

ORIGINAL ARTICLES

Bee and bee products allergy in Turkish beekeepers: determination of risk factors for systemic reactions

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ABSTRACT

Background: The prevalence of allergic reactions due to bee stings in beekeepers varies in different regions of the world. The aim of this study was to evaluate the characteristics of sting reactions and the risk factors for developing systemic reactions in Turkish beekeepers.

Methods: A self-administered questionnaire was distributed to 1250 beekeepers to be completed in seven different cities of Turkey. A total of 494 (39.6 %) questionnaires were returned.

Results: There were 444 subjects (89.9 %) with a history of sting exposure in the previous 12 months. Systemic reactions were present in 29 subjects (6.5 %) and nine (2 %) reactions were anaphylactic. Fifty-five percent of beekeepers reported more than 100 bee stings in the previous year. When systemic reactions were controlled by age and duration of beekeeping in a logistic regression model, seasonal rhinitis (OR: 4.4, 95 % CI: 1.2-11.5), perennial rhinitis (OR: 4.6, 95 % CI: 1.2-18.2), food allergy (OR: 7.0, 95 % CI: 2.0-25.0), physician-diagnosed asthma (OR: 8.0, 95 % CI: 2.5-25.6), having an atopic disease of any type (OR: 3.3, 95 % CI: 1.2-8.7) and having two or more atopic diseases (OR: 10.9, 95 % CI: 3.5-33.8) were significantly associated with systemic reactions due to bee sting in the previous 12 months.

Conclusion: The incidence of systemic reactions in Turkish beekeepers is low, which might be due to the protective effect of a high frequency of bee stings. The risk of systemic reactions increases approximately three-fold when one atopic disease is present and eleven-fold when two or more concurrent atopic diseases are present with respect to no atopic disease.

Key words: Beekeepers, Bee sting reactions. Bee sting treatment.

INTRODUCTION

Beekeeping, known as the cheapest and easiest way of employment in agricultural area, is very important for some developing countries. Beekeeping and honey production have been progressing as profitable occupations in recent years in Turkey as well. In the last ten years, the total number of beehives and honey production has increased twice and Turkey is the 4th in this area with 4,000,000 beehives producing 63,000 tons of honey¹.

As the number of beekeepers increases in Turkey, problems related to bee and wasp stings exposure, involve the beekeepers to an increasing extent. As expected, beekeepers are more susceptible to sting exposure than the general population. Although systemic reactions following bee stings have been found to be 14 % to 42 % in beekeepers²⁻⁴, it is only 0.8 % to 3.3 % in general population⁵⁻⁷. The prevalence of atopy in beekeepers varies from 20 % to 48 %^{2,8-12}.

Since there is no previous medical data about beekeepers in Turkey, we designed this study to evaluate the prevalence and types of sting reactions, con-

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current atopic diseases, risk factors for systemic reactions and self treatment choices for bee sting among Turkish beekeepers.

METHODS

Hacettepe University Bee and Bee Products Application and Research Center (HARUM) arranged educational meetings in seven different cities of Turkey including Ankara, Mersin, Mugla, Canakkale, Yalova, Balikesir and Zonguldak to improve the knowledge and skills about beekeeping of beekeepers between December 2004 and June 2005. After these meetings, a self administered questionnaire, including questions about demographic data, history of bee stings, type of reactions, emergency admissions in the last 12 months, concurrent atopic and nonatopic diseases, smoking status, self treatment tendencies, drug and food allergies, were distributed to beekeepers to be completed. Subjects were told to answer "no" if they were not sure about the answer.

In every city, between 100-350 with a total of 1245 beekeepers attended these meetings and 494 (39.6 %) of them returned the questionnaires.

Statistics

Association between factors and bee sting in the last 12 months and systemic reaction due to bee sting in the last 12 months were tested by Chi-square testing. Fisher's exact test was used when the expected cell count was below 5. Independent association between systemic reaction due to bee sting in the last 12 months and potential risk factors were assessed via logistic regression analysis after the adjustment for age and duration of beekeeping. P value less than 0.05 was considered for statistical significance.

RESULTS

Four hundred ninety four subjects who completed the questionnaire were enrolled to the study. Four hundred eighty nine (99 %) were males and five were females, with a mean age of 48.2 ± 11.5 . They have been beekeeping for a mean time of 15.3 ± 10.5 years. There were 444 subjects (89.9 %) with a history of sting exposure in the last 12 months while 50 subjects (10.1 %) denied such a history. Systemic reactions after bee stings in the last 12 months were present in 29 (6.5 %) subjects, nine of them being anaphylactic reactions. There were 28

Table I
Demographic data and summary of the answers of the questions

	n = 494 (%)
Male	489 (99)
Age (mean \pm sd)	48.22 ± 11.47
Duration of beekeeping in years (mean \pm sd)	15.33 ± 10.53
Sting exposure in last 12 months	444 (89.9)
Frequency of sting exposure in last 12 months	
0-100*	182 (45)
101-200	70 (17.3)
201-500	52 (12.9)
≥ 501	100 (24.8)
Systemic allergic reactions to bee sting in the last 12 months	29 (6.5)
Life time emergency admission due to bee sting	28 (5.7)
Emergency admission due to bee sting in last 12 months	5 (1)
Contact dermatitis due to bee products	27 (5.5)
Food allergy due to bee products	19 (3.8)
Perennial rhinitis	15 (3)
Seasonal rhinitis	46 (9.3)
Eczema	53 (10.8)
Physician diagnosed asthma	20 (4)
Food allergy (other than bee products)	15 (3)
Drug allergy	14 (2.8)
Family history of atopic disease	18 (3.6)
*90 beekeepers didn't answer the question about sting frequency.	

(5.7 %) subjects who had history of emergency room admission and only 5 of them occurred in the last 12 months. Demographic data and answers to questions were summarized in table I.

Contact dermatitis due to honey and bee products was present in 27 beekeepers (5.5 %) while food allergy was present in 19 cases (3.8 %) (table II).

Table III outlines the factors related to systemic reactions in beekeepers stung in the last 12 months. Among this group of beekeepers, seasonal rhinitis was reported in 27.6 %, food allergy in 13.8 %, familial atopy in 10.3 % and physician diagnosed asthma in 17.2 %. All these factors were significantly associated with systemic reactions due to bee sting in the last 12 months. Longer duration of beekeeping was significantly associated with higher frequency of bee stings in the last 12 months ($p < 0.01$) but there was no correlation between the duration of beekeeping and the rate of systemic reactions.

When systemic reactions due to sting exposure was controlled with age and duration of beekeeping

Table II
Food and contact allergy to bee products

	Contact dermatitis		Food allergy	
	n	%	n	%
Total	27	5.5	19	3.8
Honey	6	1.2	6	1.2
Pollen	3	0.6	7	1.4
Propolis	6	1.2	2	0.4
Bee wax	2	0.4	3	0.6
Bee venom	10	2	–	–
Royal jelly	–	–	1	0.2

in logistic regression model, seasonal rhinitis (OR: 4.4, 95 % CI: 1.2-11.5), perennial rhinitis (OR: 4.6, 95 % CI: 1.2-18.2), food allergy (OR:7.0, 95 % CI: 2.0-25.0) and physician diagnosed asthma (OR: 8.0, 95 % CI: 2.5-25.6) were significantly associated with systemic reactions due to bee sting in the last 12 months. Logistic regression analysis also showed that the risk of systemic reactions increased approximately threefold when only one atopic disease was present and eleven fold when two or more concurrent atopic diseases were present compared to having no atopic disease (table IV).

Smoking habits of beekeepers were also evaluated. There were 168 (34 %) current smokers whose mean beginning age of smoking was 18.2 ± 4.9 while there were 112 ex-smokers (22.6 %) and the mean age to quit smoking was 38.9 ± 10 . There was no relation between systemic reactions and smoking status. Treatment choices after sting exposure were shown in table V. Three hundred thirty six of them (68 %) were doing nothing when they were stung. Most frequently used therapy was applying ice and cold water (10.8 %). The ones who were taking antihistaminic tablets were only 5.6 % of them. Highly different complementary treatment modalities were listed in the table V. The frequency of using alternative treatments was not increased in the ones who have experienced systemic reactions ($p > 0.5$).

DISCUSSION

There are relatively small number of studies about bee sting reactions and clinical symptoms in beekeepers in the English literature and this is the first report from Turkey. This study presents that occurrence of systemic allergic reactions to bee stings is low but the frequency of bee stings in the last 12 months is high in Turkish beekeepers. Systemic reactions to bee sting are significantly associated with seasonal and perennial rhinitis, food allergy and physician diagnosed asthma.

Table III
Factors related to systemic reactions and sting exposure in the last 12 months

	n	Bee sting in the last 12 months			
		No n (%)	Yes n (%)	No systemic reaction n (%)	Systemic reaction n (%)
Total	494	50 (100)	444 (100)	415	29 (100)
Female	5	2 (4.0)	3 (0.7)	2 (0.5)	1 (3.4)
Age, mean (SD)	48.2 (11.5)	50.1 (11.2)	48.0 (11.5)	48.1 (11.5)	46.2 (12.0)
Duration of beekeeping in years (SD)	15.3 (10.5)	10.9 (7.9)	15.8 (10.7)*	15.6 (10.7)	18.9 (10.0)
Seasonal rhinitis	46	2 (4.0)	44 (9.9)	36 (8.7)	8 (27.6)**
Perennial rhinitis	15	1 (2.0)	14 (3.2)	11 (2.7)	3 (10.3)
Eczema	45	3 (6.0)	42 (9.5)	37 (8.9)	5 (17.2)
Food allergy	15	0 (0)	15 (3.4)	11 (2.7)	4 (13.8)***
Current smoker	168	18 (36.0)	150 (33.8)	144 (34.7)	6 (20.7)
Familial atopy	18	2 (4.0)	16 (3.6)	13 (3.1)	3 (10.3)
Physician diagnosed asthma	20	2 (4.0)	18 (4.1)	13 (3.1)	5 (17.2)**
Alternative therapy	158	13 (26)	145 (32.7)	137 (33.0)	8 (27.6)

* $p < 0.01$, in the comparison of beekeepers who had bee sting and who had no bee sting in the last 12 months.

** $p < 0.01$ in the comparisons between beekeepers who had bee sting in the last 12 months with and without systemic reaction.

*** $p < 0.05$.

In our study, 6.5 % of beekeepers reported systemic allergic reactions to bee sting. In previous studies, rate of systemic reactions in beekeepers was found to be between 14 % and 42 %^{2,3,13}. Among risk groups such as forestry workers and cellulose paper factory workers, prevalence of systemic reactions to bee sting was 21 % and 19.9 %, respectively^{14,15}. When compared to these figures, rate of systemic reactions to bee sting was low in Turkish beekeepers. Bousquet et al² claimed that the degree of sensitization of beekeepers against bee sting was strongly related to the annual number of stings and that was why beekeepers in their study that were stung often appeared to be protected against bee stings. They found that 50 stings in a year appeared to be a minimal number for protection and the risk of allergy was nearly absent over 200 stings in a year. It was also reported that the more frequent the bee stings, the fewer clinical symptoms appear⁸. Interestingly, in our study, only 10.1 % of beekeepers denied bee sting exposure in the last 12 months while 45 % reported 1-100 times, 17.3 % 100-200 times, 37.7 % more than 200 times of bee stings in a year. This data shows that Turkish beekeepers don't pay attention to protect themselves from bee sting effectively while working at beehives and as a result they spontaneously become desensitized by frequent sting exposure. Another possible mechanism to explain the low rate of systemic reactions might be due to the long period of beekeeping season in Turkey. As hypothesized previously², beekeeping all throughout the year in warm regions leads to continuous sting exposure and eventually results in continuous protection to bee stings. However, the gap between working seasons in cold regions such as northern Europe may decrease the protective effect of continuous bee sting and results in higher rate of systemic reactions.

A clinical history of atopic diseases, such as asthma, seasonal rhinitis, eczema and food allergy was present in 15 of beekeepers (51.7 %) that have experienced systemic reaction in their histories. This rate of atopy among beekeepers is similar to results of a study¹⁰ reporting a history of atopy in 47 % of systemic reactors, but higher than some other studies in which rates of atopy were reported between 20 % to 42 %^{2,9,12,16}. Differences between these figures may be due to different parameters to define atopy such as in vivo tests and clinical history. Having seasonal rhinitis ($p < 0.01$), physician diagnosed asthma ($p < 0.01$) and food allergy ($p < 0.05$) were significantly related to systemic reactions to bee stings. This is in accordance with the studies in which atopy has been shown to predispose to more severe reactions^{2,10}. When systemic reactions were controlled with age and the duration of beekeeping in logistic

Table IV
Logistic regression analysis of systemic reactions related to sting exposure in the last 12 months after the adjustment for age and duration of beekeeping

	Systemic reaction %	OR 95 % CI
Seasonal rhinitis	18.2	4.4 (1.2-11.5)**
Perennial rhinitis	21.4	4.6 (1.2-18.2)*
Food allergy	26.7	7.0 (2.0-25.0)**
Eczema	11.9	2.0 (0.6-6.1)
Physician diagnosed asthma	27.8	8.0 (2.5-25.6)***
Atopic diseases		
No disease		1
Single disease	12.7	3.3 (1.2-8.7)*
Two diseases or more	27.3	10.9 (3.5-33.8)****

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, **** $p < 0.0001$.

Atopic diseases include asthma, eczema, seasonal rhinitis or food allergy. Female beekeepers ($n = 3$) were excluded from the analysis.

Table V
Treatment choices of the beekeepers after a sting exposure

	n (%)
Doing nothing	336 (68)
Applying ice and cold water to sting site	54 (10.8)
Antihistaminic tablets	28 (5.6)
Taking out stinger	14 (2.8)
Applying ammonia to sting site	14 (2.8)
Rubbing the sting site with a cold metal	6 (1.2)
Taking cold shower	4 (0.8)
Rubbing sting site with mud	4 (0.8)
Applying garlic to sting site	4 (0.8)
Applying yogurt to sting site	3 (0.6)
Applying vinegar to sting site	3 (0.6)
Applying antihistaminic creams	3 (0.6)
Applying onion water to sting site	2 (0.4)
Drinking ayran (watery yogurt)	2 (0.4)
Applying parsley to sting site	2 (0.4)
Applying honey to sting site	2 (0.4)
Applying alcohol to sting site	2 (0.4)
Applying aspirin to sting site	1 (0.2)
Rubbing the sting site with flammable edge of a match stick	1 (0.2)
Applying wet starch to sting site	1 (0.2)
Applying wet sugar to sting site	1 (0.2)
Applying alcohol and ammonia to sting site	1 (0.2)

regression model, in addition to the previously mentioned factors perennial rhinitis was found to be significantly related with systemic reaction ($p < 0.05$).

Furthermore, the risk of systemic reactions increased approximately threefold when two or more concurrent atopic diseases were present compared to the presence of only one atopic disease. Our results clearly suggest that having atopic clinical disease significantly predispose beekeepers to systemic reactions.

Twenty-seven beekeepers (5.5 %) had a history of contact dermatitis while 19 (3.8 %) of them had food allergy to honey and bee products. Because there is no relevant data in the literature other than case reports of contact dermatitis due to propolis¹⁷, we are unable to make comparisons about these results.

In this study, there was no relation between age, duration of beekeeping and systemic reactions. This data is in accordance with the study reporting that the duration of beekeeping did not influence the symptoms of beekeepers³. However our results disagree with the findings of some previous studies, which claimed that shorter duration of beekeeping and younger ages of beekeepers were related to higher prevalence of allergic symptoms^{8,18}. High frequency of sting exposure, even in early years of beekeeping, could once more explain why there is no relation between age or duration of beekeeping and systemic reactions in Turkish beekeepers. Besides, the positive association between the duration of beekeeping and the high prevalence of bee stings in the last 12 months suggests that experienced beekeepers with no systemic reactions did not seem to be afraid of bee stings and thus paid no attention to protect themselves.

Various and interesting self-treatment alternatives were present among beekeepers. Three hundred thirty six (68 %) beekeepers did nothing for treatment when they were stung. Only 14 (2.8 %) subjects knew that they should take out the stinger after a bee sting and 28 (5.6 %) of them were carrying antihistaminic tablets with them. They applied various stuff to sting site such as ammonia, mud, garlic, yogurt, starch, honey, vinegar, cold metal, etc. At countryside in Turkey, it is known that complementary treatments are widely used by villagers not only for bee stings but also for other organic diseases, as well.

The study subjects were selected from 7 cities of Turkey, which were thought to represent all Turkish beekeepers. The large number of subjects (494) included in our study when compared to other studies about beekeepers is the strength of our study.

In conclusion, incidence of systemic reactions in Turkish beekeepers is low due to protective effect of high frequency of bee stings. History of seasonal and perennial rhinitis, food allergy and physician diagnosed asthma is associated with systemic sting reactions. This study indicates that the risk of systemic reaction increases approximately threefold when one

atopic disease is present and eleven fold when two or more concurrent atopic diseases are present compared to having no atopic disease.

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REFERENCES

1. Statistical Data of Turkish Ministry of Agriculture; 2005.
2. Bousquet J, Coulomb Y, Robinet-Levy M, Michel FB. Clinical and immunological surveys in beekeepers. *Clin Allergy*. 1982; 12:331-42.
3. Bousquet J, Menardo JL, Aznar R, Robinet-Levy M, Francois-Bernard M. Clinical and immunologic survey in beekeepers in relation to their sensitization. *J Allergy Clin Immunol*. 1984;73: 332-40.
4. Light WC, Reisman RE, Wypch JI, Arbesman CE. Clinical and immunological studies of beekeepers. *Clin Allergy*. 1975;5: 389-95.
5. Settupane GA, Newstead GJ, Boyd GK. Frequency of Hymenoptera allergy in an atopic and normal population. *J Allergy Clin Immunol*. 1972;50:146-50.
6. Charpin D, Birnbaum J, Lantenaume A, Vervloet D. Prevalance of allergy to Hymenoptera stings in different samples of the general population. *J Allergy Clin Immunol*. 1992;90:331-4.
7. Golden DBK, Marsh DG, Kagey-Sobotka A, Freidhoff L, Szkló M, Valentine MD, Lichtenstein LM. Epidemiology of insect venom sensitivity. *JAMA*. 1989;262:240-4.
8. Annala IT, Karjalainen ES, Annala PA, Kuusisto PA. Bee and wasp sting reactions in current beekeepers. *Ann Allergy Asthma Immunol*. 1996;77:423-7.
9. Neuman I, Ishay JS, Creter D. Hyperreactivity to bee stings: reevaluation. *Ann Allergy*. 1983;50:410-2.
10. Miyachi S, Lessof MH, Kemeny DM, Green LA. Comparison of the atopic background between allergic and nonallergic beekeepers. *Int Arch Allergy Appl Immunol*. 1979;58:160-6.
11. Przybilla B, Ring J, Gricshammee B. Association of features of atopy and diagnostic parameters in Hymenoptera venom allergy. *Allergy*. 1991;46:570-6.
12. Lantner R, Reisman RE. Clinical and immunologic features and subsequent course of patients with severe insect sting anaphylaxis. *J Allergy Clin Immunol*. 1989;84:900-6.
13. Light WC, Reisman RE, Wypch JI, Arbesman CE. Clinical and immunological studies of beekeepers. *Clin Allergy*. 1975;5: 389-95.
14. Kalyoncu AF, Demir AU, Ozcan U, Ozkuyumcu C, Sahin AA, Baris YI. Bee and wasp venom allergy in Turkey. *Ann Allergy Asthma Immunol*. 1997;78:408-12.
15. Shimizu T, Hori T, Tokuyama K, Morikawa A, Kuroume T. Clinical and immunologic surveys of Hymenoptera hypersensitivity in Japanese forestry workers. *Ann Allergy Asthma Immunol*. 1995;74:495-500.
16. Lockey RF, Turkeltaub PC, Baird-Warren IA, Olive CA, Olive ES, Peppe BC, et al. The Hymenoptera venom study I, 1979-1982: Demographics and history-sting data. *J Allergy Clin Immunol*. 1988;82:370-81.
17. Gulbahar O, Ozturk G, Erdem N, Kazandi AC, Kokuludag A. Psoriasisiform contact dermatitis due to propolis in a beekeeper. *Ann Allergy Asthma Immunol*. 2005;94:509-11.
18. Torre-Morin F, Garcia-Robaina JC, Vazquez-Moncholi C, Fierro J, Bonnet-Moreno C. Epidemiology of allergic reactions in beekeepers: a lower prevalence in subjects with more than 5 years exposure. *Allergol Immunopathol*. 1995;23(3):127-32.