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Quality of life and its relation to pediatric asthma severity

Heba A. Ali^{1*}

Abstract

Background Bronchial asthma is a global health problem that negatively affects the quality of life (QOL) of both children and their caregivers. However, there is a paucity of data regarding the impact of QOL on asthma severity in the pediatric population. Therefore, we aimed to examine the effect of health-related QOL of children with asthma and their caregivers on the level of asthma control and the degree of asthma severity.

Results At enrollment, thirty asthmatic children and their caregivers completed the study. The standardized Arabic versions of the Pediatric Asthma Quality of Life Questionnaire (PAQLQ) and the Pediatric Asthma Caregiver's Quality of Life Questionnaire (PACQLQ) were fulfilled by the asthmatic patients and their caregivers, respectively. Asthma control and severity were assessed using Global Initiative for Asthma guidelines and asthma severity scores. The relations between QOL and the other study parameters including asthma severity were examined which revealed that poor QOL of both asthmatic children and their caregivers was associated with frequent asthma-related hospital admissions ($p=0.046, 0.011$). In addition, significant associations were found between symptoms, activity domains of PAQLQ score, and asthma control test score ($p=0.019, 0.039$). Furthermore, both QOL questionnaires' total scores correlated strongly with asthma severity scores ($p < 0.05$ for all).

Conclusions In this study, QOL appears to be strongly related to the level of asthma control and asthma severity in children. Therefore, improving QOL is recommended for proper management of patients with severe asthma. Moreover, QOL questionnaires can be used as useful tools for monitoring asthma severity in children.

Keywords Pediatric asthma, PAQLQ, PACQLQ, Asthma control test, Caregivers, Severity

Background

Bronchial asthma (BA) is the most prevalent chronic inflammatory disease, characterized by recurrent episodes of wheezing, dyspnea, chest tightness, and cough. It is quite common in children and adolescents [1]. It is a generalized health problem in all countries irrespective of the level of development [2]. Asthma is common in Egypt, and doubtless underdiagnosed and undertreated,

particularly among children from low-income societies [3]. The burden of asthma on patients, families, and healthcare services is increasing worldwide [4].

The impact of asthma on children and their families is much far-reaching [5]. Asthma can affect the level of quality of life (QOL) of both children and their caregivers [6]. Asthma can impair QOL in its various domains and may affect the daily lives of the affected population [7]. Asthma-specific QOL questionnaires are developed to quantify in a very formal and standardized way, the influence of asthma on the patient's routine life, wellbeing, and the patient's response to treatment [8]. Additionally, measuring the QOL of caregivers is also important for carrying out the interventions designed for young children with asthma [9].

The research was done in the Pediatric Chest Clinic and Chest Department, Ain Shams University Hospital, Cairo, Egypt.

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Despite a high level of asthma among children in Egypt, studies assessing the QOL among asthmatic children and their caregivers are scarce, and the factors associated with QOL are not well understood. So, the objectives of this study were to assess the health-related QOL levels of children with asthma and their parents in our locality and determine its effect on the degree of asthma control and disease severity.

To our knowledge, the impact of QOL on asthmatic children and their caregivers on asthma severity had not previously been assessed in our Egyptian society.

Materials and methods

Study design and settings

This cross-sectional study was conducted between the first of January 2023 to the end of March 2023 at the Pediatric Pulmonology Unit, Ain Shams University Teaching Hospital, Cairo, Egypt.

The participants

The study subjects were 60 participants consisting of 30 children and adolescents with documented asthma diagnoses and 30 parents who accompanied the children during their clinic visits. The diagnosis of asthma was established according to the Global Initiative for Asthma (GINA) criteria [10].

The participants were recruited consequently from the outpatient pulmonary clinic during their routine visits. The inclusion criteria were children aged 7–17 years with physician-diagnosed asthma for at least 6 months duration before the study, while the patients suffering from other chronic respiratory diseases, having other chronic health conditions, or severe psychiatric disorders were omitted from the study.

The study was approved by the Research Ethical Committee, Faculty of Medicine, Ain Shams University, Children's Hospital (approval number FMASU R268/2022) in accordance with the principles of the Helsinki Declaration. All the participants provided informed consent to participate in the study. For participants who were minor, informed consent was obtained from the legal caregivers. Detailed information about the study's goals and procedures was presented to all participants.

Study tools

Data collection

At enrollment, the baseline characteristics of the studied patients including child age, sex, residence, educational level, parental smoking, and exposure to asthma triggers were collected. Socio-demographic characteristics of the patients and families using the socioeconomic status (SES) scale of El-Gilani et al. [11] were recorded. Clinical data, including duration and severity of asthma,

controller medications, school absenteeism, asthma comorbidities, unscheduled emergency room (ER) visits, chest clinic visits, frequency of asthma exacerbations, and hospital admissions in the last year, were also obtained from the parents' and the patients' medical hospital records. Anthropometric data including weight and height measurements with the calculation of body mass index (BMI) were recorded and interpreted according to the Egyptian Growth Charts for boys and girls [12].

Asthma control

The level of asthma control was assessed according to the standards of GINA (2015) guidelines [13]. In addition, the asthma control was classified into three levels (controlled, partly controlled, and uncontrolled) according to the childhood asthma control test (C-ACT) in the case of 7- to 11-year-old children and ACT for children aged 12 years or older [14, 15]. A cutoff point ≤ 19 indicates uncontrolled asthma in both questionnaires [14, 15].

Asthma severity

The severity of asthma was assessed using GINA (2015) guidelines [13], and asthma severity scores including the Pediatric Respiratory Severity Score (PRESS) which was used to assess tachypnea, wheezing, retractions, oxygen saturation, and feeding difficulties, with each component given a score of 0 or 1, and total scores were classified as mild (0–1), moderate (2–3), or severe (4–5) [16]. Pediatric asthma symptom scale was used to determine the frequency and severity of the asthma symptoms. Total scores range from 5 to 40, with higher scores indicating more severe and frequent symptoms [17], and pediatric respiratory assessment measure (PRAM), which is a 12-point clinical scoring that captures a patient's asthma severity, was validated in children aged 1 to 17 years old and was used for scoring asthma exacerbations, as 0–3 indicate mild, 4–7 moderate, and 8–12 severe exacerbations [18].

Quality of life assessment

We included 2 questionnaires fulfilled by both the child and the caregiver in this study and were administrated by the study physician.

a) Pediatric asthma quality of life questionnaire (PAQLQ) (Arabic version) [19]: It is a self-administered instrument, which includes 11 questions, each relating to the three domains: (symptoms 5 questions, activity limitation 3 questions, and emotional function 3 questions). It can be used for children aged at least 7 years and older. Responses to each item of the PACQLQ are given on a seven-point scale, ranging from 1 to 7, with the higher scores

indicating less impairment. The result was expressed by calculating the mean response to all its items. Patient's quality of life was classified as follows: minimal or no impairment (≥ 6.0 points), moderate impairment (3.0–5.9 points), and severe impairment (< 3.0 points) [9, 20]. Validity and reliability of the adapted Arabic translation of PAQLQ-A were assessed among Egyptians [19].

b) Pediatric asthma caregivers' quality of life questionnaire (PACQLQ) (Arabic version) [21]: It is a self-administered instrument, which includes 13 items (four concern activity limitations and nine concern emotional functions). The questionnaire asked caregivers to report impairments experienced during the previous week. The result was expressed as a mean score per item for each of the domains, as well as for the overall QOL Responses to each item of the PACQLQ are given on a seven-point scale, ranging from 1 to 7, with the higher scores indicating less impairment. The result was expressed by calculating the mean response to all its items. The total score of the PACQLQ questionnaire was 91. Three percentiles were defined: 25th (56.8), 50th (71), and 75th (80.1). Accordingly, 4 quartiles were defined: poor QOL (< 25 th), fair (25th– < 50 th), good (50th– < 75 th), and very good (75+). The standardized Arabic versions of both questionnaires have good validity and reliability [19, 21].

Controllers' adherence

Assessment of asthma controller's medication adherence among asthmatic patients was done using the Morisky medication adherence score [22], which is an 8-item questionnaire, and it was directed to asthmatic children older than 8 years or their caregivers. It was translated into Arabic language using the back-translation technique. The total score is a summation of all 8 items and ranges between 0 and 8, with scores of 8 reflecting high adherence, 7 or 6 reflecting medium adherence, and < 6 reflecting low adherence.

Lung function

Pulmonary function tests (PFTs) measurements were performed by a pulmonologist in the respiratory laboratory unit using *JAEGER Apparatus (Care Fusion Germany, 2011)*, using standardized spirometry for cooperative patients older than 6 years with average mentality, according to the European Respiratory Society (ERS) guidelines [23]. The mean value of the best three PFTs was recorded.

Statistical analysis

The collected data was analyzed by the Statistical Package of Social Services (IBM SPSS, Chicago, IL, USA) version 23. Kolmogorov–Smirnov test was used to determine the normality of data. The quantitative data with parametric distribution were presented as mean and standard deviations with ranges while non-parametric data were presented as median with inter-quartile range (IQR). Also, qualitative variables were presented as numbers and percentages. In addition, chi-square test was used to determine the differences between groups with qualitative data, and independent *t* test was used to determine the difference between paired samples with quantitative data and parametric distribution, while Mann–Whitney test was used to compare between two groups regarding quantitative data with the non-parametric distribution. One-way ANOVA test was used to compare more than two groups regarding quantitative data with parametric distribution, while Kruskal–Wallis test was used to compare between more than two groups regarding quantitative data with the non-parametric distribution. QOL was expressed as the mean score per item for each domain of PAQLQ and PACQLQ. The overall score was derived from the mean score of all items. Spearman's correlation coefficient was used to calculate correlations between patients' and caregivers' scores of QOL and the quantitative study variables including asthma severity. Variables with significant correlations were entered into a linear regression model to detect the independent predictors of QOL. $P \leq 0.05$ was considered as statistically significant, and P less than 0.01 was considered highly significant.

The sample size was calculated using PASS 11.0, with an alpha error of 5% (i.e., 95% confidence level) and a beta error of 50%. The sample size of at least 30 patients and 30 caregivers achieved a study power of 81% to assess quality of life in children with asthma and their caregivers using a two-sided hypothesis test.

Results

Socio-demographic characteristics

A total of 60 participants (30 children fulfilled the eligibility criteria and 30 caregivers) completed the study. The mean age (SD) of asthmatic children was 8.18 (5.57) years, with a male-to-female ratio of 2:1. About one-half of the patients 16 (56.7%) were urban residents. In addition, the mean Gilani score was 46.30 ± 14.57 indicating a moderate socioeconomic status among the studied patients. About 83.3% of the asthmatic patients had a family history of allergies. Meanwhile, allergic rhinitis, eczema, and food allergy were reported by 46.7%, 26.7%, and 20% of asthmatic children, respectively. It was also revealed that 50% of the asthmatic children had poorly

controlled asthma, and 73.4% complained from moderate to severe asthma. Demographic data and baseline characteristics are shown in (Table 1).

QOL scores among asthmatic children and their caregivers

The initial assessment of QOL among asthmatic patients using PAQLQ showed the mean score of the symptom domain which was 4.20 (SD 0.52), of the emotion domain which was 4.36 (SD 0.43), of the activity limitation

domain which was 4.32 (SD 0.32), and the overall score which was 4.28 (SD 0.33). QOL among asthmatic caregivers was assessed using the PACQLQ, which showed that the mean score of the emotion domain was 3.68 (SD 0.29) and the activity domain was 3.52 (SD 0.33), and the overall score was 3.63 (SD 0.22) as illustrated in Table 2.

Relations between PAQLQ and its domains with study variables

The symptom domain of PAQLQ was positively correlated with activity domain ($r=0.545$, $p=0.002$) and mild asthma exacerbations ($r=0.448$, $P=0.013$) and negatively correlated with age of diagnosis ($r=-0.370$, $p=0.044$) and frequency of hospitalizations in the last year ($r=-0.368$, $p=0.046$). The emotion domain was negatively correlated with total ER visits in the last year ($r=-0.429$, $p=0.018$). The activity limitation domain was negatively associated with socioeconomic status using Gilani score ($r=-0.423$, $p=0.020$) and moderate to severe exacerbations ($r=-0.394$, $p=0.031$). The symptom and activity limitation domains were positively correlated with the level of asthma control as measured by ACT ($r=0.425$, $p=0.019$, $r=0.378$, $p=0.039$), while the three domains (symptom, emotion, and activity limitation domains) were directly correlated with the total QOL score among the asthmatic children as well ($r=0.826$, $p=<0.001$, $r=0.392$, $p=0.032$, $r=0.609$, $p<0.001$) as shown in (E-Table 1) (Fig. 1).

In addition, there were statistically significant negative correlations found between total PAQLQ score (mainly the symptom domain) for asthmatic patients and severe

Table 1 Socio-demographic and clinical characteristics of the studied patients

Baseline characteristics (N= 30)	Values
Age, years (mean ± SD)	8.18 ± 5.57
Range	7–17
7–12	27 (90%)
13–17	3 (10%)
Sex (%)	
Male	20 (66.7)
Female	10 (33.3)
Residency	
Urban	17 (56.7)
Rural	13 (43.3)
Gilan score (mean ± SD)	46.30 ± 14.57
Range	22–68
Very low (less than 30)	3 (10.0%)
Low (30–40)	9 (30.0%)
Middle (41–60)	16 (53.3%)
High (61–84)	2 (6.7%)
Paternal consanguinity (%)	7 (23.3)
Family history of atopy (%)	25 (83.3%)
Body mass index	16.76 ± 3.03
Range	13.6–27.9
Age of symptoms onset (year)	3.85 ± 1.21
Range	0.25–5
Age at diagnosis (year) (%)	5.15 ± 2.45
Range	1.5–7
Duration of asthma (year)	4.48 ± 2.097
Range	0.1–11.5
Asthma control (%)	
Controlled asthma	15 (50.0%)
Uncontrolled asthma	15 (50.0%)
Asthma severity (%)	
Mild	8 (26.6%)
Moderate	11 (36.7%)
Severe	11 (36.7%)
Asthma comorbidities (%)	
Allergic rhinitis	14 (46.7%)
Eczema	8 (26.7%)
Food allergy	6 (20.0%)

SD standard deviation

Table 2 PAQLQ and PACQLQ domains among the studied children and their caregivers

Characteristics	Values
PAQLQ symptoms, mean ± SD	4.20 ± 0.52
Range	2.60–5.40
PAQLQ emotions, mean ± SD	4.36 ± 0.43
Range	3.67–5.33
PAQLQ activity, mean ± SD	4.32 ± 0.32
Range	3.67–5.33
PAQLQ total, mean ± SD	4.28 ± 0.33
Range	3.27–5.18
PACQLQ emotions, mean ± SD	3.68 ± 0.29
Range	3.00–4.22
PACQLQ activity, mean ± SD	3.52 ± 0.33
Range	3.00–4.25
PACQLQ total, mean ± SD	3.63 ± 0.22
Range	3.23–4.00

PAQLQ pediatric asthma quality of life questionnaire,

PACQLQ pediatric asthma caregivers' quality of life questionnaire

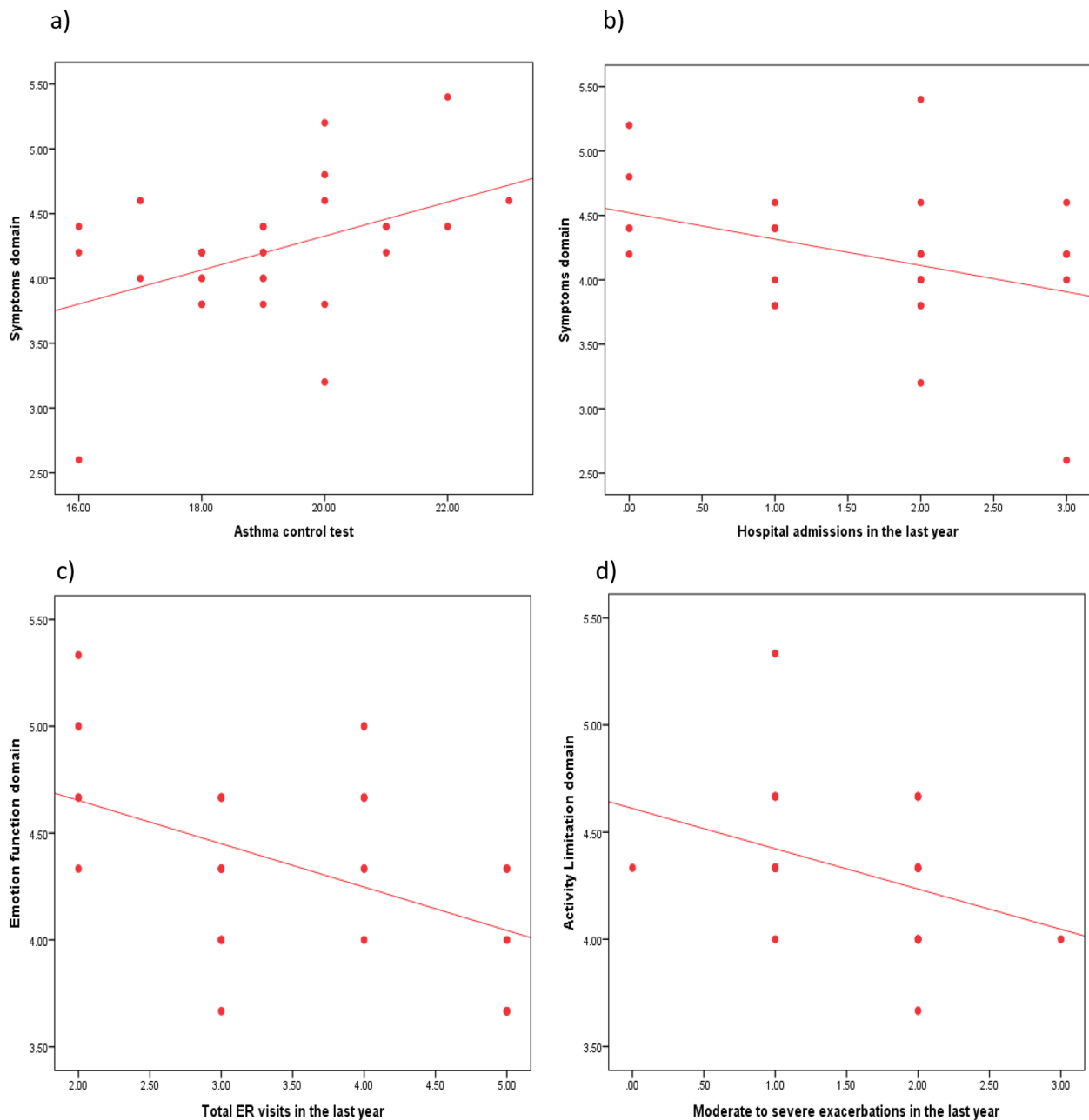


Fig. 1 Correlations between PAQLQ symptom domain score and level of asthma control as measured by asthma control test (a), PAQLQ symptom domain and frequency of hospital admissions in the last year (b), PAQLQ emotional function domain and total Emergency room (ER) visits in the last year (c), and PAQLQ activity limitation domain and moderate to severe exacerbations in the last year (d)

asthma exacerbations ($r = -0.368$, $p = 0.045$), hospital admissions ($r = -0.505$, $p = 0.004$), and asthma severity as measured by PRESS ($r = -0.515$, $p = 0.004$), pediatric asthma symptoms scale ($r = -0.423$, $p = 0.020$), PRAM score ($r = -0.407$, $p = 0.026$), while no statistically significant correlations were found with the other studied parameters as presented in (Table 3) (Supplementary Fig. 1).

Relations between PACQLO and its domains with the other study variables

The emotion domain of PACQLO was directly correlated with forced expiratory volume in the first second (FEV1) and maximum mid expiratory flow (MMEF) 75/25, total QOL score among the asthmatic children ($r = 0.621$, $p = 0.024$), ($r = 0.821$, $p = 0.001$), ($r = 0.385$, $p = 0.036$), and negatively correlated with the frequency of hospital

Table 3 Correlations between PAQLQ total score of asthmatic children and the study parameters

Variables	PAQLQ for asthmatics	
	R	p value
Age (years)	-0.111	0.561
Body mass index (kg/m ²)	0.118	0.871
Socioeconomic score	-0.326	0.079
Age at diagnosis (year)	-0.241	0.200
Level of asthma control	0.342	0.064
Forced expiratory volume in one second (FEV1)	0.323	0.282
FEV1/FVC ratio ^a	0.209	0.494
MMEF 75/25 ^b	0.392	0.185
Severe asthma exacerbations	-0.368	0.045*
Hospital admissions in the last year	-0.505	0.004**
Pediatric Respiratory Severity Score	-0.515	0.004**
Pediatric asthma symptoms scale	-0.423	0.020*
Pediatric Respiratory Assessment Measure (PRAM) score	-0.407	0.026*

PAQLQ pediatric asthma quality of life questionnaire. ^aForced vital capacity.

^bMaximum mid expiratory flow. * $p < 0.05$, ** $p < 0.01$

admissions in the last year ($r = -0.458$, $p = 0.011$). Also, there was a significant negative correlation between the activity domain and the frequency of asthma exacerbations in the last year ($r = -0.402$, $p = 0.028$). Both emotional and activity domains were positively correlated with total QOL scores among the asthmatic's caregivers ($r = 0.908$, $p < 0.001$) ($r = 0.444$, $p = 0.014$), additional data are given in (E-Table 2) (Fig. 2).

Moreover, the total PACQLQ score was also positively correlated with FEV1 and MMEF 75/25 ($r = 0.721$, $p = 0.005$), ($r = 0.649$, $p = 0.016$), and negatively correlated with the number of hospitalizations, PRESS ($r = -0.472$, $p = 0.008$), pediatric asthma symptoms scale ($r = -0.443$, $p = 0.014$), PRAM score ($r = -0.369$, $p = 0.045$) (mainly the emotion domain), while no statistically significant correlations found with the other studied parameters as presented in (Table 4) (Supplementary Fig. 1).

In addition, there was a significant relation between urban residence and higher total PACQLQ score (48.50 ± 2.42 in urban residence vs 45.71 ± 2.64 in rural residence) ($P = 0.008$).

There was no statistically significant association between PAQLQ, PACQLQ domains and gender, age, controller's medication adherence, or comorbidities of the asthmatic child ($P > 0.05$).

Finally, a multivariate regression analysis for the significant factors affecting QOL of asthmatic children, and their caregivers were performed, which revealed that the most important independent variables affecting the quality of life among asthmatic children were found

to be the level of asthma control and asthma severity as measured by pediatric asthma symptoms scale with a p value = 0.001 and 0.025, while frequent asthma-related hospital admissions was the most significant determinant of QOL among asthmatics' caregivers with a p value = 0.007.

Discussion

Asthma can adversely affect the levels of HRQOL of that of asthmatic children and also their families leading to worse disease outcomes [24]. Control of the main determinants of QOL scores might improve the QOL of these patients, and we aimed to evaluate HRQOL in children with bronchial asthma and their caregivers in an attempt to identify the most important determinants adversely affecting the HRQOL in these patients, which may improve asthma management and decrease the disease severity. Based on our results, level of asthma control, severe asthma symptoms, and recurrent hospitalizations were significant indicators of the level of quality of life among the asthmatic children and their caregivers ($p = 0.001$, 0.025, 0.010). Therefore, intensive efforts should be directed towards attaining optimal asthma control and proper severe asthma treatment, in order to obtain normal daily life activities among children, and their families to achieve better QOL for asthmatic patients and their caregivers, leading to better asthma management and less disease severity.

The current study showed that the overall mean scores of the PAQLQ and its symptom, emotion, and activity domains were 4.28, 4.20, 4.36, and 4.32, respectively (Table 2). The three domains were significantly correlated with the total score ($p < 0.001$, 0.032, < 0.001). In addition, there was a positive correlation between symptom domain and activity limitation domains of PAQLQ ($p = 0.002$) (E-Table 1).

This is in concordance with a previous Egyptian study [25], which revealed that the overall mean scores of the total PAQLQ and its activity, emotion, and symptom domains were 4.7, 4.3, 4.5, and 4.7, respectively. In addition, Ibrahim et al. [26] found a significant positive correlation between the three domains of PAQLQ among asthmatic children. Also, PAQLQ activity limitation domain had a strong positive correlation with the patient's symptoms and patient's emotions ($p < 0.001$).

Confronting our results, Jović et al. [27] in a study conducted on 100 children and adolescents with asthma showed that the majority of asthmatic patients achieved scores between 5 and 7, while there was a significantly lower number of those with values below 5.

The higher proportion of poor QOL among the studied patients indicated a lack of proper asthma management

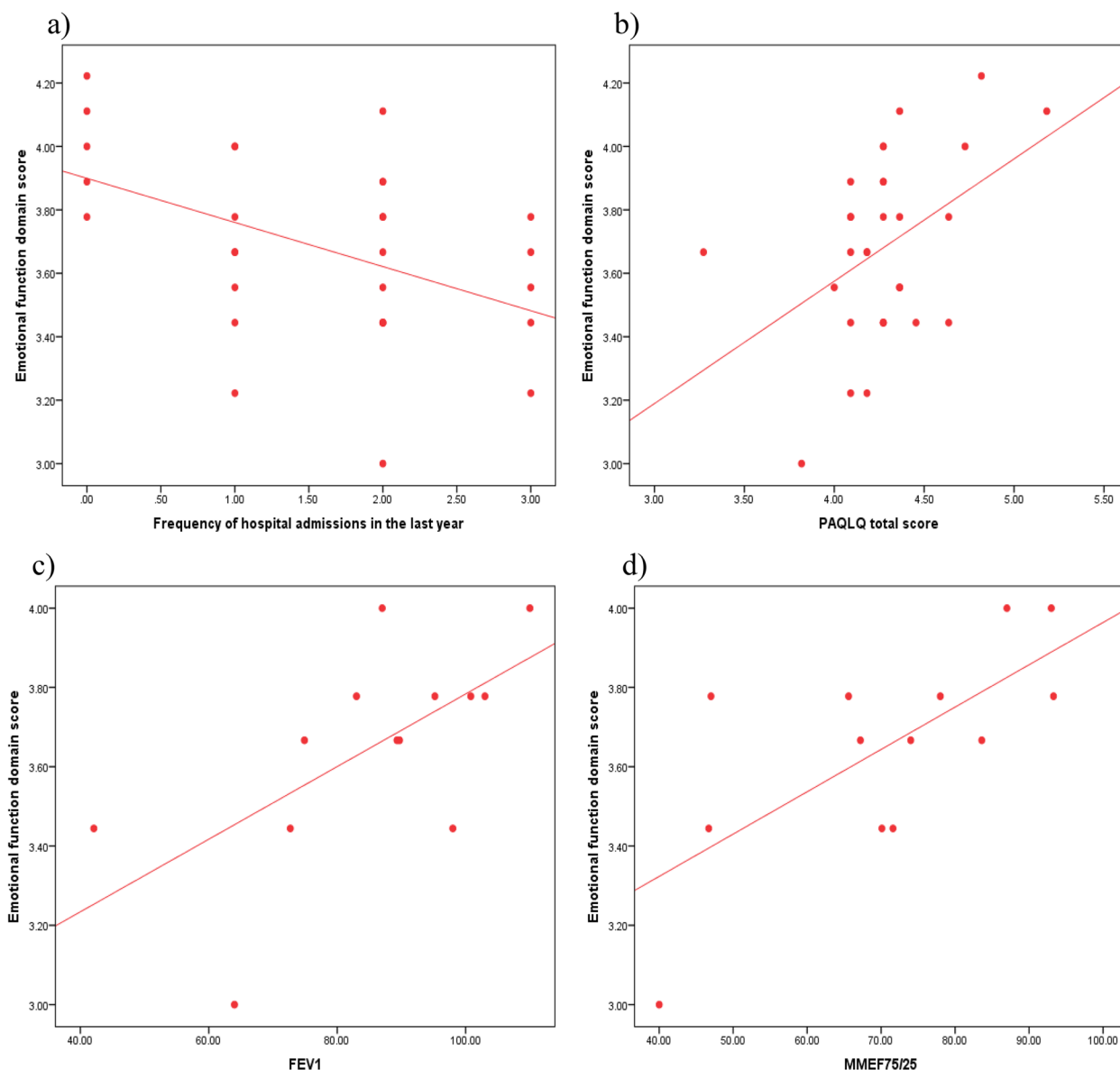


Fig. 2 Correlations between PACQLQ emotional function domain score and frequency of hospital admissions in the last year **(a)**, PACQLQ emotional domain and PAQLQ total score **(b)**, PACQLQ emotional function domain and forced expiratory volume 1 (FEV1) **(c)**, and PACQLQ emotional function domain and maximum mid expiratory flow (MMEF75/25) **(d)**

and the need for implementing optimal asthma control programs.

Our study revealed that the symptom domain was the most affected domain (4.20) with the highest correlation with PAQLQ total score ($p < 0.001$) (E- Table 1), which agrees with previous studies [25, 27], which showed that the symptoms domain was in the highest correlation with PAQLQ and it was the most affected, which reveals the negative effect of asthma symptoms and non-compliance on asthma controllers on the

QOL, and signify the importance of asthma therapy. On the other hand, several studies [28, 29], in more developed countries, found that the activity limitation domain was the most affected domain.

Our results may be attributed to a lower standard of living, less environmental control measures, and lack of proper health care services in our low-income societies.

Our study revealed that children with lower socio-economic status (SES) had significantly higher activity limitation domains of PAQLQ scores compared to those with higher SES ($p = 0.020$) (E- Table 1).

Table 4 Correlations between PACQLQ total score of asthmatic caregivers and study parameters

Variables	PACQLQ for caregivers	
	R	p value
Age (years)	-0.126	0.508
Body mass index (kg/m ²)	0.011	0.956
Socioeconomic score	0.057	0.765
Age at diagnosis (year)	-0.301	0.106
Level of asthma control	0.161	0.395
Forced expiratory volume in one second (FEV1)	0.721	0.005**
FEV1/FVC ^a ratio	0.522	0.045
MMEF 75/25 ^b	0.649	0.016*
Very severe asthma exacerbations	-0.194	0.303
Hospital admissions in the last year	-0.465	0.010**
Pediatric Respiratory Severity Score	0.472	0.008**
Pediatric asthma symptoms scale	-0.443	0.014*
Pediatric Respiratory Assessment Measure (PRAM) score	-0.369	0.045*

PACQLQ pediatric asthma caregivers' quality of life questionnaire. ^aForced vital capacity. ^bMaximum mid expiratory flow. * $p < 0.05$, ** $p < 0.01$

Contradictory to our findings, several studies [30–32] have found links between low SES and impaired patients' and caregivers' QOL, which was also consistent with a previous published study [33], which reported that medium/high SES was positively correlated better QOL of both parents and their children. Our findings could be explained by the suggestion that parents with high socio-economic status usually had better educational level, more familiar with the asthma symptoms, and more anxious about their child's disease and its complications leading to overprotection and intended unnecessary activity limitation.

In this work, a better quality of life among asthmatics' caregivers was significantly observed among urban residents ($p = 0.008$) (data not shown), which is in line with Horner et al. [34], who suggested that QOL would be lower in rural than urban asthmatic patients due to less accessibility of health care services. On the contrary, Al-Gewely et al. [35] could not reveal a significant difference in QOL scores between rural and urban asthmatic children and their caregivers.

Our findings could be explained by better standard of care and asthma awareness among urban residents.

Our study showed that there was a negative correlation between symptom domain of PAQLQ and the age of asthma diagnosis ($p = 0.044$) (E- Table 1), where earlier age of diagnosis is associated with early start of the anti-inflammatory controller medications leading to less asthma symptoms, better asthma control, and lower risk for asthma morbidities.

In the present study, patients with well-controlled asthma had significantly higher symptom and activity limitation domains of PAQLQ scores ($p = 0.019, 0.039$). Also, patients with moderate to severe asthma had significantly lower activity limitation and total score domains ($p = 0.031, 0.045$) (E- Table 1) (Fig. 1) (Table 3).

These results come parallel with a previous study conducted by Silva et al. [33] who found that children with controlled asthma reported better QOL than children with non-controlled asthma. This was also established in other multiple studies [7, 35, 36] that child's QOL is directly related to the level of asthma control. Moreover, van Gent et al. [37] concluded that an asthma diagnosis was enough for the patient to have a low QOL even if the patient's asthma was controlled. Our justification is that uncontrolled asthma is associated with more frequent symptoms, and more limitations in physical activities that might exacerbate asthma attacks. Moreover, children with uncontrolled asthma are often more apprehensive about upcoming asthma exacerbations.

This is inconsistent with a previous study [38] conducted in adults, which revealed that a good QOL score was not correlated to asthma control, which may be due to the greater ability of adults to cope with the disease.

The current study showed that the patients with frequent ER visits in the last year were found to have significantly lower emotional function domain of PAQLQ ($p = 0.001$) (E- Table 1) (Fig. 1). Consistent with our findings, a recently published study [26] revealed that all PAQLQ domains (physical, symptoms, emotional) were significantly higher among asthmatic children who did not have ER visits during the 6 months preceding the study ($p < 0.01$). Additionally, Halterman et al. [9] stated that QOL evaluation becomes mandatory for judging the effectiveness of a therapeutic asthma regimen.

In our analysis, patients with repeated hospital admissions were observed to have lower total and symptom domain of PAQLQ scores ($p = 0.004, 0.046$) (E- Table 1) (Table 3) (Fig. 1).

These findings are also in line with the results of the previous study [35] in which the overall and domains of QoL scores were significantly decreased among patients with asthma-related hospital admission ($p < 0.05$). The same results were reported by a recent Australian study [39], which found a negative association between QOL in adults with asthma and the number of hospital admissions.

Our study declared that there was a significant association between higher asthma severity scores; (PRESS, pediatric asthma symptom scale, and PRAM scores) and lower total PAQLQ scores (mainly symptom domain) among asthmatic children ($p = 0.004, 0.020, 0.026$) (Table 3) (Supplementary Fig. 1).

Consistent with our findings, a previous Egyptian study [40] revealed that patients with severe asthma had significantly worse total and categorical PAQLQ score. This was also established in other multiple studies [41, 42] that the severity of asthma was related to child QOL both directly and indirectly.

Conflicting to our results, a previous study [43] found no significant effects of asthma severity or control on parents' QOL. However, these results did not exclude the indirect effects of asthma severity on patients or parents' QOL and caregiving burden.

This study revealed that the overall mean scores of the PACQLQ and its emotion, and activity domains were 3.68, 3.52, and 3.63, respectively (Table 2). Furthermore, there was a positive correlation between total and categorical PACQLQ scores ($p < 0.001$, 0.014) (E- Table 2).

These findings agree with other previous studies [26, 32, 40] conducted in Saudi Arabia and Egypt which found lower values of QOL scores with a mean score of (3.2), (4.0), and (3.1) among the asthmatic's caregivers.

Our results are in discordance with several published studies [44, 45] which reported that most of the caregivers of asthmatic children had either very good or good QOL with a mean score of (5.55 ± 1.14) (6.07 ± 0.93), respectively.

In addition, our findings were slightly lower than the corresponding mean scores of the total PACQLQ and its activity and emotion domains, which were 4.2, 5.4, and 4.0, respectively, reported by a previous Egyptian study [25].

The lower values in our study compared to the previous publications may be explained by unawareness of the parents to the nature of the disease, failure of family adaption to the child's chronic condition, and absence of psychological support for the patients, and their families. Therefore, the implementation of an asthma education program focusing on demonstrating the chronic nature of the disease, how to deal with emergencies, and how to cope with the disease is recommended.

Moreover, our study declared that the QOL of parents was more severely affected than that of the children themselves, which signifies the role of understanding parents' specific needs and the challenges that they face throughout their asthmatic child's development for better health care in pediatric asthma.

In our analysis, there was a positive correlation between the emotional domain of PACQLQ score and the quality of life of asthmatic children ($p = 0.036$) (E- Table 2), which coincides with a previous study conducted by Stelmach et al. [46], which revealed that the changes in PACQLQ correlated positively with changes in PAQLQ in all domains. In addition, Ibrahim et al. [26] found that the

emotional domain of PACQLQ positively correlated with the patients' symptoms domain of the PAQLQ.

In contrast to these results, a previous report [47] found no correlation between PAQLQ and PACQLQ scores.

Our findings may be due to the influence of parental distress, emotional worries about their child's disease, and routine daily care of their child's chronic health condition which may limit parents' regular activities affect their effective role in managing their children's disease, contributing to poorer asthma management, which indirectly increases asthma severity, resulting in reducing the child's QOL.

The current study reported that frequent asthma exacerbations requiring ER visits were significantly associated with lower activity domain of quality-of-life scores among asthmatic caregivers ($p = 0.028$). Also, there was a significant negative association between the rate of hospitalization and total as well as the emotional domain of QOL of asthmatic caregivers ($p = 0.010$, 0.011) (E- Table 2) (Table 4, Fig. 2).

These findings are congruent with Shaikhan et al. [44] who found that the QOL mean score was significantly higher among caregivers of children who have had no emergency rooms or hospital admissions since their last visit. In addition, a previous study [26] stated that the score of the total PACQLQ domain was lower among caregivers whose children had frequent ER visits than those who have not.

Our results showed that there was a significant association between better lung function with higher total and emotional domain of QOL score among asthmatic caregivers ($p = 0.005$, 0.024) (Table 4) (E- Table 2), (Fig. 2).

Our findings stay in accordance with a previous study [28] which has shown a correlation between children's lung function and caregiver's QOL questionnaire, and it added that the emotional domain was the most impaired parent domain which significantly correlated with FEV1%FVC.

In opposite to our study, some studies [31, 46] reported weak correlations and others reported no association of pulmonary function with parents' QOL, which was disclosed by the predominant effect of clinical parameters on parents' QOL rather than the static lung function.

Our findings may be explained by the positive effect of better QOL of the caregivers on enhancing patients' adherence to controller medications, improving asthma symptoms, leading to better asthma control, and higher lung function.

What was interesting in our study is that the affection of lung function was significantly related to PACQLQ rather than with PAQLQ ($p = 0.005$ vs $p = 0.282$) which suggests that measuring the quality of life in the caregiver

can be used as a useful tool in monitoring asthma severity in children and that parental QOL may reflect current asthma status in patients.

The present study revealed that lower total QOL scores among the caregivers (mainly emotion domain) were significantly observed among patients with worse asthma severity scores ($p=0.008, 0.014, 0.045$) (Table 4) (Supplementary Fig. 1).

Similar observations [9, 46, 48] reported that QOL has been worse for parents with their children had greater asthma severity and poorly controlled symptoms. Moreover, a previous study [49] reported that a significant correlation was found between PACQLQ scores and asthma severity scores for children using a 7-item questionnaire that examined different parameters including day and night symptoms and frequency of wheezes. The aforementioned findings may be due to greater parental burden and activity limitation caused by severe asthma, which may affect the QOL of caregivers.

On the other hand, Everhart and colleagues [30] found no significant association between asthma severity and parents' QOL. These results may be attributed due to the discrepancy in the methodology of asthma severity assessment as well as patients' variability regarding the scale of asthma severity presentation.

Based on our study, it has been suggested that the causal links between child and paternal's QOL with asthma severity are bidirectional. It was also concluded that not only the reduced QOL of the children with asthma and their caregivers is the outcome of asthma severity, but also poor QOL could be the underlying cause of increasing asthma severity.

In this study, level of asthma control, pediatric asthma symptom scale, and frequent hospital admissions were the major determinants of QOL among the asthmatic children and the caregivers ($p=0.001, 0.025, 0.007$, respectively), while no significant correlation existed between age or sex of the asthmatic child and all child scores ($p=0.561$) and parent scores ($p=0.508$) (Tables 3 and 4).

These findings are in correspondence with a previous study [35] which showed that asthma-related hospital admission and level of asthma control were the determinants of overall PAQLQ score for children with bronchial asthma. On the contrary, previous observations revealed that the significant independent determinants of QOL of asthmatic children were the child's age and sex [50] and exposure to passive smoking at home among asthmatic adolescents [51].

The discrepancy between different studies may be due to the diversity of age groups, environmental factors control measures, and socioeconomic status, as well as the level of health care services.

According to our knowledge, this is one of the fewest studies in our region to reveal the association between the QOL of both children with asthma and their caregivers with asthma severity using different severity scores. The study also proved that a child's asthma can affect the child and the caregiver's QOL leading to poor asthma management, reduced pulmonary functioning, more frequent emergent care use, and increasing asthma severity.

Study limitations

The current study has some limitations: first, the modest sample size and second, the study's cross-sectional design only allowed us to report associations rather than direct causation between QOL and other study variables. In addition, long-term effects of asthma on the QOL of asthmatic children could not be predicted. Therefore, larger prospective cohort studies may be required to generalize our findings.

Conclusions

Our findings acknowledged that asthma impairs the QOL of both asthmatic children and their caregivers and that the changes in child and paternal's QOL scores may predict the changes in asthma severity in the form of level of asthma control and frequency of acute health care service utilization and lung function. Therefore, asthma-specific clinical interventions should be targeted towards improving child asthma control. Furthermore, promoting caregivers' adaptation to their children's disease, establishing effective coping strategies, and asthma educational programs may improve both parents' and child's QOL and decrease disease severity. Moreover, asthmatic patients and their caregivers should be regularly assessed by QOL scores especially for those at risk for lower QOL, for monitoring the disease severity.

Abbreviations

QOL	Quality of Life
PAQLQ	Pediatric Asthma Quality of Life Questionnaire
PACQLQ	Pediatric Asthma Caregiver's Quality of Life
BA	Bronchial asthma
GINA	Global Initiative for Asthma
SES	Socioeconomic status
ER	Emergency room
BMI	Body mass index
ACT	Asthma control test
C-ACT	Childhood Asthma Control Test
SPSS	Statistical Package of Social Services
PRESS	Pediatric respiratory severity score
PRAM	Pediatric respiratory assessment measure
PFTs	Pulmonary function tests
IQR	Inter-quartile range
FEV1	Forced expiratory volume in the first second
MMEF	Maximum mid expiratory flow

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s43168-023-00222-5>.

Additional file 1: E- Table 1. Correlations between PAQLQ score and its domains with the other study variables. **E- Table 2.** Correlations between PACQLQ score and study variables among asthmatics caregivers. **Supplementary Figure 1.** Correlations between Pediatric Asthma Quality of life Questionnaire (PAQLQ) symptom domain score and pediatric respiratory severity score (1a), PAQLQ symptom domain and pediatric asthma symptom scale(1b), PAQLQ symptom domain and pediatric respiratory assessment measure (1c), (Pediatric Asthma Caregivers Quality of life Questionnaire) PACQLQ emotional function domain and pediatric respiratory severity score (1d).

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Authors' contributions

HA performed the study design, analyzed, and interpreted the patient data, and drafted and wrote the manuscript. The author revised and approved the manuscript.

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Availability of data and materials

All data generated or analyzed during this study are included in this published article (and its Supplementary Information files).

Declarations

Ethics approval and consent to participate

The Research Ethics Committee of the Faculty of Medicine, Ain Shams University, approved the protocol. Written consent was obtained from the patients' guardians. The reference number is FMASU R268/2022.

Consent for publication

Nothing to declare.

Competing interests

The authors declare that they have no competing interests.

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