

Original Article



Venom allergy, risk factors for systemic reactions and the knowledge levels among Turkish beekeepers

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ABSTRACT

Background: Allergic reactions developing after bee sting can be severe and life-threatening. According to epidemiological data, serious systemic reactions range between 1.2%–3%, and this is 2–3 times higher (6%) in beekeeping. In different beekeepers' populations, risk factors of systemic reactions have been investigated and diverse results have been found.

Objective: The aim of this study is to evaluate the level of knowledge of beekeepers about venom allergy, epidemiological data, systemic reaction rates, risk factors for systemic reactions, and the rate of emergency admissions after bee sting.

Methods: With the collaboration of Uludağ University Beekeeping Development Research Center and Beekeepers Association, a questionnaire consisting of 19 questions was applied to 242 beekeepers in Bursa and Yalova. Two hundred twenty-one beekeepers who completed the questionnaire were involved in the study.

Results: The mean age of the beekeepers was 49.9 years (range, 18–75 years). The systemic reaction to bee sting in beekeepers was 37.6%. Allergic rhinitis was found to be a risk factor for systemic reaction. Although 80% of the beekeepers recognized that bee venom could be lethal, only 60% of the beekeepers were aware of immunotherapy, and only 30% were aware of the adrenaline auto-injector drug.

Conclusion: Similar to previous studies, we found that the systemic response to the bee sting in beekeepers was higher compared to normal population. Considering the occupational exposure to bee venom and thus higher risk, the awareness of venom allergy in this high risk population was low, and they were poorly informed about the treatment options.

Keywords: Venom allergy; Systemic reactions; Knowledge levels; Beekeepers; Sting; Allergic rhinitis

INTRODUCTION

Following a bee sting, the symptoms range from mild local reactions to severe systemic reactions varying from 1.2% to 3% of the cases according to the epidemiological data [1, 2].

Previous studies have found the incidence of systemic reactions among beekeepers to range between 6.5%–38%, and almost consistently higher than the general population.

Concomitant asthma, atopy, family history of bee sting allergy, and duration of beekeeping were found to be associated with higher incidence of systemic reactions, resulting in diverse and conflicting outcomes [3-11].

Beekeeping is a profession widely practiced around the world. Considering the high-risk occupation concerning higher exposure to bee stings, beekeepers are poorly informed and educated about bee venom allergy.

The aim of our study was to determine the frequency of bee venom allergy and the risk factors for systemic reaction among Turkish beekeepers in the town of Bursa, as well as to assess their level of knowledge about bee venom allergy, their reaction to bee sting (like immediate seek for medical help, or application of alternative medicine).

MATERIALS AND METHODS

Participants

In collaboration with Uludağ University Beekeeping Development Application and Research Center (AGAM) and the Beekeepers Association, beekeepers from Bursa and Yalova were contacted. Two hundred forty-two of 450 beekeepers could be reached, and 221 beekeepers that properly completed the questionnaire were enrolled in this study.

The questionnaire

The beekeepers were asked about demographic data, duration of beekeeping, number of active working days in a week, which kind of bees they were stung by and average number of bee stings suffered in a given day. In order to determine the severity and the type of symptoms that develop after a bee sting, beekeepers were given descriptions of local reaction, large local reaction and systemic reaction in accordance with Ring-Messmer classification and were asked to pick the option that applied to them. Small local reaction was defined as a reaction which is smaller than 10 cm and large local reaction was defined as larger than 10 cm in diameter. Ring-Messmer classification was utilised to stratify the systemic reaction in 4 grades: grade 1, generalised skin symptoms (rash, generalised urticaria, angioedema); grade 2, mild to moderate pulmonary, cardiovascular and/or gastrointestinal symptoms; grade 3, anaphylactic shock, loss of consciousness; grade 4, cardiac and/or respiratory arrest. A questionnaire was presented consisting of 23 questions to find out about concomitant allergic rhinitis, asthma history of drug/food allergies and atopic dermatitis, family history of bee venom allergy, emergency room visits following a bee sting, methods employed for self-treatment, level of knowledge regarding bee venom allergy and its treatment, and their awareness of adrenaline auto-injector device.

Statistical analysis

In this study, continuous variables were presented as mean \pm standard deviation and when the distributions were skewed, as the median and interquartile range; the differences in mean values between groups were analyzed with Student *t* test for independent samples. When distribution of variable is skewed the Mann-Whitney *U* test is used for comparison. Categorical variables were expressed as frequency and relevant percentages. Chi-square, Fisher exact chi-square and Fisher-Freeman-Halton tests were used for statistical analysis of categorical variables. Statistical analyses were performed using IBM SPSS Statistics ver. 20.0 (IBM Co., Armonk, NY, USA) and *p* value <0.05 was considered as statistically significant.

RESULTS

Two hundred forty-two beekeepers were surveyed, of which 221 that answered the questionnaire were enrolled in this study. Median age was 49.9 years (range, 18–75 years) and 96.4% (n = 213) were male. The median beekeeping duration was 10 years (1–50 years) and the median number of active working days in a week was 4 days (1–7 days). We found that 97.2% (n = 202) of beekeepers suffered from local reactions, 7.3% (n = 16) suffered from large local reactions; and whether with small or large local reaction, 37.6% (n = 83) suffered from systemic reactions following a bee sting. Beekeepers' demographic data are presented in **Table 1**.

Factors associated with increased risk of systemic reaction

The only statistically significant factor that increased the risk for systemic reaction was found to be concomitant allergic rhinitis. Systemic reactions was 4.93 times higher in patients with allergic rhinitis compared to those without (odds ratio, 4.93; 95% confidence interval, 1.83–13.27, $p = 0.002$) (**Table 2**). When all systemic reactions (grades 1 to 4) were taken together ($p = 0.982$), family history of bee venom allergy was not identified as a risk factor. However, in patients with systemic reaction grades 2–4 of the Ring-Messmer classification, family history of bee venom allergy was as a risk factor ($p = 0.046$). Age, beekeeping duration, number of active working days in a week, bee stings in a given day, and having atopic dermatitis, food/drug allergies or asthma were not a risk factor for systemic reaction or anaphylaxis (**Table 2**).

Table 1. Beekeepers' basal characteristics (n = 221)

Characteristic	Value
Age (yr)	49.9 ± 11.8
Sex	
Male	213 (96.4)
Female	8 (3.6)
Place of residence	
City centre	119/220 (54.1)
Countryside	101/220 (45.9)
Beekeeping duration (yr)	10 (1–50)
No. of active working days in a week (day)	4 (1–7)
Kind of bee that stung (%) (n = 216)	
Honeybee	79 (36.6)
Wasp	7 (3.2)
Both	130 (60.2)
No. of stings in a given day (%) (n = 208)	
Less than 1	29 (13.9)
1 to 5 times	94 (45.2)
5 to 10 times	48 (23.1)
10 to 15 times	21 (10.1)
20 times or more	16 (7.7)
History of 40 or more stings on a single occasion	
Yes	98 (44.3)
No	123 (55.7)
Course of symptoms after being stung, over the years (n = 206)	
Reduced severity	114 (55.3)
No change	86 (41.7)
Increased severity	6 (2.9)
The type of reaction where the bee stings (n = 218)	
Local reaction	202 (92.7)
Large local reaction	16 (7.3)
Systemic reaction	83 (37.6)

Values are presented as mean ± standard deviation, median (range), or number (%).

Table 2. Risk factors of systemic reactions following a bee sting among beekeepers

Variable	Incidence	SR present	SR absent	p value
Age (yr)				0.096
≤29	8 (3.7)	3 (37.5)	5 (62.5)	
30–39	38 (17.7)	15 (39.5)	23 (60.5)	
40–49	56 (26.1)	21 (37.5)	35 (62.5)	
50–59	68 (31.6)	25 (36.8)	43 (63.2)	
≥60	45 (20.9)	18 (40.0)	27 (60.0)	
Beekeeping duration (yr)				0.203
<12	114 (61.0)	49 (43.0)	65 (57.0)	
12–23	36 (19.3)	9 (25.0)	27 (75.0)	
24–38	27 (14.4)	8 (29.6)	19 (70.4)	
>38	10 (5.3)	4 (40.0)	6 (60.0)	
No. of stings in a given day				0.569
1–5 times	94 (45.2)	33 (35.1)	61 (64.9)	
5–10 times	48 (23.1)	19 (39.1)	29 (60.4)	
10–15 times	21 (10.1)	10 (47.6)	11 (52.4)	
20 times and more	16 (7.7)	4 (25.0)	12 (75.0)	
Less than 1	29 (13.9)	13 (44.8)	16 (55.2)	
No. of active working days in a week				0.123
Concomitant conditions				
Asthma	7 (3.2)	1 (14.3)	6 (85.7)	0.262
Allergic rhinitis	21 (9.5)	15 (71.4)	6 (28.6)	0.002*
Family history of bee venom allergy	64 (29.4)	24 (37.5)	40 (62.5)	0.982
Food allergy	5 (2.3)	3 (60.0)	2 (40.0)	0.364
Atopic dermatitis	11 (5.0)	5 (45.5)	6 (54.5)	0.543
Drug allergy	7 (3.2)	3 (42.9)	4 (57.1)	0.714
Family history of bee venom allergy		Ring-Messmer classification (2–4)		
		Yes	No	
	64 (29.4)	11 (17.2)	53 (82.8)	0.046*

Values are presented as number (%).

Risk factors for a systemic reaction (SR) generated statistical tests; Pearson chi-square test.

* $p < 0.05$.

Beekeepers' level of knowledge about venom allergy and actions need to be taken

For all beekeepers, emergency room visits were reported in only 37 patients (16.9%). Among those patients, 8 patients had no evident reaction at the admission to emergency room, 16 patients had grade 1 reaction, 12 patients had grade 2 reaction, and 1 patient had grade 3 reaction. In addition, 43 beekeepers who had grade 1 reaction to bee sting and 9 beekeepers who had grade 3 reaction did not seek any medical help. As a conclusion, 23.6% of those patients did not seek any medical treatment, 17.2% of patients applied ice pack, 16.3% of patients took antihistamines, 16.3% tried to remove bee stinger, 7.7% of patients applied ammonia, and some of patients applied mud, yoghurt, honey, olive oil, or some plants (like basil, common marshmallow etc.). Answers to the questions that measured beekeepers' knowledge level of venom allergy are summarised in **Table 3**.

Table 3. Beekeepers' level of knowledge of venom allergy

Question	Yes	No
Might bee venom allergy be life threatening?	183 (82.8)	38 (17.2)
Can bee venom allergy get successfully treated?	81 (36.8)	139 (63.2)
Have you heard of allergy-shots (Immunotherapy) for treating bee venom allergy?	110 (49.8)	111 (50.2)
Have you heard of adrenaline auto-injector device?	49 (38.6)	78 (61.4)

Values are presented as number (%).

DISCUSSION

In literature, data on bee venom allergy among beekeepers is scarce, and data about systemic reactions to bee stings and risk factors of systemic reactions are not consistent.

In our study, following bee stings, large local reactions ensued in 7.3% and systemic reactions were found in 37.6% of cases. While the existence of allergic rhinitis in beekeepers was associated with increased risk for systemic reactions, we have also found family history of bee venom allergy to be indicative of higher risk for anaphylaxis.

Previous epidemiological studies revealed inconsistent incidence of systemic reactions to bee sting. Systemic reaction rates were found to be higher in Finland, Canary Islands, and England, with 38%, 21%, and 20% respectively [3, 4, 6], and they were found to be low with 4% in Germany and 6.5% in a previous study conducted in Turkey by Çeliksoy et. al. [5, 8]. The low systemic reaction rate found by the German study was attributed to beekeepers' high mean age (63.7 years) and the statistically significant inverse relationship found between systemic reaction and age. Our study, as well as the English one, has found no significant association between age and systemic reactions. Furthermore, in the study by Çeliksoy et. al. [8], the systemic reaction rate of 6.5% was in a young population of beekeepers, with a mean age of 46.

Numerous studies reported history of atopy as a risk factor for systemic reactions [9-11]. Our study also supports this finding. The incidence of systemic reactions was found to be 4.93 fold higher in individuals with allergic rhinitis compared to those without. We have found that in a subgroup of patients with grades 2–4 reactions, family history of bee venom allergy indicates increased risk for anaphylaxis. Similarly, the study conducted in England found a correlation between family history of bee venom allergy and systemic reactions [6].

In our study, we found that 35.8% of beekeepers admitted to emergency room with systemic reaction. This rate was found to be lower in England (25%). Although systemic reactions increase the number of visits to emergency rooms, yet a majority of cases do not seek medical treatment. Assessment of self-treatments showed that ice-pack or cold water application, removing the stinger, taking an antihistamine tablet were prevalent. Other methods self-treatment methods described by beekeepers were rubbing mud, pressing metal, consuming or applying yoghurt or yoghurt drink, rubbing herbs or vegetables (basil, hibiscus, patience dock, and garlic) were used as an alternative medicine, albeit in a remarkably low rate. Self-treatment modalities like ice-pack or cold water application, removing the stinger, taking an antihistamine tablet might partially explain the low number of emergency room visits.

Regarding the level of knowledge beekeepers, we found that 82.8% of beekeepers were aware of the possible lethal effects of bee venom. However, only 36.8% were aware that it was treatable. Forty-nine point eight percent (49.8%) of beekeepers were aware of venom immunotherapy and 38.6% of adrenaline auto-injector device. In a previous study by Çeliksoy et. al. [8], it was demonstrated that awareness levels for venom immunotherapy was 14.2% and adrenaline auto-injector was 10.6%, in Turkey; lower than the present study. The increase in the level of knowledge of beekeepers from similar socio-cultural backgrounds was most probably due to education provided by the regional beekeepers' association, via regular meetings and periodicals. These findings are quite striking and reveal that shortcomings exist in this respect and that although level of knowledge has been improved to a certain extent,

as a result of the educational seminars. Our data show that there is still a need for continuing education to improve the level of knowledge of the beekeepers.

In line with other studies, we found that beekeepers experience a higher rate of systemic reactions in comparison to the general population. Therefore, beekeepers should be better informed and educated on this issue. We have also observed that shortcomings exist in getting the individuals who experienced systemic reactions to visit emergency rooms and to be referred to qualified centres where allergists are present for diagnosis and treatment.

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