Health Literacy and Pediatric Asthma

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Abstract

Health literacy and pediatric asthma are two prevalent and significant public health issues. Although there are limited relevant studies focused on health literacy regarding pediatric asthma, there is accumulating evidence that suggests a link between low health literacy and asthma in children. The complex interplay of social-ecological factors for health literacy and asthma requires the integrated perspectives of multiple sectors and professions to understand and promote health literacy to improve asthma outcomes for children. This review examines epidemiological studies concerning health literacy and pediatric asthma over the past decade and discusses possible avenues of future research.

Table of Contents

List of Tables

Preface

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1.0 Introduction

Asthma is a common chronic disease in childhood. According to the National Health Interview Survey in 2020, approximately 4.2 million children in the United States currently have asthma (Centers for Disease Control and Prevention, 2020). In 2019, children with asthma accounted for 790,478 emergency department visits with 64,525 hospitalizations (Centers for Disease Control and Prevention, 2020). In comparison to adults with asthma, children with asthma have higher rates of physician office visits, emergency department visits (ED), and hospitalizations, which poses multiple challenges (Pate CA, 2021; Rui P, 2016). Children with asthma and their families struggle with various stress factors, school absenteeism, missed employment, and reduced quality of life (Bellin et al., 2017; Sullivan et al., 2018; Taminskiene et al., 2019). In a retrospective analysis based on nationally representative data from 2007 to 2013, school-aged children missed an additional 7 million school days due to asthma, resulting in a 16% increase in missed workdays for each adult family member (Sullivan et al., 2018). Another study estimated that over 5.2 million school days and 8.7 million workdays due to asthma combined amounted to a total loss of $3 billion per year (Nurmagambetov, Kuwahara, & Garbe, 2018). The most recent estimated total direct cost of pediatric asthma was $6.31 billion in 2018 (Perry, Braileanu, Palmer, & Stevens, 2019). Furthermore, premature asthma mortality resulted in $210 million of future lost productivity yearly (Sullivan et al., 2018). Such substantial costs highlight the burden of pediatric asthma on society and, thus, its public health significance. The at-risk populations that suffer the most from pediatric asthma include those of Black and Puerto Rican race/ethnicity and those of low income (Pate CA, 2021). These populations are not only

disproportionately burdened with asthma but also have low parental health literacy (H. Shonna Yin et al., 2009).

At an individual level, health literacy (HL) is defined as "the degree to which individuals have the ability to find, understand, and use information and services to inform health-related decisions and actions for themselves and others" (Office of Disease Prevention and Health Promotion, n.d.). HL skills include but are not limited to health-related knowledge, oral communication, written communication, quantitative skills, and navigation and information seeking (Table 1). The US Department of Health and Human Services has HL as a high priority and central focus within the Health People 2030 initiative (Office of Disease Prevention and Health Promotion, n.d.). National organizations acknowledge HL as essential to health and health care, and this is especially true for children who rely on parents and caregivers to manage their health and healthcare needs. The only study to examine HL among a representative population of parents in the United States was a cross-sectional study that showed at least 1 in 4 parents have limited HL skills, and only 1 in 7 parents have proficient HL (H. Shonna Yin et al., 2009). Thus, parents with limited HL might have difficulty finding information to manage their child's asthma and understanding that information. For example, children with asthma can have multiple medications to manage with different indications, administration techniques, dosing, and frequency. Parents and caregivers must make critical decisions, especially in the case of an asthma exacerbation, because medications could prevent an ED visit or a hospitalization. In a cross-sectional study of parents in the United States, 68.4% of the parents were unable to fill in names and birth dates on a health insurance form correctly, and 46.4% of the parents were unable to correctly perform at least one of the two medication-related tasks (H. Shonna Yin et al., 2009).

The wake of COVID-19 and the associated infodemic has underscored the significance of HL. The COVID-19 pandemic ushered in a wave of digital communication that required responsive HL skills from individuals regarding the adjustments in healthcare guidelines and recommendations for themselves and others. For parents and caregivers, the HL demands from COVID-19 required them to make decisions for their children involving social isolation, masking guidelines, testing guidelines and sites, understanding symptoms that can overlap with asthma, and navigating the healthcare system during the pandemic. In a secondary analysis of children with asthma, a study found that decreased asthma morbidity in minority children during COVID was coupled with reduced adherence to controller medications (Feldman et al., 2023). The study concluded that the observed decrease in morbidity was not explained by improvements in adherence. Although no study has examined whether HL related to asthma has worsened following COVID-19, decreased medication adherence and variable pediatric vaccination rates are concerning findings.

This review aims to raise awareness of HL and its impact on pediatric asthma outcomes. Although there have been a limited number of relevant studies over the past decade, current evidence suggests an association between HL and asthma in children. Further research and interventions are needed to address these issues. This review will also discuss possible avenues of future research.

Table 1: Overview of Health Literacy Skills Related to Asthma and Approaches to Improve Communication

Skill Domain	Example of Skill	Example of Tasks	Communication Strategy
Knowledge	Asthma-specific knowledge	Albuterol is an asthma medicine for the quick relief of symptoms	• Use simple language • Focus on 2-3 points per visit and repeat them
Oral communication	Patient and caregiver discussion with a healthcare provider	"Can you tell me some symptoms common in asthma?" "What questions do you have for me?"	• Speak slowly without jargon for clear communication • Use the teach-back method to confirm comprehension • Help patients ask questions
Written communication	Reading and understanding written asthma action plans	A patient receives asthma education with a low-literacy asthma action plan	• Use universal precautions for low literacy with standardized health communication tools • Use pictures when applicable
Quantitative (numeracy)	Understanding numerical information involved in medication dosing and frequency	Take two steroid tablets in the morning and two tablets at night before bed	• Write medication dosing in plain language • Use pictures to help convey numerical information
Navigation and information seeking	Navigating the children's hospital website and portal	The patient and the front desk schedulers plan for a follow-up appointment in 3 months	• Empower patients to leave appointments knowing the answer to the question, what do I need to do? • Involve the front office staff

1.1 Social Ecological Model

The relation between HL and pediatric asthma reflects the complex interplay of multiple factors. A model that can be used to understand such interplay and serve as a framework for health promotion is known as the social-ecological model. The social-ecological model illustrates a public health issue's multifactorial and interconnected complexity at different levels: individual, their personal relationships, community, organizations, and policies. Studies have used this framework to explore multiple levels impacting asthma in students (Nuss et al., 2016) and factors influencing self-agency and self-management in pediatric asthma (Rangachari et al., 2019). Additionally, evidence suggests interconnected risk factors at multiple social-ecological levels drive pediatric asthma disparities (Stempel, Federico, & Szefler, 2019).

In the context of HL and asthma, the social-ecological model showcases all the levels involved in HL and pediatric asthma (Table 2). Communication spans between and among the social-ecological levels of health literacy and pediatric asthma relating to policies and actions from different levels. Additionally, accessible communication from different levels can influence parents and caregivers to make health decisions for their children with asthma. For example, parents can access content about asthma and asthma medications and contact healthcare providers through a hospital website and patient portal.

Table 2: Social-Ecological Model of Health Literacy and Pediatric Asthma in the United States

Social Ecological Model Levels	Examples
Public Policy	• Global Initiative for Asthma (GINA) • United States Affordable Care Act (ACA) • United States Medicaid and Children's Health Insurance Programs (CHIP) • Plain Writing Act of 2010 • HHS National Action Plan to Improve Health Literacy • Every Student Succeeds Act (ESSA) of 2015
Community	• Neighborhoods and built environments • Community Asthma Programs
Organizations	• Pharmaceutical companies • Children's Hospitals and healthcare facilities • School and after-school programs • Daycare facilities
Relationship	• Healthcare professionals: Nurses, Respiratory therapists, Providers, Pharmacist • School staff: teachers, school nurses, and coaches • Caregivers and family members • Peers
Individual	• Personal health literacy, which includes asthma knowledge and skills • Behaviors such as diet, exercise, & medication use • Asthma and health care experiences and quality of health • Biological and socioeconomic factors

2.0 Health Literacy Assessments

HL comprises several skill domains, which can be challenging to perceive (Table 1). Although studies have evaluated whether providers accurately perceive the HL level in adult patients, few studies have examined whether pediatric providers can accurately estimate HL. A study found that both pediatric providers and staff were poor at estimating caregiver HL in English proficiency and limited English proficiency (Cooper et al., 2018). HL assessment tools have been created and validated to assess HL skills but not all the skills together (Table 3). A few commonly used research tools to assess parent and caregiver HL include the Rapid Assessment of Adult Literacy in Medicine (REALM), the Test of Functional Health Literacy (TOFHLA), and the Newest Vital Sign (NVS). A concise three-item Brief Health Literacy Screen (BHLS) has been valid and reliable in adult clinical settings when administered by nurses (Wallston et al., 2014). In a cross-sectional study of 181 predominantly African American adolescents between the ages of 15 and 19 years that utilized the validated 3-item BHLS assessment, participants lacking confidence in filling out medical forms, needing help reading hospital materials, and having difficulty understanding written information were more likely to not have a rescue inhaler (OR 0.49; 95% CI 0.25–0.94) and to have one or more emergency visits (OR 1.21 95% CI 1.02–1.43), and one or more hospitalizations (OR 1.19; 95% CI 1.01–1.41) (Valerio, Peterson, Wittich, & Joseph, 2016). Other validated HL assessments measure specific aspects of HL in certain populations. For example, the asthma numeracy questionnaire (ANQ) assesses numeracy skills in that are relevant to asthma management, including medication dosing and frequency (Apter et al., 2006). The table below provides an overview of HL assessment tools discussed within this essay.

Table 3: Overview of Health Literacy Assessment Tools and Characteristics

Health literacy Tool	Health literacy Domain	Item Example	Number of Items
Newest Visit Sign (NVS)	• Written communication • Quantitative	Referring to an ice cream nutrition label: If you eat an entire container, how many calories will you eat?	6 items
Rapid Estimate of Adult Learning in Medicine (REALM)	• Oral communication • Written communication	Referring to a health-related vocabulary list, say all the words you know: flu, infection, allergic, emergency, medication	66 items
Test of Functional Health Literacy in Adults (TOFHLA)	• Written communication • Quantitative	Referring to a medication label: If you eat lunch at noon and want to take this medicine before lunch, what time should you take it?	50 items
Single Item Literacy Screen (SILS)	• Written communication	How often do you need someone to help you when you read instructions, pamphlets, or other written material from your doctor or pharmacy? (Never, rarely, sometimes, often, or always)	1 item
Brief Health Literacy Screen (BHLS)	• Written communication	How often do you have someone help you read hospital materials? (Never, occasionally, sometimes, often, or always)	3 items
Modified Asthma Numeracy Questionnaire (ANQ)	• Quantitative • Written communication	The doctor says your child has to lose 10% of their weight by playing sports. If your child now weighs 50 kilograms, the doctor is saying that your child should achieve a weight of (35 kilograms, 41 kilograms, 45 kilograms, or 47 kilograms)	3 items
Asthma Knowledge Questionnaire (AKQ)	• Knowledge • Written communication	Most children with asthma have an increase in mucus when they drink cow's milk (True or False)	31 items
Asthma Control Test (ACT)	• Knowledge • Written communication	How would you rate your asthma control during the past 4 weeks? (Not controlled at all, poorly controlled, somewhat controlled, well controlled, completely controlled)	5 items
European Health Literacy Survey Questionnaire (HLS-EU-Q16)	• Knowledge • Written communication	On a scale from very easy to very difficult, how easy would you say it is: understand what your doctor says to you?	16 items

3.0 Health literacy and Pediatric Asthma Outcomes

Relevant studies suggest an association between HL and pediatric asthma outcomes. The following subsections will review studies that were published over the past decade and examined the impact of HL on health utilization, asthma control, asthma medication use, lung function, and quality of life. Additionally, these studies are summarized in Table 4.

3.1 Asthma-related Healthcare Utilization

A large cross-sectional study of 351 Puerto Rican children with asthma, aged 6 to 14, found that parental numeracy was associated with asthma-related ED or urgent care visits in all participants (adjusted odds ratio [OR]=1.7, 95% confidence interval [CI]=1.03-2.7, P=.04) (Rosas-Salazar et al., 2013). Further, low parental numeracy was associated with hospitalizations for asthma in children not using inhaled corticosteroids (ICS, adjusted OR=2.8, 95% CI=1.4-5.6, *P*=.004) (Rosas-Salazar et al., 2013). In a follow-up prospective study of this cohort, persistently low parental numeracy was associated with ≥1 ED/urgent care visit for asthma, ≥1 hospitalization for asthma, and ≥1 severe asthma exacerbation in the year before the second study visit (Gutwein et al., 2023).

In a study with a cross-sectional design, low HL (based on a 3-item questionnaire) was associated with one or more emergency visits (OR 1.21, 95% CI=1.02–1.43) and one or more hospitalizations (OR 1.19, 95% CI=1.01–1.41) for asthma among 181 predominantly African-American adolescents (Valerio et al., 2016). In contrast, a cross-sectional study of 281

predominately minority parent-child dyads with children aged between 6 to 12 years old showed that higher parental HL was not associated with child healthcare utilization (Harrington, Zhang, Magruder, Bailey, & Gerald, 2015). Although two additional cross-sectional studies showed no significant association between caregivers' HL and routine asthma care visits (r =–0.391, 95% CI=–0.64–0.06) (Belice et al., 2020) or between median HL scores in adolescents and asthma-related ED admissions (Cekic et al., 2022), such findings could be explained by limited statistical power due to small sample size.

3.2 Asthma Control

The asthma control test (ACT) and asthma control questionnaire (ACQ) are validated tools to measure asthma control and response to changes in therapy (Schatz et al., 2006). A small cross-sectional study with 34 predominantly African American and Hispanic caregiver-child dyads found no association between caregiver HL and asthma control measured by the ACT ($p = 0.838$) (Belice et al., 2020). Similarly, a cross-sectional study with 176 predominately white parent-child dyads reported no association between limited parental HL and poor asthma (Brigham, Goldenberg, Stolfi, Mueller, & Forbis, 2016). In contrast, a cross-sectional study of 281 predominantly minority urban parent-child dyads with children aged 6 to 12 years old reported that lower HL was associated with worse asthma control, as reported by the provider (p= 0.007) and in the ACQ (p= 0.013) (Harrington et al., 2015). Similar findings were shown in a cross-sectional study of 81 adolescents with asthma and 47 age and sex-matched controls, in which participants with controlled asthma had significantly higher HL scores than those with uncontrolled asthma (Cekic et al., 2022).

3.3 Asthma Medication Use and Asthma Action Plans

International and national guidelines recommend written asthma action plans (AAPs) to guide medication use in all patients with asthma (Global Initiative for Asthma, 2022). A national cross-sectional online survey of 704 parents of a child with asthma found that most parents had an AAP for their child and agreed it was helpful for daily living factors and increased parental self-efficacy (Pletta et al., 2020).

Several recent studies have evaluated HL, use of asthma medications and AAPs. For example, a randomized controlled study of 217 English or Spanish-speaking parent-child dyads reported that all parents preferred low-literacy written asthma action plans (WAAP) and that those who received such plans were less likely to make a medication error compared to parents who received the standard plan (H. S. Yin et al., 2017). Furthermore, parents with a low-literacy WAAP were less likely to make errors regarding use of spacers for proper administration of inhaled asthma medications (H. S. Yin et al., 2017). Similarly, another study showed that limited parental HL was significantly associated with a parent's ability to correctly answer vignette questions related to the WAAP (b = 11.3, standard error 3.8, P= .004) (Brigham et al., 2016). Consistent with results for parents of children with asthma, a cross-sectional study of predominantly African-American adolescents aged 15 to 19 years reported that lacking confidence in filling out medical forms, needing help reading hospital materials, and having difficulty understanding written information was associated with not having a rescue inhaler (OR 0.49, 95% CI=0.25–0.94) (Valerio et al., 2016).

3.4 Lung Function

Spirometry is a test routinely performed in clinical settings to evaluate and diagnose lung function in conditions such as asthma. In two observational studies, low HL was not linked to pediatric lung function. In particular, a cross-sectional study of 351 Puerto Rican children with asthma aged 6 to 14 years found no significant association between low parental numeracy and lung function measures (Rosas-Salazar et al., 2013), and such negative findings for lung function were confirmed in a follow-up prospective study of that cohort (approximately five years later) (Gutwein et al., 2023).

3.5 Asthma-related Quality of Life

Multiple available tools can measure quality of life in children with asthma (Roncada, Mattiello, Pitrez, & Sarria, 2013), yet few studies have evaluated the relationship between HL and asthma-related quality of life in children. A small cross-sectional study of 34 caregiver dyads across two sites serving different populations of children ages 7 to 18 years found no significant association between caregiver's HL and the child's asthma-related quality of life, measured with the Pediatric Asthma Quality of Life Questionnaire or PAQLQ (Belice et al., 2020).

Newer versions of the PAQLQ include the Standardized PAQLQ and the MiniPAQLQ, which have been valid, reliable and responsive to change (Wing et al., 2012). In a cross-sectional study of 181 predominantly African-American adolescents, inadequate HL was not significantly associated with asthma-related quality of life, assessed with the MiniPAQLQ (OR 0.75, 95% CI=0.59–0.95) (Valerio et al., 2016). In contrast, a prospective cohort of 544 caregiver-child

dyads, with children aged 8 to 15 years, found that a combination of caregiver health literacy (measured with the REALM) and education explained disparities in asthma-related quality of life between Hispanics/Latinos and Whites (Washington, Curtis, Waite, Wolf, & Paasche-Orlow, 2018).

4.0 Discussion

The studies reviewed in this essay included two randomized control trials, two prospective cohort studies, and seven cross-sectional studies (Table 4). Such studies were limited by small sample size (as five of the seven cross-sectional studies included <200 participants); potential selection bias, recall bias, and residual confounding; and variable quality of the assessment of both HL and asthma outcomes (including healthcare utilization, asthma control, medication use, quality of life, and lung function); assessment of written communication without assessing other skills domains of HL; and little attention to the multiple-level factors that influence health literacy and pediatric asthma (Table 1). Despite these limitations, the aggregate evidence suggests that low parental/ caregiver's HL and low HL in adolescents are associated with one or more worse asthma outcomes (except for lung function).

Results from a systematic review suggest a relationship between health literacy and adolescents' health behaviors and recommended further studies (Fleary, Joseph, & Pappagianopoulos, 2018), yet little is known about HL and asthma outcomes in adolescents, a demographic group capable of assuming more responsibility for their asthma care. Of interest, a study showed no significant correlation between caregiver HL and adolescent HL (Jordan, Bush, Ownby, Waller, & Tingen, 2019), and a cross-sectional study of adolescents 16 to 20 years old concluded that transition readiness is suboptimal, even for late adolescents with asthma (Rhee, Choi, & Tumiel-Berhalter, 2023). Thus, establishments and healthcare providers should focus on promoting HL for adolescents and caregivers, especially as adolescents become more independent and transition from pediatric to adult healthcare providers.

To date, most published studies have focused on the HL of parents or caregivers without the context of their relationship and communication with healthcare professionals and educational resources. In a national survey about HL and provider-patient communication, a random sample of 1605 pediatricians reported limited time and the volume and complexity of information as the main barriers to effective communication with parents (Turner et al., 2009). Future interventions should have a practical perspective for applications in a busy clinical setting addressing the needs of children, their parents or caregivers, and healthcare professionals. Moreover, education resources tailored for universal low HL precautions to facilitate guideline-concordant care should assess understanding and usefulness for adolescents and caregivers.

Our understanding of the intricate relationship between HL and pediatric asthma has improved, yet further research is needed to fill notable gaps in our current knowledge. Indeed, the most recent HL national assessment regarding parents was over a decade ago, and no national estimates have been applied to adolescents. the impact of various types of HL (knowledge, written, oral, numeracy, and navigational) from parents, caregivers, and adolescents on pediatric asthma outcomes remains unclear.

Given current knowledge gaps and the potential positive impact of improved health literacy on childhood asthma, further research is required. In particular, there is a need for future large-scale studies with a prospective observational and mix-method design and randomized clinical trials that assess all levels of the social-ecological model and employ standardized definitions and objective measures of both HL and asthma. Further, such studies should examine how and why a particular skill of HL or their combination impacts outcomes to tailor interventions.

5.0 Conclusions

Low HL and pediatric asthma are major public health issues that disproportionately burden historically marginalized populations. Current evidence, though limited, suggests an association between low HL and worse asthma outcomes during childhood. Future longitudinal studies and randomized clinical trials are needed to improve our understanding of the low HL-asthma link and to design effective interventions to increase HL to improve asthma outcomes in children and adolescence.

Table 4: Overview of Studies of Health Literacy and Pediatric Asthma

Reference	Design	Sample population	HL tools	Main findings
Harrington et al., 2015	Cross-sectional	281 caregiver-child dyads, children aged 6 to 12, English-speaking	• Parental HL: TOFHLA and AKQ	• Caregiver asthma knowledge was significantly associated with health literacy • Lower health literacy was associated with worse asthma control as rated both by the provider and the asthma control questionnaire
Washington et al., 2018	Prospective cohort	544 caregiver-child dyads, children aged 8 to 15 English speaking	• Parental HL: REALM	• Caregiver health literacy, education level, household income level, employment status, and insurance status were associated with all asthma outcomes • African American race and Hispanic/Latino ethnicity are significantly associated with worse asthma compared to Whites • Sociodemographic factors are potent mediators of these disparities • Health literacy and education level are partial mediators
Yin et al., 2017	Randomized control trial	217 parent-child dyads, children aged 2 to 12 Spanish and English speaking	• Parental HL: NVS and AKQ	• A low literacy written asthma action plan was associated with a better parent understanding of asthma management
Brigham et al., 2016	Cross-sectional	176 parent-child dyads, children aged 4 and 12, English speaking	• Parental HL: NVS	• Limited HL was associated with poor asthma control in univariate analysis but not in a logistic regression model controlling for other significant variables. • The written asthma management plan score based on a parent's response to asthma vignettes was associated with limited HL and not asthma control.

Table 4: Overview of Studies of Health Literacy and Pediatric Asthma (comt.)

Belice et al., 2020	Cross-sectional	34 caregiver-child dyads, children aged 7 to 18, Spanish and English speaking	• Parental HL: NVS	• No direct relationship between health literacy and asthma outcomes • Caregiver health literacy was significantly related to language • When adjusted for language and child age, there was no significant association between caregivers' HL and routine asthma care visits
Desha et al., 2019	Randomized control trial	198 caregiver-adolescent dyads with an average age of 15.3 years old	• REALM • SILS • NVS • Lung Health Survey	• The correlation between education level and traditional literacy suggests that these contribute to the health literacy of adolescents with asthma. • The correlation between adolescent and caregiver health literacy was not supported.
Valerio et al., 2016	Cross-sectional	181 adolescents ages 15 and 19	• Adolescent HL: BHLS	• Inadequate health literacy score was associated with students who were more likely to be younger, not on Medicaid, have at least one hospitalization, and have a lower quality of life • Students lacking confidence in filling out medical forms, needing help reading hospital materials, and having difficulty understanding written information were more likely not to have a rescue inhaler, have one or more emergency visits, and have one or more hospitalizations.
Ogasawara et al., 2020	Cross-sectional	790 mother-child, children aged 2 to 11 Japanese-speaking Tokyo, Japan	• Parental HL: Validated HL questionnaire (Ishikawa, Nomura, Sato, & Yano, 2008)	• The prevalence of a child's asthma in the past year was significantly higher in the high maternal HL group than in the low HL group. • High maternal HL was positively associated with the child's asthma symptoms after adjusting for the child's clinical factors, household income, maternal educational attainment, psychological distress, and employment status

Table 4: Overview of Studies of Health Literacy and Pediatric Asthma (cont.)

Cekic et al., 2022	Cross-sectional	81 adolescents aged 12 to 18 Turkish-speaking, Turkey	• Adolescent HL: HLS-EU-Q16	• Those with controlled asthma had disease prevention, health promotion subscale, and HL scores higher than those with uncontrolled asthma • Although not significant, the median HL scores were lower in patients with ED admissions due to asthma exacerbations or in patients who needed systemic steroid use in the past year compared to those who did not visit the ED or require systemic steroids in the prior year.
Rosas-Salazar et al., 2013	Cross-sectional	351 parent-child dyads children aged 6 to 14 Spanish-speaking in San Juan, Puerto Rico	• Parental HL: Modified ANQ	• Low parental numeracy was associated with increased odds of visits to asthma-related ED or urgent care. • Low parental numeracy was associated with asthma-related hospitalizations only among children not using inhaled corticosteroids • There was no association between low parental numeracy and the use of systemic steroids or spirometry measures.
Gutwein et al., 2023	Prospective cohort	225 parent-child dyads, children aged 6 to 14 and 9 to 20 Spanish-speaking in San Juan, Puerto Rico	• Parental HL: Modified ANQ	• Persistently low parental numeracy was associated with asthma-related ED visits and hospitalization, and severe asthma exacerbation the year before the follow-up visit. • Persistently low parental numeracy was not significantly associated with spirometry measures.

Bibliography

Apter, A. J., Cheng, J., Small, D., Bennett, I. M., Albert, C., Fein, D. G., . . . Van Horne, S. (2006). Asthma numeracy skill and health literacy. *J Asthma, 43*(9), 705-710. doi:10.1080/02770900600925585

Belice, P. J., Mosnaim, G., Galant, S., Kim, Y., Shin, H. W., Pires-Barracosa, N., . . . Becker, E. (2020). The impact of caregiver health literacy on healthcare outcomes for low income minority children with asthma. *J Asthma, 57*(12), 1316-1322. doi:10.1080/02770903.2019.1648507

Bellin, M. H., Collins, K. S., Osteen, P., Kub, J., Bollinger, M. E., Newsome, A., . . . Butz, A. M. (2017). Characterization of Stress in Low-Income, Inner-City Mothers of Children with Poorly Controlled Asthma. *Journal of Urban Health, 94*(6), 814-823. doi:10.1007/s11524-017-0162-1

Brigham, E. L., Goldenberg, L., Stolfi, A., Mueller, G. A., & Forbis, S. G. (2016). Associations Between Parental Health Literacy, Use of Asthma Management Plans, and Child's Asthma Control. *Clin Pediatr (Phila), 55*(2), 111-117. doi:10.1177/0009922815587089

Cekic, S., Karali, Z., Canitez, Y., Esmen, S., Ortac, H., Abdu, S., & Sapan, N. (2022). The effects of health literacy on disease control in adolescents with asthma. *J Asthma*, 1-7. doi:10.1080/02770903.2022.2160344

Centers for Disease Control and Prevention. (2020). Most Recent National Asthma Data. Retrieved from https://www.cdc.gov/asthma/most_recent_national_asthma_data.htm.

Cooper, M., Jr., Blucker, R., Thompson, D., Griffeth, E., Grassi, M., Damron, K., . . . Dunlap, M. (2018). Health Literacy Estimation of English and Spanish Language Caregivers. *Health Lit Res Pract, 2*(2), e107-e114. doi:10.3928/24748307-20180503-02

Feldman, J. M., Serebrisky, D., Starr, S., Castaño, K., Greenfield, N., Silverstein, G., . . . Arcoleo, K. (2023). Reduced asthma morbidity during COVID-19 in minority children: is medication adherence a reason? *Journal of Asthma, 60*(3), 468-478. doi:10.1080/02770903.2022.2059510

Fleary, S. A., Joseph, P., & Pappagianopoulos, J. E. (2018). Adolescent health literacy and health behaviors: A systematic review. *J Adolesc, 62*, 116-127. doi:10.1016/j.adolescence.2017.11.010

Global Initiative for Asthma. (2022). *Global Strategy for Asthma Management and Prevention*. Retrieved from www.ginasthma.org

Gutwein, A., Han, Y. Y., Colon-Semidey, A., Alvarez, M., Acosta-Perez, E., Forno, E., . . . Celedon, J. C. (2023). Low parental numeracy and severe asthma exacerbations in a prospective study of Puerto Rican youth. *Ann Allergy Asthma Immunol*. doi:10.1016/j.anai.2023.03.004

Harrington, K. F., Zhang, B., Magruder, T., Bailey, W. C., & Gerald, L. B. (2015). The Impact of Parent's Health Literacy on Pediatric Asthma Outcomes. *Pediatr Allergy Immunol Pulmonol, 28*(1), 20-26. doi:10.1089/ped.2014.0379

Ishikawa, H., Nomura, K., Sato, M., & Yano, E. (2008). Developing a measure of communicative and critical health literacy: a pilot study of Japanese office workers. *Health Promotion International, 23*(3), 269-274. doi:10.1093/heapro/dan017

Jordan, D. M., Bush, J. S., Ownby, D. R., Waller, J. L., & Tingen, M. S. (2019). The impact of traditional literacy and education on health literacy in adolescents with asthma. *J Asthma, 56*(8), 882-890. doi:10.1080/02770903.2018.1494191

Nurmagambetov, T., Kuwahara, R., & Garbe, P. (2018). The Economic Burden of Asthma in the United States, 2008-2013. *Ann Am Thorac Soc, 15*(3), 348-356. doi:10.1513/AnnalsATS.201703-259OC

Nuss, H. J., Hester, L. L., Perry, M. A., Stewart-Briley, C., Reagon, V. M., & Collins, P. (2016). Applying the Social Ecological Model to Creating Asthma-Friendly Schools in Louisiana. *J Sch Health, 86*(3), 225-232. doi:10.1111/josh.12369

Office of Disease Prevention and Health Promotion. (n.d.). Health Literacy in Healthy People 2030. *Healthy People 2030.* Retrieved from https://health.gov/healthypeople/priority-areas/health-literacy-healthy-people-2030

Pate CA, Z. H., Qin X, Johnson C, Hummelman E, Malilay J. . (2021). *Asthma Surveillance — United States, 2006-2018.* Retrieved from http://dx.doi.org/10.15585/mmwr.ss7005a1

Perry, R., Braileanu, G., Palmer, T., & Stevens, P. (2019). The Economic Burden of Pediatric Asthma in the United States: Literature Review of Current Evidence. *Pharmacoeconomics, 37*(2), 155-167. doi:10.1007/s40273-018-0726-2

Pletta, K. H., Kerr, B. R., Eickhoff, J. C., Allen, G. S., Jain, S. R., & Moreno, M. A. (2020). Pediatric Asthma Action Plans: National Cross-Sectional Online Survey of Parents' Perceptions. *JMIR Pediatr Parent, 3*(2), e21863. doi:10.2196/21863

Rangachari, P., May, K. R., Stepleman, L. M., Tingen, M. S., Looney, S., Liang, Y., . . . Rethemeyer, R. K. (2019). Measurement of Key Constructs in a Holistic Framework for Assessing Self-Management Effectiveness of Pediatric Asthma. *International Journal of Environmental Research and Public Health, 16*(17), 3060. Retrieved from https://www.mdpi.com/1660-4601/16/17/3060

Rhee, H., Choi, Y., & Tumiel-Berhalter, L. (2023). Transition readiness in middle and older adolescents with asthma and associated factors: a descriptive study. *Journal of Asthma, 60*(5), 991-999. doi:10.1080/02770903.2022.2119864

Roncada, C., Mattiello, R., Pitrez, P. M., & Sarria, E. E. (2013). Specific instruments to assess quality of life in children and adolescents with asthma. *Jornal de Pediatria, 89*(3), 217-225. doi:https://doi.org/10.1016/j.jped.2012.11.010

Rosas-Salazar, C., Ramratnam, S. K., Brehm, J. M., Han, Y. Y., Acosta-Pérez, E., Alvarez, M., . . . Celedón, J. C. (2013). Parental numeracy and asthma exacerbations in Puerto Rican children. *Chest, 144*(1), 92-98. doi:10.1378/chest.12-2693

Rui P, O. T. (2016). *National Ambulatory Medical Care Survey*. Retrieved from https://www.cdc.gov/nchs/data/ahcd/namcs_summary/2016_namcs_web_tables.pdf.

Schatz, M., Sorkness, C. A., Li, J. T., Marcus, P., Murray, J. J., Nathan, R. A., . . . Jhingran, P. (2006). Asthma Control Test: reliability, validity, and responsiveness in patients not previously followed by asthma specialists. *J Allergy Clin Immunol, 117*(3), 549-556. doi:10.1016/j.jaci.2006.01.011

Stempel, H., Federico, M. J., & Szefler, S. J. (2019). Applying a biopsychosocial model to inner city asthma: Recent approaches to address pediatric asthma health disparities. *Paediatr Respir Rev, 32*, 10-15. doi:10.1016/j.prrv.2019.07.001

Sullivan, P., Ghushchyan, V. G., Navaratnam, P., Friedman, H. S., Kavati, A., Ortiz, B., & Lanier, B. (2018). School absence and productivity outcomes associated with childhood asthma in the USA. *Journal of Asthma, 55*(2), 161-168. doi:10.1080/02770903.2017.1313273

Taminskiene, V., Alasevicius, T., Valiulis, A., Vaitkaitiene, E., Stukas, R., Hadjipanayis, A., . . . Valiulis, A. (2019). Quality of life of the family of children with asthma is not related to asthma severity. *European Journal of Pediatrics, 178*(3), 369-376. doi:10.1007/s00431-018-3306-8

Turner, T., Cull, W. L., Bayldon, B., Klass, P., Sanders, L. M., Frintner, M. P., . . . Dreyer, B. (2009). Pediatricians and Health Literacy: Descriptive Results From a National Survey. *Pediatrics, 124*(Supplement_3), S299-S305. doi:10.1542/peds.2009-1162F

Valerio, M. A., Peterson, E. L., Wittich, A. R., & Joseph, C. L. (2016). Examining health literacy among urban African-American adolescents with asthma. *J Asthma, 53*(10), 1041-1047. doi:10.1080/02770903.2016.1175473

Wallston, K. A., Cawthon, C., McNaughton, C. D., Rothman, R. L., Osborn, C. Y., & Kripalani, S. (2014). Psychometric Properties of the Brief Health Literacy Screen in Clinical Practice. *Journal of General Internal Medicine, 29*(1), 119-126. doi:10.1007/s11606-013-2568-0

Washington, D. M., Curtis, L. M., Waite, K., Wolf, M. S., & Paasche-Orlow, M. K. (2018). Sociodemographic Factors Mediate Race and Ethnicity-associated Childhood Asthma

Health Disparities: a Longitudinal Analysis. *J Racial Ethn Health Disparities, 5*(5), 928-938. doi:10.1007/s40615-017-0441-2

Wing, A., Upton, J., Svensson, K., Weller, P., Fletcher, M., & Walker, S. (2012). The standardized and mini versions of the PAQLQ are valid, reliable, and responsive measurement tools. *J Clin Epidemiol, 65*(6), 643-650. doi:10.1016/j.jclinepi.2011.12.009

Yin, H. S., Gupta, R. S., Mendelsohn, A. L., Dreyer, B., van Schaick, L., Brown, C. R., . . . Tomopoulos, S. (2017). Use of a low-literacy written action plan to improve parent understanding of pediatric asthma management: A randomized controlled study. *J Asthma, 54*(9), 919-929. doi:10.1080/02770903.2016.1277542

Yin, H. S., Johnson, M., Mendelsohn, A. L., Abrams, M. A., Sanders, L. M., & Dreyer, B. P. (2009). The Health Literacy of Parents in the United States: A Nationally Representative Study. *Pediatrics, 124*(Supplement_3), S289-S298. doi:10.1542/peds.2009-1162E