates) increased it 3.1 times.

Conclusion. The study indicated that the participating farmers’ knowledge of and attitudes towards the proper use of pesticides were inadequate, and that there was a strong relationship between their Knowledge and Attitude Index scores and their sociodemographic characteristics.

Key words: pesticide, knowledge, attitude, sociodemographic characteristics, public health.

INTRODUCTION

Excessive, illogical and unconscious use of pesticides which have been widely used in agricultural activities since the early 1970s, [6, 13] is an important public health problem threatening human and environmental health [13]. The fact that the number of people working in agriculture is high all over the world but in particular in developing countries places the pesticide use-related short- and long-term damage at the forefront of the current agenda as a serious problem [5, 17, 25, 31]. According to United Nations (U N), an average of about 200,000 people die from the toxic exposure of pesticides per year across the World [15]. Pesticides also create a serious burden of disease (The disability-adjusted life-year (DALY) in many countries, especially in developing countries [16]. In addition, the use of highly toxic pesticides, forbidden in developed countries, is widespread in developing countries, which increases the risk of pesticide-related deaths in those countries [22]. Due to factors such as unnecessary use of pesticides [1], inappropriate use of pesticides [3, 4, 7, 8, 22], not using or misusing protective equipment [3], due to lack...
of knowledge / attitude, farmers face serious health problems [8, 13, 21]. Since farmers who do not have the accurate knowledge of pesticide use and display poor attitudes towards it are in an at-risk group [3], it is important to identify their knowledge / attitude levels and determinants of these low levels in order to clarify the situation and to guide public health interventions.

In the literature, according to studies conducted to investigate farmers' knowledge of and attitudes towards pesticide use, the rate of farmers whose knowledge / attitude level is considered as sufficient ranges between 34% and 85% [3, 7, 17, 18, 19, 27, 28, 29]. As is reported in the literature, knowledge / attitude score is affected by factors such as age [28], income level [28], total length of time spent in farming [29], educational status [26, 27, 29] and cultural characteristics [33]. In Turkey, approximately one-fifth of the labor force, most of whom are men, is employed in agriculture [30]. In Turkey, the number of population-based studies designed to assess farmers' knowledge of and attitudes towards pesticides is very limited and the samples of the available studies include a small number of farmers [7, 21].

In the present study conducted in Karacabey District of Bursa, a province in northwest Turkey, it was aimed to investigate the relationship between the sociodemographic characteristics of farmers who were registered in the Chamber of Agriculture and their knowledge of and attitudes towards pesticide use. To our current knowledge, our study is the first study conducted on this issue in this region.

**MATERIALS AND METHODS**

This cross-sectional study was carried out within the scope of the Balikesir University scientific research project titled “Determination of farmers’ knowledge of, and attitudes and behaviors towards pesticide use” (BAUN BAP No: 2018/169). This project has three stages: The first stage is the assessment of the knowledge and attitudes of the farmers registered in the Chamber of Agriculture in Karacabey District regarding the use of pesticides. The second stage is the determination of the behavioral characteristics of farmers who use pesticides during agricultural activities and actively work in the spraying of pesticides, and the frequency of pesticide poisoning. The third stage is the provision of training on the health effects of pesticides and ways of protection against the harmful effects of pesticides. In this study, the findings obtained from the first stage of the project are presented. The study was carried out in Karacabey district of Bursa between December 2018 and April 2019. Karacabey is a district with a population of 89,000 people. The district has three million hectares (about 741316 acres) of fertile land where vegetables and fruits are intensively cultivated [10] (Figure 1).

The population of the study comprised 9750 people registered in Karacabey Chamber of Agriculture. The sample size was calculated as 1924 using the Epi-info Statcalc Program by assuming the prevalence as 50%, type I error as 5%, standard deviation as 3% and design effect as 2. During the study, 2100 people were reached using the multi-stage sampling method. In the
study, firstly, the neighborhoods where the farmers registered in the Karacabey Chamber of Agriculture lived were determined. Each of the 85 neighborhoods in Karacabey district was considered as a cluster. The number of farmers targeted to be reached in each cluster was determined in proportion to the farmer population in the neighborhood. Interviews were started from the first house in each cluster and continued by skipping the second house and visiting the third house in a row. If there was no farmer in the house, then the household in the next house was interviewed.

The dependent variable of the study was the participating farmers’ knowledge of and attitudes towards pesticide use score. The score was determined using the Knowledge and Attitude Index developed by the researchers based on the pertinent literature [3, 8, 14, 17, 29]. The independent variables of the study were the place of residence, age, marital status, educational status, the number of households, monthly income and total length of time spent in farming. The study data were collected using the Personal Information Form and the Knowledge and Attitude Index.

**Personal Information Form:** The form developed by the researchers based on the literature consists of 7 items that question the participants’ socio-demographic characteristics (age, marital status, education etc.) [19, 24, 32].

**The Knowledge and Attitude Index:** Included 22 items questioning the participants’ knowledge and attitudes regarding the effects of pesticides on human and environmental health, pesticide selection, pesticide application time, use of protective equipment during spraying, smoking status, hand washing and taking a shower after spraying, how to dispose of empty pesticide boxes. Responses included three options: “yes”, “no” and “I don’t know”. While responses indicating that the participant’s knowledge and attitudes were correct were given “1 point”, responses indicating that the participant’s knowledge and attitudes were incorrect were given “0 points”. If the participant selected the “I don’t know” option, “0 points” were given too. Therefore, the highest and lowest possible scores that can be obtained from the index were 22 and 0 respectively. After the scores obtained by the farmers were calculated, then the median value which was used as the cutoff point was determined. While the scores below the median value indicated that the knowledge and attitude levels were “low”, the scores equal to or higher than the median value indicated that the levels were “high”. The Knowledge and Attitude Index used in the study was administered to 10 farmers who were not included in the study sample for pilot testing, and then the necessary revisions were made in the index.

The data obtained in the study were summarized as percentage distribution. The relationship between the dependent and independent variables was analyzed in the SPSS 25.0 program using the chi-square test and binary logistic regression model. P-values less than 0.05 were considered statistically significant.

Ethical approval was obtained from the Ethics Committee of Balikesir University (Dated April 04, 2018, Numbered 2018/73). The farmers to participate in the study gave their verbal consent indicating that they volunteered to participate in the study.

**RESULTS**

Within the scope of the study, 2100 farmers were reached. All the participating farmers were vegetable and fruit growers, and applied pesticides to their crops. Of the participating farmers, 78.5% lived in a village. 24.1% were ≥55 years old, 3.4% were single, 14.1% did not have any formal education. 15.9% earned more than 2000 Turkish liras ($357 according to April 2019. exchange rates) per month and 43.9% had been engaged in farming for more than 20 years (Table 1).

| Table 1. Sociodemographic characteristics of the participating farmers |
|-----------------------------|-----------------|-----|
| **Variables**               | **n**           | **%** |
| **Place of residence**      |                 |      |
| District center             | 451             | 21.5 |
| Village                     | 1649            | 78.5 |
| **Age**                     |                 |      |
| ≤44 years                   | 378             | 18.0 |
| 45-54 years                 | 1215            | 57.9 |
| ≥55 years                   | 507             | 24.1 |
| **Marital status**          |                 |      |
| Married                     | 2028            | 96.6 |
| Single                      | 72              | 3.4  |
| **Education level**         |                 |      |
| No formal education         | 298             | 14.1 |
| Primary school              | 1020            | 48.6 |
| Junior High School          | 644             | 30.7 |
| Senior High school          | 138             | 6.6  |
| **Family size (n)**         |                 |      |
| ≤4 people                   | 1277            | 60.8 |
| ≥5 people                   | 823             | 39.2 |
| **Income per month (USD)**  |                 |      |
| ≤$357                       | 1766            | 84.1 |
| >$357                       | 334             | 15.9 |
| **Total length of time spent in farming** | |      |
| ≤20 years                   | 1179            | 56.1 |
| >20 years                   | 921             | 43.9 |
| **Total**                   | 2100            | 100.0 |

*1$ = 5.74 Turkish Liras according to April 2019 exchange rates
While a great majority of the farmers (86.8%) stated that pesticides would increase productivity in agriculture, 22.0% stated that pesticides were harmful to human health and 83.0% said that cheaper pesticides should be preferred more. A very small number of the farmers thought that protective clothing such as masks and special overalls should be worn during the application of pesticides. While 62.0% of the farmers stated that empty pesticide containers should be buried in the ground, 57.9% of them stated that the containers might be left in the environment, 35.1% of them said that the containers should be left in outdoor garbage cans (Table 2).

The minimum and maximum scores the participating farmers obtained from the Knowledge and Attitude Index were 4 and 19 respectively. While the mean scores the participants obtained from the Knowledge and Attitude Index was 12.8 ± 2.8 (min: 4, max: 19), the median value was 13. As is seen in table 3, of the participating farmers, 49.5% obtained a score lower than the median value, and 51.5% obtained a score equal to or above the median value.

Among the variables which increased the possibility of getting a low score from the Knowledge and Attitude Index were the advanced age (2.7 times), not being married (35.7 times), not getting formal education (30.1 times), living in a non-crowded household (2.1 times), and low income (≤2000 Turkish liras per month equal to ≤$357 according to April 2019 exchange rates) (3.1 times) (Table 3).

### DISCUSSION

This community-based study with a large sample is the first study conducted in Turkey to determine farmers' knowledge of and attitudes towards pesticide use, and related factors, and to provide decision-makers with data on this issue. The mean scores the participants obtained from the Knowledge and Attitude Index was 12.8 ± 2.8 (min: 4, max: 19) and

| Table 2. The participating farmers' knowledge of and attitudes towards pesticide use |
|---|---|---|---|
| Pesticides increase productivity in agriculture | Yes | No | I do not know |
| n | % | n | % | n | % |
| 1822 | 86.8 | 278 | 13.2 | 0 | - |
| Pesticides are harmful to human health | 462 | 22.0 | 864 | 41.1 | 774 | 36.9 |
| Pesticides are harmful to the environment | 1427 | 68.0 | 19 | 0.9 | 654 | 31.1 |
| Pesticides can leave residue in vegetables and fruit | 1368 | 65.1 | 658 | 31.3 | 74 | 3.5 |
| Pesticides should only be used for the product for which it is licensed. | 903 | 43.0 | 562 | 26.8 | 635 | 30.2 |
| Pesticide selection can be made (pesticides to be used can be selected) according to the recommendation by a friend /neighbor / relative | 1375 | 65.5 | 408 | 19.4 | 317 | 15.1 |
| Cheaper pesticides should be preferred. | 1742 | 83.0 | 303 | 14.4 | 55 | 2.6 |
| Pesticide selection should be based on the disease / pest | 1252 | 59.6 | 491 | 23.4 | 357 | 17.0 |
| The dosage of the pesticide should be adjusted as stated on the information label on the package of the pesticide | 1456 | 69.3 | 300 | 14.3 | 344 | 16.4 |
| If necessary, more than the recommended dose of pesticide can be sprayed | 1390 | 66.2 | 187 | 8.9 | 523 | 24.9 |
| Spraying should be performed just before harvesting | 815 | 38.8 | 892 | 42.5 | 393 | 18.7 |
| Spraying should be done out of noon hours | 699 | 33.3 | 1319 | 62.8 | 82 | 3.9 |
| Gloves should be worn during spraying | 1423 | 67.8 | 548 | 26.1 | 129 | 6.1 |
| A mask should be worn during spraying | 677 | 32.2 | 886 | 42.2 | 537 | 25.6 |
| Special overalls should be worn during spraying | 809 | 38.5 | 503 | 24.0 | 788 | 37.5 |
| Boots should be worn during spraying | 1077 | 51.3 | 531 | 25.3 | 492 | 23.4 |
| One can smoke during spraying | 900 | 42.9 | 788 | 37.5 | 412 | 19.6 |
| Hands should be washed after spraying | 1442 | 68.7 | 129 | 6.1 | 529 | 25.2 |
| One should take a shower after spraying | 1377 | 65.6 | 545 | 26.0 | 178 | 8.5 |
| Empty pesticide containers should be buried in the ground | 1303 | 62.0 | 641 | 30.5 | 156 | 7.4 |
| Empty pesticide containers might be left in the environment | 1216 | 57.9 | 677 | 32.2 | 207 | 9.9 |
| Empty pesticide containers should be put in a plastic bag and then in an outdoor garbage can | 737 | 35.1 | 1121 | 53.4 | 242 | 11.5 |
The median value was 13. Approximately half of the farmers’ (49.5%) score was lower than the median value. The variables which increased the possibility of getting a low score from the Knowledge and Attitude Index were advanced age, not being married, not getting formal education, living in a non-crowded household, and low income.

In the present study, the rate of the farmers who thought that pesticides were harmful to human health was 22% which was lower than that in the literature [12]. On the other hand, 68% of them thought that pesticides were harmful to the environment which was consistent with the literature [12, 32] and 69.3% stated that labels should be read, which was also consistent with the literature [23]. In our study, the rate of the farmers who took a shower immediately after spraying was 65.6%, which was slightly lower than that in the literature [12, 25]. Consistent with the literature, two-thirds of the farmers in our study stated that the empty pesticide containers might be left in the environment [21, 28]. In our study, the rates of those who thought that protective clothing such as masks and special overalls should be worn during spraying were 32.2% and 38.5% respectively. However, these rates ranged between 32.2% and 68.8% in the literature [4, 7, 17, 21, 23, 25, 28].

In our study, the Knowledge and Attitude Index scores of the majority of the participating farmers were low. The review of studies in the literature indicated that the rate of the participants whose knowledge / attitude was sufficient ranged between 34% and 85% [3, 7, 17, 18, 19, 27, 29]. The results of our study are consistent with those of studies in the literature. However, the fact that knowledge / attitude levels were low in half of the farmers in the present study conducted in an agriculture intensive region located in the West of Turkey is an important issue. While knowledge / attitude levels of 33% (n = 70) of the participating farmers in a study conducted by Derafsi et al. in a more developed region of Turkey, and 65.9% (n = 56) of the participating farmers in a study carried out by Saeed et al. in Pakistan were lower than were those of the participants in our study [7], in Thao et al.’s study carried out in the USA, 85% (n = 28) of the participating farmers had sufficient knowledge / attitude levels. These differences may be due to

| Table 3. Correlation between the farmers’ Knowledge and Attitude Index scores and their sociodemographic characteristics |
|-----------------|-----------------|-----------------|-----------------|
| **Variables**   | Knowledge and Attitude Index score | Univariate analysis | Multivariate Logistic regression |
|                 | low (%)         | high (%)        | X²              | p   | OR   | p   | %95 GA |
| Place of residence |                 |                 |                 |     |      |     |        |
| District center       | 203 (45.0)     | 248 (55.0)     |                 |     |      |     |        |
| Village                  | 837 (50.8)     | 812 (49.2)     | 4.679           | 0.031 | 0.9 | 0.587 | 0.7-1.1 |
| Age                                                                 |
| ≤ 54 (ref)             | 665 (41.7)     | 928 (58.3)     |                 |     |      |     |        |
| ≥ 55                    | 375 (74.0)     | 132 (26.0)     | 159.712         | 0.001 | 2.7 | **0.001** | 1.9-3.8 |
| Marital status                  |                 |                 |                 |     |      |     |        |
| Married (ref)           | 970 (47.8)     | 1058 (52.2)    |                 |     |      |     |        |
| Single                  | 70 (97.2)      | 2 (2.8)        | 67.856          | 0.001 | 35.7 | **0.001** | 8.6-147.4 |
| Educational status                        |
| No formal education     | 293 (98.3)     | 5 (1.7)        | 330.819         | 0.001 | 30.1 | **0.001** | 11.9-76.2 |
| Primary school and above (ref) | 747 (41.5)   | 1055 (58.5)    |                 |     |      |     |        |
| The number of households |                 |                 |                 |     |      |     |        |
| ≤ 4                    | 810 (63.4)     | 467 (36.6)     | 252.070         | 0.001 | 2.1 | **0.001** | 1.7-2.6 |
| ≥ 5 (ref)              | 230 (27.9)     | 593 (72.1)     |                 |     |      |     |        |
| Income per month (USD)** |                 |                 |                 |     |      |     |        |
| ≤$357                  | 963 (54.5)     | 803 (45.5)     | 111.322         | 0.001 | 3.1 | **0.001** | 2.2-4.4 |
|>$357 (ref)             | 77 (23.1)      | 257 (76.9)     |                 |     |      |     |        |
| Total length of time spent in farming |                 |                 |                 |     |      |     |        |
| ≤ 20 years (ref)      | 477 (40.5)     | 702 (59.5)     |                 |     |      |     |        |
| > 20 years             | 563 (61.1)     | 358 (38.9)     | 88.386          | 0.001 | 0.8 | 0.122 | 0.67-1.1 |

* Row percentage; OR: Odds Ratio
**$1 = 5.74 Turkish Lira according to April 2019 exchange rates.
differences between the participants’ educational levels and cultural backgrounds, and regions they live in [29].

In the present study, advanced age increased the possibility of getting a low score from the Knowledge and Attitude Index 2.7 times. The results of Sharafi et al.’s [28] study conducted with 311 farmers in Iran. On the other hand, in Derafshi et al.’s study including 70 farmers, unlike the present study, as the age increased so did the level of knowledge/attitude, which is probably due to the fact that educational status of the farmers in Derafshi et al.’s study was higher and that no further analysis was performed [7].

In the present study, not getting formal education increased the possibility of getting a low score from the Knowledge and Attitude Index 30.1 times. Educational status is a factor which not only increases the level of knowledge/attitude regarding the reading of the labels on pesticides, understanding the instructions on how to use protective equipment, knowing the harmful effects of pesticide use [19, 20, 27], but also reduces pesticide poisoning [26, 28, 29]. In Abollahzadeh et al.’s [2], Sharafi et al.’s [9] and Fuhriman et al.’s [28] studies, similar to our study, the knowledge/attitude levels of those with a high level of education were high.

In the present study, low income (≤2000 Turkish liras per month equal to ≤$357 according to April 2019 exchange rates) increased the possibility of getting a low score from the Knowledge and Attitude Index 3.1 times. The lower the income level was the lower the participant’s knowledge/attitude score was, which was consistent with that in the literature [18, 28], which caused those with low income to have inappropriate sanitation conditions [5] and to be exposed to pesticides more [7, 13].

In the present study, being single increased the possibility of getting a low score from the Knowledge and Attitude Index 2.1 times, which was consistent with the results of several studies in the literature. This might be due to the fact that farmers who were single or lived with a small number of people did not care about the potential effects of pesticides [11] and that their perception of risk was low [24]. On the other hand, contrary to the finding of our study, in Muleme et al.’s study with a sample size of 167 people, marital status and the number of people living in the household did not affect the knowledge and attitude score [18]. This difference between the studies probably stemmed from the differences between the characteristics and cultural backgrounds of the study groups [7, 33].

CONCLUSIONS

The most noteworthy result of our study is that although it was conducted in a region in the west of Turkey, where people’s education is higher, about half of the participating farmers’ knowledge and attitude levels were inadequate. The mean scores the participants obtained from the Knowledge and Attitude Index was 12.8 ± 2.8 (min: 4, max: 19) and the median was 13.

Among the factors which caused the participants’ mean Knowledge and Attitude Index score to be lower than the median value was advanced age, not being married not getting formal education, living in a non-crowded household, and low-income level. Given the participants’ mean knowledge/attitude score was lower, it is recommended that farmers should be trained on harmful effects of pesticides on human health and disposal of hazardous pesticide-related waste and empty containers, and that they should be informed where they can receive information on this issue. They should also be taught about the importance of the use of protective equipment because the participating farmers’ tendency to use protective equipment was low. Moreover, public health interventions for farmers should be planned, and training programs for the Pesticide Management Process should be implemented.

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Conflict of interest
The authors have no potential conflict of interest.

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