

Cough in the Pediatric Population

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Cough is the most common presenting symptom for medical office visits in the United States. Cough in children is usually related to viral respiratory tract infection and typically resolves spontaneously. Between 35% and 40% of school-age children still cough 10 days after the onset of a common cold, and 10% of preschool children have cough 25 days after respiratory tract infection.¹ In children, cough has been associated with environmental factors, such as outdoor and indoor air pollution, including particulate matter, irritant gases, environmental tobacco smoke exposure, and dampness in the home.² The frequent presentation of cough in children is further complicated by studies documenting that parental reporting of cough in children correlates poorly with objective measurement of frequency, duration, or intensity of cough.³ Cough in children disrupts both the parent's and the child's daily activities and can be associated with impaired quality of life in the child and significant stress in parents that improves with cough resolution.⁴ It is extremely common for parents to treat children with over-the-counter (OTC) cough and cold medications (CCMs) before seeing a health care provider. In a recent survey, approximately 10% of US children were found to be receiving an OTC CCM in any given week. Although OTC CCMs receive Food and Drug Administration (FDA) approval for adults, testing for efficacy and safety in young children has not been adequate,⁵ and inappropriate use of CCMs in children has been documented.⁶ Adverse events associated with use of OTC CCMs do occur and rare infant deaths have been reported. In January 2008, the FDA issued a public health advisory regarding OTC CCM use in children questioning safety and efficacy and whether the clinical benefits justify potential risks;⁷ it now recommends avoiding these medications in children under age 2 years. The FDA also has supported the recent recommendation by the Consumer Health Product Association to avoid OTC CCM use in children under age 4 years. An American Academy of Pediatrics

(AAP) position statement questions the efficacy and safety of these medications in children under age 6 years.

The Cough Reflex

Cough is a protective reflex, a component of normal respiratory physiology that enhances mucociliary function and clears excessive secretions and airway debris from the respiratory tract, as well as a very common symptom of respiratory disease. Cough receptors are located in the respiratory tract from the larynx to the segmental bronchi.⁸ The cough reflex has vagal afferent input, brain stem centralization with cortical modulation, and motor efferent activity involving respiratory muscles. Cough reflex sensitivity (CRS) can be modulated either by disease or pharmacologically. Up-regulation of CRS causes triggering of cough from a relatively nonspecific provocation. Heightened CRS has been demonstrated following viral respiratory tract infections⁹ (postviral or postinfectious cough), as well as in asthma, gastroesophageal reflux disease (GERD), and angiotensin-converting enzyme inhibitor therapy. The prevalence of CRS is similar in prepubertal and early pubertal girls and boys but significantly higher in postpubertal girls and adult women. Using mechanical stimulation, cough can be elicited in 10% of 27-week gestational age preterm infants and up to 90% of full-term infants.¹⁰

Defining Cough in Children

Children cough differently from adults in terms of duration, presentation, and underlying causes. The classification of cough in children reflects these differences.

Normal or Expected Cough

"Normal" children cough. According to objective measurements, healthy school-age children (mean age, 10 years; no respiratory illness in the 4 weeks before the study) typically experience 10 or 11 (and as many as 34) cough episodes/

AAP	American Academy of Pediatrics
ACCP	American College of Chest Physicians
BAL	Bronchoalveolar lavage
CCM	Cough and cold medications
CF	Cystic fibrosis
CRS	Cough reflex sensitivity
CT	Computed tomography
FDA	Food and Drug Administration
FeNO	Fraction of exhaled nitric oxide
GERD	Gastroesophageal reflux disease
ICS	Inhaled corticosteroids
OTC	Over the counter
PBB	Protracted bacterial bronchitis
UACS	Upper airway cough syndrome

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day.¹¹ Sometimes these “normal” cough episodes are prolonged or nocturnal, triggering parental concerns about discomfort and disturbed sleep. Recurrent viral respiratory infections are common in children, particularly in the fall and winter. These may appear to cause persistent cough, but usually the child experiences short breaks between illnesses. Postinfectious cough in normal children may have multiple causes, including heightened CRS. Less than 5% of coughs persisting >8 weeks are believed to be postinfectious (other than pertussis syndromes).¹²

Abnormal Cough

Abnormal cough in children includes cough associated with underlying disease states, as well as ineffective cough from underlying neuromuscular weakness or structural airway abnormalities. Abnormal cough in children can be classified by duration (acute vs chronic); character, quality, and timing (eg, dry vs wet, day vs night); age of child; and etiology (specific vs nonspecific). Overlap among the different categories can make classifying abnormal pediatric cough confusing. To aid in the diagnosis and treatment of the coughing child, the following questions may be helpful:

1. How long has the child coughed? Most adult studies and consensus guidelines define cough as acute (<3 weeks), subacute (3 to 8 weeks) or chronic (>8 weeks).¹³ Most acute and subacute coughs in adults and children are associated with viral upper respiratory tract infection and do not require specific diagnostic evaluation. The definition of chronic or persistent cough in children varies, ranging from 3 to 12 weeks depending on the study or guideline.^{14,15}
2. What is the character of the cough? The character or quality of chronic cough in adults has been shown to be not helpful in predicting specific etiology, and the 2006 American College of Chest Physicians (ACCP) guidelines recommend it not be used in determining etiology in adults.¹³ In contrast, the character or quality of cough in some children is recognizable and reproducible, and may suggest a specific etiology (Table I).
3. Is the cough wet or dry? A moist or wet cough in children is associated with secretions detected on bronchoscopy and can be accurately reported by clinicians and parents.¹⁶ The descriptor “wet” or “moist” cough may be used interchangeably with “productive” cough, even though young children rarely expectorate despite excessive secretions. A recent cross-sectional survey of more than 2000 children age 11 to 15 years found a 7.2% prevalence of chronic productive cough.¹⁷ Chronic productive cough was strongly associated with reports of current asthma symptoms and with environmental tobacco smoke exposure, although specific causes were not investigated.¹⁷ A recent review of chronic wet cough in children without cystic fibrosis (CF) found that the majority of the children had an endobronchial bacterial infection.¹⁸ Chronic wet cough is very rare in children with uncomplicated

Table I. Traditional recognizable cough characteristics at various ages

Cough characteristic	Possible etiology
Infancy	
Barking or brassy	Croup, tracheomalacia/other anatomic abnormalities of respiratory or GI tract
Dry, staccato	Chlamydophilia
Wet	PBB, sinusitis
Childhood	
Barking or brassy	Croup
Spasmodic/paroxysmal (with or without whoop)	Pertussis-like syndrome
Wet (with or without produced sputum)	PBB/sinusitis
Adolescence	
Barking/honking	Habit/psychogenic
Spasmodic/paroxysmal (with or without whoop)	Pertussis-like syndrome
Wet (with or without produced sputum)	Pneumonia/PBB/sinusitis

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asthma. Sinusitis with or without asthma also may cause a wet cough that is responsive to antibiotic therapy. Chronic cough with purulent sputum in children is always pathological, calling for specific assessment for such conditions as CF, non-CF bronchiectasis, and ciliary dysmotility syndromes.

4. Is the cough nocturnal? Nocturnal cough is often cited a hallmark of asthma; however, most objective studies have not confirmed this finding, and parental reporting of nocturnal cough is unreliable compared with objective measurements.^{3,19} As such, other causes of cough should be considered as well. Cough generally is suppressed by sleep, and habit cough most characteristically ceases at night.²⁰
5. How old is the child? Age at onset of cough is important diagnostically; in infants and younger children, greater consideration must be given to anatomic abnormalities of the upper and lower respiratory tracts and the gastrointestinal (GI) tract, as well as possible foreign body aspiration (Table I).

In children, as in adults, cough is subject to psychological influences.¹³ Habit cough is more commonly recognized in children.²⁰ Age also may play a role in the etiology of chronic cough in children. Studies with younger children demonstrate different causes of chronic cough compared with those with predominately older children and teens, who have similar causes as adults.²¹⁻²³

Etiology of Abnormal Pediatric Cough

A previously proposed diagnostic paradigm of specific versus nonspecific cough in children forms the basis of the approach to evaluation and treatment in the 2006 ACCP guidelines.^{13,24} Specific cough is associated with underlying respiratory or systemic disease, and the need for further investigation is typically evident from coexisting symptoms

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