A CROSS-SECTIONAL STUDY ON THE HEALTH-RELATED QUALITY OF LIFE OF ASTHMATIC CHILDREN IN NAIROBI

A research project in partial fulfilment of the Degree of Master of Medicine (Paediatrics and Child Health), University of Nairobi

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DECLARATION

This dissertation proposal is my original work and has not been presented for the award of a degree in any other university.

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LIST OF ABBREVIATIONS

ACT	Asthma Control Test
AKUH	Aga Khan University Hospital
ANOVA	Analysis of Variance
APCs	Antigen Presenting Cells
AQLQ	Asthma Quality of Life Questionnaire
ATAQ	Asthma Therapy Assessment Questionnaire
C-ACT	Childhood - Asthma Control Test
CAQ	Childhood asthma questionnaire
CI	Confidence Interval
DALYs	Disability-adjusted life years
FEV1	Forced Expiratory Volume in the one second
FVC	Forced Vital Capacity
FEF	Forced Expiratory Flow
GGCH	Gertrude's Garden Children's Hospital
GINA	Global Initiative for Asthma
HAY	How Are You
HRQL	Health-related quality of life
ICS	Inhaled corticosteroids
IgE	Immunoglobulin E
IL-	Interleukin-
ISAAC	International Study of Asthma and Allergies in Childhood
IQR	Interquartile range
KNH	Kenyatta National Hospital
LAQ	Life Activities Questionnaire
MID	Minimum Important Difference
OR	Odds Ratio
PAQLQ	Paediatric Asthma Quality of Life Questionnaire
PAQLQ(S)	Paediatric Asthma Quality of Life Questionnaire (Standardized)

PACQLQ	Paediatric Asthma Caregivers Quality of Life Questionnaire
PedsQL	Paediatric quality of life inventory
PEF	Peak Expiratory Flow
PFT	Pulmonary Function Tests
PI	Principal Investigator
RA	Research Assistant
SPSS	Statistical Package for Social Sciences
SD	Standard Deviation
SE	Standard Error
SEM	Standard Error of the Mean
TNF	Tumor Necrosis Factor
QoL	Quality of Life
WHO	World Health Organization

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SUMMARY OF THE STUDY

Background: The burden of asthma, worldwide, is high and it accounts for the loss of 1% of disability-adjusted life years. The prevalence of the disease in Kenya is over 10% and is on the rise. While it contributes substantially to the burden on the healthcare system, its effects on the quality of life of those affected should not be underestimated. Asthma has been shown to significantly affect the quality of life of those affected in other parts of the world, and assessing this component constitutes an important aspect of the management of patients with asthma. However, similar studies have not yet been undertaken in Kenya. ***Methods***: One hundred and twenty-six children with previously diagnosed with asthma between the ages of 7 and 17 years were recruited from chest clinics at three tertiary care hospitals in Nairobi, Kenya. Health related quality of life (HRQL) and constituent domains namely activity limitation, symptoms and emotional function, and level of asthma control were assessed for each patient using two separate questionnaires. Overall quality of life and domain quality of life scores were calculated and results analysed in relation to level of asthma control (well-controlled vs. uncontrolled). ***Results***: Health Related Quality of Life is not optimal in the children being attending the chest clinics at the above facilities. All children experienced some level of impairment, with a majority (59%) experiencing moderate to severe impairment. The mean overall HRQL score was 4.65 on a 7-point responsive scale. Level of asthma control is significantly related to HRQL with a correlation coefficient of 0.59 ($p = 0.000$). ***Conclusion***: It is important to evaluate HRQL in asthmatic children as an adjunct to overall management so as to improve asthma care, and to ensure that asthma control is also optimal as it is a major determinant of HRQL.

BACKGROUND

Asthma

Introduction and Epidemiology

Asthma is a chronic inflammatory disorder affecting the small airways of the lung. It is characterized by hyper-responsiveness and reversible narrowing of the airways that cause airflow obstruction and manifest clinically as episodic, intermittent or persistent symptoms of cough, wheezing, breathlessness, and chest tightness.

According to the Global Initiative for Asthma (GINA) guidelines, an estimated 300 million individuals worldwide suffer from asthma – an estimated prevalence rate of 5 to 6% (1). The World Health Organization (WHO) has estimated that asthma accounts for the loss of approximately 15 million disability-adjusted-life-years (DALYs) which is 1% of the overall loss of DALYs worldwide. Data from an International Study of Asthma and Allergies in Children (ISAAC) estimates prevalence rates based on self-reported asthma symptoms to range from 1 to 18% from international country-specific data (2). In Kenya, the ISAAC research studies conducted in Eldoret and Nairobi, estimated the prevalence rates among children aged 13-14 years to have risen from 13.5% to 15.8% in six years (1995-2001) (2). Little prevalence data exists locally outside this age group, but a study done by Odhiambo et al among school children aged 9-11 years in 1989, estimated prevalence rates of 9.5% in Nairobi (3). This data suggests that asthma is a significant medical problem not only worldwide, but in Kenya as well. The WHO estimates that by the year 2025, there will be an additional 100 million persons with asthma, and low-income countries such as Kenya are expected to contribute significantly to this burden.

Natural History and Pathophysiology

The natural history of asthma is variable. The disease may develop early in childhood or in adulthood. Most individuals who develop chronic asthma have a genetic predisposition, and environmental factors such as allergens, infections and irritants, participate in the evolution of the disease. Exposure of the airway epithelium to the environment contributes to the severity and persistence of asthma.

Inflammation is central to the development and expression of asthma, and is initiated or perpetuated by complex interactions between and among several cell types and over 100 inflammatory mediators. Immunologically, the development of asthma has been linked to a possible imbalance in immune programming that leads to a predominant atopic immunological phenotype. The T-helper 2 (Th2) subclass of lymphocytes has been directly linked to allergic responses, and is thought to predominate over a T-helper 1(Th1) immune response in asthma. The immune cells involved include various antigen-presenting cells (APCs) e.g. dendritic cells and macrophages; and a variety of effector cells such as eosinophils, mast cells, and neutrophils. The APCs process environmental allergens and present them to Th2 cells which they also activate. This serves to initiate and potentiate the immune response against presented allergens. T-helper 2 cells then stimulate and effect the multiplication, migration and activation of B lymphocytes, mast cells, eosinophils, and macrophages. B-lymphocytes produce IgE antibodies; mast cells degranulate on cross-linking with bound IgE antibodies; eosinophils release radicals and basic proteins; and macrophages release various chemical mediators of inflammation. Intercellular activation is mediated by the release of pro-inflammatory mediators such as cytokines, chemokines, and leukotrienes, and forms the basis of the structural and functional airway changes that characterize the disease.

Diagnosis and Evaluation

Asthma symptoms often occur or worsen in the presence of common asthma triggers such as exercise, changes in weather, viral respiratory infections, and exposure to allergens or airway irritants such as smoke. To diagnose asthma, the physician must exclude all other conditions that present similarly. The diagnosis is particularly difficult in very young children because wheezing is common and many diseases can cause symptoms similar to those seen in asthma. Clinical features which point to a diagnosis of asthma include recurrent cough and/or wheeze which are particularly worse at night and/or early in the morning, recurrent episodes of difficulty in breathing, as well as episodic chest tightness. Response of these symptoms to asthma bronchodilator therapy further supports the diagnosis.

Initial evaluation typically consists of a detailed medical history, including pattern of symptoms and

observed precipitating factors. Past medical history should include risk factors for asthma such as atopy, prior exacerbations, treatments used, and their effects. A positive family history of parental asthma increases the risk of asthma in a child. The most common clinical finding is wheeze, but the examination often yields normal findings, although there may be signs of eczema or allergic rhinitis which are strongly associated with the disease.

Various guidelines recommend objective measurements such as pulmonary function tests (PFTs) also known as spirometry, as part of the initial evaluation. Measurement of lung function provides an assessment of the severity of airflow limitation, its variability and reversibility. Various methods have been used to assess airflow limitation, but forced expiratory flow in one second (FEV_1) and forced vital capacity (FVC) and peak expiratory flow (PEF) are the two methods that have gained wide acceptance (1). Most children above 6 or 7 years are capable of performing forced expiratory manoeuvres if coached by an experienced technician, but in younger children, history, symptoms and clinical examination must be relied upon. Peak expiratory flow measurements are best used to monitor the patient against his or her best performance.

Treatment

Asthma medication is divided into 'controller' and 'reliever' therapy. Inhaled corticosteroids (ICS) are the mainstay of controller medication, but others include leukotriene modifiers, systemic corticosteroids, and long-acting inhaled β_2-agonists in combination with the ICS among many others. Reliever therapy which is used on an 'as-needed' basis, acts to reverse bronchoconstriction. Relievers include short-acting β_2-agonists and inhaled anticholinergic drugs among others. Inhaled corticosteroids are the only drugs consistently shown to meet the goals of pharmacotherapy in asthma management. The goals are: 1) to minimize underlying physiological abnormalities; and 2) to reduce the impact of the disorder on the children's' experience. In other words, we aim to:

1. Achieve and maintain asthma control, and
2. Improve quality of life (QoL)

The primary goal of asthma treatment is identical for patients regardless of the severity.

1. Asthma Control

The concept of asthma control has been evolving over the years, and is currently used by clinicians to describe a range of clinical features that are used to assess the effectiveness of current therapy in an individual patient and the need for modification of therapy. It is, thus, considered a function of underlying disease severity and adequacy of management. The goal of asthma control is to achieve a state wherein the patient has 1) minimal or no symptoms; 2) requires minimal or no use of rescue medication; 3) has no limitation in activity; and 4) has (near) normal lung function, where measured, with no adverse treatment side-effects.

A. Assessment of Asthma Control

The Global Initiative for Asthma (GINA) guidelines are the international standard for determining the level of asthma control (Table 1). The guidelines define 3 potential levels of control that guide treatment action: 1) controlled; 2) partly controlled; and 3) uncontrolled. The characteristics used to determine 'level of control' in the GINA guidelines include daytime symptoms, limitation of activities, nocturnal symptoms, need for reliever medication, lung function test results (PEF or FEV_1) and the number of exacerbations. Evaluation of level of control in children who are five years or younger varies within each category, and does not include assessment of lung function (Appendix 1). Asthma therapy can be stepped up or down based on the level of control achieved, but this requires good monitoring and follow-up of patients on a regular basis.

Table 1: GINA Guidelines – Levels of Asthma Control

CHARACTERISTIC	CONTROLLED (all of the following)	PARTLY CONTROLLED (Any measure present)	UNCONTROLLED
A. Assessment of current control preferably over 4 weeks			
Daytime symptoms	None (twice or less/week)	More than twice/week	Three or more features or partly controlled asthma present in any week†
Limitation of activities	None	Any	
Nocturnal Symptoms/awakening	None	Any	
Need for reliever/rescue treatment	None (twice a week or less)	More than twice/week	
Lung Function (PEF or FEV_1)‡	Normal	<80% predicted or personal best (if known)	
B. **Assessment of Future Risk** (risk of exacerbations, instability, rapid decline in lung function, side-effects)			
Features that are associated with risk of adverse events in the future include: Poor clinical control, frequent exacerbations in the past year*, ever admission to critical care for asthma, low FEV1, exposure to cigarette smoke, high dose medications			

†*By definition, an exacerbation in any week makes that uncontrolled asthma week*
‡*Without administration of bronchodilator, lung function is not a reliable test for children 5 years and younger*
**Any exacerbation should prompt review of maintenance treatment to ensure that it is adequate*

B. Instruments for measuring Asthma Control

More simplified tools have been developed for measuring asthma control in lieu of using the GINA guidelines. They evaluate the same characteristics included in the GINA guidelines with the exception of PFTs. The Asthma Control Test (ACT) is one of the tools which has been validated and widely disseminated. It was developed as a population screening and monitoring tool. Studies including children 12-17 years of age have reported significant correlations between the ACT score and changes in asthma control as measured by physician global ratings and FEV_1 ratings. In addition study results highlight the ability of the ACT to identify high-risk adolescent patients with or without pulmonary function tests (5). An ACT for children aged 4-11 years has also been developed (Childhood Asthma Control Test (C-ACT).

Table 2: Comparison of the GINA and ACT Tools

MEASUREMENT TOOL	ACT[1]	GINA[2]
Target Population (years)	4-12 and >12	Under 5, older than 5, adolescents, adults and the elderly
Recall period	4 weeks	Weekly
CLINICAL FEATURES		
Daytime symptoms	X[a]	X[b]
Night-time	X	X
Activity limitation	X	X
Exacerbation		X
Rescue medication use	X	X
Perception of control	X	
Lung function		X
School-time loss		
Adverse effects		X

1. *ACT – Asthma Control Test*
2. *GINA – Global Initiative for Asthma*

a. *Frequency of shortness of breath*

b. *Symptom score based on frequency, length, and impact of asthma symptoms (nonspecific) on normal daily activities*

Health-related Quality of life (HRQL)

In clinical medicine, QoL reflects the World Health Organization's (WHO) definition of health being a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity. Quality of life is a subjective concept based on an individuals' perception of the impact of events and experiences on his or her life. It encompasses the individuals' satisfaction or happiness in key areas known as 'domains' that are important to the individual. Health–related quality of life is more specific, and refers to overall QoL as determined primarily by a person's health status. Measuring HRQL has a role in describing health outcomes, guiding and assessing management, predicting health outcomes, formulating clinical policy, and allocating health resources (4).

Components of HRQL

The HQRL measures assess dimensions of perception or experience within core domains. Dimensions often measured include symptoms, physical functioning, and disability in the *physical* domain; positive and negative affect and behaviour in the *psychological* domain, and an individual's relationships and roles (work and leisure) in the *social* domain. Health-related quality of life can be both a determinant and an outcome of disease impact (4).

Assessment of HRQL

Various instruments for measuring HRQL have been developed. There are generic instruments that cover areas that are neither disease nor domain-specific. These are useful when measuring QoL of subpopulations with different diseases, or when comparing patients with a particular disease to a healthy control group. There are also disease-specific instruments. These, in contrast, focus on domains that are most relevant to a particular disease (10).

In children, majority of instruments are designed for parent completion. Parents' answers are a proxy response for a child's daily functioning. There is evidence that the parents' perceptions, however, differ from their children. In the study by Mussafi et al, mentioned above, significant correlations between parent's and children's HRQL scores were found (spearman's rank correlation coefficient of 0.61, $p<0.001$), but parents tended to underestimate the impact of the asthma on the child's overall well-being. Proxy assessment of health status may, therefore, be valuable only in younger children and should be combined with a child's self-reported information. Health status may be assessed by proxy, but HRQL is based on the individuals' perception, and should always be self-reported where possible.

Instruments for measuring HRQL

There are several instruments for measuring HRQL in asthma. These include the How Are You (HAY) questionnaire, the Paediatric Quality of Life Inventory (PedsQL), the Childhood Asthma Questionnaire (CAQ), the Life Activities Questionnaire for Childhood Asthma (LAQ), and the Paediatric Asthma Quality of Life Questionnaire (PAQLQ).

The strength of disease-specific instruments is that they focus on the areas of function that are most important to patients with the disease, and are much more responsive to small but important changes in HRQL. An instrument used for a cross-sectional study must have good discriminative properties, i.e. if an investigator wants to compare QoL in asthmatics vs. non-asthmatics or compare QoL among those with

mild, moderate or severe impairment the properties required for good discrimination are reliability and cross-sectional construct validity (11). The PAQLQ(S) is one such instrument.

Table 3: Summary of Instruments Used to Assess HRQL in Children with Asthma

INSTRUMENTS	AGE RANGE (yrs)	STRENGTHS	WEAKNESSES
HAY	8 to 12	Useful for both discriminative and evaluative research	Contains generic components
PedsQL	2 to 8	Suitable for evaluative (response to change over time) and discriminative (differentiate between better and worse quality of life) objectives	Generic instrument and not specific for asthma
CAQ	Form A: 4 to 7 Form B: 8 to 11 Form C: 12 to 16	Different questionnaires for different age groups allowing focus on age-related issues	Has generic components which are unlikely to be affected by the disease and thus poorly discriminative
LAQ	5 to 17	Assesses activity limitation in 5 different categories so more comprehensive	71-item long questionnaire
PAQLQ	7 to 17	Suitable for evaluative and discriminative objectives	One version covers a wide age range

The PAQLQ was primarily designed for evaluative purposes (i.e. to assess change over time), but it also has discriminative purpose (i.e. it is able to distinguish between those with worse and those with better HRQL). The PAQLQ has been pretested in children to ensure that even the youngest children can conceptually understand the questions and response options. Even in the youngest the instrument has strong measurement properties in all domains with good reliability, responsiveness and both cross-sectional and longitudinal validity (10. For overall HRQL and for each of the domains, the Minimum Important Difference (MID) has been determined as a change in the mean score of 0.5 (11). The other instruments are lacking in some of these important aspects.

Cultural adaptation

The PAQLQ and its various versions have been adapted for a large number of languages and cultures. The cultural adaptations are adapted by the MAPI research Institute. Hai et al. in Egypt assessed the validity of the Arabic PAQLQ among Egyptian children. They did not modify the properties of the original questionnaire and found it to be reliable for assessing HRQL among Egyptian children (12). Around the world, similar results have been obtained by those that have tested the tool in their local environments,

and no changes, other than language, have been found necessary to make to the original questionnaire. The tool exists in over 40 different languages from all continents including Afrikaans and French, in addition to the Arabic version, which are utilized in Africa. The questionnaire can be translated into Kiswahili for wider use in our local population if found to provide important additional information for management of asthma among Kenyan children, and validated for the same.

The PAQLQ (S) uses a 7-point responsive scale for each question; each item being equally weighted. The final score is a mean of the score for each item, and higher scores indicate a better HRQL (Table 4). It has good construct validity, responsiveness to change over time, and test-retest reliability. The PAQLQs focus on symptoms and emotional well-being may contribute to its excellent responsiveness as these domains are likely to respond faster and more significantly to therapeutic interventions than an instrument that focuses more on the social domain (10).

Table 4: PAQLQ(S) Questionnaire Domains and Scoring

Questionnaire Domains	**No. of Questions**	*Score ranges from 1 to 7 for each question* ***Overall score*** *is the mean overall score* ***Domain score*** *is the mean score in each domain*
Activity limitation	5	
Symptoms	10	
Emotional function	8	
OVERALL	***23***	

Relationship between HRQL and Level of Asthma Control

The primary goals of asthma management are two-fold as discussed above; to achieve control of the disease and to improve quality of life. These goals are interlinked, and achievement of one has significant impact upon the achievement of the other; each factor influencing the other.

Patients who exhibit good control of their asthma are expected to have good HRQL. Bloomberg et al. conducted a study in St. Louis Children's Hospital in Missouri, to identify factors related to level of control in children receiving asthma care. They used the PAQLQ to evaluate HRQL in children between the ages of 5 and 12 years. Out of a subject population of 362, they found 25% of children to be well-controlled, 20% to be partly-controlled, and 56% poorly-controlled. Overall, quality of life scores varied significantly

by level of asthma control, for both parents and children, ($p<0.05$, analysis of variance). For children categorized as well-controlled, partly-controlled, and poorly-controlled the mean HRQL scores were 6.1 (0.9), 5.7 (1.0), and 5.5 (1.1) respectively for children, and 6.5 (0.5), 6.2 (0.9), 5.4 (1.3) for parents respectively out of a total of 7 (standard deviations in parentheses) (6).

Although asthma control provides a different method of evaluating a patient with asthma, it fails to incorporate patient-specific goals of treatment or desired level of control. The clinician may still need to translate the control assessment into terms that are meaningful to the child and parent or caregiver. This is where assessment of HRQL comes into the management of asthma. Assessment of control should lead to action, and actions may require paying attention to issues such as trigger avoidance, and providing psychosocial support among others, and not just increasing medication dosages or adding another class of drugs to the treatment regimen.

In children QoL measurement has, traditionally, been based on conventional assessment of asthma severity; PFTs; presence and intensity of night-time symptoms; the need for medication; and on discussions with parents. Today, ample evidence exists to suggest that clinical parameters have a weak correlation to what the child is feeling and his/her actual daily function (7). A study done by Williams et al in Wales has also shown little correlation between the beliefs of the healthcare professional about asthma control, the asthma-related problems of the child, and parental experience of the impact of asthma (8). The physician is frequently unaware of the impact of a child's chronic disease upon the parent and the child despite repeated clinic visits. They also found no correlation between FEV1% or FEF 25%-75% predicted and HRQL. This is not surprising as PFTs reflect the situation at one snapshot in time while asthma is a disease of much variability (6). It is also important to remember that factors that affect quality of life in general such as socioeconomic status, do not affect the results of a disease-specific HQRL assessment which specifically measures the impact of a particular disease on functioning; the disease in this case being asthma.

Mussafi et al. also demonstrated no correlation between physician's asthma severity scoring and HRQL. To assess the feasibility of an electronic health-related quality of life (HRQL) standardized questionnaire in clinical care they recruited and analysed data from a cohort of 115 pairs (pair = parent and their child). No correlation was found between HRQL scores (for either parents or children) and FEV1% of FEF 25%-75%. Similarly, there was also no difference between the clinical asthma severity groups and total HRQL score ($p = 0.086$) (9). Incorporating HRQL measures to asthma management is important for these reasons.

STUDY

Question

What is the health-related quality of life of asthmatic children attending chest clinics in Nairobi?

Rationale

Asthma is a frustrating disease for both patients and health care providers. Patients with asthma often feel their asthma is not treated effectively. Surveys reveal that most asthma patients limit their activities because of respiratory symptoms and as a consequence, report dissatisfaction with their lifestyles (11). Many paediatricians now recognize the importance of incorporating HRQL assessment into their clinical studies. Conventional clinical measures usually provide valuable information about status of the affected organ system but rarely capture impairments (social, physical, emotional) that are important to children in their everyday lives. To obtain a complete picture of a child's health status both conventional and clinical indices and the child's HRQL should be measured.

Based on the research review, it is evident that the impact asthma has on a child's quality of life cannot be inferred from clinical indices; it must be measured directly. Very little data relating to HRQL in childhood asthma exists from Africa. There are no HRQL studies that have been done in Kenya, and as we have seen, assessing HRQL is an important adjunct to improving the well-being of children living with asthma.

Objectives

1. To describe the HRQL of asthmatic children aged 7-17 years who are attending specialist chest clinics at three hospitals in Nairobi.
2. To evaluate the differences in HRQL between well-controlled and uncontrolled asthmatic children aged 7-17 years attending specialist chest clinics at three hospitals in Nairobi.

Methods

Study Design

This is a descriptive cross-sectional survey.

Study Sites

The study was carried out at the following three hospital sites in Nairobi: Aga Khan University Hospital (AKUH), Gertrude's Garden Children's Hospital (GGCH), and Kenyatta National Hospital (KNH).

Gertrude's Garden Children's Hospital

Gertrude's Garden Children's Hospital is a private paediatric hospital located in a more affluent part of Nairobi, largely serving the middle and upper socioeconomic classes of Nairobi. It provides both emergency and ambulatory health services, taking care of new-borns and children up to the age of 21 years, although admissions are restricted to children below the age of 18 years. The study will be carried out in the chest clinic.

Aga Khan University Hospital

The AKUH is a private teaching hospital affiliated with the Aga Khan University Health Sciences. It provides secondary and tertiary level healthcare also, largely, to the middle and upper socioeconomic classes. The hospital has a Paediatric department through which the study will be conducted. It also provides both emergency and ambulatory care services that include outpatient chest clinics through which patients will be recruited.

Kenyatta National Hospital

Kenyatta National Hospital is the oldest hospital in Kenya and is the country's chief referral and teaching institution. It is a public hospital, and serves the entire country's population, posing few if any financial barriers to healthcare access, unlike the above two institutions. Patients for the study will be recruited from the adult chest clinic which manages patients from the age of 12 years and above. The paediatric chest clinic is currently not operational.

Study Period

The study was carried out in the year 2011 during the months of September, October and November.

Study Population

The study enrolled children aged 7-17 years attending chest specialty clinics at the above three hospitals in Nairobi. They had all previously been diagnosed as having asthma according to their records or previous history, and were undergoing follow-up as outpatients.

Inclusion criteria

- Age between 7-17 years
- Ever been previously diagnosed with asthma by a clinician (physicians and other clinical personnel)
- Use of bronchodilators and/or inhaled steroids in the past one year
- Literacy in English

Exclusion Criteria

- Presence of other chronic illness affecting major organ systems such as cardiac, haematological, renal, etc. – this served to limit chronic co-morbidities as tools are designed to measure HRQL in patients that suffer from asthma.
- Age below 7 and above 18 years
- Inability to understand and respond to the questions

- Diagnosed with asthma less than one month prior to enrolment in the study
- Refusal to participate

Sample size

The sample size was calculated using the formula below which is used when comparing means.

$$N = 4\sigma^2(Z_{crit} + Z_{powr})^2/D^2$$

N=total sample size which is the sum of the sizes of both comparison groups

σ = the standard deviation of each groups, assumed to be equal in both groups

Zcrit = the desired significance criterion

Zpowr = desired statistical power

D = the minimum expected difference

The estimation of D and σ were based on studies by Juniper and Bloomberg et al:

1. The minimum expected difference of clinical significance is for the PAQLQ has been determined by studies done by Juniper et al and is 0.5 (Juniper Supplement 1997).
2. The expected measurement variability or standard deviation within each group is estimated at 1 as derived from the study by Bloomberg et al.. (6)
3. The power of the study will be set at 80% (0.842).
4. The criteria for significance will be set at 0.05 (1.96).
5. Difference in comparison will be two-tailed.

Based on the above criteria the minimum sample size required is 124; 62 of whom must be "controlled" and the other 62, poorly-controlled.

Study Procedures

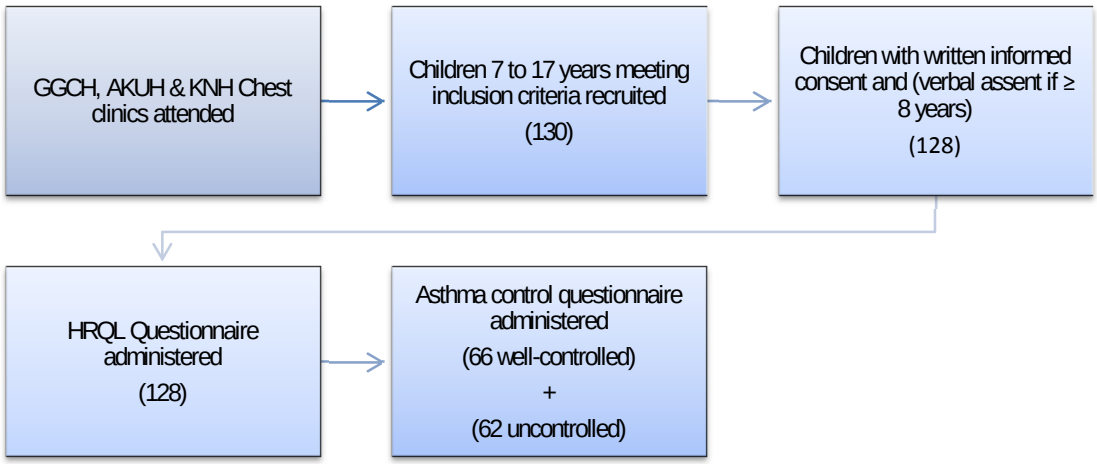

Figure 1: Study Process

Subjects were recruited consecutively by the principal investigator as they attended the chest clinic of each of the study sites during the months of September to November in the year 2011. Patients attending the chest clinic for asthma care were identified from the files as patients registered, and eligibility based on age between 7-17 years was used to identify the children that could potentially be recruited. Parents of potential study subjects were then interviewed by the principal investigator (PI) to determine the purpose of their visit. Those who confirmed they were attending the clinic for asthma management were informed about the study and its purpose, and asked if they would be willing to allow their child/children to participate. Those who agreed were provided with the 'Subject Screening' questionnaire (appendix 7). Parents with children who met 2 other inclusion criteria (Ever been previously diagnosed with asthma or hyper-reactive airway disease and ever used bronchodilators and/or inhaled corticosteroids in the past one year) were then asked to allow the PI to check that they were able to read and comprehend the PAQLQ introductory paragraph and response options. The parents of those who were able to complete this task were then provided with the Consent form (Appendix 8) to complete. Once written consent had been obtained from the parents, children above the age of 8 years were asked to assent verbally. Those who agreed were then guided through completion of the PAQLQ (S), and then the ACT or C-ACT depending on their age. Both questionnaires were interviewer administered to ensure completeness of the data. The questions were read verbatim, however, many children had difficulty understanding the

words “frustrated”, and “irritable”. Once the problem was identified on day one data collection, the words were substituted with the words ‘feel annoyed’, and ‘want to get annoyed’ respectively to minimize information bias. Parents who had children between the ages of 4- 11 years were given the C-ACT to complete after the child had completed it.

All eligible participants were registered in a log book by name and the unique identifier assigned in the log book was used on the questionnaire. This allowed tracking of patients that had already completed the questionnaires so as to avoid duplication of data, and also ensured confidentiality of data. Subjects who declined to participate were also logged into the log book to allow calculation of the participation rate at the end of data collection. The log book was kept in the possession of the principal investigator and the information documented was not shared.

Study Tools

The two instruments used for data collection were as follows:

1. The Asthma Control Test (age-specific)
    a. The ‘**Childhood Asthma Control Test for Children 4-11 years**’ (Appendix 2)

        This tool is scored by summing up the scores of 4 questions with a 3-point scale, and 3 questions with a 5-point scale. The minimum score is zero, the maximum score is 27, and a score of ≤19 indicates uncontrolled asthma.

    b. The ‘**Asthma Control Test for people 12 years and Older**’ (Appendix 3)

        This is a 5-item survey each item being on a 5-point scale. The minimum score is 5 and the maximum score is 25. Once again, a score ≤19 indicates that the patient’s asthma is uncontrolled.

2. **The Paediatric Asthma Quality of Life Questionnaire (Standardized) (PAQLQ (S))** (Appendix 4)

    This instrument has been validated for use among children between the ages of 7 and 17 years. It has a total of 23 questions which are answered on a 7-point response scale. The best score is 7; this means that the child has no impairment due to their asthma. However, once the score

begins to drop below 7, this means that the child is experiencing some degree of impairment. There are no standardized methods of grading these scores, so for purposes of this study and data analysis the scores will be graded as shown in Table 4.

Table 5: Grading of HRQL Scores

PAQLQ(S) Scores	Grading of HRQL Scores	
7 5-6.99	No impairment Mild impairment	→ Good QoL
3-4.99 1-2.99	Moderate impairment Severe impairment	→ Poor QoL

Data Management

Data was entered into a Microsoft Office Excel 2010 spread-sheet using the assigned unique identifiers of each subject. The data was then imported into the Statistical Package for Social Sciences (SPPS) version 16.0 for windows, checked for completeness, cleaned and verified before further analysis.

Ethical Considerations

Ethical approval was obtained from the KNH Ethics Research Committee, as well as the GGCH Ethics Board, and the AKUH Research Committee. Clearance was also obtained from the Chest Specialists and support staff running each of the clinics prior to embarking on data collection. Identities and contact information collected were stored in a registration book, and kept in the possession of the PI to ensure confidentiality.

Statistical Analysis

Descriptive summary statistics are used to describe the respondent demographic characteristics, level of asthma control and HRQL. Means and standard deviations are calculated for continuous variables, and proportions used to describe discrete data. The Chi-square statistic is used for comparison of categorical data, and a p-value of less than 0.05 was considered to be statistically significant. HRQL has also been transformed into a categorical variable for better description of the variable. Analysis of variance (ANOVA) is used to compare means of HRQL between groups (level of asthma control) using the

same level of significance.

The correlation coefficient is used to explore the underlying relationships between the key variables (i.e. asthma control score and HRQL and its three domains), and a p-value less than 0.05 is considered statistically significant.

RESULTS

One hundred and thirty subjects were eligible for the study, out of which 128 provided written consent to participate in the study (participation rate = 98%). A total number of 128 subjects were, therefore, enrolled.

A: Respondent Demographics

Among the 128 study participants, 81 (63%) were recruited from GGCH, 46 (36%) from AKUH, and 1 (1%) from KNH. The median age of the population was 10 years (IQR: 8 to 12 years). Of all children, 66 (52%) were male and 62 (48%) were female. The respondents' ages were also categorized into two groups based on the asthma control tool age group limits; there were 90 respondents (70%) between the ages of 7 to 11years; and 38 (30%) who were 12 years and above. The males in these two age sub-categories were 43 (48%) among those aged 7 to11 years, and 23 (61%) and among those aged 12 years and above.

Table 6: Respondent Demographic and Clinical characteristics (N = 128)

Characteristics	Category	Total N (%)
Hospital	GCH AKUH KNH	81 (63) 46 (36) 1 (1)
Gender*	Males	66 (52)
Age categories for asthma control tests	4 to 11 years 12 years and above	90 (70) 38 (30)
Level of Asthma Control	Well-controlled Uncontrolled	62 (48) 66 (52)

**Females: 48%*

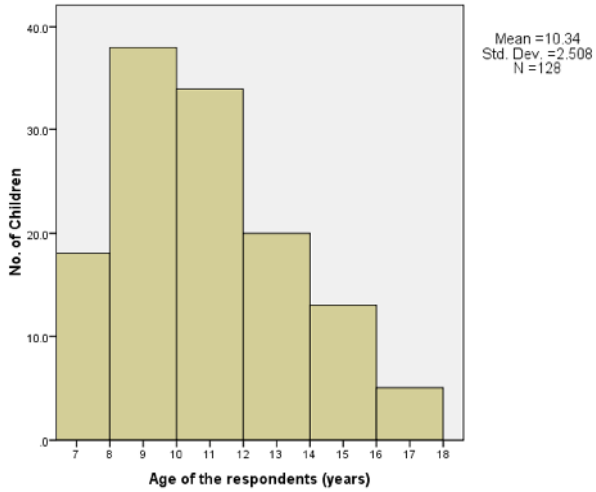

Figure 2: Age distribution of study population

Only one patient was recruited from KNH; this data was removed from further analysis as the overall study results will not be generalizable to this study site in view of the lack of adequate numbers. The total number of study subjects analysed is 127.

B: Health Related Quality of Life

The overall mean HRQL score in the study population out of a possible mean score of 7 was 4.7 (SD 1.1; 95% CI 4.46 to 4.85). Among the domains of HRQL, the activity mean HRQL score was 4.7 (SD 1.2, 95% CI 4.76 to 4.8); the symptoms mean HRQL score was 4.6 (SD 1.3, 95% CI 4.62 to 4.64); and the emotional function mean HRQL score was 4.6 (SD 2.3, 95% CI 4.61 to 4.64).

When we categorize HRQL by level of impairment, we find that overall, of the 127 subjects, 53 (41%) had mild impairment, 69 (54%) had moderate impairment; and 6 (5%) had severe impairment (Table 7).

Table 7: HRQL by Level of Impairment (N=127)

Level of Impairment	Overall No. (%)	Activity No. (%)	Symptoms No. (%)	Emotional Function No. (%)
None	0 (0)	5 (4)	2 (2)	5 (4)
Mild	53 (41)	56 (44)	58 (45)	46 (36)
Moderate	68 (54)	57 (45)	53 (42)	66 (52)
Severe	6 (5)	9 (7)	14 (11)	10 (8)

Majority of the children with severe impairment overall had impairment in the symptom domain (14(11%)); while for moderate impairment, most children had emotional function impairment (67(52%)). Among the children with mild impairment, most had impairment in the symptom domain (58(45%)) as well.

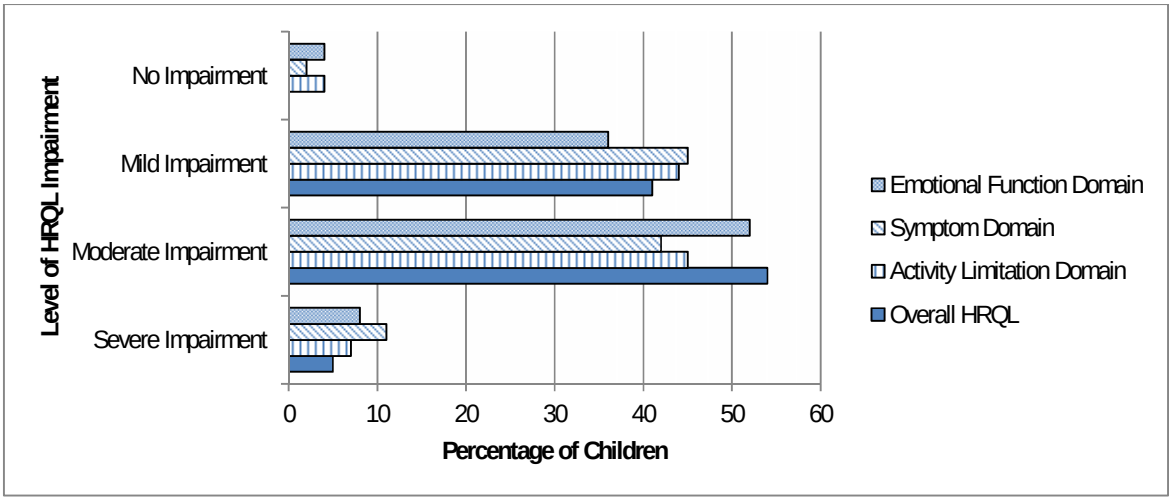

Figure 3: HRQL by Level of Impairment

The HRQL variable was further categorized into 2 categories (good quality of life and poor quality of life) to facilitate further description of the data. A mean score of 5 and above was assigned as good QoL (this encompasses those with mild or no impairment in HRQL according to the scale used previously), and a score below 5 were categorized as poor QoL. Among the factors assessed for association with HRQL (asthma control, age and gender), only level of asthma control was significantly associated with HRQL. Among the children with uncontrolled asthma 49 (75%) had poor QoL compared to 26 (42%) of those with well-controlled asthma (OR 4.2, $p < 0.001$).

Table 8: Association between Overall HRQL and Asthma control, Age, and Gender

Variable	(N)	Poor QoL No. (%)	Good QoL No. (%)	OR	95% CI	X^2 statistic p-value
Asthma Control	Uncontrolled (66) Well-controlled (62)	49 (75) 26 (42)	16 (25) 36 (58)	4.24	1.98-9.04	**< 0.001**
Age	7-11 years (90) ≥12 years (38)	57 (63) 18 (49)	33 (37) 19 (51)	1.82	0.84-3.95	0.165
Gender	Male (66) Female (62)	40 (62) 35 (56)	25 (38) 27 (44)	1.23	0.60-2.50	0.592

Among the domains of HRQL assessed, children with uncontrolled asthma were found to have higher odds of having poor quality of life (Table 9 A, 9 B and 9 C) in each of the domains, with particularly worse odds associated with the symptom domain (In the *activity domain* the odds were 3.8 times higher (95% CI 1.8 to 8.1, p < 0.001); in the *symptoms domain* the odds were 5.2 times higher (95% CI 2.4 to 11.2, p < 0.001), and in the *emotional function domain*, the odds were 2.5 times higher (95% CI 1.8 to 5.3, p < 0.017)). Although children > 12 years were not significantly more likely to have good quality of life overall than their younger counterparts (7 to 11 years), they had almost 3-fold higher odds (Table 9 C) of their emotional function domain affecting their HRQL, as compared to 1.8 times higher odds in the activity domain and 1.3 times higher odds in the symptoms domain (Table 9 A and 9 B).

Table 9 A: Association between HRQL *Activity* domain and Asthma control, Age and Gender

Variable	(N)	Poor QoL No. (%)	Good QoL No. (%)	OR	95% CI	X^2 statistic p-value
Asthma Control	Uncontrolled Well-controlled	47 (72) 25 (40)	18 (28) 37 (60)	3.86	1.83-8.12	**< 0.001**
Age	7-11 years ≥12 years	55 (61) 17 (46)	35 (39) 20 (54)	1.84	0.85-4.00	0.167
Gender	Male Female	36 (55) 36 (58)	29 (45) 26 (42)	0.89	0.44-1.81	0.858

Table 9 B: Association between HRQL *Symptoms* domain and Asthma control, Age and Gender

Variable	(N)	Poor QoL No. (%)	Good QoL No. (%)	OR	95% CI	X^2 statistic p-value
Asthma Control	Uncontrolled Well-controlled	49 (75) 23 (37)	16 (25) 39 (63)	5.19	2.41-11.15	**< 0.001**
Age	7-11 years ≥12 years	55 (61) 20 (54)	35 (39) 18 (46)	1.33	0.61-2.90	0.167
Gender	Male Female	40 (62) 32 (52)	25 (38) 30 (48)	1.50	0.74-3.03	0.286

Table 9 C: Association between HRQL *Emotional Function* domain and Asthma control, Age and Gender

Variable	(N)	Poor QoL No. (%)	Good QoL No. (%)	OR	95% CI	X^2 statistic p-value
Asthma Control	Uncontrolled Well-controlled	49 (75) 34 (55)	16 (25) 28 (45)	2.52	1.87-5.36	**0.017**
Age	7-11 years ≥12 years	65 (72) 18 (49)	25 (28) 19 (51)	2.74	1.24-6.06	**0.014**
Gender	Male Female	42 (65) 41 (66)	23 (35) 21 (34)	0.94	0.45-1.94	1.000

When children are divide further into the following groups (7 to 8 years; 9 to 12 years; and 13 to 17 years), we find a trend for association among the 9 to 12 year-olds where emotional HRQL score contributes significantly to poor HRQL in the children with uncontrolled asthma (77%) versus those with well-controlled asthma (49%) (OR 3.5; p = 0.02).

Table 10: Association between HRQL Emotional Function Domain and Age

Variable	(N)	Poor QoL No. (%)	Good QoL No. (%)	OR	95% CI	X^2 statistic p-value
7 to 8 years	Uncontrolled (16) Well-controlled (19)	15 (94) 15 (79)	1 (6) 4 (21)	4.00	0.4 – 40.1	0.347
9 to 12 years	Uncontrolled (31) Well-controlled (35)	23 (77) 17 (49)	7 (23) 18 (51)	3.50	1.18 - 10.19	**0.024**
13 to 17 years	Uncontrolled (19) Well-controlled (8)	11 (58) 2 (25)	8 (42) 6 (75)	4.12	0.65 – 26.00	0.209

C: Level of Asthma Control

Of all the 127 children, 65 (51%) were well-controlled and 62 (48%) were uncontrolled. Level of asthma control was divided into two groups based on the total score of one of the two asthma control testing tools (C-ACT and ACT) discussed previously. Children who scored ≤19 were grouped as 'uncontrolled' and those who scored >19 were grouped as 'well-controlled'. Figures 4 and 5 show the distribution of asthma control test scores by age category. Children between the ages of 7 and 11 years (N = 90) tended to be better controlled with a mean control score of 19.7 (SD 3.84; 95% CI 18.8 to 20.5)) than the teenagers (N = 37) whose mean control score was 17.2 (SD 3.7; 95% CI 15.8 to 18.3). Fifty-one (57%) of the 7 to 11 year-olds were well-controlled, whereas only 11 (30%) of the teenagers were well-controlled.

These differences in level of asthma control between the two age categories were statistically significantly (p = 0.007).

Table 11: Associations between level of asthma control and the age and gender variables (N = 127)

		No. (%)	Level of Asthma Control		OR	95% CI	X^2 statistic p-value
			Uncontrolled N = 65 No. (%)	Well-controlled N = 62 No. (%)			
Gender	Male	65 (51)	37 (57)	28 (43)	1.60	0.79 – 3.23	0.216
	Female	62 (49)	28 (45)	34 (55)			
Age	7-11 years	90 (71)	39 (43)	51 (57)	0.32	0.14 – 0.73	0.007
	≥12 years	37 (29)	26 (70)	11 (30)			

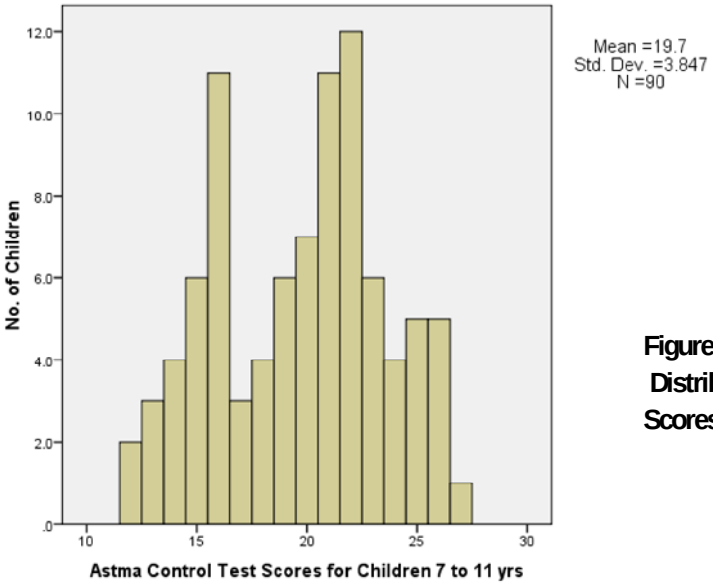

Figure 4:
Distribution of Asthma Control Test Scores by Age (7 to 11 years)

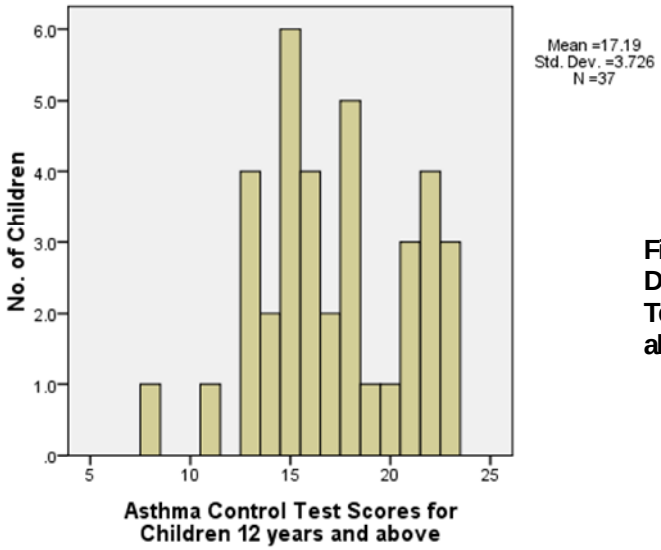

Figure 5:
Distribution of Asthma Control Test Scores by Age (12 years and above)

D: Relationship between Level of Asthma control and HRQL

Before further examining the relationship between asthma control and HRQL, the normality and linearity of the data had to be established. As can be seen in Figure 6, the HRQL data are normally distributed (skewness of 0.117 (SEM 0.215), and kurtosis of -0.990 (SEM 0.427) and linearly distributed (Q-Q plot), therefore, further analysis using parametric statistical tests can be done without the need to transform the data.

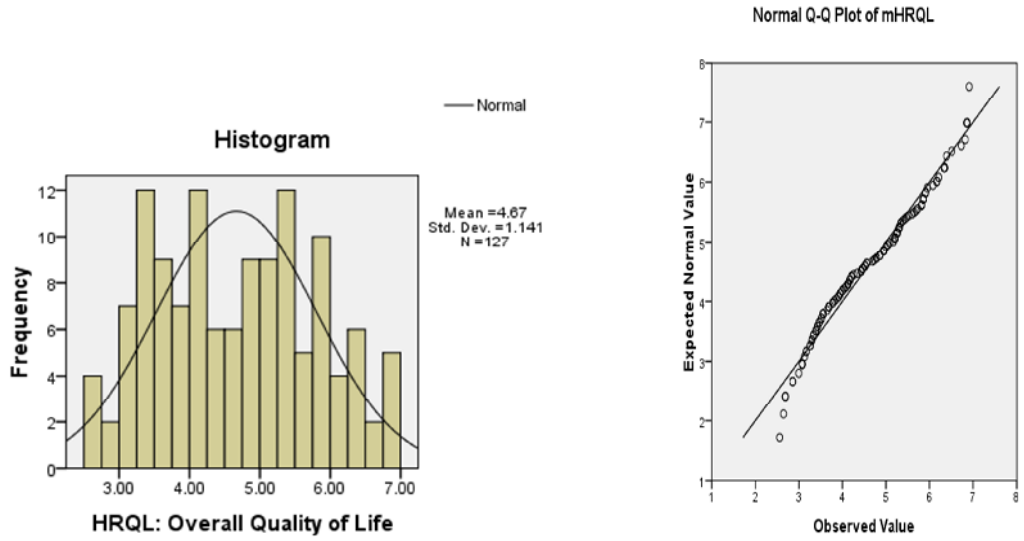

Figure 6: Exploratory Data Analysis of the HRQL variable

Analysis of variance also shows significant associations between mean HRQL score and level of asthma control both overall, and within each of the HRQL domains.

Table 12: Comparison of mean HRQL Scores between Well-controlled and Uncontrolled groups

HRQL Domains	Mean HRQL Score (SD) Well-controlled	Mean HRQL Score (SD) Uncontrolled	ANOVA p-value
Overall	5.24 (0.97)	4.12 (1.01)	< 0.001
Activity limitation	5.28 (1.23)	4.33 (1.04)	< 0.001
Symptoms	5.27 (1.09)	3.99 (1.15)	< 0.001
Emotional function	5.15 (1.08)	4.16 (1.26)	< 0.001

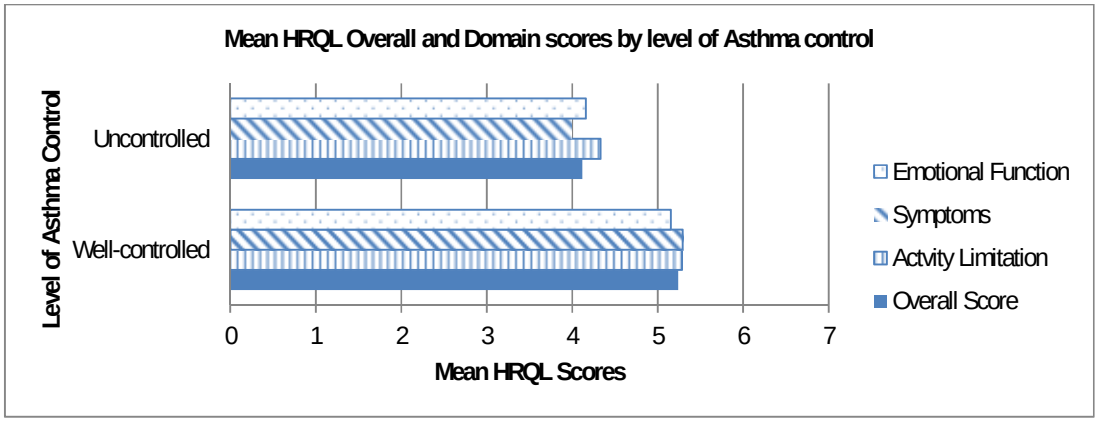

Figure 7: Differences in Mean HRQL Scores in Well-controlled and Uncontrolled Asthma groups

Further assessment of the relationship between mean HRQL score and asthma control using Pearson's correlation analysis shows that asthma control is directly correlated to mean HRQL score ($r = 0.59$; $\alpha=0.01$); HRQL increases with increasing level of asthma control.

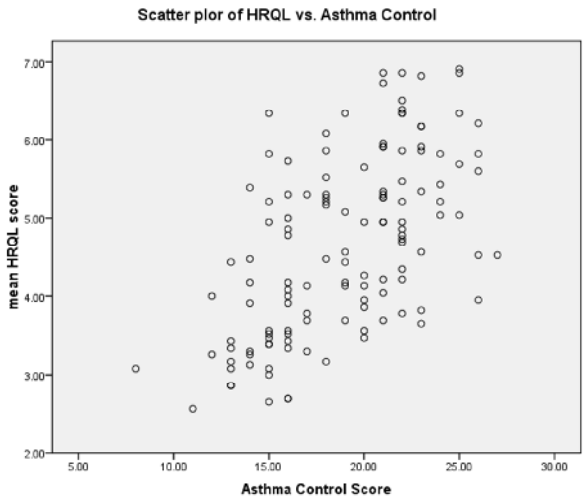

Figure 8: Scatter plot of Mean HRQL Scores and Asthma Control Test Scores

DISCUSSION

Historically, it has been assumed assessment of asthma control by a physician would be suitable enough means of establishing the need upon which to base adjustment of treatment. However, physician assessments using parameters such as symptoms and lung function tests have been shown to correlate poorly with measurements of quality of life, and yet one of the goals of asthma management is to improve the quality of life of the child being managed for asthma. Studies such as the one done by Williams et al

showed no correlation between asthma control as viewed by the doctor or nurse in charge and the quality of life scores obtained from the children (8). Other parameters, therefore, need to be included in the assessment to facilitate optimal management of these children. Chronic illnesses such as asthma often have a strong psychosocial component that has an impact on morbidity.

Health Related Quality of Life has been found to be a measure of asthma morbidity, and thus important in our understanding of the disease and its management. Various studies from the high-income countries have shown HRQL in asthmatic patients to be related to severity of asthma. There is little information in low-income countries about HRQL in children with asthma. This study sought to assess the state of HRQL among children with asthma in the low-income country of Kenya, and to determine whether it is linked to the level of asthma control, as better asthma care has been shown to improve HRQL. The PAQLQ was chosen for this purpose as it is a specific tool for asthma and has been widely used it for measuring HRQL in children with asthma, incorporating the physical, symptom and emotional aspects. It has also been validated in many countries around the world.

The study results show that HRQL is not optimal in our setting. The mean HRQL score was 4.7 out of a possible score of 7. In a study done in Iran among 113 patients between the ages of 7 and 17 years, the total mean scores are not given, but the mean scores of males and females were 5.3 and 6.7 respectively as compared to our population where males and females scored a mean of 4.6 and 4.1 respectively (26). In Sweden, Nordlund et al, using the same tool to assess HRQL, obtained a mean total HRQL score of 5.4 (28). In Brazil, La Scala et al, who studied a population of 56, obtained a total mean score of 6.36 (7). In a study population in Egypt, the mean overall HRQL score was 4.0 (19). The mean HRQL scores generally tend to be higher in high-income countries and lower in low-income countries as well as among immigrant populations in high-income countries. There are exceptions, however, as demonstrated by Brazil, and there is, therefore, room to improve the HRQL of children in Nairobi who are living with asthma, and by extension children in Kenya (26). Sixty percent of the study population had moderate to severe impairment possibly reflects sub-optimal control for this majority group.

Further analysis of the HRQL scores by specific domains reveals that among the children with severe impairment, most were affected by symptoms rather than by activity or emotions, but these data are not replicated elsewhere. Studies done have not used impairment to describe their populations, so comparisons are difficult to extrapolate and conclusions cannot be drawn. It is however, expected that children with more symptoms are poorly controlled and will, will therefore, have worse quality of life as is discussed below, improving asthma control improves HRQL

The effect of level of asthma control on HRQL was also examined. Health-related quality of life differed significantly between children who had well-controlled asthma and those with uncontrolled asthma. The study by Nordlund et al showed a strong correlation between asthma control scores and HRQL scores (spearman correlation coefficient (r) = 0.8), and also demonstrated lower HRQL scores among girls as compared to boys (28). Such gender differences have been attributed to different physiological responses to asthma, but this study did not demonstrate this finding; there were no significant differences in asthma control or HRQL based on gender. Studies in children are, however, limited. A study done in Iran by Zandieh et al actually found males subjects had significantly worse HRQL scores than their female counterparts (27), but a mental health study in Germany that targeted the same age group (7 to 17 years, showed girls to have worse HRQL scores than boys, although the tool used to assess HRQL was different with a decrease among girls being more distinctive as the children get older. In this study, there is a trend for association of the age of 9 to 12 years and emotional HRQL score. The German study suggests that mental health status contributes significantly to HRQL, and in a study done by Okelo et al in adolescents (11 to 17 years) it was found that this age group reports poorer scores in emotional HRQL; poor asthma-specific emotional QoL was strongly related to worse asthma control and other markers of morbidity such as emergency room visits, hospitalization, doctor visits for worsening asthma and missed school because of asthma (31). The adolescent appears to be a special group that needs to be further studied in our setting. The effects of age and gender on HRQL are varied in the literature, even when similar domains are measured.

Hubert Chen et al did studies on adult patients in 2007 and identified asthma control as an independent predictor of disease-specific quality of life (29).There is indeed a significant and direct relationship between level of control and HRQL that has been shown in other parts of the world as well. Identifying the children with poor quality of life will help focus attention on children who have treatment plans that are not working well for them, and these children will by and large tend to have uncontrolled asthma.

The major limitation of the study was the reliance on instruments that have been developed and validated in countries that have different socio-cultural practices and language. Potential study subjects who did not speak English were not included and this limited the diversity of the study population and conclusions regarding the findings in the lower socioeconomic strata. It was however, more important to obtain valid data, than to collect data that would have been inconsistent due to the need to adapt questions to children that had difficulty understanding questionnaires. It would be important to translate and validate a Kiswahili version of the instrument to enable use of the tool more broadly to capture data that will be more generalizable to the country as a whole. It is also important to note that patients were recruited from chest clinics to increase confidence in the diagnosis of asthma as other measurements were not used to confirm the diagnosis. There is, thus, the possibility of selection bias, and generalizability of the results to the broader community on this basis, will also be limited.

We need to listen more our children so that we can evaluate fully the morbidity they experience, optimize health management, and their capacity to function normally thus improving their quality of life. Some of the aspects of asthma-specific HRQL can be altered, so collecting information on HRQL for daily care with a valid HRQL instrument may not only contribute to better insight in the influence of asthma on the child's life, but also has the potential to improve HRQL of the paediatric asthma patient since the components that are bothering the patient can be integrated into medical care decisions for the individual patient. This study confirms that it is both quick and straightforward to administer the PAQLQ(S) in a routine clinical situation to assess HRQL.

CONCLUSIONS

1. All the children in the study experienced some level of impairment in their overall health-related quality of life, with a larger proportion of them (59%) experiencing moderate to severe impairment.
2. Impairment is experienced in all domains of health-related quality of life (i.e. activity limitation, symptoms and emotional function), and is greatest in the symptom domain overall. The activity limitation domain is the least affected overall.
3. There is a significant difference in quality of life between children with well-controlled and uncontrolled asthma. Children with uncontrolled asthma have a four-fold higher risk of having poor quality of life as compared to children with well-controlled asthma.
4. Health-related quality of life increases with increasing asthma control.

RECOMMENDATIONS

1) We recommend that regular evaluation of health related quality of life be incorporated into routine asthma care.
2) There is a need to develop asthma management strategies for improving health related quality of life in our setting, and measures for improvement of asthma control would be key among them.

ACKNOWLEDGEMENTS

I would like to thank Professor Elizabeth F. Juniper from McMaster University, Canada for her permission to use the PAQLQ(S) questionnaire for the study, as well as all the children and their families for their participation in this study, and thus their invaluable contribution to our knowledge of the situation of asthma care in Kenya. I would also like to thank my family for all their sacrifices that made this possible; thank you and God bless all of you.

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APPENDIX 1: GINA Guidelines - Level of Asthma Control for Children Five Years Old or Younger

Characteristic	**Controlled** (All of the following)	**Partly Controlled** (Any measure present in any week)	**Uncontrolled** (3 or more features of partly controlled asthma in any week)
Daytime Symptoms: Wheezing, cough, difficulty in breathing	None (less than twice/week, typically for short periods on the order of minutes and rapidly relived by use of a rapid-acting bronchodilator)	More than twice/week (typically for short periods on the order of minutes, and rapidly relived by use of rapid-acting bronchodilator)	More than twice/week (typically lasts minutes or hours or recur, but partially or fully relieved with rapid-acting bronchodilator)
Limitation of activities	None (child is filly active, plays and runs without limitation or symptoms	Any (may cough, wheeze or have difficulty in breathing during exercise, vigorous play, or laughing)	Any (may cough, wheeze, or have difficulty breathing during exercise, vigorous play, or laughing)
Nocturnal symptoms/awakening	None (including no nocturnal coughing during sleep)	Any (typically during sleep or wakes with cough, wheezing and/or difficult breathing)	Any (typically coughs during sleep or wakes with cough, wheezing and/or difficult breathing)
Need for reliever/rescue treatment	<2 days/week	>2 days/week	>2 days/week
Any exacerbation should prompt review of maintenance treatment to ensure that it is adequate. Although patients with current clinical control are less likely to experience exacerbations, they are still at risk during viral upper respiratory tract infections and may still have one or more exacerbations per year.			

APPENDIX 4: Paediatric Asthma Quality of Life Questionnaire

I want you to tell me how much you have been bothered by your asthma during the past week. I will tell you which card to use. Pick the number that best describes how much you have been bothered by your asthma in the past week.

1. A How much have you been bothered by your asthma in **PHYSICAL ACTIVITIES** (such as running, swimming, sports, walking uphill/upstairs and bicycling) during the past week? (BLUE CARD)
2. A How much have you been bothered by your asthma in **BEING WITH ANIMALS** (such as playing with pets and looking after animals) during the past week? (BLUE CARD)
3. A How much have you been bothered by your asthma in **ACTIVITIES WITH FRIENDS AND FAMILY** (such as playing at recess and doing things with your friends and family) during the past week? (BLUE CARD)
4. S How much did **COUGHING** bother you in the past week? (BLUE CARD)
5. E How often did your asthma make you feel **FRUSTRATED** during the past week? (GREEN CARD)
6. S How often did your asthma make you feel **TIRED** during the past week? (GREEN CARD)
7. E How often did you feel **WORRIED, CONCERNED, OR TROUBLED** because of your asthma during the past week? (GREEN CARD)
8. S How much did **ASTHMA ATTACKS** bother your during the past week? (BLUE CARD)
9. E How often did your asthma make you feel **ANGRY** during the past week? (GREEN CARD)
10. S How much did **WHEEZING** bother you during the past week? (GREEN CARD)
11. E How often did your asthma make you feel **IRRITABLE** (cranky, grouchy) during the past week? (GREEN CARD)
12. S How much did **TIGHTNESS IN YOUR CHEST** bother you during the past week? (BLUE CARD)
13. E How often did you feel **DIFFERENT OR LEFT OUT** because of your asthma during the past week? (GREEN CARD)
14. S How much did **SHORTNESS OF BREATH** bother you during the past week? (BLUE CARD)
15. E How often did you feel **FRUSTRATED BECAUSE YOU COULDN'T KEEP UP WITH OTHERS** during the past week? (GREEN CARD)
16. S How often did your asthma **WAKE YOU UP DURING THE NIGHT** during the past week? (GREEN CARD)
17. E How often did you feel **UNCOMFORTABLE** because of your asthma during the past week? (GREEN CARD)
18. S How often did you feel **OUT OF BREATH** during the past week? (GREEN CARD)
19. A How often did you feel **YOU COULDN'T KEEP UP WITH OTHERS** because of your asthma during the past week? (GREEN CARD)
20. S How often did you have trouble **SLEEPING AT NIGHT**, because of your asthma, during the past week? (GREEN CARD)
21. E How often did you feel **FRIGHTENED BY AN ASTHMA ATTACK** during the past week? (GREEN CARD)
22. A Think about all the activities that you did in the past week. How much were your bothered by your asthma doing these activities? (BLUE CARD)

23. S How often did you have difficulty taking a **DEEP BREATH** in the past week? (GREEN CARD)

DOMAIN CODE:
S = Symptoms
A = Activity Limitations
E = Emotional Function

APPENDIX 5: RESPONSE OPTIONS

GREEN CARD

1. ALL OF THE TIME
2. MOST OF THE TIME
3. QUITE OFTEN
4. SOME OF THE TIME
5. ONCE IN A WHILE
6. HARDLY ANY OF THE TIME
7. NONE OF THE TIME

BLUE CARD

1. EXTREMELY BOTHERED
2. VERY BOTHERED
3. QUITE BOTHERED
4. SOMEWHAT BOTHERED
5. BOTHERED A BIT
6. HARDLY BOTHERED AT ALL
7. NOT BOTHERED

APPENDIX 6: RESPONSE SHEET

REFERENCE NUMBER: _____ **DATE:** _____

ITEM	RESPONSE
1. Physical activities	
2. Being with animals	
3. Activities with friends and family	
4. Cough	
5. Frustrated	
6. Tired	
7. Worried/Concerned/Troubled	
8. Asthma attacks	
9. Angry	
10. Wheezing	
11. Irritable	
12. Tightness in chest	
13. Feeling different or left out	
14. Shortness of breath	
15. Frustrated can't keep up with others	
16. Wake up during the night	
17. Uncomfortable	
18. Out of breath	
19. Can't keep up with others	
20. Trouble sleeping at night	
21. Frightened by asthma attack	
22. Bothered in activities overall	
23. Deep breath	

APPENDIX 7: Subject Screening Tool

REFERENCE NUMBER: _____ DATE: _____

Name: _____ Gender: ☐ Male ☐ Female

Clinic Location: _____ Date of birth: (day/month/year) ____

Purpose of visit: _____

Child's condition (history): ☐ Asthma ☐ Recurrent Wheeze ☐ Other _____

Clinician Diagnosis: ☐ Asthma ☐ Hyper-reactive airways ☐ Other _____

Asthma medication

Name of Medication	When started	If stopped, When stopped	Duration of Use

Class of Drugs: ☐ Reliever Medication[1] ☐ Controller Medication[2] ☐ Other _____

Inclusion Criteria

☐ Aged between 7-17 years

☐ Ever been previously diagnosed with asthma or hyper-reactive airway disease

☐ Ever used bronchodilators and/or inhaled corticosteroids in the past one year

☐ Literate in English

INFORMED CONSENT ☐ YES ☐ NO

CONTACT - Telephone Number: _____

[1]Reliever medication: Short acting inhaled β_2-agonists

[2]Controller medication: Inhaled corticosteroids and/or leukotrienes modifiers and/or long acting inhaled β_2-agonists

APPENDIX 8: Consent Form

Principal Investigator: Dr. Lena Kombo **Institution**: University of Nairobi

STUDY PURPOSE

The purpose of this study is to examine the problems that many children with asthma find troublesome in different areas of their lives such as school and physical activities, and to see how this makes them feel. Looking at these other aspects of life is important in understanding what impact asthma has on the well-being of our children. We currently do not know.

STUDY PROCEDURE

This requires you and your child to complete 2 questionnaires. One questionnaire will help us determine how the asthma is affecting your child's life, and the other one will tell us how well your child's asthma is controlled. The questionnaires ask about the symptoms your child is experiencing, and how their physical activity and their emotions are affected. We would also like to know what medication your child has used to treat their asthma in the past year.

POSSIBLE BENEFITS

It is important for us as doctors to know whether the way we are managing your child's asthma is making an important difference to their well-being. Sometimes simply controlling the symptoms with medication is not enough to make this difference. It is important to know what areas of life are affected so that these can also be addressed.

INSTITUTIONAL APPROVAL

This study has been approved by the Kenyatta National Hospital/University of Nairobi Ethics and Research Committee. You may contact the Secretary of the committee with any further questions about the project at Telephone: 726300-9 or on Email: KNHplan@Ken.Healthnet.org. I can be reached at 0737-468736 for any follow-up questions that you may have.

CONFIDENTIALITY

All information disclosed in the questionnaire will be treated as confidential. Your and your child's personal identity will not be revealed in any publication or given to any other institution.

VOLUNTARY PARTICIPATION

Participation in the study is voluntary. If you are willing to have you and your child participate, please sign on the line below.

Thank you for your time and support.

.....

I agree to take part in the following Study "A Cross-Sectional Study on the Health-related Quality of Life of Asthmatic children in Nairobi

....

Signature of Parent/Guardian Date

....

Name of Child Reference Number

Enter Name

Enter Address

Enter City/State/Zip

Today's Date: _____

Patient's Name: _____

Childhood Asthma Control Test for children 4 to 11 years.

This test will provide a score that may help the doctor determine if your child's asthma treatment plan is working or if it might be time for a change.

How to take the Childhood Asthma Control Test

Step 1 Let your child respond to **the first four questions (1 to 4)**. If your child needs help reading or understanding the question, you may help, but let your child select the response. Complete the remaining **three questions (5 to 7)** on your own and without letting your child's response influence your answers. There are no right or wrong answers.

Step 2 Write the number of each answer in the score box provided.

Step 3 Add up each score box for the total.

Step 4 Take the test to the doctor to talk about your child's total score.

19 or less If your child's score is 19 or less, it may be a sign that your child's asthma is not controlled as well as it could be. Bring this test to the doctor to talk about the results.

Have your child complete these questions.

1. How is your asthma today?

 0 Very bad	 1 Bad	 2 Good	 3 Very good

SCORE

2. How much of a problem is your asthma when you run, exercise or play sports?

 0 It's a big problem, I can't do what I want to do.	 1 It's a problem and I don't like it.	 2 It's a little problem but it's okay.	 3 It's not a problem.

3. Do you cough because of your asthma?

 0 Yes, all of the time.	 1 Yes, most of the time.	 2 Yes, some of the time.	 3 No, none of the time.

4. Do you wake up during the night because of your asthma?

 0 Yes, all of the time.	 1 Yes, most of the time.	 2 Yes, some of the time.	 3 No, none of the time.

Please complete the following questions on your own.

5. During the last 4 weeks, how many days did your child have any daytime asthma symptoms?

5 Not at all	4 1-3 days	3 4-10 days	2 11-18 days	1 19-24 days	0 Everyday

6. During the last 4 weeks, how many days did your child wheeze during the day because of asthma?

5 Not at all	4 1-3 days	3 4-10 days	2 11-18 days	1 19-24 days	0 Everyday

7. During the last 4 weeks, how many days did your child wake up during the night because of asthma?

5 Not at all	4 1-3 days	3 4-10 days	2 11-18 days	1 19-24 days	0 Everyday

TOTAL

APPENDIX 3: Take the Asthma Control Test™ (ACT) for people 12 years and over

REFERENCE NUMBER: _____ DATE: _____

Take the Asthma Control Test™ (ACT) for people 12 yrs and older.

1. In the past **4 weeks**, how much of the time did your **asthma** keep you from getting as much done at work, school or at home?

All of the time 1	Most of the time 2	Some of the time 3	A little of the time 4	5

2. During the past **4 weeks**, how often have you had shortness of breath?

More than once a day 1	Once a day 2	3 to 6 times a week 3	Once or twice a week 4	5

3. During the past **4 weeks**, how often did your **asthma** symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning?

4 or more nights a week 1	2 or 3 nights a week 2	Once a week 3	Once or twice 4	5

4. During the past **4 weeks**, how often have you used your rescue inhaler or nebulizer medication (such as albuterol)?

3 or more times per day 1	1 or 2 times per day 2	2 or 3 times per week 3	Once a week or less 4	5

5. How would you rate your **asthma** control during the **past 4 weeks**?

Not controlled at all 1	Poorly controlled 2	Somewhat controlled 3	Well controlled 4	5

SCORE ☐

TOTAL ☐

If score is 19 or less, asthma may not be controlled as well as it could be.

The ACT is:

- A simple, 5-question tool that is self-administered by the patient
- Clinically validated by specialist assessment and spirometry[1]
- Recognized by the National Institutes of Health

Reference: 1. Nathan RA et al. *J Allergy Clin Immunol*. 2004;113:59-65.