
The prevalence of atopic dermatitis in Puerto Rican school children

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Background: Atopic dermatitis is a common inflammatory disease of the skin that usually begins in childhood and its diagnosis depends on clinical criteria. Recent reports have indicated that the worldwide prevalence of atopic dermatitis is increasing. The objective of this study was to determine the prevalence of atopic dermatitis in schoolchildren between the ages of six and seven in two school districts in Puerto Rico.

Methods: The Laughter questionnaire, developed to determine the prevalence of atopic dermatitis in schoolchildren was translated and validated in Spanish. A population-based prevalence survey was conducted among second grade students in the districts of Guaynabo and Humacao, Puerto Rico. The prevalence of atopic dermatitis was determined by sex, school type (private or public), and geographical location (urban or rural) using the questionnaire.

Results: Ninety-two percent (92%) of the eligible schools participated in the study. A total of 2,393 questionnaires were distributed with a response rate of 53%. The prevalence of atopic dermatitis among the population surveyed was 24.8%. The prevalence of atopic dermatitis by sex or geographic location was not significantly different ($p > 0.05$). An excess of atopic dermatitis was observed in private schools (31.0%) when compared to public schools (19.9%). The effect remained after controlling potential confounders ($POR_{\text{Mantel-Haenszel}} = 1.37$; 95%CI: 1.07 – 1.42).

Conclusion: This study presents evidence of a significant public health problem in Puerto Rico. The prevalence of atopic dermatitis in Puerto Rico is high and possibly a large percentage (70%) of the patients is not been diagnosed.

Key words: Atopic dermatitis, Prevalence, Asthma, Children, Hispanics.

Atopical dermatitis (AD) is a common inflammatory disease of the skin that typically begins in childhood and peaks during the first year of life (1). These patients usually present with pruritus, which can lead to secondary skin infections, and can impair the patient's ability to socially interact with other children (2,3). The diagnostic criteria of the disease have been a subject of debate, and its diagnosis depends mostly on clinical findings (1,4).

There have been several reports that indicate that the prevalence of atopic dermatitis is increasing (5-8). In previous studies conducted in Europe, the cumulative incidence rate of atopic dermatitis in children before 1960 was 2-3%, increasing to 15-20% in the 1980s (9,10). Even though some of the increase could be attributed to changes in diagnostic criteria or increased awareness of the disease, researchers using the same method (questionnaire) in different time periods have provided evidence of the increasing trend. The prevalence of this condition in Puerto Rico has never been studied.

The prevalence of atopic dermatitis at the population level has been estimated in several studies using self-administered questionnaires. The International Study of Asthma and Allergies in Childhood (ISAAC) established a standard methodology that facilitated international research collaboration (8). ISAAC developed a screening questionnaire to assess the prevalence of atopic dermatitis, asthma and allergic disease. The highest prevalence was reported in Australia, New Zealand, Northern and Western Europe, Urban Africa and Japan. The lowest prevalence reported was in Eastern and Central

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Europe, and China. (6,7). The striking international differences detected in the ISAAC study suggested that environmental factors are critical. A slight female preponderance in the prevalence of atopic dermatitis was observed in all participating countries.

In 1980, Hanifin and Rajka (1) established the criteria for the diagnosis of atopic dermatitis. Williams and the United Kingdom Working Party in 1990 simplified and validated those criteria (11-13). According to the newly proposed diagnostic guidelines of atopic dermatitis, known as the United Kingdom refinement of the Hanifin and Rajka criteria, the patient must have an itchy skin condition plus three or more of the following: history of involvement of flexural and extensor areas, personal history of asthma or hay fever or first-degree relative with asthma or hay fever, history of generalized dry skin, visible flexural eczema and onset under the age of 2.

In 1992, Schultz Larsen (9) developed a questionnaire based on the original Hanifin-Rajka criteria and demonstrated that the questionnaire model was a cost-effective, sensitive and specific method to determine the prevalence of AD. Laughter, et al. modified the Schultz Larsen Questionnaire (SLQ) and used it to estimate the prevalence of atopic dermatitis in schoolchildren between the ages of 5 and 9 in Oregon, USA (14). The Laughter questionnaire was used to develop the instrument for this study.

The objectives of this study were to determine the prevalence of atopic dermatitis in children in two separate school districts in Puerto Rico (Humacao and Guaynabo) and to calculate the prevalence by gender, school type (private versus public), and geographical location (urban versus rural).

Methods

Translation and validation of questionnaire. The Laughter questionnaire (14) was evaluated and translated into Spanish. The process was guided by the concept of “decentering” translation (15) which produces culturally adequate questions that collect the same type of information in the translated language as intended in the original instrument. The content and vocabulary of the instrument were modified to account for literacy level, and to improve the readability. These modifications facilitated the interpretation of questions.

The score value for each question remained identical to the English version of the Laughter questionnaire. However, the a question regarding seasonal changes was eliminated since there are no major temperature fluctuations in Puerto Rico throughout the year; and the question regarding use of clothing made of wool was

modified since this is not commonly used in Puerto Rico. The final questionnaire consisted of 11 questions and each question had an assigned value. A total score was calculated for each participant. The maximum number of points that could be obtained was 140 points. The total number of points is the same as in the original (SLQ) Shultz-Larsen questionnaire (10).

The validation process was conducted with 56 pediatric patients from a dermatologic clinic in Puerto Rico. A coded questionnaire was given to one of the patient’s parents to complete, afterwards the patients were evaluated and examined by a dermatologist to determine whether they had atopic dermatitis. The patient was classified according to one of the following diagnoses: “Patient with atopic dermatitis”, “No atopic dermatitis” or as “Other condition with pruritus”. The sensitivity, specificity and positive predictive value of the questionnaire were calculated using the dermatologist diagnosis as the Gold Standard. Two different cutoff points were evaluated using the experience of the European studies (scores ≥ 50 points or scores ≤ 80 points) (10).

When a score of ≥ 50 points in the questionnaire was taken as an indicator of atopic dermatitis, the sensitivity of the test was 100% (22/22) and the specificity was 59% (20/34). The positive predictive value was 61% and the negative predictive value was 100%. If a cutoff score of ≥ 80 points is used the instrument have a sensitivity of 68% and a specificity of 71%, as well as a positive predictive value of 60% and negative predictive value of 60%. The cutoff of 50 score points was selected due to better sensitivity. A high sensitivity improves the opportunity of identifying those patients with atopic dermatitis. Even though the specificity of this questionnaire is not as high, it is within the acceptable values. A questionnaire with a score of 50 points was classified as positive for atopic dermatitis. With this instrument, all participants with atopic dermatitis will have a positive questionnaire and can be identified.

Prevalence Survey. The study was designed as a population-based survey and was conducted in two school districts in Puerto Rico, namely Guaynabo and Humacao. The municipality of Guaynabo is located in the northern metropolitan area, while Humacao is a municipality on the Eastern coast of Puerto Rico. In Humacao, the per capita income was estimated to be \$7,677 and 53% of the families were considered to be under the poverty level during 1999 (16). In Guaynabo, the per capita income was estimated to be \$16,287 and 39% of the families were considered to be under the poverty level during 1999. In Humacao and Guaynabo, the percentage of children between the ages of 5 to 9 was similar (7.9% and 7.4%, respectively) (16).

The school listing and the number of second grade students per school were obtained from the General Council of Education of Puerto Rico. They were approached after the appropriate authorizations were obtained from the Department of Education of Puerto Rico, and from the directors of private schools. Five schools (1 public, 4 private) out of a total of sixty-six refused to participate in the study due to conflicting activities in the schools, therefore, less than 8% of the target schools were not included in the survey.

Second grade students between the ages of 6 and 7 were eligible to participate. The participating schools in Guaynabo were 32 schools (17 public schools and 15 private schools) with 1,356 second grade students: 778 students in public schools and 578 students in private schools. Nine schools were in the rural area and 23 schools were in the urban area. The participating schools in Humacao were 29 schools (22 public schools and 7 private schools) with 1,037 second grade students: 806 students in public schools and 231 students in private schools. Twenty schools were in the rural area and nine schools were in the urban area.

The questionnaire, distributed to the children in the classroom was to be completed by the parents at home. It included an explanatory cover letter and an informed consent form. The cover letter specified that all the information was anonymous. The authors had no personal or identifying information once the questionnaire was retrieved from the school. Children were asked to return the questionnaire within a week to their homeroom teacher. To enhance participation and return of questionnaires, every child returning a questionnaire received a small gift. School principals were later contacted by phone to collect any questionnaire that was returned after the posted dateline.

Analysis. Information was entered into an electronic data bank using EPIINFO (17). Ten percent of the questionnaires were re-entered to evaluate data entry errors as well as unaccepted data values that were not detected by programming strategies. Frequency tables were constructed and the data was first analyzed by evaluating variables distributions. The prevalence was calculated by sex, school type and geographical area in the two school districts. The prevalence odds ratio was also estimated to evaluate the statistical significance of the observed results. The potential of interaction and confounding of the collected variables (gender, school type and geographical area) was evaluated by school district, since the estimation of a combined prevalence of atopic dermatitis was an important study objective. The Mantel Haenszel method was used to evaluate the potential for interaction and confounding by stratifying the suspected variables by

school district. Multivariate adjustments by logistic regression analysis was conducted using STATA (18).

Results

A total of 2,393 questionnaires were distributed among 61 schools. Twelve hundred sixty five (1,265) questionnaires were received for a response rate of 53%. The response rate was similar in both Humacao and Guaynabo school district (53%). Twenty-five questionnaires were incomplete. The following results were based on 1,240 completed questionnaires received. In Humacao, 402 completed questionnaires were received from public schools and 142 from private schools. In Guaynabo 401 completed questionnaires were received from the public schools and 295 from the private schools. The distribution of participating children grouped by school district was different for gender ($p=0.06$), school type ($p<0.001$) and geographical area ($p<0.001$). (Table 1).

Table 1. Number and distribution of study participants by school district

Characteristics	Humacao Number (%)	Guaynabo Number (%)	c ² (p value)
Returned questionnaires	551 (53%)	714 (53%)	0.85 (p=0.82)
Complete	544	696	
Incomplete*	7	18	
Missing questionnaires	486 (47%)	642 (47%)	
Total	1037	1356	
Participating children			
Gender			
Girls	288 (55%)	341 (50%)	3.53(p=0.06)
Boys	232 (45%)	342 (50%)	
Total	520 _‡	683	
School type			
Private	142 (26%)	295 (42%)	35.4(p<0.001)
Public	402 (74%)	401 (58%)	
Total	544	696	
Geographical area			
Urban	220 (40%)	493 (71%)	115.4 (p<0.001)
Rural	324 (60%)	203 (29%)	
Total	544	696	

*Incomplete questionnaire had one or more unanswered questions that were needed to estimate the participant atopic dermatitis score and were not included in the analysis.

‡Missing information regarding the sex of the participant.

The prevalence of atopic dermatitis was 22.8% in Humacao and 26.4% in Guaynabo. The unadjusted prevalence of atopic dermatitis for both school districts was 24.8%. The prevalence of atopic dermatitis according

to gender, school type and geographical location are presented in Table 2. The prevalence of AD is slightly lower for girls in the school district of Humacao but slightly higher in the school district of Guaynabo. Nevertheless, the observed difference by gender was not statistically significant ($p > 0.05$) in either school district. The prevalence of AD is higher among children in private school in both school districts. There is a significant association ($POR = 1.81$; $p = 0.01$) between the type of school (private school)

A question regarding previous diagnosis of atopic dermatitis by a physician was included. Ninety percent (90%) of the participants that had a previous diagnosis of atopic dermatitis were correctly identified by the questionnaire. Nevertheless, a considerable proportion of children (70%) with scores of ≥ 50 points in the questionnaire, that suggest atopic dermatitis, also answered that they had never being diagnosed by a clinician.

Table 2. Number and prevalence of atopic dermatitis cases by gender, school type (private or public), and geographical location (urban or rural area) and unadjusted Prevalence Odds ratio (p value) for each participating school district (Humacao and Guaynabo).

Characteristics	Humacao				Guaynabo			
	AD Cases*	Number participants	Prevalence (%)	POR†† (p value)	AD Cases*	Number participants	Prevalence (%)	POR†† (p value)
Gender								
Girls	64	288	(22.2)	0.92(p=0.68)	96	341	(28.2)	1.18(p=0.33)
Boys	56	232	(24.1)	Reference	85	342	(24.9)	Reference
Total	120	520†			181	683†		
School type								
Private	44	142	(31.0)	1.81(p=0.01)	83	295	(28.1)	1.16 (p=0.38)
Public	80	402	(19.9)	Reference	101	401	(25.2)	Reference
Total	124	544			184	696		
Geographical location								
Urban	51	220	(23.2)	1.04(p=0.86)	133	493	(27.0)	1.10(p=0.61)
Rural	73	324	(22.5)	Reference	51	203	(25.1)	Reference
Total	124	544			184	696		

* Atopic dermatitis cases based on a questionnaire score of ≥ 50 points

† Missing values

††Unadjusted Prevalence Odds Ratio

and the prevalence of atopic dermatitis in the school district of Humacao, but the association ($POR = 1.16$) was not significant ($p = 0.38$) in the school district of Guaynabo. Even though the prevalence of AD is slightly higher in the urban area when compared to the rural area, the difference was not significant ($p > 0.05$).

As seen in Table 3, there is no significant effect by either gender or geographical location of the school when the adjusted odds ratio ($POR_{Mantel-Haenszel}$) was calculated. The $POR_{Mantel-Haenszel}$ was slightly higher for girls (1.06) and for urban schools (1.07), but the 95% confidence interval included the null value on both estimates. However, the significant effect of school type (private school) remained ($POR_{Mantel-Haenszel} = 1.37$; 95% CI: 1.07 – 1.42) even after controlling the potential differences in the distribution of the number of private and public schools in each school district. The statistical power of this observation is 80% which was considered appropriate for this survey.

Table 3. Number and prevalence of atopic dermatitis for the total sample by gender, school type and geographical area and adjusted POR (95% CI) by school district

Characteristics	Total sample: Humacao and Guaynabo			
	AD cases*	Number participants	Prevalence (%)	POR _{Mantel-Haenszel} †† (95% CI)
Gender				
Girls	160	629	25.4	1.06 (0.81-1.39)
Boys	141	574	24.6	
Total	301†	1203†		
School type				
Private	127	437	29.1	1.37 (1.04-1.81)
Public	181	803	22.5	
Total	308	1240		
Geographical location				
Urban	184	713	25.8	1.07 (0.81 - 1.42)
Rural	124	527	23.5	
Total	308	1240		

* Atopic dermatitis cases based on a questionnaire score of ≥ 50 points

† Missing values

††Adjusted prevalence odds ratio (POR) by school district

Discussion

The prevalence of AD at the population level has been recently determined in several studies with self-administered questionnaires. The self-administered questionnaire has proven to be an effective tool for epidemiologic investigations in clinical as well as in population-based settings.

The prevalence of atopic dermatitis for children between the ages of 6-7 in Puerto Rico (24.8%) is similar to the prevalence reported in countries such as Denmark (22%), Norway (24%) and England (20%) using the questionnaire methodology (19-21). The ISAAC Study estimated a lower prevalence of atopic dermatitis in the 1990's, in Costa Rica (8.7%), Mexico (4.9%), and Brazil (7.3%) (6-8). Since the prevalence of atopic dermatitis could also be increasing in those countries, we may predict that the current prevalence would be much higher. Recent studies in Italy (15.2%) and in Oregon USA (17.2%) revealed a lower prevalence of atopic dermatitis than the prevalence observed in Puerto Rican children (22,14).

There are several factors that could explain the high prevalence of atopic dermatitis in Puerto Rico. In a cross-sectional prevalence survey of 693 junior schoolchildren in London, it was found that the prevalence of atopic dermatitis, according to examination by a dermatologist, was 16.3% in black Caribbean children and 8.7% in white children (23). The authors suggested that there could be a phenomenon of natural selection for people capable of making large amounts of IgE that was previously useful in the defense against helminthes in their country of origin. Helminthic infections were common in Puerto Rico in the past, and perhaps our patients have a Th2 system which strongly reacts against these kinds of infections, making them more susceptible to activation by allergens.

The high prevalence of atopic dermatitis obtained in this study correlates with reports of a high prevalence of asthma observed in Puerto Ricans. According to a study performed in New York, Puerto Ricans have a high prevalence of asthma when compared to other Latinos in the community (24). Other data from the Hispanic Health and Nutrition Examination Survey done in 1982-1984 revealed a high prevalence of asthma among Puerto Ricans when compared to Mexicans and Cubans (25). In the ISAAC study, the centers with a low prevalence of atopic dermatitis symptoms were the same as those with low asthma prevalence.

In an independent study conducted in Humacao, a high prevalence of asthma (21.5%) was found among schoolchildren (26). The odds ratio between asthma and atopic dermatitis was 3.35 (95% CI: 2.08-5.40) among these children (26). There have been reports that nearly 80% of

children with AD develop allergic rhinitis or asthma, suggesting that allergen sensitization through the skin predisposes people to a lifetime of allergies and respiratory diseases (27-28). Studies of long-term prognosis of AD indicate that 30-50% of those attending clinics due to AD subsequently develop asthma (9). If the correlation with asthma continues to be strong in prospective studies, the early detection of atopic dermatitis could also serve as an indicator of the risk of a more severe and life threatening disease.

There was no statistical difference between the percentage of students with atopic dermatitis in rural schools (23.5%) and urban schools (25.8%). This was expected since there are no major differences in the geographical areas in Puerto Rico in terms of environmental exposure (climate and degree of urbanization) or type of clothing used.

Students in private schools have 1.37 times the possibility of having atopic dermatitis when compared to students in public schools. This finding correlates with several other studies that have found a higher prevalence of atopic dermatitis among higher socioeconomic classes (29-30). Possible explanations for these findings include the lack of exposure to infections and antigens in children from higher socioeconomic classes at a very young age ("the hygiene hypothesis"), however, it is also possible that parents in the private schools are more aware of the disease, leading to a reporting bias due to an earlier evaluation and diagnosis of the condition.

Non-response bias represents a considerable problem in epidemiological studies. It is more prominent in surveys using mailed questionnaires but also may be present in studies like this one, where parents, school teachers and children are involved in carrying through the process of returning questionnaires. The 24.8% prevalence of atopic dermatitis could be an overestimation of the true prevalence if the majority of non-respondents were indeed parents of healthy children. If the majority of non-respondents had children with atopic dermatitis, but were not motivated enough to participate, the observed prevalence (24.8%) would be an underestimation of the true prevalence. Since the majority of respondents (66%) were from public schools, and this is correlated with a lower socioeconomic level, the observed prevalence of atopic dermatitis is more likely to be an underestimation of the true prevalence.

The study had certain limitations. Dermatologic conditions with pruritus also obtained high scores in the questionnaire and represented the possibility of being a false positive. The age of the patient influences the total score of the questionnaire. A younger age translates into shorter duration of the condition and less opportunity for

the observation of symptoms, thus fewer points could be obtained in related questions. Also fewer points will be obtained in questions related to life styles patterns. For these reasons the questionnaire should not be used in children less than 4. There is a possibility of recall bias since the answers depended on parent's memory. Also those families with allergic conditions might be more inclined to report symptoms.

There was no practical method to increase participation in this survey. Children and their parents were not identified and non-respondents could not be followed through with motivational strategies to remind them of returning the questionnaires. The authors of the study acknowledge this limitation. Even though the response rate was low (53%) the percent of children returning the questionnaire was similar in both school districts, which had different socioeconomic characteristics. Unless the effort to return the questionnaire was associated with a previous diagnosis of atopic dermatitis, there is little reason to suspect that volunteer bias modified study results. This response rate is comparable with the Oregon study, which had an overall response rate of 56.8% (14). Also, since 92% of eligible schools participated in this survey, the schools that refused could not produce significant response bias.

In conclusion, this study presents evidence of a significant public health problem in Puerto Rico that has not been adequately assessed. In spite of the high prevalence of the disease in both school districts, almost 70% of those patients have not been properly diagnosed and treated. The results obtained in this study established the questionnaire's effectiveness in assessing the prevalence of atopic dermatitis in a Hispanic population. The questionnaire model is cost-effective, and sufficiently sensitive and specific. This study could serve as a model for other epidemiologic investigations among Hispanic children.

Resumen

La dermatitis atópica es una enfermedad inflamatoria de la piel que usualmente comienza en la niñez. Su diagnóstico depende de criterios clínicos. Reportes recientes sugieren que la prevalencia de esta enfermedad está aumentando.

Este estudio tiene el objetivo de determinar la prevalencia de la dermatitis atópica en niños entre 6 y 7 años de dos distritos escolares en Puerto Rico. El cuestionario Laughter que se utiliza para determinar la prevalencia de dermatitis atópica en estudiantes se tradujo y se validó al idioma español. Con éste se determina la prevalencia de la enfermedad en los distritos de Guaynabo y Humacao en Puerto Rico.

Se distribuyó un total de 2,593 cuestionarios con una respuesta del 53%. Se encontró que la prevalencia de la enfermedad era 24.8%; 31.0% - escuelas privadas y 19.9% escuelas públicas. Este estudio presenta evidencia de que la dermatitis atópica es un problema de salud pública significativo, y probablemente muchos pacientes no son diagnosticados.

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