

Determinants of Quality of Life in Children With Asthma

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Summary. Background: HRQoL in children with asthma depends on multiple factors, among which asthma severity and level of control are believed to play a vital role. The determinants of the connection between asthma severity and asthma control with quality of life remain unclear. Aims: Primary aim of the study was to evaluate the HRQoL in children with asthma and to determine the factors that affect it. Materials and Methods: In total 504 children and one of their parents were recruited during a regular follow up visit in an outpatient asthma clinic. The measures used were the DISABKIDS smiley measure (DSmM), chronic generic measure—long form (DCGM-37) and the Condition-specific modules for asthma along with a special form for collecting demographic and clinical characteristics. Results: Three hundred fifteen children with mean age 5.35 years (Group A) and 189 with mean age 10.79 years (Group B), were recruited. Children with controlled asthma had significant higher mean score than the other asthma control groups ($P < 0.001$). Corticosteroid use, asthma severity, number of visits in doctor's office and lack of asthma control were significantly associated with the DCGM-37 scores as well as Impact Scale and Worry Scale. Lack of Asthma Control was the only factor that was associated with negative HRQoL in all the multiple regression models, controlling for the effect of the other covariates, in both age groups. Conclusions: In conclusion, the evaluation of asthma HRQoL independently reflects the asthma control state and a dimension of its severity. These results highlight the need to modify asthma management strategy. **Pediatr Pulmonol.** © 2013 Wiley Periodicals, Inc.

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INTRODUCTION

Nowadays, there is a broad acceptance that health-care must focus on patient-related outcomes such as health-related quality of life (HRQoL). This may be more important in patients with chronic diseases where the treatment is directed towards symptom control rather than cure.^{1,2} Additionally, international guidelines on asthma management point to the concept that asthma control is currently considered the target of treatment.^{3–8} Therefore, patients' burden of asthma cannot be assessed just by disease severity; it requires measurements reflecting personal perception such as the impact on everyday life due to disease, emotional functioning and HRQoL.^{5,9,10}

The most characteristic feature of childhood asthma is the variability of the condition with marked fluctuations in symptoms and asthma control over time.^{5,6} HRQoL in children with asthma depends on multiple factors, among which asthma severity and level of control are believed to play a vital role. They both refer to distinct clinical aspects of the disease, with asthma

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control to reflect the degree to which these symptoms limit activities, disturb sleep, or require the use of a relief inhaler.^{11,12}

Several studies indicate that HRQoL tend to be lower in children with moderate to severe asthma. Nevertheless, limited information is available in children with mild asthma.^{5,13–15} Thus, the determinants of the connection between asthma severity and asthma control with quality of life (QoL) remain still unclear. Previous studies have demonstrated high levels of QoL in spite of the severity of illness, due to a successful process of adaptation to the disease.¹⁶ Furthermore, a broad range of ages must be assessed, since usually such studies rely on proxy reports for younger children and self-reports for older ones. As a consequence, differences in HRQoL between age groups may be attributed to reporting differences.¹⁷

According to our research hypothesis due to asthma clinical variability, the HRQoL in children is associated with a variety of factors, among which asthma severity and level of control are believed to have a key role. Furthermore, we hypothesized that the level of asthma control has a direct effect on HRQoL independently of its severity. Consequently, primary aim of this study was to evaluate the HRQoL in children with asthma and to determine the factors that affect it. Reporting differences may affect the evaluation of HRQoL and therefore we parallelly explored the level of agreement between child self-report and parent proxy-reports concerning HRQoL in children with asthma.

MATERIALS AND METHODS

Participants

In total 504 children and one of their parents were recruited during a regular follow up visit in the outpatient asthma clinic of Penteli Children's Hospital in Athens over the period from springtime 2005 to autumn 2007. Data was obtained through interviews from both children and parents (separately) in randomly selected dates throughout the aforementioned time period. Participants were divided in two age groups (Group A, aged 4–7 years and group B, aged 8–14 years (group B)) in order to match the age-appropriate research instruments.

ABBREVIATIONS:

GINA	Global Initiative for Asthma
QoL	Quality of Life
HRQoL	Health-related quality of life
DSmM	DISABKIDS smiley measure
DCGM-37	DISABKIDS chronic generic measure—long form

Measures

The measures used for the study were the DISABKIDS smiley measure (DSmM), the DISABKIDS chronic generic measure—long form (DCGM-37) and the DISABKIDS Condition-specific modules for asthma along with a special form for collecting demographic, asthma treatment, asthma symptom, home environment, school environment and clinical characteristics.^{18–20}

The DISABKIDS chronic generic module (DCGM-37) consists of 37 rating-scaled items assigned to six dimensions: Independence, Emotion, Social inclusion, Social exclusion, Limitation, and Treatment. These scales have showed satisfactory internal consistencies, ranging from $\alpha = 0.79$ (Social inclusion) to $\alpha = 0.90$ (Emotion). These six dimensions can be combined to produce a general score for HRQoL. DISABKIDS-Smiley measure assesses general HRQoL in children between 4 and 7 developmental years. A 5-point scale of smiley faces response scale was used.^{2,18,19}

The condition specific asthma questionnaire (DISABKIDS Asthma Module) consists of two domains: the impact domain (six items), concerning limitations and symptoms and the worry domain (five items), concerning fears related to asthma. The internal consistency of the impact domain is $\alpha = 0.83$ and $\alpha = 0.84$ for the worry domain.^{2,18,19} In the study both DISABKIDS self-report versions (child version) and proxy versions (completed by one of their parents) were used.

Data Collection

Data collection was performed, after hospital's ethics committee's approval was granted, through interviews with children and their parents (parents were not present during child's interview and vice-versa). Parents and older children signed the informed consent for their participation and younger children gave their oral consent. The study conformed fully with the Declaration of Helsinki for biomedical research on human subjects.

Demographic, home and school environment characteristics along with the age appropriate DISABKIDS Instruments were filled. The next step was a thorough history concerning asthma symptoms triggers and treatment. Asthma severity assessment was based on symptoms, airflow obstruction, response to treatment and treatment requirements during the last 6 months prior to the interview. The level of asthma control was assessed for the 4-week period prior to the interview. Questions regarding daytime symptoms, activity limitations, nocturnal symptoms, quick-relief medications usage, along with questions about hospital care and occurrence of exacerbations were included. Spirometry and clinical examination were also performed before the interview. Asthma severity was defined according to the updated 2006 GINA guidelines which categorize asthma

severity into four categories (intermittent, mild persistent, moderate persistent, severe persistent) and defines asthma control as controlled, partly controlled and uncontrolled.⁴ Asthma friendly house (friendly, not friendly) was defined according to the protective measures taken in the house along with the level of exposure to possible asthma triggers and data concerning home environmental characteristics. Moreover, asthma exacerbations or asthmatic symptoms related to season climate changes and exposure to certain triggers (moisture, dust, smoke, etc.) were noted.

Statistical Analysis

Intra-class correlation coefficients (ICC) were used to assess the degree of agreement in child's HRQoL scores between children and parents. Comparisons between different groups of continuous variables were performed by the calculation of Student's *t*-test and one-way Analysis of Variance (ANOVA). Simple linear regression analysis was applied using as dependent variables all the HRQoL outcomes measured by the DISABKID modules for Group A and Group B. Furthermore, in order to examine for possible effect modification between asthma severity and asthma control (as dichotomous variables), the significance of the change in the coefficients of determination (R^2) for the Group A and B models with an interaction (product) term in relation to the models without it, was estimated. All the variables significantly related in the simple regression analysis were entered simultaneously in a multivariate linear regression model assessing the adjusted effect of each one covariate for the presence of all the others in the regression model, plus age and gender for Group A, and six statistical significant variables chosen with clinical criteria from the univariate analysis plus age and gender for Group B, due to the small number of participants in each strata. All reported *P* values are based on two-sided tests and compared to a significance level of 5%. STATA 11.0 software (Stata Inc., 2011, College Station, TX) was used for all the analyses.

RESULTS

In Group A 315 children were recruited, with mean age 5.35 years and 189 in Group B with mean age 10.79 years. Table 1 presents the several demographics and socioeconomics characteristics of participants and their parents for the two age groups, respectively.

Younger children's (Group A) mean DSMM score was 67.74 (± 18.44) whereas their parents showed a higher one (72.54 ± 11.73 , mean difference: -4.8 ; $P < 0.001$). Girls rated HRQoL higher than boys (70.29 ± 17.73 vs. 66.13 ± 18.74 , mean difference: 4.16 ; $P = 0.048$) and mothers rated lower DSMM score

than fathers (71.7 ± 11.71 vs. 75.23 ± 11.47 , mean difference: -3.5 $P < 0.001$). Nevertheless, fathers' assessment of HRQoL score was closer to their children self-assessment as the mean ICC was significantly higher than mothers (0.581 and 0.448, respectively). Similarly, in Group B the ICCs ranged between 0.405 (i.e., inclusion sub-scale) and 0.720 (i.e., impact) with lower degree of agreement (0.244) for general sub-scale.

A simple linear regression analysis was performed in order to investigate the effect of a variety of demographic and clinical characteristics on DSMM score in Group A. These results are provided as Table 1 in the supplement. The R^2 for the crude model (without the interaction term) was 0.53, denoting that 53% of the total HRQoL score could be attributed to the covariates included. However, the R^2 change for multiple regression models with and without an interaction term between asthma control and asthma severity was statistical significant ($P = 0.012$), revealing a significant effect modification between the aforementioned variables. The stratified results according to the level of asthma severity are presented in Table 2. Lack of asthma control had the major negative effect in the HRQoL of 4–7 years old children with mild intermittent or persistent asthma with the smallest adjusted standardized beta value compared with the betas of all the other covariates, while for the children of Group A with moderate or severe asthma, lack of asthma control, although remained the most important of all the models' covariates, had almost half of the effect in the HRQoL compared to the children with mild asthma. On the opposite, as much as 55.9% of the HRQoL score variance could be attributed to the model's covariates for the children with moderate or severe asthma compared to the 34.7% of the same model for the children with mild asthma.

Similarly in Group B, a simple linear regression analysis was performed on DCGM-37 Generic Measure Scale and all the sub-scales as well as Impact Scale and Worry Scale scores. These results are provided as Table 2 in the supplement. Treatment duration, asthma triggers (pet ownership and residing in asthma friendly houses), asthma symptoms (phlegm and wheezing) and lack of asthma control were chosen from the set of the significantly associated variables in the univariate analysis to be included in the multivariate regression model. Moreover, similar to Group A, the R^2 change for the multiple regression models with and without an interaction term between asthma control and asthma severity was also statistical significant ($P = 0.039$). In Tables 3a and 3b, the stratified results according to the level of asthma severity (mild intermittent or persistent and moderate or severe) are presented. Lack of Asthma Control was the only factor that was associated with

TABLE 1—Descriptive Socio-Demographic Characteristics of Children and Their Parents

Children	Group A, 4- to 7-year-old (n = 315)		Group B, 8- to 14-year-old (N = 189)	
Gender	Boys	Girls	Boys	Girls
Number of participants	193 (61.27%)	122 (38.73%)	121 (64.02%)	68 (35.98%)
Age ¹ (years)	5.73 (1)	5.30 (1)	10.83 (2.05)	10.03 (1.97)
Age at time of diagnosis ¹ (years)	2.35 (1.51)	2.49 (1.51)	4.80 (3.16)	5.22 (2.75)
Duration of treatment ¹ (years)	3.06 (1.32)	2.84 (1.58)	5.52 (3.57)	4.87 (3.28)
Nationality				
Greek (469, 93.05%)	182	112	112	63
Other (35, 6.95%)	11	10	9	5
Place of residence				
Urban (378, 75.00%)	146	89	95	48
Rural (126, 25.00%)	47	33	26	20
Doctor's visits per year				
<3 (201, 39.88%)	43	78	57	23
≥3 (303, 60.12%)	150	44	64	45
Asthma severity				
Intermittent (52, 10.32%)	15	19	14	4
Mild persistent (227, 45.04%)	90	57	47	33
Moderate (201, 39.88%)	79	40	52	30
Severe (24, 4.76%)	9	6	8	1
Asthma control				
Controlled (277, 54.96%)	94	74	63	46
Partly controlled (168, 33.33%)	73	36	40	19
Uncontrolled (59, 11.71%)	26	12	18	3
Parents	Group A (n = 315)		Group B (N = 189)	
Gender	Fathers	Mothers	Fathers	Mothers
Number of participants	74 (23.49%)	241 (76.51%)	46 (24.34%)	143 (75.66%)
Age ¹ (years)	36.02 (5.27)	33.10 (5.01)	41.13 (5.18)	38.43 (4.77)
Educational status (years)				
Low-basic (≤12 years; 230, 45.63%)	28	110	17	75
High (>12 years; 274, 54.37%)	46	131	29	68
Family income (€ per month)				
0–2,000	135 (42.86%)		46 (24.34%)	
2,001–4,000	162 (51.43%)		127 (67.20%)	
>4,000	18 (5.71%)		16 (8.46%)	
Family socio-economical status				
Low	21 (6.67%)		32 (16.93%)	
Medium	217 (68.89%)		132 (69.84%)	
High	77 (24.44%)		25 (13.23%)	

¹Mean values (standard deviations).

negative HRQoL in all the multiple regression models, controlling for the effect of the other covariates except social inclusion for children with mild moderate or persistent asthma and physical activity for children with moderate or severe asthma. Moreover, standardized beta coefficients manifested lack of asthma control to be the covariate with the most negative HRQoL impact for Group B children with mild asthma while for the children with moderate or severe asthma, the same trend was identified except for Independence, Medication and Worry sub-scales. Overall, R^2 coefficients in the regression models for the children with mild asthma had higher values than the ones for children with moderate or severe asthma. The model explained the highest amount of variance in the Impact sub-scale for the mild

asthma category and in the Independence sub-scale for the moderate or severe asthma category.

DISCUSSION

Our study results pointed out that asthma control is the most important determinant of HRQoL in both age groups, among those variables that were tested in the model, since lack of asthma control was the only factor that was associated with negative HRQoL in all the multiple regression models, controlling for the effect of the other covariates. This finding is in accordance to the recent international practice and clinical guidelines that have begun placing greater emphasis on the concept of asthma control.^{6,21–23} Nowadays, asthma severity is

TABLE 2—Results From the Simple and Multiple Linear Regression Assessing the Effect of Various Factors in the Health-Related Quality of Life of Children Aged 4- to 7-Year-Old (Group A, n = 315) According to Level of Asthma Severity (Mild Intermittent or Persistent vs. Moderate or Severe)

	Mild intermittent or persistent children (n = 181)			Moderate or severe asthmatic children (n = 134)		
Coefficient of determination ² (R ²)	0.347			0.559		
Factors	Adjusted β^1 (95% CI)	Standardized betas	P-value	Adjusted β^1 (95% CI)	Standardized betas	P-value
Father smoker (yes vs. no)	−1.90 (−5.96, 2.16)	−0.060	0.36	−6.19 (−10.63, −1.74)	−0.17	0.007
Father allergic (yes vs. no)	−7.16 (−12.99, −1.31)	−0.16	0.01	−7.72 (−12.73, −2.71)	−0.18	0.003
Mother smoker (yes vs. no)	−2.80 (−6.97, 1.36)	−0.09	0.18	−3.79 (−8.25, 0.66)	−0.10	0.09
Pet owner (yes vs. no)	5.38 (0.61, 10.16)	0.15	0.02	9.96 (4.37, 15.56)	0.22	0.001
Asthma friendly houses (yes vs. no)	−15.25 (−22.39, −8.10)	−0.29	<0.001	−8.88 (−15.29, −15.29)	−0.18	0.007
Friendly school environment (yes vs. no)	−5.98 (−11.19, −0.76)	−0.15	0.02	−5.34 (−9.72, −0.95)	−0.15	0.01
Asthma triggers smoke (yes vs. no)	−4.69 (−13.00, 3.62)	−0.07	0.26	−7.97 (−14.16, −1.78)	−0.16	0.01
At least 1 doctor visit per 3 months for asthma	0.98 (−3.24, 5.19)	0.03	0.64	−8.39 (−12.64, −4.14)	−0.24	<0.001
Lack of asthma control (vs. controlled or partially controlled)	−30.89 (−43.24, −18.55)	−0.32	<0.001	−14.25 (−19.48, −9.02)	−0.35	<0.001

¹Adjusted for the effect of age, gender, father's smoking and allergic status, pet ownership, residing in asthma friendly houses, at least one visit in doctor's office every 3 months and the level of asthma control.

²R² for the model with no interaction term = 0.53.

thought to be a quite stable characteristic that may change, but usually slowly, whereas asthma control is a relatively short-term assessment of adequate management.^{6,24} Consequently, a child whose asthma symptoms are not well controlled might experience greater impairment in HRQoL. In addition, since poorly controlled asthma may lead to an increase in anxiety and/or depression, it is believed that emotional reaction as coping strategy influences HRQoL negatively.^{25,26}

We found that children with severe asthma experience analogous QoL as patients with moderate or even mild disease, providing that their level of asthma control was equal. In a previous study it was stated that there is a symptom related factor separate from symptom frequency that substantially influences the asthma subjective experience.²⁷ This appears to be the bother, frustration, concern, or discomfort caused by the symptoms or the need to modify one's environment to avoid the symptoms. Our results are in agreement with previous studies concluding that children with severe asthma report an even lower HRQoL compared to children with mild asthma.^{15,25} Moreover, in both age groups the loss of asthma control had a greater negative impact on children's HRQoL with mild severity in comparison to children with moderate or severe asthma. Therefore, when assessing the effect of asthma control on HRQoL, differences in disease severity should be taken into consideration.

Although children with severe asthma tend to have a poorer QoL than children with milder disease, parental and children's perception can be influenced by a number of factors.^{5,28} In agreement to this viewpoint, we

found that there are differences between proxies' and children's ratings despite asthma severity and that level of asthma control was affecting HRQoL independently of its initial severity. Katz et al. found that the number of life activities affected by asthma and the individual's perceived control of asthma explained variations in asthma-specific HRQoL, cross-sectionally and longitudinally. However, the relationship is complex.^{29–31}

Children and their parents stated that wheezing and phlegm have major negative effect to their HRQoL. Unquestionably, children are distressed by the symptoms themselves and the limitations they cause.¹³ Additionally, a patient's perceived lack of control may contribute to increased physical symptoms, while lack of self-efficacy has been associated with readmissions.³² Furthermore, in the active phases of asthma, parents may restrict the activity of affected children. Therefore, not only do these children bear the disease-induced symptoms, but their daily life and social communications are profoundly affected, which results in a decreased HRQoL.

The younger children are disturbed by every limitation in their preferable activities, such as sport, playing with their friends and/or pets, and visiting their friends.⁹ This is also supported by the fact that the children who owned a pet stated better HRQoL and that was correlated positively with their level of asthma control. Therefore, pet ownership could act as a good marker of independence and be correlated with better HRQoL and better level of asthma control. However, these findings must be interpreted with caution, since in our sample there were a limited number of children with known pet

TABLE 3a—Results From the Multiple Linear Regression Analysis Assessing the Effect of Various Factors in the Health-Related Quality of Life of Children Aged 8–16 Years Old (Group B, n = 98) With Mild Intermittent or Persistent Asthma (DCGM-37 & Disabkids Asthma Module)

Factors	Disabkids chronic generic measure—long form (DCGM-37)										Disabkids asthma module	
	General score adjusted β^1 (95% CI) Stand. beta	Independence adjusted β^1 (95% CI) stand. beta	Emotion adjusted β^1 (95% CI) stand. beta	Social exclusion adjusted β^1 (95% CI) stand. beta	Social inclusion adjusted β^1 (95% CI) stand. beta	Medication adjusted β^1 (95% CI) stand. beta	Physical activity adjusted β^1 (95% CI) stand. beta	Worry adjusted β^1 (95% CI) stand. beta	Impact adjusted β^1 (95% CI) stand. beta			
Coefficient of determination (R^2)	0.301	0.203	0.355	0.271	0.138	0.296	0.257	0.291	0.363			
Treatment duration	—	—	—	—	—	—	—	—	—			
Asthma triggers	—	—	—	—	—	—	—	—	—			
Pet owner (yes vs. no)	—	—	—	—	—	—	—	—	—			
Asthma friendly houses (yes vs. no)	—	—	—	—	—	—	—	—	—			
Asthma symptoms	—	—	—	—	—	—	—	—	—			
Phlegm ² (yes vs. no)	−6.92 (−11.73, −2.11)	−9.29 (−17.38, −1.19)	−16.47 (−26.14, −6.80)	−10.2 (−17.90, −2.53)	—	−17.09 (−27.98, −6.19)	−7.38 (−13.20, −1.56)	−14.04 (−24.45, −3.63)	−19.10 (−29.18, −9.02)			
Wheezing ² (yes vs. no)	−0.26 (−7.33, −0.82)	−0.05 (−7.33, −0.82)	−0.29 (−16.84, −3.78)	−0.24 (−11.99, −1.60)	−5.61 (−10.88, −0.35)	−0.28 (−17.20, −2.48)	−0.23 (−13.20, −1.56)	−0.24 (−16.31, −2.24)	−0.32 (−15.28, −1.66)			
Lack of asthma control ² (vs. controlled or partially controlled)	−4.08 (−23.04, −6.91)	−19.19 (−32.76, −5.62)	−35.73 (−51.95, −19.52)	−20.30 (−33.19, −7.42)	−0.21 (−10.88, −0.35)	−0.24 (−17.20, −2.48)	−17.79 (−27.55, −8.04)	−32.13 (−49.58, −14.68)	−35.56 (−52.46, −18.66)			

¹Adjusted for the effect of sex, age, treatment duration, asthma triggers (pet owner and residing in asthma friendly houses), asthma symptoms (phlegm and wheezing) and lack of asthma control for every regression model with depended variable the level of asthma severity.

²All results are statistically significant with $P < 0.05$.

TABLE 3b—Results From the Multiple Linear Regression Analysis Assessing the Effect of Various Factors in the Health-Related Quality of Life of Children Aged 8–16 Years Old (Group B, n = 91) with moderate or severe asthma (DCGM-37 & Disabkids Asthma Module)

Factors	Disabkids chronic generic measure—long form (DCGM-37)								Disabkids asthma module	
	General score adjusted β^1 (95% CI) stand. beta	Independence adjusted β^1 (95% CI) stand. beta	Emotion adjusted β^1 (95% CI) stand. beta	Social exclusion adjusted β^1 (95% CI) stand. beta	Social inclusion adjusted β^1 (95% CI) stand. beta	Medication adjusted β^1 (95% CI) stand. beta	Physical activity adjusted β^1 (95% CI) stand. beta	Worry adjusted β^1 (95% CI) stand. beta	Impact adjusted β^1 (95% CI) stand. beta	
Coefficient of determination (R^2)	0.188	0.303	0.235	0.206	0.187	0.231	0.157	0.175	0.204	
Treatment duration ²	0.73 (0.06, 1.41) 0.23	—	—	—	—	—	—	—	—	
Asthma triggers	—	—	—	—	—	—	—	—	—	
Pet owner (yes vs. no)	—	—	—	—	—	—	—	—	—	
Asthma friendly houses (yes vs. no)	—	—	—	—	—	—	—	—	—	
Asthma symptoms	—	—	—	—	—	—	—	—	—	
Phlegm (yes vs. no)	—	—15.00 (-21.66, -8.34) -0.42	-12.68 (-20.70, -4.66) -0.31	-8.37 (-15.43, -1.30) -0.23	-6.20 (-10.66, -1.75) -0.28	-11.31 (-19.60, -3.02) -0.27	-6.67 (-12.17, -1.17) -0.25	-9.40 (-16.74, -2.05) -0.26	-9.93 (-18.28, -1.59) -0.24	
Wheezing ² (yes vs. no)	—	-15.74 (-24.34, -7.14) -0.34	-17.89 (-28.25, -7.53) -0.34	-14.99 (-24.11, -5.86) -0.33	-5.83 (-11.59, -0.08) -0.20	-14.93 (-25.64, -4.23) -0.27	—	-11.02 (-20.50, -1.54) -0.24	-19.07 (-29.85, -8.30) -0.35	
Lack of asthma control ¹² (vs. controlled or partially controlled)	-6.28 (-11.19, -1.37) -0.26	-15.74 (-24.34, -7.14) -0.34	-17.89 (-28.25, -7.53) -0.34	-14.99 (-24.11, -5.86) -0.33	-5.83 (-11.59, -0.08) -0.20	-14.93 (-25.64, -4.23) -0.27	—	-11.02 (-20.50, -1.54) -0.24	-19.07 (-29.85, -8.30) -0.35	

¹Adjusted for the effect of sex, age and all the other statistical significant-related covariates in the simple linear regression models for every dependent variable.²All results are statistically significant with $P < 0.05$.

allergy. Therefore, in order to generalize these findings more investigation is needed in the subgroup of children with asthma triggered by pets.

According to our data analysis, treatment duration had a positive effect only in the dimension of HRQoL concerning physical activity and was statistically significant only in the older children. In conflict, Pereira et al.¹⁴ in their systematic review concluded that patients with longer duration of disease had better QoL. They hypothesized that a likely explanation for that finding is the learning effect (the development of strategies for coping with the disease). Our findings suggest that children with uncontrolled asthma keep being frightened and state impaired HRQoL, independently of the duration of their treatment.

This study reveals that HRQoL assessment differs between younger and older children. Pradel et al.³³ commented that children with asthma change their knowledge and perceptions over time. Based on Piaget's theory (cognitive-developmental theory of intertwined stages) they quoted that asthma understanding of younger children will not be developed as those of older and therefore the concept "health" and "QoL" may have different meanings to children of different ages. Based on Bloom's taxonomy, they also implied that children's understanding may differ due to the type of asthma management task involved. Children and adolescents use different coping strategies (cognitive and behavioral responses) in order to manage impact of asthma on their daily lives. In adults, coping strategies such as avoidant coping (avoidance, denial coping) is associated with a poorer HRQoL, whereas active coping (planning, information seeking, etc.) is associated with a higher HRQoL.³⁴ On the contrary, it is thought that if children accept asthma, they do not need to use other coping strategies because asthma is totally integrated in their lives. Moreover, children use less cognitive coping strategies such as information seeking and positive reappraisal than adults.^{34,35}

Our results also confirm the significant difference between boys and girls both in terms of asthma control and QoL. Chen et al.,³ had concluded that female sex was associated with a reduction in general health status that was not reflected in asthma-specific HRQoL. Nordlund et al.³⁶ in a group of children with problematic severe asthma found that girls demonstrated a significantly lower HRQoL than boys. In the literature it is proposed that such gender differences could reflect different psychological responses to their disease, rather than actual differences in the disease itself.²⁶

Gender differences were also noted in parents' assessment of their child's HRQoL. We found, in accordance to previous studies that mothers, tended to rate their children's limitations and disorders as worse.^{5,17,37} Our study illustrated that parents overestimate HRQoL

of their children with asthma even though moderate agreement between children self-reports and parent proxy-reports on HRQoL was noticed. Fathers seem to be better proxy-reporters than mothers.² In literature is reported that parental assessment and not the child's, is associated with asthma management.³⁸ Children and adolescents' perception of their family and its function can be different from their parents. Thus, it is particularly important to assess implications of adolescents' own perception of family support for asthma outcomes, instead of relying on parents' reports.³⁹

Asthma friendly homes and schools were found to affect HRQoL in both ages and especially in older children that the multiple regression analysis revealed a correlation in both domains (impact and worry) of the condition specific asthma questionnaire. While some studies of home interventions aimed at eliminating these allergens have shown significant promise in improving asthma outcomes, other studies show no such benefit.^{40,41} In our study, mother's smoking was associated with poorer ratings of HRQoL in both groups. But even though the relationship between home-based and/or school-based triggers and asthma outcomes has been established, there is still a need for further investigation into the complex link between environmental characteristics and asthma.⁴¹

A very interesting finding in our study was that family income had no effect on HRQoL. This may reflect the effectiveness of public health services in Greece, since according to our health insurance system all children have equal access to health services and medications, independently of their family income. This is also supported by the fact that no racial or ethnic difference was noticed. These findings come to partial antithesis with previous findings concerning the influence of sociodemographics on the HRQoL of children with asthma.^{37,42}

There are some limitations in this study. First, we defined a selected group of variables with most clinical relevant information to be included in the multivariate analysis. We may have missed associations of variables that have not been tested. Also we did not focus on diverse groups of children with asthma. According to Everhart and Fiese, this would increase our knowledge of the association between asthma severity and child QoL in populations of children perhaps most at risk for an impaired QoL.¹⁵ Even though, the DISABKIDS Smiley Measure, DCGM-37, and Asthma Module showed great correlations with changes in the level of asthma control.

In conclusion, the evaluation of asthma HRQoL is a useful assessment tool as it reflects in a way the asthma control state and another dimension of its severity. We also found that asthma control is the most important determinant of HRQoL, among the variables that were

assessed, even when underlying differences in severity classification are taken into account. These results highlight the need to modify our asthma management strategy in order to improve asthma control and to improve QoL.

Moreover, our empirical results provide some practical insights into the relationships between measures of HRQoL and asthma control, and their usefulness in different research contexts. Optimal measurement of HRQoL in children with asthma should involve determining both parent and adolescent perceptions. These findings have important implications in terms of patient and parents' education.

CLINICAL IMPLICATIONS

- A major association between level of asthma control and severity of asthma, as defined by GINA with HRQoL dimensions as stated by both children with asthma and their parents (patient centered), was observed.
- Our findings confirm the importance of a gender perspective, especially because gender differences in HRQoL were observed in both children and their parents' assessment.
- Any evaluation of current approaches to measuring children's HRQoL needs to allow both parent and child to give their own perspective.
- Unpredictable symptoms and perceived loss of control could significantly impact HRQoL, independently of its severity.
- Identifying the aspects of asthma control that explain variations in HRQoL may assist in targeting interventions to improve HRQoL.
- Asthma management strategies should be targeting to the improvement of asthma control and to a better quality of life.

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