

Wheezing defined

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1. ABSTRACT

Wheeze is both a symptom to parents (reported as noisy breathing) and a sign to clinical staff – with very differing perspectives between parents and clinicians on what constitutes “wheeze”. The purpose of this article is to consider these differences of understanding from the perspective of different stakeholders so that nobody is “lost in translation”. Misunderstandings may lead to epidemiologic and treatment faults. Every effort should be made to educate parents and improve their communications with clinicians.

2. INTRODUCTION

Noisy breathing is one of the most common symptoms reported by parents of infants and older children (1). Wheeze is both symptom to parents (reported as noisy breathing) and sign to clinical staff – with very differing perspectives between parents and clinicians on what constitutes “wheeze”. To make things even more complicated - nearly 200 years after the invention of the stethoscope by Laennec (2, 3) – and despite wheeze being the most common adventitious lung sound (4), health care providers rarely agree with each other (5-7).

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The purpose of this article is to consider these differences of understanding from the perspective of different stakeholders so that nobody is “lost in translation”. The need for clarity is important, as most epidemiologic studies of asthma rely on parental reporting of wheeze (8, 9). With tremendous variation in the prevalence of reported “recent wheeze” (between different countries and time periods) could much of this be attributable to different parental understandings of the term or are the differences indeed real? (10-14). “Are we too ready to diagnose asthma in children?” as Keely and Silverman wondered back in 1999? (15) Additionally, measuring bronchial hyper-reactivity and inflammation in children still remains problematic; “doctor-diagnosed asthma” and “doctor-observed wheeze” cannot be considered synonymous (15).

Wheeze has been defined as a high pitched, continuous musical noise, often associated with prolonged expiration (16-18). The word “continuous” in the adult literature relates to a minimum duration of 250msec (19). Whilst predominantly expiratory noise, the noise may also be present on inspiration if airways obstruction is severe (20). “Whistling” is commonly incorporated in the definition and this may have important consequences; Turner *et al* have shown that compared with other respiratory sounds, whistle is likely to persist and require asthma treatment in future (21). The pathophysiology of wheeze is still debated, but it is generally accepted that it can arise from both large and small airways obstruction (16), as the audible manifestation of airway oscillations at points of flow limitation (17, 22). Wheeze has an extensive differential diagnosis (remember the old adage “all that wheezes is not asthma”), which may be found in any major textbook of paediatric pulmonology (23) or in review publications (24, 25).

3. “PARENTS VS CLINICIANS”

Paediatrics is unique in that on most occasions history is taken from a third party – the parent - not the patient themselves. When parents and clinicians have different meanings for the wheeze, outcomes that rely on identification of wheeze (in both epidemiologic and interventional studies) may be called into question.

Discrepancies between parental and clinician perspectives of wheeze have been studied over the last 10 years. Groups from the U.K. have highlighted the discrepancy between parental and clinician reporting of wheeze (26, 27). Cane *et al* showed that parents do not share with doctors epidemiological definitions and clinical labeling of childhood wheeze in a consistent manner (26). A 12 item questionnaire was administered to parents (English and non-English) of children attending a chest clinic. Open questioning regarding recognition of wheeze led 26% of the parents to report only non-auditory cues, like difficulty in breathing and being unwell. In response to closed questions, 23% of the parents did not select “what you hear” as an option for knowing when their child is wheezy. We could safely assume that these percentages would be even higher in the general population, since the

authors excluded from this already selected population of patients that had already been referred to a specialist those parents that admitted not recognizing the term “wheeze”. In the same study parents of children that attended the accident and emergency department agreed with the clinicians in less than half of the occasions regarding wheeze/asthma. Additionally, 19% of parents reported cough when clinicians found wheeze and 14% of the parents used the term “wheeze” when doctors did not confirm the presence of wheeze. Therefore this study showed that proxy reports of wheeze can be falsely positive or negative and that parental interpretation of wheeze may differ substantially from that of physicians. Elphick *et al* from Sheffield emphasized the inaccuracy involved in the use of the term wheeze in clinical practice; they performed a survey of respiratory sounds in infants younger than 18 months that were hospitalized, attended respiratory clinics or were seen in the community for noisy breathing (27). Initially 53% of the parents claimed that their children were wheezing, but one third of those parents dropped the term “wheeze” by the end of the interview. At the same time the use of the word “rattle” (a term that is synonymous to “rattle” in Yorkshire) doubled (from 40% at the beginning of the interview to 81% at the end of it) signifying that lots of parents confuse rattle and wheeze; it seems that wheeze is probably over reported whereas rattle/rattle is underreported. These dramatic changes in the figures followed more detailed questioning and the use of videos or imitations of the sounds by the clinician. In the same study it was shown that parents of children seen on an outpatient basis were more likely to use the term wheeze wrongly compared to parents of hospitalized children. This finding implies that in the general population these discrepancies in the terminology may be even more pronounced. Another interesting finding of this important study was that only 12% of parents that used the term “wheeze” incorporated whistle in their description in contrast to what most epidemiological large scale studies portray. The authors concluded that it is the doctor’s responsibility to ensure that the interpretation of the terminology used by the history providers reflects accurately the noisy symptom they mean to describe. The same group of investigators had previously shown that the acoustic properties of wheeze and rattle are quite distinct (28). Recently a group from Portugal contributed to this ongoing discussion from the perspective of a non-English speaking country with findings that may be applicable to other non-English speaking populations. (29). Fernandez *et al* performed a cross-sectional questionnaire study in hospital and community settings using a convenience sample of parents accompanying children younger than 14 years of age. They found that 34% of the participants in this high response rate study were not familiar with the term “wheezing”. Additionally, nearly one quarter of the parents that claimed knowing the term “wheezing” failed to identify it as a sound and 13% of them did not name the chest as its site of origin. “Wheezing” was located to the nose and mouth by 24 % of the history providers. Furthermore, 43% of the parents that claimed to know the term “wheezing” reported rattles- or snoring- like terms as synonyms of “wheezing”. In this population, participants that reported knowing the term had a prevalence of “ever wheezing” of 51%. The study

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emphasizes that parental understanding of “wheezing” is significantly different from that of health professionals, since 97% of the latter identified “wheezing” as a sound (29). It would be interesting to find out more on this subject by studies in other non-English speaking nations. Mohangoo *et al* from the Netherlands showed in the Generation R study that the prevalence of wheezing derived from questionnaires was significantly higher than the prevalence estimated from physician interview; only 41% of questionnaire – reported symptoms were verified by the doctor interview (30). In a prospective study, Lowe *et al* compared three groups: children with physician confirmed wheeze to children; parentally reported but unconfirmed wheeze; children who had never wheezed (31). In their study 41% of parents reported that their child had wheezed, with 28.6% of the study participants having wheeze confirmed by a health care professional. Lung function (plethysmographic measurement of specific airway resistance) was significantly poorer when wheeze was confirmed by a physician. This study emphasizes the need of verifying parental reports of wheeze by paediatricians (30) and ideally by objective lung function tests (31). The parental perspective of childhood asthma symptoms has been vividly described by Ostergaard’s qualitative studies with semi-structured interviews (32). Ostergaard emphasizes the importance of listening to the parents in order to make the diagnosis and to secure their participation in anti-inflammatory treatment. The following quotes from the interviews in the study are enlightening: “The doctors ask: does he wheeze or rattle? But you know, all these words. I think it can be difficult to distinguish. Because he never wheezes...It’s just that when he eats, he breathes like a bull, ...so, it has nothing resembling wheezing or rattling or anything like that, he snorts.”. “It’s the breathing that is affected immediately. And the coughing. Does she also wheeze? Yes, very much. It sounds like a coffee machine. Like what? A coffee-machine, which has not been decalcified.” One of the most striking findings in this field came from Michel *et al* that reported in a large population-based study that 17% of the families didn’t define wheeze as a whistling noise despite the fact that a description of wheeze was included in the questionnaire (14).

4. “CLINICIANS VS CLINICIANS AND OTHER HEALTH PROFESSIONALS”

“Putting the blame” on the parents would be convenient. But have we done our part? Are health professionals consistent in their use of the term “wheeze”? It has been well known for a long time now that clinicians - despite the existence of standardized nomenclature (33-35) - show an intra-observer agreement on lung sounds recognition that is far from satisfactory (36-38). Considering that most of the studies showing that the level of agreement on findings of auscultation is poor come from the adult literature, one can only imagine that a screaming infant or toddler does not make things easier... We hope that the work of the recently assembled taskforce of the European Respiratory Society (<http://lungsounds-ers.net/>) will create a reference database on respiratory sounds and will help to further standardize their nomenclature.

The findings from Cane and McKenzie are characteristic: In an effort to explore parental interpretation of children’s respiratory symptoms on video they filmed 55 children; out of these they chose 15 children showing single clinical features. Still, in only 10 out of the 15 selected clips agreement was reached between 5 clinicians (39). These figures highlight that clinicians should improve the communication between themselves before asking too much from the parents. Elphick *et al* performed a blinded prospective comparison of acoustic analysis with stethoscopic examination in hospitalized infants with noisy breathing arising from a lower respiratory tract illness (40). Two experienced specialist registrars with additional experience in respiratory paediatrics exhibited poor agreement regarding stethoscopic identification of wheeze: specifically, they only agreed in 20 out of 36 infants. This agreement was far lower than that for rattles or crackles (40). The authors concluded that auscultation is not reliable for the evaluation of wheezing illnesses in infancy, leaving all the rest of us wondering what the alternative would be...May be Forgacs was right back in 1969 when he described the stethoscope as a “a largely decorative tool in so far as its value in diagnosis of pulmonary disease is concerned” (41). These findings also raise the question about the level of agreement regarding respiratory signs among more junior staff that are in the front line during busy on calls (17); given the fact that treatment may be quite different (42), the therapeutic implications of respiratory sounds misclassification by the clinicians are obvious (43, 44).

It is not just the level of expertise or experience among medical staff; physical therapists exhibit similarly problematic reliability, especially when inexperienced, regarding identification of wheeze and other adventitious lung sounds (7). Doctors and other health professionals may also have different understandings regarding wheeze. In the previously mentioned paper from Portugal, Fernadez *et al* showed that 22% of nurses and physiotherapists did not locate wheezing to the chest; in the same paper 38% of nurses and physiotherapists reported using visual cues and 14% of them a sense of being unwell in order to identify wheezing. All these figures were statistically significantly higher compared to what was reported by doctors (29). Therefore caution should be exercised when interprofessional discussion takes place.

5. “PARENTS VS. CHILDREN”

We have already seen that parents and health care professionals are not always in agreement regarding respiratory sounds (16). But what happens inside the family? Do parents and children share the same views regarding asthma symptoms and especially regarding wheezing? Obviously, infants and younger children cannot be questioned, leaving only older children to have their say. An American study on Latino asthmatic children concluded that children were more likely than their parents to report wheezing (45). The same authors showed that child and not parental reports of wheezing correlated significantly with a pulmonary function deficit. Davies *et al* produced similar results showing that agreement regarding reporting of

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wheezing was slight ($\kappa=0.16$), with parents once more underreporting wheezing compared to the children themselves (46). Another study from the University of Alabama confirmed that children report more asthma symptoms (including wheezing) compared to their parents and the authors conclude that the use of child responses is an equally valuable option in case-detection procedures (47). Other authors have similarly proposed that reliance on parental answers is not likely to improve the reliability of a school-based asthma surveillance programme (48); Yu and Wong showed that in children older than ten years of age administering the questionnaires to children themselves will yield better information (49).

6. VIDEO AND WHEEZING

The use of video has been suggested as a useful way of educating health care professionals and as an adjunct in standardizing definitions of simple respiratory signs (50). Also, a video clip demonstrating an episode of wheezing has been shown to facilitate the doctor – parent communication in children of diverse ethnic backgrounds (51). We described earlier the difficulties with recording good quality clips that Cane and McKenzie faced in their study (39). Saglani *et al* found that in a tertiary centre the application of a video questionnaire may be a useful tool in infants and preschoolers with reported wheeze; they proposed that its use will help clinicians to identify children with upper airway abnormalities. Importantly, none of the children in their study whose parents identified only wheeze on the video questionnaire had any abnormalities detected on bronchoscopy (52). It appears that in every day clinical practice the use of a characteristic video by the clinician may improve the information yield during history taking (27, 52).

Video questionnaires have also been used in epidemiological studies (53-62). A common finding from these studies is that written questionnaires provide higher prevalence of wheeze compared to video questionnaires (56, 62).

7. PARENTAL EDUCATION AND WHEEZING

Children's respiratory health is well known to be associated with parental education (63). The association between parental education and asthma symptoms is complex; children from highly educated parents appear to be protected from non-atopic respiratory symptoms; this observation has been attributed to a lower rate of household smoking and a higher rate of breastfeeding (64, 65). Dom *et al* suggested that aspects associated with a high maternal educational level may be important in the development of atopy. In their study, atopic recurrent wheezing was positively associated with the education of the parents, whereas non-atopic recurrent wheezing was negatively associated (66); others have questioned this link (67). An international multi-centre study comparing risk factors in infants living in affluent and non-affluent areas of the world reported that university studies of mother protected only in Latin America (8, 68). These associations will continue to puzzle investigators for a long time. What is

more important from an educational point of view is to explore the effect of parental educational status on correct use of terminology and to find out how we can educate parents to recognize asthma symptoms like wheeze in a more efficient manner. The importance of this was underlined in a recent meta-analysis which concluded that "providing pediatric asthma education reduces mean number of hospitalizations and emergency department visits and the odds of an emergency department visit for asthma" (69). Michel *et al* found that maternal and not paternal education was positively associated with a correct definition of wheeze. They calculated that "a well-educated, English speaking mother living in a non deprived neighborhood, with a wheezing child and a personal history of asthma has a probability of 96% of knowing that wheeze means whistling. For a non English-speaking father, from a deprived area and with no family history of asthma or wheeze, the figure would be 52%". Fernandez *et al* showed that parents of lower educational background more frequently did not recognize the term "wheezing" and even when they were familiar with it they less frequently associated wheeze with auditory cues (29). This comes to no surprise since social, cultural and linguistic characteristics have been shown to influence caregivers' understandings of respiratory symptoms (70-73).

Can we teach our patients' families what wheeze really is so that misunderstandings are avoided? Lee *et al* studied parental evaluation of wheezing in children with asthma after teaching sessions that lasted a few minutes. They found that the accuracy of wheezing detection in parents was improving the more experience they gained. They concluded that the parents can be taught to detect wheezing, since in their study population the parents could identify wheezing in 99% of the examinations when the wheezing was easily heard by the physician. Results were less impressive when the physician barely heard the wheezing (74).

8. CONCLUSIONS

Parental reports of wheezing should always be verified by a health care professional. Terminology should be clarified to avoid any misunderstandings that may lead to epidemiologic and treatment faults. Every effort should be made to educate parents and improve their communications with the clinician in charge of their child's care.

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Wheezing defined

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