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REVIEW

Questionnaire for Clinical Diagnosis of House Dust Mite's Allergy Approved by Delphi Consensus

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Abstract

Despite house dust mite (HDM)-allergy is the most frequent in the world, no standard questionnaire exists to help physicians in their clinical practice for screening patients with this possible diagnosis. The objective of this survey was to develop a questionnaire that could be used to identify patients with suspicion of HDM-allergy. The survey was conducted using the Delphi methodology. Nineteen international experts in allergology constituted the scientific board who established the items included in the first version of the questionnaire, defined the criteria of the selection for the next steps, and validated the final questionnaire and its interpretation. The initial version of the questionnaire included 15 items. For each item, five answers were suggested graduated by scores from "no importance" to "very high importance." The predefined conditions for the item selection after each round were a median score ≥ 7 and $> 50\%$ of responses according "high importance" and "very high importance." The electronic survey circulated within the Interasma Scientific Network platform. Eight questions based on the occurrence/worsening of symptoms induced by HDM-allergen exposure meet the survey criteria after the second and the third rounds and were included in the final questionnaire. Binomial answers for each question with 1 point accorded for "Yes" and none for "No" were suggested for the final version with a score ≥ 5 points associated with a high probability for HDM-allergy. By applying the Delphi process, we generated a brief questionnaire with binomial answers, easy to use in clinical practice for screening patients with HDM-allergy.

Keywords Clinical diagnosis · HDM-allergy · Questionnaire · Screening · Survey

Abbreviations

HDM	House dust mites
IgE	Immunoglobulin E
Th2	T helper 2 cells
IL	Interleukin
Der p	*Dermatophagoides pteronyssinus* Allergens
GAA	Global Asthma Association
INESNET	Interasma Scientific Network

Introduction

House dust mites (HDM), one of the most prevalent indoor allergen sources worldwide, are strongly associated with allergic diseases including perennial allergic rhinitis, allergic asthma, and atopic dermatitis. HDM-allergy affects 1–2% of the global population, in total approximately 65–130 million people [1]. One half of patients with HDM-allergy have asthma, while the prevalence of HDM-allergy in patients with allergic asthma varies from 40 to 85% [2–4]. The major allergenic HDM are *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, and *Euroglyphus maynei* belonging to the family Pyroglyphidae [1]. These species constitute 80–90% of HDM globally. In tropical and subtropical areas, the domestic mite *Blomia tropicalis* coexists with *Dermatophagoides pteronyssinus* and represents an important source of allergens [1, 4]. HDM are found in all continents except for the Arctic and Antarctic regions, due to the extremely low temperatures in those areas. Temperatures between 18 and 24 °C and a relative humidity above 70% are ideal conditions for the growth of HDM [1].

HDM-allergy is an immunoglobulin E (IgE)-mediated type I hypersensitivity reaction to allergens from mite fecal pellets and/or exoskeleton. HDM allergens with protease

Extended author information available on the last page of the article

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activity induce cleavage of the tight junctions between the epithelial cells and facilitate transepithelial allergen delivery with presentation to antigen presenting cells, notably dendritic cells [1, 4]. Releasing of alarmins after epithelial injury and activated dendritic cells promote Th2 differentiation, secretion of proinflammatory cytokines (e.g., interleukins IL-4, −5, and −13), and allergen-specific IgE production by B cells [1, 5]. Specific IgE bind to FcƐRI receptors on mast cells and basophils in the tissue and blood. On subsequent exposure to the same allergens, there is a crosslinking of the bound IgE-sensitized cells, leading to their degranulation with release of inflammatory mediators (e.g., histamine, cytokines/chemokines, lipid mediators) causing the clinical manifestations of the HDM-allergy [1, 4]. Certain HDM allergens generate leukocyte infiltration through Toll-like receptors and protease-activated receptors in the airways, amplifying the response to allergens [1]. Continuous exposure and sustained inflammation induce airway remodeling in patients with asthma associated with irreversible airway obstruction, poor lung function, and lower response to standard treatment [6]. In these conditions, the early detection and management of HDM-allergy are mandatory.

Diagnosis of HDM-allergy includes anamnesis with confirmation of the exposure-driven symptoms and evidence of allergic sensitization to specific allergens. Allergic sensitization is the development of specific IgE antibodies to allergens inhaled, ingested, or absorbed. Currently, the HDM-sensitization is proved by performing skin tests with allergen extracts and/or the measurement of serum allergen-specific IgE [1, 7]. The use of individual purified allergens for diagnosis may be considered an alternative for mite extracts. Testing the major allergens Der p 1, Der p 2, and Der p 23 together with the mid-tier allergens Der p 5, Der p 7, and Der p 21 can diagnose 98–99% of sensitized patients [1]. Asthma patients with HDM-sensitization have recurrent exacerbations, impaired lung function, and increased disease severity [8]. Current guidelines recommend allergen sublingual immunotherapy as add-on treatment for HDM-driven asthma in adults and adolescents with well or partially controlled disease, as well as for HDM-induced allergic rhinitis with moderate-to-severe symptoms not controlled by pharmacotherapy, a recognized risk factor for asthma development [7–11].

Important progress has recently been made in molecular diagnostic and allergen immunotherapy for HDM-allergy; however, currently there is no standardized questionnaire for screening patients in clinics with this suspected diagnosis. The absence of such a questionnaire and the fact that standardized questions accurately predict a detailed history performed by an experienced allergologist [12] have provided justification for developing the Delphi process presented here. The aim of this survey was to concept a questionnaire to use in clinical practice for screening patients with suspected HDM-allergy including one or more of the following diagnoses: allergic rhinitis, conjunctivitis, and asthma.

Method

This study was conducted using the Delphi method, a structured technique applied to determine the extent of agreement on a complex issue by asking experts to answer survey questions in iterative rounds [13]. In health care, this method is used to obtain consensus on topics for which accurate tested data are not available, guidelines are insufficient, or knowledge is uncertain or incomplete, providing qualitative and quantitative elaboration data [14, 15]. The Delphi method includes three stages: selection of an expert panel, development of survey, and iterative processes to gain consensus. The goal of multiple interactions in the Delphi method is to decrease responses gradually and achieve consensus through three pivotal points: anonymity, controlled feedback, and statistical group response [15].

A board of 19 experts in pneumology and allergology was appointed as scientific committee, including clinicians from 14 countries across the world (Argentina, Belgium, Brazil, Bulgaria, France, Greece, Italy, Mexico, Poland, Romania, Spain, Turkey, the UK, and the USA). Panel members were selected by the facilitator (the first author) based on their clinical expertise in this domain, prior published research, contribution to current guidelines, membership in Global Asthma Association (GAA), and their interest in the project.

During the first meeting, experts defined the aim of the survey and validated its deployment (Fig. 1). Based on the literature data and the experts' clinical experience, a list of candidate items for the questionnaire was drafted. For each item, there were five possible answers with different scores: (A) no importance (2 points), (B) low importance (4 points), (C) moderate importance (6 points), (D) high importance (8 points), and (E) very high importance (10 points). The predefined conditions necessary for the selection of items in the questionnaire were a median score ≥ 7 and $> 50\%$ of responses "high importance" and "very high importance" without disagreement (a disagreement index [DI] less than 1.0 indicating "consensus reached" and calculated as the ratio of the interpercentile range and the interpercentile range adjusted for symmetry). The first two consecutive rounds for questionnaire validation were conducted by e-mail with the expert panel.

In round 1, the experts were invited to modify the existing items and suggest new statements. During round 2, they were asked to vote for each of 15 items from the modified questionnaire. Eight questions reaching the predefined conditions and validated by the expert panel were included in the questionnaire (Table 1). An electronic

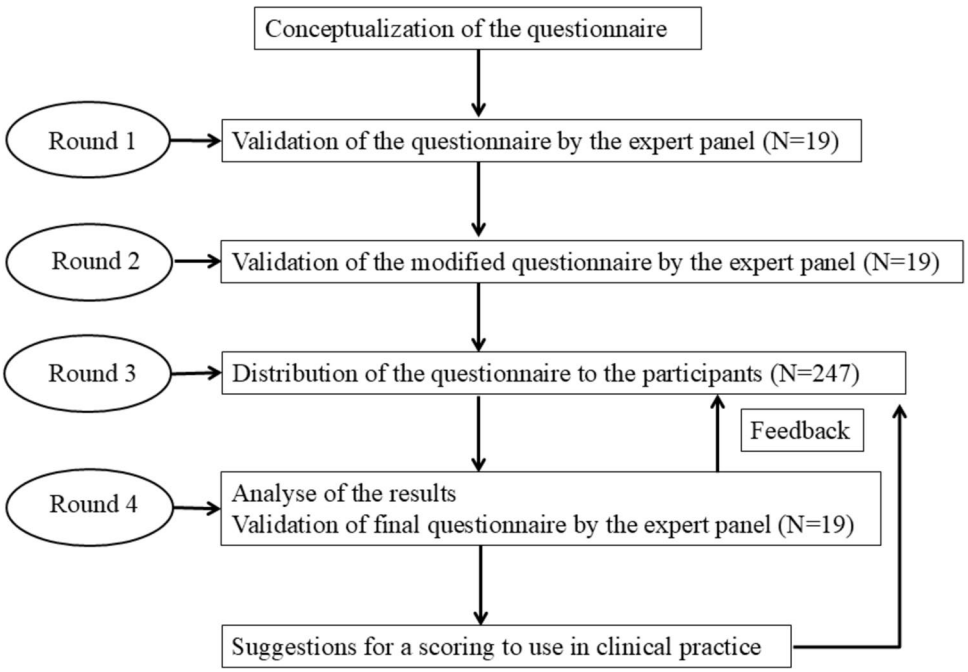


Fig. 1 Delphi process used for the present survey

Table 1 Validation of the survey questionnaire during the second round

Item	Median (2–10)	DI	Responses D & E
Q1. Do you have more symptoms indoors than outdoors?	**8 (4–10)**	0.17	**95%**
Q2. Are your symptoms predominant in the night or upon awakening?	**8 (4–10)**	0.31	**74%**
Q3. Do your symptoms decrease throughout the day, especially outdoors?	6 (2–10)	0.23	47%
Q4. Do you have more symptoms in the bedroom than in other places of your home?	**8 (6–10)**	0.44	**57%**
Q5. Do you have symptoms when you are entering into a dusty place?	**8 (6–10)**	0.17	**89%**
Q6. Do you have symptoms in hotel rooms?	6 (2–10)	0.23	37%
Q7. Are your symptoms more important in a place with carpets, curtains and/or stuffed animals?	**8 (6–10)**	0.06	**89%**
Q8. Do you experience a worsening of your symptoms when you are cleaning your home (e.g. vacuum cleaning, dusting)?	**10 (6–10)**	0.05	**89%**
Q9. Do you have symptoms that persist all year round?	**8 (6–10)**	0.31	**79%**
Q10. Did you remark an aggravation of your symptoms in Spring and Autumn or during the Christmas-New Year holidays?	**8 (4–10)**	0.36	**63%**
Q11. Do you have symptoms when you are doing the seasonal change of clothes from the wardrobe?	6 (2–8)	0.08	32%
Q12. Do you have more symptoms when you start heating home in Autumn/Winter?	6 (6–10)	0.08	32%
Q13. Do you control the indoor humidity between 30–50%?	6 (2–10)	0.23	5%
Q14. Do you keep the temperature in your home inferior to 20 °C?	6 (2–10)	0.23	5%
Q15. Do the symptoms get better if you take antihistamines and/or local corticosteroids?	6 (2–10)	0.23	21%

DI disagreement index

survey (round 3) was circulated within the Interasma Scientific Network (INESNET) platform (109 members), GAA membership (> 500 members), contact list of the coauthors, and national associations for specialists between 1 April and 31 May 2024. The e-mail invitation contained a message encouraging recipients to disseminate the survey on their social network.

Statistical analysis was performed using the SPPS program version (SAS Institute, Cary, NC, USA). Qualitative variables in descriptive analysis were expressed as numbers and percentages. Quantitative variables were presented as median with interquartile range. During round 4, the results were analyzed by the expert panel to validate the final questionnaire. The items reaching the predefined conditions with

a median score ≥ 7 and > 50% of responses "high importance" and "very high importance" without disagreement were included in the questionnaire. The participants who chose to be informed about the results of the survey had feedback by e-mail with the summary of analyses and the final version of the validated questionnaire.

For use of the questionnaire in clinical practice, the experts suggested binomial answers for each question with scores (yes, 1 point; no, 0 points) and established a cut-off that could be associated with a high probability for HDM-allergy.

Results

During the first round, 15 items were included in the questionnaire by the international expert panel. The questions were focused on the occurrence/worsening of symptoms during the exposure to allergens, their variation in time (nictemeral and seasonal) and according to location, their improvement with exposure cessation or after medication use, and measures taken to control the environmental conditions favorable for HDM development. After voting in the second round, only eight questions reached the predefined conditions and were retained in the questionnaire (highlighted in Table 1). All these items had a median score ≥ 8 (4–10) and ≥ 57% of responses "high importance" and "very high importance" with DI values < 0.5.

The electronic survey (round 3) was conducted with the new version of the questionnaire, including the eight questions validated by the expert panel. Two hundred forty-seven questionnaires were completed by specialists in allergology from 27 countries. The repartition by gender of participants was proportionate with 51% females and 49% males. The participation per country is represented in Fig. 2. The most active countries were Italy (13%), Belgium, Poland (12%), Mexico (10%), and Brazil (9%). Fifty-one percent of participants chose the option to be involved in the scientific dissemination of results.

During round 3, all eight questions had a median score of 8 (2–10). For the question "Do you have more symptoms indoors than outdoors?", 38% of answers were "high importance" and 34% "very high importance" (Fig. 3A). For the question "Are your symptoms predominant in the night or upon the awakening?", 39% of participants accorded "high importance" while 29% of them "very high importance" (Fig. 3B). The item "Do you have more symptoms in the bedroom than in other places of your home?" summarized 58% of responses D and E (Fig. 3C). Forty-four percent of participants responded by "very high importance" to the question "Do you have symptoms when you are entering into a dusty place?", and 31% of them chose the answer "high importance" (Fig. 3D). Both items "Are your symptoms more important in a place with carpets, curtains and/or stuffed animals?" and "Do you experience a worsening of your symptoms when you are cleaning your home (e.g., vacuum cleaning, dusting)?" obtained three quarters of responses "high and very high importance" (Fig. 3E and F). For the question "Do you have symptoms that persist all year round?", 36% of answers were D and 30% E (Fig. 3G).

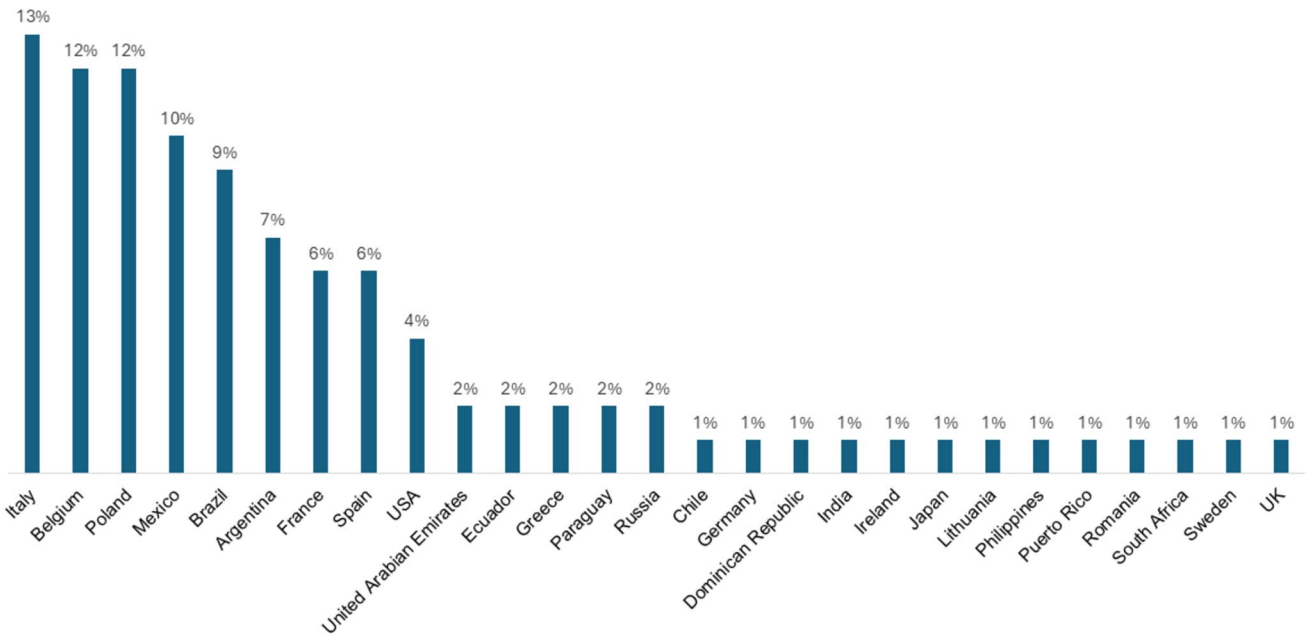
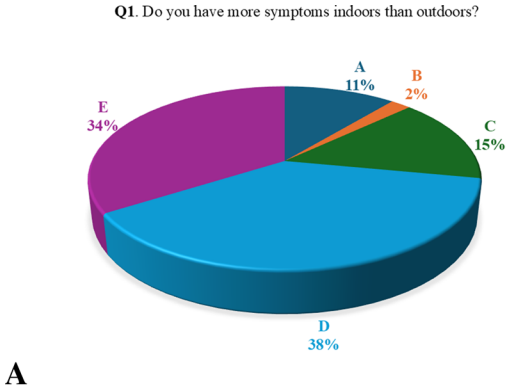
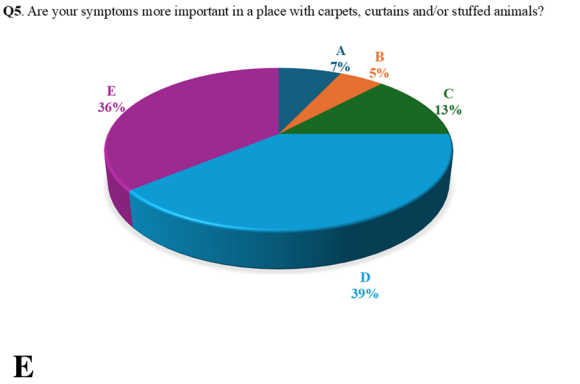
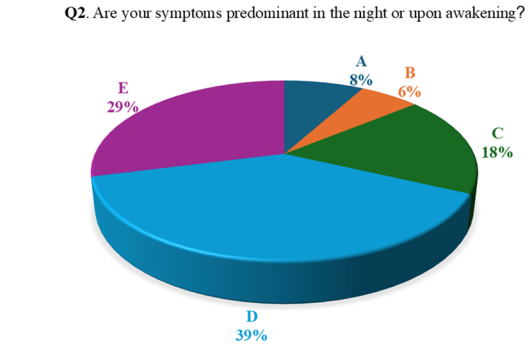
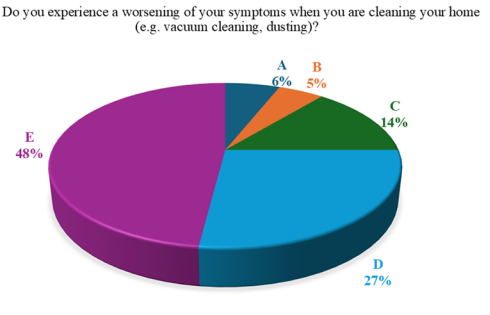


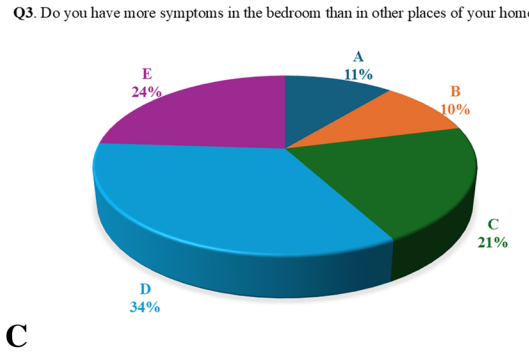
Fig. 2 Participation in survey per country

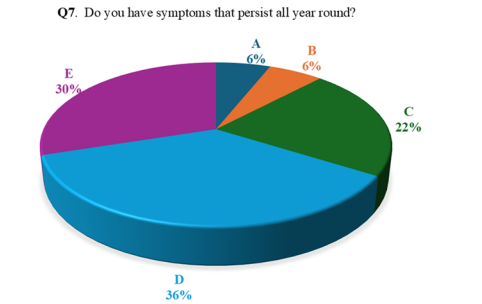


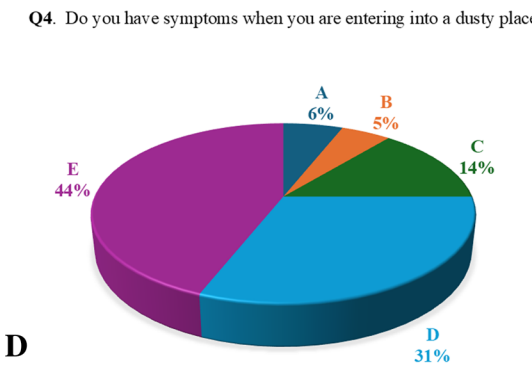












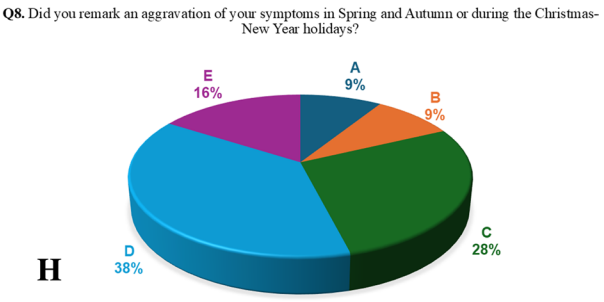


Fig. 3 **A** Distribution of the answers for question 1, **B** Distribution of the answers for question 2, **C** Distribution of the answers for question 3, **D** Distribution of the answers for question 4, **E** Distribution of the answers for question 5, **F** Distribution of the answers for question 6, **G** Distribution of the answers for question 7, **H** Distribution of the answers for question 8

Thirty-eight percent of participants accorded "high importance" to the item "Did you remark an aggravation of your symptoms in Spring and Autumn or during the Christmas-New Year holidays?" and 16% "very high importance" (Fig. 3H). The ranking of the questions, according to the sum of answers "high importance" and "very high importance" are represented in Fig. 4.

By fulfilling the predefined conditions with a median score ≥ 7 and $> 50\%$ of responses "high importance" and "very high importance" without disagreement, all eight questions were included in the final questionnaire. During round 4, the expert panel validated the questionnaire. To facilitate its use in clinical practice, the experts suggested binomial answers for each question with 1 point accorded for "Yes" and none for "No." The consensus decision was that a score ≥ 5 points (equal to $> 50\%$ of answers affirmative) could be associated with a high probability for HDM-allergy (Table 2).

Discussion

By applying the Delphi method, the present survey has successfully generated a questionnaire easy to use in clinical practice for screening patients with suspected HDM-allergy. The final questionnaire includes eight questions with binomial answers (positive and negative) and takes 1 min to be completed by doctors or patients. A sum of ≥ 5 points obtained by addition of affirmative answers scored by one point each one could select patients with possible HDM-allergy for future investigations and diagnosis confirmation.

Structured and detailed clinical history is considered the cornerstone of diagnosis in medicine. However, in the era when medical doctors general and specialists are overloaded by clinical and administrative tasks, having simple tools such as a standardized questionnaire for orientation to a rapid diagnosis could be interesting in daily practice. The concept of using questionnaires in allergology for screening patients with suspected allergic disease is ancient [12, 16, 17]. Various questionnaires were developed and validated by skin prick tests in pediatric and young adult populations that proved their usefulness in identification of patients with allergic diseases but their implantation in the clinical practice remains limited [12, 16, 18, 19]. Applying standardized questions showed an accuracy superior to 85% for predicting the answers obtained by an experienced allergologist during anamnesis and superior to 50% for predicting the positive reactions to skin prick tests. No standard questionnaire exists for screening patients with suspicion of HDM-allergy, but the analyses of the questions concerning this allergy included in a previous general questionnaire found an accuracy between 93 and 96% for predicting allergologist's detailed history and between 50 and 79% for predicting positive results to skin prick tests [12]. These promising results allowed us to do this survey with the aim of generating a standard questionnaire easy to use in clinical practice for the selection of patients with possible HDM-allergy.

The clinical evaluation of patients with suspected HDM-allergy typically includes a history of symptoms related to allergen exposure. Symptom-based questions have previously shown high specificity for screening patients with allergic diseases [1, 20]. After the first round of the survey, 15 questions were included in the initial version of the questionnaire: 13 focused on the symptoms' variation according to the exposure to allergens or medication use and two items based on the measures taken for controlling environmental factors (humidity and temperature) that facilitate the growth/reproduction of HDM. After the second round, only eight were retained in the questionnaire (Table 1).

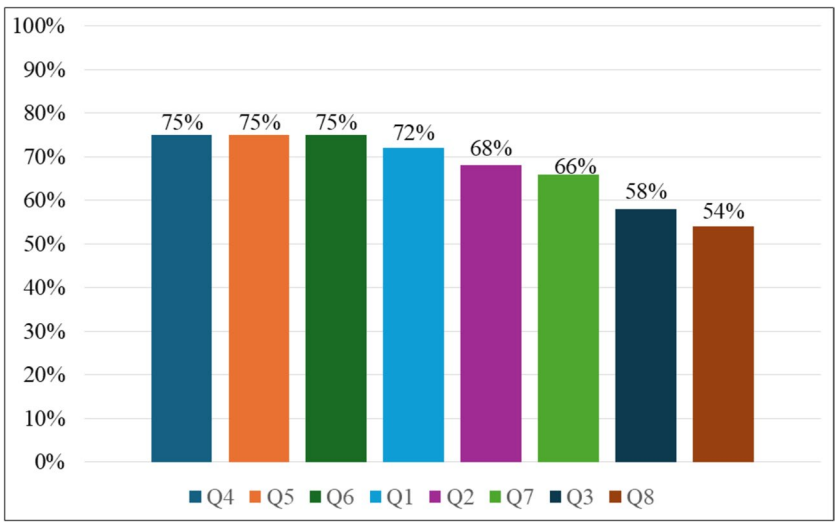


Fig. 4 Ranking of items of the final questionnaire according to the answers "high importance" and "very high importance"

Table 2 Validated questionnaire for HDM-induced allergy

1. Do you have symptoms when you are entering into a dusty place? o Yes o No
2. Are your symptoms more important in a place with carpets, curtains and/or stuffed animals? o Yes o No
3. Do you experience a worsening of your symptoms when you are cleaning your home (e.g. vacuum cleaning, dusting)? o Yes o No
4. Do you have more symptoms indoors than outdoors? o Yes o No
5. Are your symptoms predominant in the night or upon awakening? o Yes o No
6. Do you have symptoms that persist all year round? o Yes o No
7. Do you have more symptoms in the bedroom than in other places of your home? o Yes o No
8. Did you remark an aggravation of your symptoms in Spring and Autumn or during the Christmas-New Year holidays? o Yes o No

Score: Yes = 1 point; No = 0 points

A score ≥ 5 points suggests a high probability for HDM-induced allergy

The first question on the worsening of symptoms indoors than outdoors is related to the reality that HDM is the predominant source of indoor aeroallergens due to the presence of favorable conditions for their replication and survival [1, 21]. High levels of HDM allergens were found in homes, but also in schools, day care centers, work environments, and public transportation across the world [21–23]. Early life exposure to increased concentrations of major allergens Der p1 and Der p2 is correlated with higher risk of HDM sensitization and allergy [23–28]. More recently, sensitization to Der p23 in childhood was found to be significantly associated with asthma [29, 30]. Fortunately, while the HDM sensitization is highly prevalent (21.7% according to the results of skin prick tests in a large survey), only 1–2% of these people have clinical symptoms defining HDM-allergy [1, 21, 31]. The occurrence or worsening of allergic symptoms after HDM exposure in mite-sensitive patients is well documented by real-world studies but also by specific allergen challenge tests [32–38]. Q1 meets the predefined conditions of the survey and was included in the final version of the questionnaires.

A dose–effect relationship has been also reported with more symptoms and increase of their severity at higher concentrations of HDM allergen exposure [35, 37–39]. The questions Q4–8 and Q11 of the initial questionnaire (Table 1) are based on the aggravation of symptoms by contact with high levels of household dust in indoor places recognized as important reservoirs of HDM allergens and during domestic activities such as vacuum cleaning, dusting, or seasonal change of clothes from the wardrobe [21, 23, 25, 39, 40]. Only five items (Q1, Q4, Q5, Q7, and Q8) reached the survey criteria and were included in the final version of the questionnaire. In a previous study, the worse symptoms in bedroom had an accuracy of 95% for predicting the answers obtained by an experienced allergist and of 50% for a wheal ≥ 5 mm to skin prick tests. Similarly, for the item concerning the aggravation of symptoms during vacuuming or dusting, the accuracy for predicting the clinical diagnosis of HDM-allergy was 93% and for a positive reaction to skin prick tests 71% [12].

The second question of the initial questionnaire is related to the circadian variation of symptoms in patients with HDM-allergy with worsening during the night and in the early morning. This fact was demonstrated by previous data, and it is due probably to longer exposure during the night to high concentration of HDM allergens as found in mattresses, pillows, and blankets [41]. The presence of nocturnal symptoms induced frequent awakenings in 38% of adults and 28% of children with HDM-allergy in a previous large study. A poor quality of sleep was reported by 50% of adults and 37% of children with HDM-allergy due to their symptoms [42]. Forty-nine percent of patients with respiratory allergies

induced by HDM recognized a strong and very strong impact of nocturnal symptoms on their quality of their sleep in France, 25% in Spain, and 23% in Italy [2]. By reaching the criteria of the survey, this item was included in the final version of the questionnaire. A previous study found for a similar item an accuracy of 96% for predicting the answers obtained by an experienced allergist and 59% for a wheal ≥5 mm in diameter to skin prick tests for HDM [12].

In contrast, the third item concerning the improvement of symptoms throughout the day and outdoors did not attempt the predefined criteria of the survey after the second round. A possible explanation for this result could be that high levels of HDM allergens were found in common transport and public places, so the patients with HDM-allergy could have symptoms during the day and outside their homes [43, 44]. In addition, in developed countries, people spend more than 90% of their time indoors, so a variation of the symptoms according to the exposure of allergens is more difficult to be perceived [43].

Items 9 and 10 of the initial questionnaires were focused on the presence and the variation of symptoms during the year. Despite the HDM allergens are perennial, seasonal variations of their concentrations were identified in temperate regions with peaks in spring and autumn that could induce fluctuations in the HDM-allergy symptoms [45–47]. A large European survey showed that only one-third of patients with HDM-allergy have symptoms almost every day of the year, while half of patients in this population reported symptoms only during these specific periods. The presence of HDM-allergy symptoms was associated with a high negative impact on patients' quality of life [2, 47]. A third peak in the evolution of symptoms and environmental levels of HDM allergens was enregistered in mid-winter [46, 47]. These seasonal trends are related to the environmental conditions of humidity and temperature more favorable for the HDM development during these periods in temperate climates [1, 21, 45, 46, 48]. The question on the worst symptoms in December showed an accuracy of 63% for predicting a positive reaction to HDM allergens on skin prick tests in a previous study [12]. Both items Q9 and Q10 reached our survey criteria and were included in the final questionnaire.

Question 12 is based on the possible influence of home heating on the occurrence of symptoms. A prospective study showed that infants sleeping in heating rooms have higher risk to develop wheezing and asthma [49]. Several data suggested also differences according to the heating system. Higher levels of HDM allergens were found in apartments heated with wood-burning stoves than those using another system and current home gas use was associated with increased risk of HDM-sensitization in children and poor lung function [50, 51]. In contrast, lower concentrations of HDM major allergens were found in Korean houses using an under-floor "ondol" heating system that removes dust and provides hot and dry conditions when activated [52]. This item did not reach survey criteria after the second round, so it was not included in the final questionnaire.

Questions 13 and 14 on the control of environmental conditions did not fulfil the predefined conditions after the second round. Concerning the humidity, even though its control should be the mainstay of reducing mite exposure, it is a goal difficult to attempt because nearly half of the people in the world live on coastal areas where humidity levels are typically higher. In addition, HDM activity is not directly related to relative humidity but depends more on the microenvironment existing in bedding and carpets, so a simple measurement of humidity may not assure surroundings free of allergens [21]. Evidence on clinical benefits of dehumidification using mechanical ventilation with dehumidifiers remains scanty [53]. For the temperature, it is known that only extreme ends of the spectrum could impact mite survival. Hot temperatures (≥ 50 °C) tend to be more effective in destroying HDM eggs than freezing [54]. However, these extremes are not usual conditions of human life. Despite the active heat-steam treatment of homes showed benefits in reducing HDM concentration and bronchial hyperreactivity in asthmatic patients, this is not a measure that could be generally applied [55]. Air conditioners could reduce HDM allergen levels by maintaining cool temperature and low humidity but are not broadly accessible in real world [21]. Similar to the previous two questions, item 15 based on the improvement of symptoms after antihistamine or anti-inflammatory medication use did not meet the predefined criteria of the survey to be included in the final questionnaire, probably due to the lack of specificity for HDM-allergy.

The originality of this work is the creation of a standard questionnaire as a valuable and rapid tool, which is easy to use in clinical practice for screening patients with HDM-allergy, by using the Delphi process. The strength of this study is the vast participation in the survey with people from multiple countries across the world opening the door for a large implementation in clinical practice. This questionnaire could be broadly used by allergologists for their standard consultation (e.g., to be completed by patients in the waiting room beforehand) but also by other practitioners to identify patients with possible HDM-allergy for referrals to specialists. Most questions included are based on the occurrence/worsening of symptoms after HDM-allergen exposure and several of them previously showed a good accuracy to predict the clinical diagnosis established by an experienced allergist but also the positive reaction to skin prick testing. In contrast with the previous questionnaire developed for predicting atopic sensitization to airborne allergen in children including questions on the variability of symptoms following exposure to dust mite, pets, and pollens, our version is focused specifically on HDM and could be applied

in both adult and pediatric population [12]. Other questionnaires were previously developed for the diagnosis of allergic diseases. The international study of asthma and allergy in childhood used core questionnaires to identify patients with allergic rhinitis, wheezing, and eczema without any question dedicated to HDM-allergy [16]. A standardized questionnaire was developed later to discriminate patients with allergic and non-allergic rhinitis with a score ≥ 7 able to identify those with allergy. This questionnaire includes one item where HDM is suggested as an answer between other trigger factors for symptoms occurrence [19]. To the best of our knowledge, our study is the first in the literature that applies the Delphi method to generate a questionnaire. This method is more frequently used in medicine to establish consensual definitions, based-evidence practice, and guideline development [56–58]. However, our study has some limitations related mainly to the lack of real-world validating clinical data, potential selection bias (given that the Delphi panel includes only experts, without general practitioners), and the self-reported nature of expert opinions without patient-level assessment. In addition, the absence in the expert panel of a representant from Asian/Pacific countries could pose limitations for a generalized acceptance. Indeed, the seasonal variations to HDM exposure (item 10) were documented only in temperate regions but not in subtropical/tropical areas [45–48].

Future works are needed to validate our questionnaire in clinical setting and to confirm its accuracy for predicting the diagnosis of HDM-allergy. Furthermore, the questionnaire could be adapted for the occupational exposure and different geographical regions.

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Author Contributions A.T. and C. P. drew the project. A.T. managed the project, did the analysis, and wrote the main manuscript. All authors were involved in the Expert panel and reviewed the manuscript.

Data Availability No datasets were generated or analysed during the current study.

Declarations

Competing Interests AT reports honoraria for lectures, presentations, speakers bureaus, educational events from AstraZeneca, BMS, Roche; support for attending meetings and/or travel from Chiesi; consulting fees from AstraZeneca FB reports grants from Chiesi, GSK, Vitalaire; consulting fees from AstraZeneca, GSK, Chiesi, Menarini; honoraria for presentations from Menarini group, AstraZeneca, GSK, Chiesi, Novartis; he is president of Interasma KK reports licenses for UpToDate; honoraria for presentations from ALK, AstraZeneca, Aurivitas Pharma, Berlin Chemie, Chiesi, Emma MDT, Stallergenes; support for attending meetings from Berlin Chemie GGF reports honoraria from Reprints Unlimited HCG reports consulting fees from AstraZeneca, Novartis, Sanofi; honoraria for presentations from AstraZeneca, Novartis, Sanofi, GlaxoSmithKline, Takeda JCI reports honoraria for presentations from Laboratorios Casasco; leadership for World Allergy Organization, Latin American Society of Allergy, Asthma & Immunology DM, SN, PN, JB, AY, AB have no conflict of interest to declare. FJGB reports grants from GSK; consulting fees from ALK, AstraZeneca, Bial, Chiesi, Gebro Pharma, GSK, Menarini, Novartis, Rovi, Roxall, Sanofi, Stallergenes-Greer, Teva; support for attending meetings from ALK, Menarini, Sanofi; participation on Advisory Boards from ALK, AstraZeneca, GSK, Menarini, Novartis, Sanofi, Teva PS reports consulting fees from AstraZeneca, Boehringer Ingelheim, Chiesi, Elpen, GSK, Guidotti, Menarini, Specialty Therapeutics; honoraria for presentations from AstraZeneca, Boehringer Ingelheim, Chiesi, Elpen, GSK, Guidotti, Menarini, Novartis, Pfizer, ResMed, Specialty Therapeutics; support for attending meetings from AstraZeneca, Boehringer Ingelheim, Chiesi, Elpen, GSK, Guidotti, Menarini, Pfizer DN reports honoraria for presentations from AstraZeneca, Berlin Chemie, Chiesi, Takeda; support for attending meetings from AstraZeneca, Stallergen SM reports grants from GSK; honoraria for presentations from AstraZeneca, Gebro Pharma, Sanofi PiS reports consulting fees from AstraZeneca, Sanofi, Dompe, Gilead; honoraria for presentations from Menarini, Edmondpharma, GSK; leadership for Italian Respiratory Society GWC reports consulting fees from AstraZeneca, GSK, Menarini, Stallergenes, Sanofi; honoraria for presentations from AstraZeneca, GSK, Menarini, Stallergenes, Sanofi, Menarini, Chiesi; support for attending meetings from AstraZeneca, Menarini, Stallergenes, Sanofi, Menarini CP reports consulting fees from AstraZeneca, Chiesi, GSK, Sanofi; honoraria for presentations from AstraZeneca, Chiesi, GSK, Sanofi.

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