
The prevalence of latex allergy in sixth-year medical students: assessment of knowledge, risk, and attitudes about future specialty direction

Ferda Öner Erkeköl, MD*; Gülfem E. Çelik, MD*; Mutlu Hayran, MD, PhD†; Berna A. Dursun, MD*; Özlem Keskin Göksel, MD*; Mehmet Selçuk Mısırlıgil‡; and Yavuz S. Demirel, MD*

Background: In the prevention of latex allergy, knowledge levels and risk determination for latex allergy of medical students gain importance.

Objectives: To evaluate the latex allergy knowledge levels of sixth-year medical students and their latex allergy risk.

Methods: Students completed a questionnaire that assessed basic knowledge of latex allergy and that evaluated latex-related symptoms and latex exposure. The specialty branch students were going to choose in the Medical Specialty Examination was also asked. Skin prick tests (SPTs) with latex and inhalant allergens and patch tests with latex-related products were then performed. Finally, students were asked again about any changes in branch selection after learning their individual risks.

Results: Two hundred twenty sixth-year students were enrolled. Forty-four percent of the students gave the right answer for description of latex. Correct identification of at least 1 latex-related product used outside and inside hospitals was 55.5% and 95.5%, respectively. The prevalence of latex sensitization was 4.4% according to SPT results. The positivity of SPT to any inhalant allergen was 35% (n = 64). None of the students changed their mind about their specialty branch after learning their latex allergy risk.

Conclusions: Last-year medical students have a remarkably low latex allergy knowledge level, which imposes a serious professional risk. Training strategies based on the benefit to this risk group and reevaluation are strongly recommended before graduation from medical school.

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INTRODUCTION

With rapid widespread use of latex products in the hospital environment, latex allergy has become an important health problem seriously threatening health care workers. Depending on the diagnostic methods and patient selection criteria used, type 1 hypersensitivity to latex in health care workers has been reported to be 2.9% to 12.1%.^{1–5} Beyond its high prevalence, latex allergy is an important disease because of the work loss it causes. Individuals with latex allergies have been reported to have a low work ability index.⁶ Moreover, 20% to 42% of patients with latex allergy had to change jobs, and 12.9% had to leave the workforce completely or become unemployed.^{7–9} Considering the treatment difficulties arising after latex allergy has already developed, the goal should be primary prevention. The recommendations of the National Institute for Occupational Safety and Health regarding latex allergy state that risk groups should be informed about latex allergy as the first step in the prevention of latex allergy.¹⁰

In Turkey, medical education continues with the medical specialty examination (MSE) after 6 years of basic education. The specialty in which training will be taken is determined according to the degree in this examination. The presence of such an examination makes it difficult to change the working area in the future. At this point, latex allergy knowledge levels of physicians before entry into the profession gain importance. To our knowledge, there are no data about the information levels of this group regarding latex allergy.

In this study, we primarily evaluated latex allergy knowledge levels of medical students attending the final class (sixth-year students). We also determined their latex allergy risks in terms of skin prick testing (SPT) with latex and inhalant allergen and patch testing with latex-related products and examined the effects of knowledge and results of skin testing on the selection of medical specialties.

MATERIALS AND METHODS

Study Protocol

Sixth-year medical students (2005–2006 seasons) were included in the study. The study was approved by the local ethics committee of Ankara University School of Medicine, and informed consent was obtained from all the participants. The study consisted of 5 steps performed on the same day. In the first step, demographics, presence of symptoms related to allergy and physician-diagnosed allergic diseases, basic knowledge levels about latex allergy, and MSE preferences

Affiliations: * Division of Allergy, Department of Chest Disease, Ankara University School of Medicine, Ankara, Turkey; † Department of Preventive Oncology, Hacettepe University Institute of Oncology, Ankara, Turkey; ‡ Ankara University School of Medicine, Ankara, Turkey.

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Table 1. Effects of Being Informed Previously About Latex and Having Acquaintances With Latex Allergy on the Latex Allergy Knowledge Level^a

Question	Being informed previously about latex			Having acquaintances with latex allergy		
	Yes	No	P value	Yes	No	P value
Define substances containing latex outside the hospital						
Correct identification	40 (32.8)	82 (67.2)	.86	30 (24.6)	92 (75.4)	.99
Incorrect identification	31 (31.6)	67 (68.4)		24 (24.5)	74 (75.5)	
Define substances containing latex in the hospital						
Correct identification	69 (32.9)	141 (67.1)	.51	53 (25.2)	157 (74.8)	.46
Incorrect identification	2 (20.0)	8 (80.0)		1 (10.0)	9 (90.0)	
No. of identified latex-containing substances in the hospital environment						
0–2	60 (30.0)	140 (70.0)	.02	52 (26.0)	148 (74.0)	.17
≥3	11 (55.5)	9 (45.0)		2 (10.0)	18 (90.0)	
What is the effect of latex on health?						
Do not know	6 (14.0)	37 (86.0)	.02	10 (23.3)	33 (76.7)	.98
Know that it causes allergy	59 (36.6)	102 (63.4)		40 (24.8)	121 (75.2)	
Define types I and IV hypersensitivity	6 (37.5)	10 (62.5)		4 (25.0)	12 (75.0)	
What are the prevention methods for latex allergy?						
Correct answer	66 (38.6)	105 (61.4)	<.001	50 (29.2)	121 (70.8)	.03
Incorrect answer	5 (10.2)	44 (89.8)		4 (8.2)	45 (91.8)	

^a Data are given as number (percentage).

were evaluated using a questionnaire. In this step, students were asked about the definition of latex, latex sources inside and outside the hospital, and types of latex-related allergic reactions. They were also asked whether they or anybody in their surroundings had a diagnosis of latex allergy, to identify methods of latex allergy prevention, whether they have received information about latex, and, if so, from which sources they had received this information (Table 1).

In the second step, standard verbal information was given by the study investigators to standardize the knowledge levels of students about latex allergy and to eliminate misunderstanding of the questions in the third step. This step was followed by another questionnaire evaluating the latex-related symptoms and past and current latex exposure levels of the students. Use of a pacifier, duration of pacifier use, surgery and dental operation history, other latex material use (ie, pelvic and rectal examination history, latex gloves in daily life, condoms), and frequency of other use were determined. Hospital latex exposure was evaluated using job descriptions (ie, number of gloves used by the participants and their coworkers, number of tourniquets applied, stethoscope use, number of all kinds of catheterizations performed by the participants). Students were also asked to define whether they had any allergy-related symptoms (symptoms related to lower and upper airways, dermatitis, hypotension, urticaria, angioedema, and other symptoms related to the involvement of other systems to anaphylaxis) while being subjected to the procedures. After completion of the questionnaire, SPTs and patch tests using the methods described in the following subsections were performed on students consenting to undergo such tests, and students were asked whether there were

any changes in their MSE preferences in accordance with the information provided by investigators and the skin test results. In any stage of the study, no attempts were made to steer the students' answers, and the students could leave the questions blank if they did not wish to reply. The questionnaires were prepared by us and consisted of open-ended or multiple-choice questions.

Skin Prick Tests

The SPTs were performed with a panel of *Dermatophagoides pteronyssinus* and *Dermatophagoides farinae* and grass, tree, weed pollen, cat, dog, *Alternaria*, *Cladosporium*, and latex antigens (ALK-Abello, Hørsholm, Denmark). The puncture method was used in SPTs, and a mean wheal diameter of 3 mm or greater than that of the control solution was considered positive. Histamine dihydrochloride (10 mg/mL) and glycerol diluent were used as positive and negative controls, respectively.

Patch Tests

Patients underwent patch testing to a rubber additive series (thiuram mix, carba mix, mercapto mix, black rubber mix, tetramethylthiuram monosulphide, mercaptobenzothiazole, N-cyclohexylbenzothiazyl sulfonamide, tetramethylthiuram disulphide, hexamethylenetetramine, N-isopropyl-N-phenyl-4 phenylenediamine, 1,3-diphenylguanidine, tetraethylthiuramdisulphide, dipentamethylenethiuram disulphide) (ALK-Abello). Patch testing was performed by means of IQ Chambers, which were left on the back for 48 hour. Readings were taken at days 2 and 4. All reactions were scored according to recommendations of the International Contact Dermatitis Research Group.¹¹

Table 2. Characteristics of Students With Latex Prick Test Positivity

Student No./sex	MSE preference	Physician-diagnosed allergic disease	Symptoms related to latex exposure	Skin prick test results
1/M	Surgical sciences	None	Dyspnea	Negative
54/M	Surgical sciences	None	None	Pollen
73/M	Internal medicine	None	None	HDM, cockroach, mold
94/M	Surgical sciences	None	None	HDM, cockroach
105/F	Surgical sciences	Food allergy, atopic dermatitis	Urticaria	Cockroach
142/F	Surgical sciences	Atopic dermatitis	Dermatitis	Negative
163/F	Internal medicine	Allergic rhinitis, drug allergy	None	HDM, pollen, dog
193/F	Internal medicine	Urticaria	None	HDM

Abbreviations: HDM, house dust mite; MSE, medical specialty examination.

Statistical Analyses

Statistical analyses were performed using a software program (SPSS version 11.0; SPSS Inc, Chicago, Illinois). Values are described as number (percentage) and mean (SEM). The χ^2 method or the Fisher exact test was used to compare categorical variables between groups that define latex-related events.

RESULTS

Of 336 sixth-year students initially screened, we reached 220 (65.5%) (123 women and 97 men). The mean (SEM) age of the study group was 24.09 (1.35) years.

Evaluation of the Latex Allergy Knowledge Levels of the Students

Q1 “What is latex?”: In this section, answers such as “it is a substance obtained from rubber” (n = 51; 44.7%), “it is a substance used in the manufacture of hospital supplies” (n = 47; 41.2%), and “it is an allergenic substance” (n = 33, 28.9%) were accepted as correct. The rate of correct answers to this question was 51.8% (n = 114).

Q2 “Knowledge about latex sources inside and outside the hospital”: Correct identification of at least 1 latex-containing product in daily life and in the hospital was 55.5% (n = 122) and 95.5% (n = 210), respectively. In daily life, condoms were the most frequently known latex source (67.2%), followed by gloves (58.2%), balloons (12.3%), and pacifiers (12.3%). In the hospital, all the students gave the correct answer of gloves, followed by catheters (17.1%), surgical materials (8.6%), intravenous lines (7.6%), and syringes (3.3%). In the hospital, the rate of identification of a second material containing latex besides gloves was only 26.7% (n = 56).

Q3 “Knowledge about latex-related allergy”: Of the sixth-year students, 80.5% (n = 177) knew that latex caused allergy. However, only 7.3% (n = 16) knew that it caused type I and type IV hypersensitivities, 39.5% (n = 87) could not define the hypersensitivity types, and 33.6% (n = 74) could define only 1 of the types.

Q4 “Knowledge about latex allergy protection methods”: When latex allergy prevention methods were questioned, the

Table 3. Characteristics of Students Defining Symptoms on Latex Exposure and Having Negative Prick Test Results to Latex

Student No./sex	MSE preference	Physician-diagnosed allergic disease	Symptoms related to latex exposure	Skin prick test results
25/F	Surgical sciences, internal medicine	Food allergy	Urticaria	Negative
28/F	Surgical sciences, internal medicine	Food allergy	Dermatitis	Negative
56/F	None	Allergic rhinitis, atopic dermatitis	Rhinitis	Negative
67/F	Surgical sciences	Contact dermatitis	Dermatitis	Negative
91/M	Surgical sciences	None	Dermatitis	Negative
128/F	Surgical sciences, internal medicine	None	Dermatitis	Negative
130/F	Surgical sciences, internal medicine	Allergic rhinitis	Dermatitis	Negative
131/F	Surgical sciences, internal medicine	None	Dermatitis	Negative
132/F	Surgical sciences, internal medicine	Contact dermatitis	Dermatitis	Negative
134/F	Surgical sciences	Food allergy	Dermatitis	Negative
159/M	Surgical sciences	Food allergy, atopic dermatitis, urticaria	Dermatitis	HDM, cockroach, mold, dog, cat
165/M	Surgical sciences	Contact dermatitis	Dermatitis	HDM, cockroach
166/F	Internal medicine	Contact dermatitis	Dermatitis	HDM, cockroach
183/M	Surgical sciences, internal medicine	None	Dyspnea	Negative
188/M	Internal medicine	None	Dermatitis	Negative

Abbreviations: HDM, house dust mite; MSE, medical specialty examination.

rate of correct answers was 77.7% (n = 171). Avoidance of latex products, use of vinyl gloves beneath latex gloves to prevent direct contact with skin, and desensitization were regarded as correct answers and were given by 145 students (84.8%), 27 (15.8%), and 12 (7.0%), respectively.

Q5 "Previous information source related to latex allergy": Of all 220 students, 67.7% (n = 149) were not given information about latex and latex allergy. Hearsay was the most common information source (n = 40; 56.3%), followed by bedside training (n = 29; 40.8%), books (n = 8; 11.3%), Internet (n = 2; 2.8%), and television (n = 2; 2.8%).

When the effect of being informed previously about latex on the knowledge level of latex allergy was investigated, it was found that having received information had a statistically significant difference on identification of 3 or more latex-containing products in the working environment and awareness of the prevention methods. Similarly, having acquaintances with latex allergy affected awareness of prevention methods (Table 1).

SPT and Patch Test Results

Of 220 students, 183 agreed to undergo SPTs. Results of SPTs were positive to any inhalant allergen in 64 students (35.0%). Latex positivity in SPT was observed in 8 students (4.4%). All the results in the 84 students consenting to patch tests were negative.

Characteristics of Students Defining Symptoms on Latex Exposure or Having Latex SPT Positivity

Eighteen of the 196 students (9.2%) defined symptoms after latex exposure. Latex SPT sensitivity was positive in 3 of them (16.7%). In addition, positivity to latex in SPTs was observed in 5 students not defining any symptoms. Characteristics of students describing symptoms or having latex skin test positivity are given in Tables 2 and 3.

Latex exposure-related symptoms were not found to be associated with past and current latex exposure and inhalant allergen sensitivity. However, rates of physician-diagnosed contact dermatitis, food allergy, atopic dermatitis, and symptoms congruent with dermatitis during the past 12 months were significantly higher in the group that defined symptoms with latex (Table 4). No difference was found between latex SPT positive and negative groups regarding exposure levels and medical histories. However, atopy rates were significantly higher in the latex-sensitive group (Table 4).

Effect of Information About Latex and Skin Test Results on MSE Preferences

At the beginning of the study, 93.2% of the students (n = 205) had already decided on their MSE preferences. The preferences for surgical sciences, internal medicine, and basic medical sciences were 73.7%, 62.4%, and 3.9% (n = 151, 128, and 8), respectively. At the end of the study, none of the students had made any changes in their preferences.

DISCUSSION

This study revealed that sixth-year medical students trained in a hospital where latex gloves are routinely used had low knowledge levels about latex allergy and documented the groups at risk for latex allergy in the future, thereby providing an opportunity for the study group to know their individual risks before starting their professional life, in which they are exposed to latex products.

Nearly half of the students could not define latex or identify latex-containing products outside the hospital. When questioned about latex-containing products in the hospital, most students (95.5%) gave gloves as an answer, but 73.3% of them could not identify another product. The definition of latex allergy and awareness of prevention methods were also at insufficient levels. These results demonstrate that last-year medical students do not have sufficient information about latex. To our knowledge, this is the only study investigating the knowledge levels of risk groups regarding latex allergy. When asked about information sources as an important cause of this low knowledge level, 67.7% of the students stated that they did not receive information about latex previously. Of those who had received information, 56.3% reported that they were informed by hearsay. The rate of taking information from books or bedside training was 51.1%. According to these results, rates of recognizing latex products and knowing the protective methods in latex allergy were higher in the group reporting receiving information. Because latex allergy has different clinical components, in our medical school, it is discussed in different disciplines within the scope of practical training. These results regarding the inadequacy of baseline latex allergy knowledge levels and current training organization related to latex allergy give us an opportunity to critique our local system. We believe that evaluation of knowledge levels of risk groups is necessary, and training of these groups may need revision according to the benefit of these students.

When the risk of this study group, which had insufficient knowledge about latex, was examined for latex allergy, skin test positivity to latex was 4.4%. This value is higher than those obtained from studies^{1,12-14} in which the latex sensitivity of the general population was examined (<1.0%-1.1%). On the other hand, latex sensitivity based on skin test positivity in health care workers is 2.3% to 21.9% depending on the characteristics of the group included in the study.¹⁻⁵ Whereas lower rates have been reported for hospital workers, higher sensitivity rates came from the groups in which operating room nurses, surgeons, and anesthesiologists are the majority. In our hospital, during the screening of physicians, nurses, and auxiliary health personnel working in the operating room in 1995 and 2005, latex sensitivity was found to be 6% and 11.9%, respectively.^{5,15} It seems that the 4.4% latex sensitivity rate obtained from sixth-year medical students is greater than that of the general population but lower than that of the operating room staff.

Because the sensitization rates of these students at medical school entry are not known, it is difficult to conclude for sure

Table 4. Comparison of Students Defining Symptoms on Latex Exposure or Having Positive Skin Prick Test Results to Latex^a

	Symptoms with latex exposure			Prick test with latex		
	No	Yes	P value	Positive	Negative	P value
Physician-diagnosed allergic diseases						
Asthma						
Positive	2 (100)	0	>.99	0	2 (100)	>.99
Negative	175 (90.7)	18 (9.3)		8 (4.5)	171 (95.5)	
Rhinitis						
Positive	27 (93.1)	2 (6.9)	>.99	1 (3.4)	28 (96.6)	>.99
Negative	151 (90.4)	16 (9.6)		7 (4.6)	146 (95.4)	
Urticaria						
Positive	15 (93.8)	1 (6.3)	.67	1 (6.3)	15 (93.8)	.53
Negative	163 (90.6)	17 (9.4)		7 (4.2)	159 (95.8)	
Contact dermatitis						
Positive	13 (76.5)	4 (23.5)	.03	0	16 (100)	>.99
Negative	165 (92.2)	14 (7.8)		8 (4.8)	158 (95.2)	
Food allergy						
Positive	5 (50.0)	5 (50.0)	.001	1 (10.0)	9 (90.0)	.37
Negative	173 (93.0)	13 (7.0)		7 (4.1)	165 (95.9)	
Drug allergy						
Positive	14 (100)	-	.37	1 (7.7)	12 (92.3)	.45
Negative	164 (90.1)	18 (9.9)		7 (4.1)	162 (95.9)	
Atopic dermatitis						
Positive	4 (50.0)	4 (50.0)	.003	2 (25.0)	6 (75.0)	.04
Negative	174 (92.6)	14 (7.4)		6 (3.4)	168 (96.6)	
Symptoms congruent with allergic diseases during the last 12 mo						
Dyspnea						
Positive	20 (83.3)	4 (16.7)	.25	1 (4.2)	23 (95.8)	>.99
Negative	158 (91.9)	14 (8.1)		7 (4.4)	151 (95.6)	
Rhinitis						
Positive	57 (89.1)	7 (10.9)	.55	3 (4.8)	60 (95.2)	>.99
Negative	121 (91.7)	11 (8.3)		5 (4.2)	114 (95.8)	
Urticaria						
Positive	28 (87.5)	4 (12.5)	.50	3 (10)	27 (90.0)	.13
Negative	150 (91.5)	14 (8.5)		5 (3.3)	147 (96.7)	
Dermatitis						
Positive	11 (68.8)	5 (31.3)	.009	1 (6.3)	15 (93.8)	.53
Negative	166 (92.7)	13 (7.3)		7 (4.2)	158 (95.8)	
Atopy						
Positive	60 (93.8)	4 (6.3)	.30	6 (9.4)	58 (90.6)	.02
Negative	103 (88.0)	14 (12.0)		2 (1.7)	117 (98.3)	

^a Data are given as number (percentage).

that medical students develop the sensitivity during medical school years. However, when the results of general population studies and studies conducted in students receiving health professional training are considered, the presence of such a risk may be possible. Two cross-sectional studies^{16,17} showed that symptoms related to latex exposure in first-year and last-year medical students were not statistically significant. However, another study¹⁶ showed a tendency toward increased symptom positivity across time, being 7.7% in the first year and 13.3% in the fifth year. Similarly, in the study by Stone and Ellis,¹⁷ although there was no difference between the first and fifth years based on symptom positivity, rash prevalence in fifth-year students was found to be signif-

icantly higher than in first-year students. There are few follow-up studies belonging to the same group in the literature. Archambault et al¹⁸ documented that the skin test results of 7 of 110 students (6.4%) from the hygiene technology program became positive during 6-year follow-up. In addition, the high sensitivity rate (11.9%) in the operating room staff in our hospital¹⁵ suggests that if measures are not taken in this group, the sensitivity rates may increase at least in the specialties where intense exposure will take place.

In this group, it is almost certain that the 8 students having latex skin test positivity will be the first individuals to become symptomatic if their latex exposure will be intense. Again, although skin test results were negative, the 15 stu-

dents describing symptoms on latex exposure may be expected to lead the group developing latex allergy. Taking into account patch test negativity, the hand eczema defined by most of these students ($n = 13$) is thought to be irritant contact dermatitis. It is known that this group is at risk for type I hypersensitivity.^{17,19} Individuals with atopy, eczema, hay fever, or a family history of atopic conditions have been reported to have more symptoms with latex.¹⁷ We also determined the atopic students thought to be at risk for latex allergy.

Present data reveal that some student groups are at risk for latex allergy and require protection. Until now, studies related to the prevention of latex allergy were conducted on symptomatic or latex skin test–positive patients and investigate the success rate of secondary and tertiary preventions.^{20,21} Because of the successful results of these studies, today the use of powder-free gloves with low latex allergen levels are recommended.¹⁹ However, the main target in latex allergy should be primary prevention. Few studies indicate whether primary prevention is possible. Allmers et al²² demonstrated that a decline in the number of suspected cases of occupational allergies caused by latex can be achieved by education combined with arrangements in the hospitals. In addition to measures intended to decrease latex allergen exposure, informing people is an important factor in primary prevention. In the recommendations of the National Institute for Occupational Safety and Health in 1997, it was stated that groups at risk should be informed about latex allergy, and informing about latex allergy was included in the first recommendations directed to employers and workers.¹⁰ Haynes and Ludgar²³ underlined that the first step in creating an environment with low allergen levels for prevention of latex allergy is education. At this point, the importance of the results implying information insufficiency obtained in this study is highlighted again.

In this study, we selected medical students attending the final class because they constitute the group closest to the profession. It was interesting to learn their behavioral attitudes against the issue, which is directly related to their health, particularly in the risk group, after learning their individual risk of latex allergy. Five of the 8 students with latex SPT positivity reported that they preferred surgical sciences in the MSE before tests and information. None of these students changed their mind after learning the test results and their risks. Similarly, none of the atopic students, who can be considered to be at high risk for latex sensitization, changed their surgical science preferences after the test results and information. The cause of this result may be that education in a short time during bedside trainings and this study could be insufficient. This supports the necessity of giving education at the beginning of medical training and perhaps repetitively.

This study has some limitations. First, this is a questionnaire-based study, and all the data about medical history were based on self-reported data. Although information about latex allergy has been given to eliminate misunderstanding of the

questions before evaluating latex-related symptoms and past and current latex exposure levels of the students, insufficiencies could have occurred in taking the medical history. This can explain the discrepancy between latex skin test results and history. Dermatitis reported by symptomatic patients may be irritant dermatitis instead of allergic dermatitis. This may expand the discrepancy between patch test results and symptoms. Second, we primarily aimed to evaluate the knowledge levels of a risk group about latex allergy, so a general population was not included in the study as a control group. Because the prevalence of latex sensitization in the general Turkish population is not known, the sensitization rate of the general population was obtained from the literature. However, with a control group it would have been more appropriate to evaluate the questions about knowledge levels and to analyze the prevalence of latex sensitization. Third, we used SPT but not specific IgE to evaluate latex sensitivity. However, because current Food and Drug Administration–approved in vitro latex IgE assays have lower sensitivity and specificity than SPT and produce many false-negative and false-positive IgE antibody results,²⁴ SPT is recommended as the first choice for documentation of sensitization.²⁵

In conclusion, last-year medical school students have a low knowledge level about latex allergy, which imposes a serious professional risk to them, and are at risk for latex allergy, so that the strategies related to training for latex allergy should be revised and updated based on the benefit to this risk group, and reevaluation is strongly recommended to determine risk of latex allergy before choosing specialty preferences or graduating from medical school. In light of these results, we had an opportunity to critique our training system, and a new training system covering practical and theoretical points about latex allergy was added to the education program, and effort was given to introducing powder-free gloves with reduced protein levels in our university. We believe that these results can be pioneer in bringing attention to the education of risk groups.

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- Requests for reprints should be addressed to:*
Ferda Öner Erkekol, MD
Ankara Üniversitesi Tıp Fakültesi Cebeci Hastanesi
Göğüs Hastalıkları Anabilim Dalı Allerjik Hastalıklar Bilim Dalı
06100 Dikimevi, Ankara, Türkiye
E-mail: erkekol@medicine.ankara.edu.tr
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