



Evaluation of a Spanish Language version of the Asthma Trigger Inventory

Hernando Torres-Zevallos, Alfredo G. Guerreros, Juan C. Bazo-Alvarez, German F. Alvarado, Karinna Vazquez, Jonathan M. Feldman & Thomas Ritz

To cite this article: Hernando Torres-Zevallos, Alfredo G. Guerreros, Juan C. Bazo-Alvarez, German F. Alvarado, Karinna Vazquez, Jonathan M. Feldman & Thomas Ritz (2020): Evaluation of a Spanish Language version of the Asthma Trigger Inventory, Journal of Asthma, DOI: [10.1080/02770903.2020.1734022](https://doi.org/10.1080/02770903.2020.1734022)

To link to this article: <https://doi.org/10.1080/02770903.2020.1734022>



Accepted author version posted online: 22 Feb 2020.



Submit your article to this journal [↗](#)



Article views: 22



View related articles [↗](#)



View Crossmark data [↗](#)



Running title: Spanish Language Asthma Trigger Inventory

Evaluation of a Spanish Language version of the Asthma Trigger Inventory

Hernando Torres-Zevallos, M.D.¹, Alfredo G. Guerreros, M.D.², Juan C. Bazo-Alvarez, MSc³, German F. Alvarado, M.D., Ph.D.¹, Karinna Vazquez, Ph.D.⁴, Jonathan M. Feldman, Ph.D.⁵, and Thomas Ritz, Ph.D.^{6*}

¹Facultad de Salud Pública y Administración “Carlos Vidal Layseca”, Universidad Peruana Cayetano Heredia, Lima, Peru

²Clinica Internacional, Lima, Peru

³Instituto de Investigación, Universidad Católica Los Angeles de Chimbote, Chimbote, Peru

⁴Memorial Rehabilitation Institute, Hollywood, FL, USA

⁵Ferkauf Graduate School of Psychology/Yeshiva University, Albert Einstein College of Medicine/Montefiore Medical Center, Bronx, NY, USA

⁶Southern Methodist University, Dallas, TX, USA

This article is accompanied by an *Online Supplement* file

**Address for correspondence:* Thomas Ritz, Department of Psychology, Southern Methodist University, 6116 North Central Expressway, Suite 1160, Dallas, TX 75206; phone: +1 214 768 3724; fax: +1 214 768 0821; email: tritz@smu.edu

Abstract

Background: Perceptions of asthma triggers provide important guidance for patients’ disease management. A psychometrically valid instrument, the Asthma Trigger Inventory, is available in English and German language versions, however, a version in Spanish as major world language has been missing.

Method: A Spanish-language version of the ATI was evaluated in 339 adult patients with asthma, 223 of these in Peru and 107 in the USA. Principal Component analysis (PCA) with Varimax rotation was used to identify coherent trigger domains across and within samples. Resulting subscales were evaluated for internal consistency.

Results: PCA suggested differences in factor structures between sites. Whereas the USA sample largely replicated original factors for animal allergens, pollen allergens, physical activity, air pollution/irritants, infections, and psychology, the initial analysis of the Peru sample suggested substantial overlap of air pollution/irritant, infection, and allergen items. Subsequent analysis of an expanded research form of the ATI for the Peru site culminated in extraction of five factors related to psychology, climate/temperature, combined pollen and animal allergens, physical activity, and infection. Internal consistencies were in an acceptable to excellent range ($\alpha=.74$ to $.94$). Additional free trigger responses confirmed the importance of climate variables for patients in Peru. Psychological triggers were reported by 26% (Peru) and 31% (USA) of patients.

Conclusion: Coherent trigger domains are readily identified and measured reliably by a Spanish-language ATI version. However, factor structures vary between samples from different Hispanic/Latino cultural and geographic domains. Culturally adapted versions of this instrument are therefore required for Hispanic/Latino population studies.

Keywords: asthma; asthma triggers; questionnaire; Hispanic/Latino populations; illness perception; asthma management; climate; air pollution; psychology; allergic triggers

INTRODUCTION

In asthma, the airways are hyper-responsive to a variety of triggers¹. Air pollution, allergens, infections, physical activities, or cold air are the most common triggers related to

episodes of obstruction in asthmaⁱ. These triggers can have different presentation depending on the population, and geography, and each could have different effects on the severity of asthma symptomsⁱⁱ. Evidence shows that subpopulations of asthma patients may have particular trigger types^{2,iii,iv}. Factors such as asthma phenotype^{v,vi} or racial/ethnic origin^{vii}, may explain the differences in asthma illness perception between patient populations, and differences in trigger types.

The assessment of patients' asthma triggers is vital for successful asthma management^{viii}. Knowing the asthma triggers of a patient can help health care professionals to guide their treatment decisions and give avoidance recommendations^{ix,10}. Asthma triggers have been shown to consistently share variance with poor asthma control across studies¹¹⁻¹⁴. Triggers that are harder to avoid or control may put a greater burden on professional asthma care, asthma self-management, and patients' quality of life. Psychosocial stress, air pollution, and airway infections, are among the triggers that are more difficult to control or avoid².

Asthma triggers as an aspect of patients' illness perception have only recently been studied using a structured methodology. The Asthma Trigger Inventory (ATI) has been developed as a self-report measure that allows for a psychometrically valid measurement of patients' perceived asthma triggers². The assessment of the 32-item English language version in primary care patients yielded a six-factor structure that justified the formation of reliable subscales, including, animal allergy, pollen allergy, physical activity, air pollution/irritants, infection, psychological triggers, and a single item for house dust. The Asthma Trigger Inventory (ATI) was validated in English and German language versions^{2,15}. The feasibility, factor structure, and psychometric integrity of the ATI was confirmed in American child and adolescent asthma patients varying in gender, race and socioeconomic status¹⁶. Findings with the ATI

suggest that greater reports of non-allergic triggers, in particular psychological triggers, are associated with poor perceived health, more psychopathology, increased use of health care, and suboptimal asthma control^{2,15-18}. Thus, variations in patients' predominant trigger factors may tap into clinically relevant distinctions among subgroups of asthma patients.

However, the instrument has not yet been evaluated for measuring the perception of asthma triggers in the Spanish language. Although results with British, German, and American versions of the ATI appeared to converge, there were also differences in terms of frequencies of trigger factors and associations with demographics.. In addition, different geographical regions or environments can be expected to produce different asthma trigger factors. Thus, in a pilot study of an ATI version translated into Bahasa Indonesia we found that additional climate-related factors could be relevant for a sample from the island of Java, Indonesia¹⁹. In approaching a Spanish language version, an additional complication can be language differences between different national or cultural groups of Hispanics/Latinos. This has been documented in other questionnaire research where differences in wording complicated the construction of a universal Spanish language version²⁰. Therefore, we studied the factor structure and psychometric properties of a Spanish version of the ATI in two different samples of Hispanics/Latinos, one drawn from a patient population in Peru and one from a Puerto Rican population residing in the US.

METHODS

Participants

The study included a total of 339 Spanish-speaking adults with asthma, 232 of these participated in Lima, Peru and 107 in New York, NY, USA. All participants were at least 18 years of age at the time of the evaluation.

Patients from the Lima sample met the following criteria: (1) a medical diagnosis of asthma¹, with any level of severity (rated according to standard criteria¹), and currently receiving medical attention, (2) being regularly seen as ambulatory patient at the institution, (3) having spirometry testing, no more than 3 months prior to the study, and grade A, for forced expiratory volume in the first second (FEV₁) and forced vital capacity (FVC) pre- and postbronchodilator maneuvers, according to ATS/ERS acceptability and repeatability criteria²¹. Patients were excluded if they, (1) had a smoking history (more than 10 packs/year), (2) were diagnosed with COPD, (3) were unable to read, (4) used immunotherapy in the past year, (5) used biological therapy (e.g. omalizumab) in the past year, or (6) had active rheumatic disease. Concomitant diseases were self-reported. However, medical history was reviewed from the patient data basis of the institution. .

For the New York sample, participants were recruited primarily from asthma clinics, hospitals, and the community in the context of an asthma and panic treatment study. All participants self-classified as Hispanic/Latinos. Participants were excluded for (1) smoking history of 20 packs-years or more, (2) respiratory disorder other than asthma, (3) active psychosis, substance dependence or abuse, or bipolar disorder.

Measures

Asthma Trigger Inventory. The ATI included the 32 translated items of the prior evaluations of the ATI^{2,15,16} for New York. Items were rated on a 5-point scale (0-4, “Never”,

“Rarely”, “Sometimes”, “Often”, and “Always”) indicating how often each agent triggered the participant’s asthma symptoms or exacerbations. In the second free report part, participants were then asked to indicate up to 6 agents that trigger asthma the most. Each of these six top triggers were then rated by the patient on a 5-point scale (0-4, “Not at all”, “Slightly”, “Moderately”, “Very Much”, and “Completely”) indicating (1) how much the agent affects their daily life, and (2) the degree to which they can avoid or control that agent without the use of bronchodilators. These freely reported triggers can uncover additional items not covered in the standard version for additional individualization of asthma management. The Spanish version of the scale was translated independently by two bilingual Spanish speakers of Mexican and Venezuelan ancestry and the consensual version was back-translated and subsequently reviewed by a third bilingual Spanish speaker of Mexican ancestry. For the Lima sample, additional review of items was undertaken by two bilingual Peruvian pulmonologists with expertise in asthma and psychometric assessment. This resulted in an expanded research version with 71 items total that also included culturally adapted trigger items.

Procedure

The study protocol was approved by the Universidad Peruana Cayetano Heredia and Albert Einstein College of Medicine Institutional Review Boards. Questionnaires were administered during outpatient medical visits at university-affiliated hospitals. All participants provided informed consent before any study procedure. For the Lima sample, all the participants had an asthma diagnosis and ambulatory control in the Pulmonology Service at the Clinica Internacional in Lima, Peru. We randomly recruited one out of every three patients with asthma for this study. The data were collected by a self-administered questionnaire under the supervision

of the study coordinator. For the New York sample, recruitment was undertaken in primary care clinics, asthma, allergy, and chest clinics, and emergency rooms at Jacobi Medical Center, Montefiore Medical Center and North Central Bronx Hospital. Flyers were also posted and providers sent mail advertising the study to their patients. Eligibility was determined by a questionnaire administered in clinics and over the phone as a part of the screening for a larger treatment study.

Statistical analysis

Descriptive statistics were calculated for each site. Exploration of factor structure was undertaken by principal component analysis (PCA) followed by orthogonal Varimax rotation with Kaiser normalization, in correspondence with previously published ATI studies^{2,15,16}. The number of extracted factors was guided by experience with established versions of the ATI and examination of scree plots, communalities, and content validity^{2,15}. Variance contributions of factors were calculated for the rotated solution.

Initially, the 32 items identical across both study samples were examined. Subsequently, when inconsistencies arose with the standard version, a PCA exploration was planned with the expanded research item pool for the Lima sample. Items with primary factor loadings $>.45$ and $h^2 >.40$ were retained for the final version of the questionnaire.

Psychometric properties of the subscales were determined for the complete sample as well as each study site separately. This included internal consistency by Cronbach's α , inter-item correlations, item difficulty by item means, and item-test correlation analysis. Additionally, the associations between resulting subscales were examined by Pearson correlations. Free reports of

triggers were analyzed descriptively with the percentage of reports from the whole study sample at the two sites.

RESULTS

Sample characteristics

Participants were on average middle aged with a wide range, with those at the New York site being older and predominantly female (Table 1). Participants were recruited primarily from letters mailed from providers (54.8%), outpatient clinics (16.5%), newspaper advertisement (7.8%), emergency departments (5.2%) and other sources (15.7%). Additional data from the Lima site showed married status for 59.1% ($n=137$), and severity of asthma as mild persistent 6.9% ($n=16$), moderate persistent 39.7% ($n=92$), and severe persistent 53.5% ($n=124$). Education level for the Lima sites was as follows: less than high school 3.9%, high school 37.5%, additional technical studies 23.7%, university 30.6%, and postgraduate education 4.3%.

Factor structure of the Spanish version of the original 32-item version of the ATI

Initial analysis of the overall sample showed the best solution with extraction of five factors. Four factors were related to psychological triggers (10 items, 18.1% of the variance after rotation), allergens (combining pollen and animal-related triggers; 7 items, 16.8%), physical activity (3 items, 7.7%), and infection (4 items, 6.4%). However, the third factor (9.5%) showed only rudimentary resemblance to an air pollution/irritant factor, with 3 items (cigarette smoke, exhaust fumes, certain intensive odors) showing acceptable loadings, whereas 3 more items (smell of paint, perfumes, sprays) showing primary loadings on the allergen factor. One physical activity item was also loading on the third factor, rendering the solution unsatisfactory.

Differences in factor structure of the 32-item ATI version between US and Peru samples

Examination of the factor structure separately for the subsamples revealed a more satisfactory 6-factor structure closer to the original ATI version for the New York site. However, given the smaller sample size of the New York site, the main evaluation of a new Spanish version was subsequently focused on the Lima site (n=232) (see *Online Supplement* for preliminary evaluation of the factor structure for the New York site and the final questionnaire version in Table S1). The solution for the Lima site using 32 items was not satisfactory, with allergen and air pollution/irritant items loading on one factor and the four infection items spread out over the last two factors.

Factor structure of an expanded Spanish research version of the ATI for Peru

Exploring the expanded 71-item research version for the Lima site extraction of all factors with eigenvalues >1 showed good separation for cold air/humidity, psychological factors, physical activity, and infection items. Air pollution/irritant items were spread out over multiple factors, with some (perfumes, sprays, smell of paint, certain intensive odors) joining a factor that was otherwise characterized by animal and pollen allergens. Assembly of the final version focused on the 5 item domains that loaded most coherently. For this final version, a satisfactory solution was obtained with extraction of 5 factors related to psychological triggers (8 items, 19.9%), climate/temperature (7 items, 16.9%), combined pollen and animal allergens (6 items, 12.2%), physical activity (6 items, 11.7%), and infection (4 items, 6.5%). The house dust item, which was interpreted separately in the original version, showed stronger loadings on the climate factor (.56) and a secondary loading on the allergen factor (.42). It was thus kept and interpreted

as a separate individual item to avoid potential misinterpretation (see Table 2 for factor loadings and *Online Supplement Appendix S1* for final Lima version of the questionnaire).

Psychometric properties

Table 3 shows mostly favorable psychometric properties for all resulting final subscales at both sites. Internal consistency was good to excellent for most scales, with Cronbach's alphas ranging between .74 and .94 for the Lima site and .68 and .87 for the New York site. Only the coefficient for the infection scale remained unsatisfactory (.56) for the New York site.

Intercorrelations of trigger scales and their association with demographics

Subscales showed mostly moderate correlations, with higher coefficients for the ATI version of the Lima site (Table 4). For the New York site, allergen subscales showed on average lower associations with the non-allergic trigger subscales. Associations with age, gender, and asthma onset were mostly low and nonsignificant (Table 5).

Free report of triggers

Self-reported top triggers showed similarities and differences between sites (Figure 1). For Lima, additional triggers related to climate, frozen drinks, laughing, coughing, and sore throat were reported. Climate-related triggers were less relevant for the New York site, whereas air pollutants were equally mentioned. Approximately 30% of patients in both samples found psychological triggers relevant to their asthma. Plant-related triggers (e.g., pollen) were barely considered by patients from Lima.

DISCUSSION

The present study for the first time evaluated a Spanish language version of the ATI. Our findings showed that, although a meaningful structure can be identified for subsamples of Spanish speaking individuals with asthma, they are likely to vary across regions and populations. Structures were not fully comparable between the largely Hispanic/Latino communities in the US and Peru. Such variations are possibly due to differences in climate, geography, industry, vegetation, and/or education. Similarities with factor structures identified in earlier studies of samples from Great Britain², Germany¹⁵, and the English-speaking US¹⁶ were restricted to trigger domains of psychology, allergens, and physical activity. Psychometric properties were well acceptable for the resulting subscales. Our evaluation resulted in two different Spanish-language versions of the ATI, one for the US that resembled largely prior versions and one for Peru, which featured a new climate/temperature subscale, but had no separate air pollution/irritant scale. More research with larger samples is needed to replicate and consolidate these proposed Spanish-language questionnaire measures.

Comparing both populations, the psychological trigger domain was well replicated both in its structure and frequency, mirroring the experience with other language versions of the ATI. Approximately 30-40% of participants reporting the major importance of this domain for their asthma compared well with 43% of adult patients reporting lifetime experience with this type of trigger in a survey of five European countries¹³ and 20-40% of asthmatic populations experiencing clinically significant bronchoconstriction when exposed to bronchoconstrictive suggestions or emotional stimuli^{22,23}. Regarding mean item scores, the psychological trigger scale showed lower values compared to scales of the other major domains, again reflecting prior experience and possibly the fact that their experience is less frequent than those of other domains (8.2 weeks per

year compared to 18.2 weeks for “dust or dusting”, the most frequent trigger in the European survey¹³). Despite that, psychological triggers have been shown to be related to asthma control and exacerbations, even when controlling for other major triggers^{17,18}. Physical activity and exercise were also relatively consistently identified as a coherent trigger domain in analysis of item structure across samples. Whereas some studies estimate the prevalence rate of exercise-induced bronchoconstriction in asthma with up to 90%, only 30-40% of patients in our two samples reported exercise as a major trigger, which is more compatible with 54% of patients that reported any lifetime experience of this trigger in the European survey¹³. It is also possible that cultural differences or lifestyle choices, such as preference of more sedentary behavior in urban settings of New York and Lima, account for the lower rates observed in our samples. Interestingly, difficulties in replicating trigger domains were mostly linked to air pollution/irritants, respiratory infections, and pollen allergens, for which the initial evaluation of the original ATI identified a factor that largely collapsed these domains into each other. It could be speculated that perceived air quality is viewed as a major problem for asthma in particular Hispanic/Latino cultures and that fewer distinctions are sometimes made between different sources of suboptimal air quality. The desert climate of Lima with high levels of air pollution may account for this finding. Consequently, a coherent climate factor was identified with the expanded and culturally more relevant research version of the ATI. Aspects related to climate are well known to be associated with worsening of asthma, such as cold temperature²⁴, heat^{25,26}, dampness and humidity²⁷, and dry air²⁸. Pilot findings with the ATI evaluated in Bahasa Indonesia language included two climate related factors, with cold/humid air and dry/hot air¹⁹. Patients from Lima also viewed house dust as related to climate factors or air pollution^{29,30}. For the sample from New York, the respiratory infection items were not satisfactory in their coherence, as shown by low internal consistency estimates. The

findings suggest that the cognitive structure of perceived triggers of asthma, similar to other aspects of asthma perception and management, is likely culture-specific^{8,31-36}. In addition to varying environments, cultural specifics, and lay perceptions, the level of traditional biomedical asthma education may also play a role in emphasizing particular triggers more than others.

Key findings of our study also point to an obvious limitation, in that the ATI was only evaluated across two populations, and broader evaluations in different Hispanic/Latino cultures would be needed. The New York subsample was also smaller than the Lima sample. However, the similarity of the New York factor structure with the original ATI increases our confidence in the findings. A further limitation was that we also did not have a comparison with biological tests of trigger impact, but the goal of the ATI as a self-report instrument is not the replacement of biological exposure or challenge tests, but to capture patients' cognitive structure of asthma triggers as an important aspect of illness perception, which can determine asthma management strategies.^{3,9-11,37,38} Positive associations with responding to skin tests for allergies or bronchoconstriction to standardized emotion induction have been shown before^{2,15}. These and other associations with actual biological trigger effects will need to be replicated in future observational and challenge studies with Hispanic/Latino samples. As an additional limitation, despite being both Hispanic/Latino populations, our two samples not only differed in geographical and cultural aspects, but also in recruitment method and demographics (older age and more women in the NY sample, somewhat higher education level in the Lima sample). There may also have been differences in education level and asthma severity. Although direct comparisons are not possible due to lack of more detailed information about the full NY recruitment sample, the treatment study sample that was eventually drawn from the NY sample³⁹ had a lower education with 27.1% showing less than high school education and 45.8% education beyond high school. In

addition, severity of the Lima sample was relatively high with 53.5% being classified as severe persistent, which is substantially more than in prior ATI samples^{15,16} and the NY treatment study³⁹ that were in the 25-30% range for severe asthma. The focus of the Lima recruitment site on patients that require extra specialty care probably contributed to that. However, whereas it is conceivable that the number of possible trigger factors and their impact is higher in more uncontrolled or severe asthma^{13,37,38}, it would be more difficult to explain how differences in the structure of trigger domains would be affected by asthma control or severity.

In conclusion, Spanish language versions of the ATI have been identified that show promise for capturing patients' trigger perception in two different Hispanic cultural spheres. Variations in perceptions of trigger factors across Hispanic/Latino cultures and geographical regions have to be considered in future research.

Acknowledgments

The authors thank Miriam Dum, John Malka, and Georgina Ahumada for helping with the translation process of the questionnaire.

Funding Details

Part of this study was completed by HZT as part of the Master of Epidemiological Research Program offered jointly by the Universidad Peruana Cayetano Heredia, Lima, Peru (UPCH) and the Center for Tropical Disease Research of the U.S. Navy (NAMRU-6). The master program is part of the program 2D43 TW007393 "International Training Consortium in Epidemiological Research," sponsored by the Fogarty International Center of the National Institutes of Health (NIH/FIC).

Disclosure Statement

None of the authors has a financial conflict of interest to report.

Author Contributions

HTZ, JF, and TR conceived and designed the study. HTZ, AG, and KV collected and curated the data. HTZ and TR analyzed and interpreted the data. HTZ, JF, and TR drafted the manuscript.

HTZ, JF, AG, JBA, GA, and TR revised the manuscript for important intellectual content. HTZ, AG, JBA, GA, KV, JF and TR approved of the final version of the manuscript.

Data Availability Statement

Data are available from the authors upon request within reasonable limits.

REFERENCES

1 National Heart, Lung, and Blood Institute. National Asthma Education Program. (2007). Expert Panel on the Management of Asthma. Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma. Full Report 2007. Washington DC: US Department of Health and Human Services; 2007.

Available from: <https://www.nhlbi.nih.gov/health-topics/guidelines-for-diagnosis-management-of-asthma>

2 Ritz T, Steptoe A, Bobb C, Harris AH, Edwards M. The asthma trigger inventory: validation of a questionnaire for perceived triggers of asthma. *Psychosom Med*. 2006;68:956-65.

3 Janssens T, Ritz T. Perceived triggers of asthma: key to symptom perception and management. *Clin Exp Allergy*. 2013;43:1000-8.

4 Charpin D, Ramadour M, Lanteaume A, Vervloet D. Triggers in intrinsic asthma in the EGEA study. *J Asthma*. 2003;40:87-91.

- 5 Sarafino EP, Gates M, DePaulo D. The role of age at asthma diagnosis in the development of triggers of asthma episodes. *J Psychosom Res.* 2001;51:623-8.
- 6 Rackemann FM. Intrinsic asthma. *Bull N Y Acad Med.* 1947;23:302-6.
- 7 Wenzel SE. Asthma phenotypes: the evolution from clinical to molecular approaches. *Nat Med.* 2012;18:716-25.
- 8 Koinis-Mitchell D, McQuaid EL, Friedman D, Colon A, Soto J, Rivera DV, Fritz GK, Canino G. Latino caregivers' beliefs about asthma: causes, symptoms, and practices. *J Asthma.* 2008;45:205-10.
- 9 Taggart V, Rachelefsky G. Patient education: creating a partnership for effective asthma care. In: Bierman CW, Pearlman DS, Shapiro GG, Busse. WW (Eds.), *Allergy, asthma, and immunology from infancy to adulthood.* Philadelphia: WB Saunders. 1996. pp. 268-81.
- 10 Kaur R, Chupp G. Phenotypes and endotypes of adult asthma: Moving toward precision medicine. *J Allergy Clin Immunol* 2019;144:1–12.
- 11 Bobb C, Ritz T, Rowlands G, Griffiths C. Effects of allergen and trigger factor avoidance advice in primary care on asthma control: a randomized- controlled trial. *Clin Exp Allergy.* 2010;40:143-152.
- 12 Vernon MK, Wiklund I, Bell JA, Dale P, Chapman KR. What do we know about asthma triggers? A review of the literature. *J Asthma.* 2012;49:991-8.
13. Price D, Dale P, Elder E, Chapman KR. Types, frequency and impact of asthma triggers on patients' lives: a quantitative study in five European countries. *J Asthma* 2014;51:127-35.
- 14 Morales-Raveendran E, Goodman E, West E, Cone JE, Katz C, Weiss J, Feldman JM, Harrison D, Markowitz S, Federman A, Wisnivesky JP. Associations between asthma trigger reports, mental health conditions, and asthma morbidity among world trade center rescue and recovery workers. *J Asthma* 2019;56:833-840.

- 15 Ritz T, Kullowatz A, Kanniess F, Dahme B, Magnussen H. Perceived triggers of asthma: evaluation of a German version of the Asthma Trigger Inventory. *Respir Med.* 2008;102:390-8.
- 16 Wood BL, Cheah PA, Lim J, Ritz T, Miller BD, Stern T, Ballou M. Reliability and validity of the Asthma Trigger Inventory applied to a pediatric population. *J Pediatr Psychol.* 2007;32:552-60.
- 17 Ritz T, Bobb C & Griffiths C. Predicting asthma control: The role of psychological triggers. *Allergy Asthma Proc* 2014;35:390-7.
- 18 Ritz T, Wittchen H-U, Klotsche J, Mühlhig S, Riedel O. sap-NEEDs study group. Asthma trigger reports are associated with low quality of life, exacerbations, and emergency treatments. *Ann Am Thorac Soc* 2016;13:204-11.
- 19 Zeni SG, Yuniarti KW, von Leupoldt A, Dahme B, Ritz T. Structure and psychometric properties of an Indonesian version of the Asthma Trigger Inventory. *Psychosom Med.* 2009;71:A-51
- 20 Smith TL, Klein MH, Alonso C, Salazar-Fraile J, Felipe-Castaño E, Moreno CL, Acosta SR, Rios LI, Martí-Sanjuán V. The Spanish version of the Wisconsin Personality Disorders Inventory-IV (WISPI-IV): tests of validity and reliability. *J Pers Disord* 2011;25:813-33.
- 21 Graham BL, Steenbruggen I, Miller MR, Barjaktarevic IZ, Cooper BG, Hall GL, et al. Standardization of Spirometry 2019 Update. An Official American Thoracic Society and European Respiratory Society Technical Statement. *Am J Respir Crit Care Med.* 2019;200(8):e70–e88. .
- 22 Isenberg SA, Lehrer PM, Hochron S. The effects of suggestion and emotional arousal on pulmonary function in asthma: a review and a hypothesis regarding vagal mediation. *Psychosom Med* 1992;54:192-216.
- 23 Ritz T. Airway responsiveness to psychological processes in asthma and health. *Front Physiol* 2012;3:343.

- 24 Hyrkäs H, Ikäheimo TM, Jaakkola JJ, Jaakkola MS. Asthma control and cold weather-related respiratory symptoms. *Respir Med.* 2016;113:1-7.
- 25 Xu Z, Huang C, Hu W, Turner LR, Su H, Tong S. Extreme temperatures and emergency department admissions for childhood asthma in Brisbane, Australia. *Occup Environ Med.* 2013;70:730-5.
- 26 Wisniewski JA, McLaughlin AP, Stenger PJ, Patrie J, Brown MA, El-Dahr JM, Platts-Mills TA, Byrd NJ, Heymann PW. A comparison of seasonal trends in asthma exacerbations among children from geographic regions with different climates. *Allergy Asthma Proc.* 2016;37:475-481.
- 27 Voelker R. Asthma forecast: why heat, humidity trigger symptoms. *JAMA.* 2012;308:20.
- 28 Nielsen KG, Bisgaard H. Hyperventilation with cold versus dry air in 2- to 5-year-old children with asthma. *Am J Respir Crit Care Med.* 2005;171:238-41.
- 29 Romieu I, Gouveia N, Cifuentes LA, de Leon AP, Junger W, Vera J, Strappa V, Hurtado-Díaz M, Miranda-Soberanis V, Rojas-Bracho L, Carbajal-Arroyo L, Tzintzun-Cervantes G; HEI Health Review Committee. Multicity study of air pollution and mortality in Latin America (the ESCALA study). *Res Rep Health Eff Inst.* 2012;(171):5-86.
- 30 Cadelis G, Tourres R, Molinie J. Short-term effects of the particulate pollutants contained in Saharan dust on the visits of children to the emergency department due to asthmatic conditions in Guadeloupe (French Archipelago of the Caribbean). *PLoS One.* 2014;9:e91136.
- 31 Lieu TA, Lozano P, Finkelstein JA, Chi FW, Jensvold NG, Capra AM, Quesenberry CP, Selby JV, Farber HJ. Racial/ethnic variation in asthma status and management practices among children in managed medicaid. *Pediatrics.* 2002;109:857-65.
- 32 Hardie GE, Janson S, Gold WM, Carrieri-Kohlman V, Boushey HA. Ethnic differences. Word descriptors used by African-American and white asthma patients during induced bronchoconstriction. *Chest.* 2000;117:935-43.

- 33 Pachter LM, Cloutier MM, Bernstein BA. Ethnomedical (folk) remedies for childhood asthma in a mainland Puerto Rican community. *Arch Pediatr Adolesc Med.* 1995;149:982-8.
- 34 Panettieri RA Jr, Spector SL, Tringale M, Mintz ML. Patients' and primary care physicians' beliefs about asthma control and risk. *Allergy Asthma Proc* 2009;30:519-28.
- 35 Sidora-Arcoleo K, Feldman JM, Serebrisky D, Spray A. A multi-factorial model for examining racial and ethnic disparities in acute asthma visits by children. *Ann Behav Med.* 2012;43:15-28.
- 36 Tay TR, Choo XN, Yii A, Chung KF, Chan YH, Wong HS, et al. Asthma phenotypes in a multi-ethnic Asian cohort. *Respir Med* 2019;157:42–8.
- 37 Rank MA, Wollan P, Li JT, Yawn BP. Trigger recognition and management in poorly controlled asthmatics. *Allergy Asthma Proc* 2010;31:99-105.
- 38 Peterson MG, Gaeta TJ, Birkhahn RH, Fernández JL, Mancuso CA. History of symptom triggers in patients presenting to the emergency department for asthma. *J Asthma* 2012;49:629-36.
- 39 Feldman JM, Matte L, Interian A, Lehrer PM, Lu SE, Scheckner B, Steinberg DM, Oken T, Kotay A, Sinha S, Shim C. Psychological treatment of comorbid asthma and panic disorder in Latino adults: Results from a randomized controlled trial. *Behav Res Ther* 2016;87:142-54.

Table 1. Demographics, descriptive statistics from variables collected at both sites

	Lima (n=232)	New York (n=107)
Age		
Mean	39.6	53.6
±SD	13.4	11.9
Min - max	18-84	24-86
Gender, % women	55.6	77.8
Age of onset of asthma		
Mean	18.8	30.3
±SD	13.6	19.3
Min - max	0-65	0-73

Table 2. Results of the Principal Component Analysis with Varimax-rotated factors for the Spanish language version of the Asthma Trigger Inventory (Lima, Peru)

Item	Psychology	Climate/ Temperature	Allergens	Physical Activity	Infection	Communalities (h ²)
Depressed mood	.83	.14	.21	.16	.13	.80
Intense worries	.81	.14	.11	.21	.17	.75
Being excited	.79	.07	.12	.17	.22	.72
Feeling tense	.79	.18	.13	.15	.09	.71
Feeling unhappy	.79	.12	.29	.10	.18	.77
Stress at home	.77	.18	.08	.28	.02	.71
Arguments with people	.73	.12	.17	.25	.13	.66
Feeling alone	.65	.14	.34	.21	.07	.60
Humid air	.11	.75	.26	.25	.02	.70
Cold air	.10	.74	.21	.10	.11	.62
Dampness outside	.16	.73	.17	.30	.14	.70
Damp rooms	.15	.71	.36	.17	.17	.72
Weather changes	.07	.69	-.03	.14	.18	.53
Humidity on house walls	.11	.65	.27	.20	.11	.55
Cold drinks	.38	.63	.19	.13	.05	.59
Pollen from weeds	.33	.21	.74	.14	.11	.74
Feathers from birds	.27	.42	.70	.11	.09	.76
Cats	.16	.36	.67	.34	.10	.73
Pollen from grass	.38	.22	.66	.19	.23	.72
Animal hair	.18	.39	.62	.25	.04	.64
Sport activities	.25	.19	.19	.76	.17	.73
Running	.19	.29	.08	.75	.14	.71
Climbing flights of stairs	.40	.31	.07	.61	.12	.65
Overexertion	.25	.25	.39	.60	.20	.68
Bicycle riding	.36	.13	.37	.59	.05	.64
Brisk walking	.32	.37	.20	.59	.06	.62
Sinus problems	.15	.06	.35	.12	.72	.68
Flu	.21	.45	-.03	.15	.66	.71
Having a cold	.32	.37	.00	.10	.62	.63
Viruses	.26	.11	.29	.38	.46	.51
House dust	.10	.57	.41	.16	.14	.54

Table 3. Psychometric properties of Spanish language Asthma Trigger Inventory scales

ATI trigger subscale	N items	Item mean	$\pm$ SD	r_{ii} (mean)	α
Lima, Peru					
Psychology	8	1.48	1.02	.66	.94
Climate/Temperature	7	2.67	0.91	.55	.89
Allergens	5	1.92	1.10	.64	.90
Physical activity	6	2.08	0.94	.58	.89
Infection	4	2.37	0.89	.42	.74
New York, USA					
Psychology	10	1.51	1.01	.40	.87
Air pollution/irritants	6	2.55	0.96	.31	.73
Allergens (animal)	3	2.21	1.41	.51	.76
Allergens (pollen)	3	2.40	1.28	.52	.77
Physical activity	4	1.86	1.10	.34	.68
Infection	4	2.33	0.96	.24	.56

Table 4. Correlations (Pearson) between subscales of the Spanish versión of the Asthma Trigger Inventory

Lima	Psychology	Climate/ Temperature	Allergens	Physical activity	
Psychology	-				
Climate/Temperature	0.46	-			
Allergens	0.59	0.67	-		
Physical activity	0.65	0.63	0.67	-	
Infection	0.56	0.58	0.56	0.58	
New York	Psychology	Air pollution/ irritants	Allergens (animals)	Allergens (pollen)	Physical activity
Psychology	-				
Air pollution/irritants	0.33	-			
Allergens (animal)	0.23	0.31	-		
Allergens (pollen)	0.12	0.40	0.38	-	
Physical activity	0.37	0.36	0.24	0.08	-
Infection	0.35	0.30	0.26	0.24	0.44

Note: for coefficients $r > .25$: $p < .01$

Table 5. Correlations (Pearson) between Asthma Trigger Inventory subscales and participant characteristics

Lima (n=232)	Psychology	Climate/ Temperature	Allergens	Physical activity	Infection	
Age	.10	.05	.15	.02	.03	
Gender	.09	.14*	.05	.12	.18**	
Asthma onset	.04	.08	.08	-.09	-.05	
New York (n=107)	Psychology	Air pollution/ Irritants	Allergens (animal)	Allergens (pollen)	Physical activity	Infection
Age	-.16	.01	.12	.08	-.22*	-.23*
Gender	.06	-.08	.03	.13	-.12	-.09
Asthma onset	-.19	-.11	-.14	.01	-.19	-.08

Note: Coefficients by Pearson product-moment correlation (age, age of onset) or point-biserial correlation (gender, female =1)

* $p < .05$ ** $p < .001$

Figure 1. Percentage of self-reported triggers over the total of participants in Lima and New York samples (each participant contributed up to six of their most important asthma triggers)

Figure 1.

