INEFFECTIVE AIRWAY CLEARANCE IN CHILDREN WITH ASTHMA: A DESCRIPTIVE STUDY

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ABSTRACT: This cross-sectional study was performed with 147 children with a medical diagnosis of asthma admitted to a public children's hospital in Fortaleza, Cerará (CE). The objective of the study was to analyze the accuracy of the defining characteristics of the nursing diagnosis "ineffective airway clearance" in children with asthma. A physical examination checklist was used for data collection. The most frequent defining characteristics were adventitious respiratory sounds (82.3%), dyspnea (55.8%), and changes in respiratory rate (50.3%). The nursing diagnosis "ineffective airway clearance" was present in 55.8% of the sample. The defining characteristic with the greatest sensitivity was "adventitious respiratory sounds". The specific characteristic for this diagnosis was "wide eyed". Regarding the predictive values, adventitious respiratory sounds showed a high negative predictive value. In conclusion, studies that contribute to defining the most common defining characteristics for a particular population should be encouraged, as they serve as a guide for the practice of nursing.

DESOBSTRUÇÃO INEFICAZ DAS VIAS AÉREAS EM CRIANÇAS ASMÁTICAS: UM ESTUDO DESCRITIVO

RESUMO: Estudo transversal, realizado com 147 crianças internadas com diagnóstico médico de asma, em um hospital infantil público de Fortaleza-CE. Foi desenvolvido com o objetivo de analisar a acurácia das características definidoras do diagnóstico de enfermagem "desobstrução ineficaz das vias aéreas" em crianças asmáticas. Utilizou-se um roteiro de exame físico para a coleta de dados. As características definidoras mais frequentes foram ruídos respiratórios adventícios (82,3%), dispneia (55,8%), e mudança na frequência respiratória (50,3%). O diagnóstico de enfermagem: "desobstrução ineficaz das vias aéreas" esteve presente em 55,8% da amostra. A característica definidora de maior sensibilidade foi "ruídos adventícios respiratórios". A característica específica para este diagnóstico foi "olhos arregalados". Com relação aos valores preditivos, os ruídos adventícios respiratórios mostraram elevado valor preditivo negativo. Conclui-se que estudos que contribuem para definir o perfil de características definidoras mais comuns para uma população particular devem ser estimulados, pois servem de guia para a prática de enfermagem.

DESCRITORES: Diagnóstico de enfermagem. Cuidado da criança. Asma.

DESCRIPTORS: Nursing diagnosis. Child care. Asthma.

LIMPIEZA INEFICAZ DE LAS VÍAS AÉREAS EN NIÑOS ASMÁTICOS: UN ESTUDIO DESCRIPTIVO

RESUMEN: Estudio transversal realizado con 147 niños asmáticos ingresados en un hospital público de Fortaleza-CE, Brasil. Ha sido desarrollado con el objetivo de analizar la efectividad de las características definitorias del diagnóstico de enfermería "limpieza ineficaz de las vías aéreas" en niños asmáticos. Se utilizó un guión de examen físico para recopilar los datos. Las características definitorias más frecuentes fueron ruidos respiratorios agregados (82,3%), disnea (55,8%) y cambio en la frecuencia respiratoria (50,3%). El diagnóstico de enfermería: "limpieza ineficaz de las vías aéreas" estuvo presente en el 55,8% de la muestra. La característica definitoria para este diagnóstico fueron los "ruidos respiratorios agregados". La característica específica ha sido "ojos muy abiertos". Con relación a los valores predictivos, los ruidos respiratorios agregados presentaron un alto valor predictivo negativo. Se llegó a la conclusión de que los estudios que contribuyen a configurar el perfil de las características definitorias más comunes a una población particular deben ser fomentados, pues sirven de guía para la práctica de enfermería.

DESCRIPTORES: Diagnósticos de enfermería. Cuidado de niños. Asma.

INTRODUCTION

Establishing a nursing diagnosis assumes vital importance during the application of the nursing process, as this is considered to be the intellectual activity that nurses are expected to perform in their daily practice in order to judge the human responses that require nursing care. The nursing diagnosis is an essential element in the nurses' decision-making process, permitting the identification of evidence based on factual information regarding the real condition of the individual, thus allowing nursing professionals to identify the accurate nursing diagnosis, thereby promoting adequate interventions and achieving effective outcomes.[1]

The nursing diagnosis was introduced in Brazil in 1967 by Wanda de Aguiar Horta, and is used as a planning tool to guide care in specific clinical situations. Therefore, the diagnosis is highly important to direct nursing practice and to organize the knowledge grounding this practice.[3] The nursing diagnosis is a clinical judgment regarding the responses of the individuals, family or community to the health problems and real or potential processes, and is used to guide one's care plan.[4]

In order to achieve an accurate nursing diagnosis, it is necessary to identify clinical indicators capable of predicting them. Clinical indicators (the term) has also been used as being synonymous to defining characteristics, clinical evidence, signs and symptoms.[5] The nursing diagnosis must have clinical references (defining characteristics) that are present in a population with a specific diagnosis.[6] To determine these, it is necessary to identify a pattern standard that guarantees selecting patients that either have or do not have the specific diagnosis, and knowing the cause of their problems. Therefore, achieving an accurate nursing diagnosis means determining the specificity, sensitivity and predictive value of indicators associated with a specific diagnosis, which are relevant aspects for its validation.[5]

This study was defined as a continuation of earlier studies, developed as a partnership between members of the Group for Studies on Nursing Diagnosis, Interventions and Outcomes.

According to the NANDA taxonomy[7], Ineffective Airway Clearance (IAC) is defined as the inability to clear secretions or obstructions from the respiratory tract to maintain a clear airway. The defining characteristics of IAC are dyspnea, diminished breath sounds, orthopnea, adventitious respiratory sounds (crackles, sonorous breath sounds and wheezes), ineffective cough, absent cough, ineffective or absent sputum production, cyanosis, difficulty vocalizing, wide-eyed expression, changes in respiratory rate and rhythm, and restlessness.

The selected group (children with asthma) presents important characteristics, because asthma has great epidemiological importance. Every year in Brazil, there are nearly 280,000 admissions due to asthma, which ranks as the fourth cause of hospital admissions according to the Unified Health System (2.4% of the total number of admissions in 2006). Furthermore, asthma ranks as the third cause of admissions among children and young adults. In 2006, the Northeast region accounted for nearly 120,000 admissions due to asthma (approximately 44% of all asthma cases). Considering only children younger than nine years of age, in 2006 asthma accounted for 7.75% of hospital admissions in Brazil.[8] It has been reported that the number of hospital admissions increased between 1993 and 1999. In 2006, admissions due to asthma cost the Unified Health System 88 million Reais, 1.3% of the total annual expenses related to hospital admissions and the third largest amount spent on one single disease.[8]

From this perspective, the present study had the following objectives: to identify the prevalence of the IAC nursing diagnosis among children with asthma; determine the association between this diagnosis and its defining characteristics; verify the reproducibility of the defining characteristics for establishing the ICA nursing diagnosis in children with asthma; and identify the accuracy of the defining characteristics of the ICA nursing diagnosis in children with asthma.

METHOD

This quantitative, cross-sectional study was developed with children having a medical diagnosis of asthma. A cross-sectional study is an epidemiological study based on investigations that produce "instantaneous" results regarding the health condition of a group or community, observing the factors and effects within the same historical period. Representative samples of a population with a carefully selected reference reveal the prevalence of the disease.[9] The study addresses the IAC nursing diagnosis, a component of the "physical injury class" and the "security/protection" domain of the North American Nursing Diagnosis Association Taxonomy II (2007-2008).

The study was performed at a public children's hospital in Fortaleza-CE, located in the area covered by the Regional Administrative Department referred to as *Secretaria Executiva Regional IV* – SER IV. The referred hospital was chosen because it is responsible for the Program for Comprehensive Care to Children with Asthma (*Programa de Atenção Integral à Criança com Asma* - PROAICA), in Fortaleza-CE. Other determining factors for choosing the referred location included its easy accessibility and the attachment established with the professionals in the Program regarding other studies developed in the same location.

The study population consisted of children with asthma who were inpatients in the referred hospital. In 2009 in Fortaleza, 3384 children between zero and nine years of age were admitted with asthma, and the mean length of stay was 3.4 days. The sample size was estimated according to the formula $n=Z\alpha^2.P.Q/E^2$, which considers an infinite population, due to the impossibility of defining the exact size of the population in the referred institution in which: n=sample size; Zα= significance level; P = prevalence of the health condition; Q = (1-P); and E =sample error.

The following parameters were considered: significance level of 95% ($Z\alpha$=1.96); and sample error of 7%. Regarding the prevalence of the event, a 75% rate was considered, which had previously been estimated in a study regarding the nursing diagnosis involving acute respiratory infection.[10] It was not possible to use the prevalence of the studied diagnosis as a reference because it was not found in literature. The estimated sample size was 147 children with asthma.

The following inclusion criteria were used: children aged between zero and six incomplete years; and children with a medical diagnosis of asthma. The exclusion criterion was: children with another associated chronic disease.

Consecutive sampling was used, considering all the children who met the inclusion criteria. The children were recruited from the hospital unit of the referred hospital.

The data collection instrument was based on the taxonomy from the *North American Nursing Diagnosis Association*,[7] divided into domains and classes to identify the IAC nursing diagnosis. Therefore, to allow for a more accurate identification of the defining characteristics, a physical examination checklist was used. The chosen data collection instrument contains the signs and symptoms that represent the defining characteristics and factors related to the IAC nursing diagnosis which are likely present in children with asthma. The instrument was validated in terms of its appearance and content by four faculty members who had been engaged in studies regarding nursing diagnosis in patients with heart disease, two of whom work directly with children having congenital heart disease. After making adjustments according to submitted suggestions, the instrument was applied as a pilot test on five children with asthma in conditions similar to those assessed in the present study. No inadequacies were observed in the test and, thus, the instrument was considered to be adequate.

The data were collected after the children's parents/guardians were fully informed abut the confidentiality of the information and identities, and signed the Free and Informed Consent Form (FICF). A thorough nursing clinical examination was performed, based on the data collection instrument and by consulting the results of biochemical and radiological exams, including the prescriptions and evaluations of every professional that comprised the nursing healthcare team at the hospital.

The process of elaborating and inferring the diagnosis and collaborative problems was performed according to the following steps: data collection, interpretation/grouping and naming of the categories.[11] In order to name the diagnoses, the NANDA Taxonomy II was used.[7]

In the diagnostic inference process, the clinical backgrounds were forwarded to five experts with the purpose of observing their agreement regarding the presence or absence of the IAC diagnosis.

There was a consensus among most experts regarding the occurrence or absence of the diagnosis, i.e., the diagnosis was present when three or more experts considered the patient to have asthma. All experts signed the FICF.

The data were organized into tables and analyzed based on absolute and percentage frequencies, also including measures of central tendency, measures of dispersion, tests of means and correlation coefficients associations and differences.

The Kolmogorov-Smirnov test was used to verify the normality of the numerical data, and Levene's test was used to verify the homogeneity of variances.

Regarding the association tests, the Chi-Square test was used to determine the expected

frequencies greater than five, and the Fisher's test for the expected frequencies smaller than five. The Chi-Square and Fisher's tests are non-parametric tests used to compare two nominal variables, verifying if there is a dependent relationship between them.

The T test was used to calculate the difference between the means. Pearson's correlation coefficient was used for the data showing normality, homogeneity of variance and linearity. For the other data, Spearman's Rho correlation coefficient was used. Accuracy was analyzed by means of sensitivity, specificity and the predictive value.

The research proposal was evaluated and approved by the Federal University of Ceará Ethics Committee, under review number 181/07, and the hospital gave permission for the data collection.

Before the study, the patients' parents/guardians provided consent and signed the FICF. The patients' parents/guardians were informed regarding their right to participate or decline participation, with no harm to their care or treatment.

RESULTS

This section presents tables containing the present study results. The tables show the demographic data and the IAC diagnosis, with an analysis of their defining characteristics.

Table 1 – Children with asthma according to gender, age, weight and length of stay. Fortaleza-CE, 2009

Variables	N	%		
Gender				
Female	66	44.9		
Male	81	64.3		
Total	**147**	**100.0**		
	KS* (p value)	**Mean**	**Standard deviation**	**Median**
Age (months)	0.002	24.42	19.667	18.00
Weight (grams)	0.000	13690.15	21767.389	11200.00
Length of stay (days)	0.001	3.96	2.622	3.00

*Kolmogorov-Smirnov test.

According to the data, it is observed that there is a higher prevalence of male children with asthma (64.3%). The children's mean age was 24.42 months (±19.667), the median weight was 11.200 kg (± 21.7) and the median length of stay was three days (Table1). An asymmetrical distribution ($p< 0.05$) was observed for the weight and length of stay variables, in view of the presence of extreme values.

Regarding the agreement between the experts in terms of the IAC nursing diagnosis, a 0.170 value was reported for Kendall's coefficient of concordance (Kendall's W). This value denotes the overall agreement among all the experts. In this study, a 17% combined agreement was found among the experts.

Table 2 – Prevalence of the defining characteristics and the diagnosis for ineffective airway clearance. Fortaleza-CE, 2009

Defining characteristics	n	%
Diminished breath sounds	27	18.4
Adventitious respiratory sounds	121	82.3
Ineffective cough	32	30.5
Absent cough	36	24.5
Excessive sputum	66	44.9
Difficulty vocalizing	8	5.4
Changes in respiratory rate	74	50.3
Changes in respiratory rhythm	24	16.3
Restlessness	25	17.0
Dyspnea	82	55.8
Orthopnea	48	32.7
Ineffective airway clearance		
Present	82	55.8
Absent	65	44.2
Total	**147**	**100**

The most prevalent defining characteristic was "adventitious respiratory sounds" (82.3%). Only three characteristics presented prevalence greater than 50%. The IAC nursing diagnosis was present in 55.8% of the studied population.

Table 3 – Relationship between the diagnosis of ineffective airway clearance and the defining characteristics. Fortaleza-CE, 2009

Defining characteristics	IAC		Statistics
	Present	Absent	
Diminished breath sounds			p*=0,000 RP=0,458 CI95%=0,37–0,55
Present	27	-	
Absent	55	65	
Adventitious respiratory sounds			p†=0,000 RP=3,36 CI95%=1,60–7,06
Present	81	40	
Absent	1	25	
Ineffective cough			p*=0,000 RP=3,36 CI95%=1,60–7,06
Present	26	6	
Absent	27	46	
Absent cough			p*=0,001 R =2,68 CI95%=1,37–5,34
Present	29	7	
Absent	53	58	
Excessive sputum			p*=0,000 RP=4,0 CI95%=2,28–7,01
Present	55	11	
Absent	27	54	
Difficulty vocalizing			p†=0.010 RP=0.53 CI95%= .45–0.62
Present	8	-	
Absent	74	65	
Change in respiratory frequency			p*=0.000 RP=2.28 CI95%=1.50–3.45
Present	54	20	
Absent	28	45	
Change in respiratory rhythm			p*=0.001 RP=4.03 CI95%=1.37–11.79
Present	21	3	
Absent	61	62	
Restlessness			p*=0.002 RP=3.12 CI95%=1.25–7.80
Present	21	4	
Absent	61	61	
Dyspnea			p*=0.000 RP=2. 155 CI95%=1.46–3.16
Present	58	24	
Absent	24	41	
Orthopnea			p*=0.000 RP=3.455 CI95%=1.79–6.65
Present	40	8	
Absent	42	57	
Wide-eyed expression			p*=0.630 RP= .79 CI95%=0.32–9.87
Present	3	1	
Absent	79	64	

*Chi-Square Test; † Fisher's exact test.

Nearly all of the defining characteristics of the IAC diagnosis presented a statistically significant association ($p<0.05$). The only exception was the characteristic "wide-eyed expression" ($p=0.630$). Among the characteristics with statistical significance, those with greater magnitude were: excessive sputum and change in respiratory rhythm. The prevalence ratio of these characteristics showed that they can increase the child's probability of presenting the IAC diagnosis up to four times.

Table 4 - Sensitivity, specificity, Positive Predictive Value (PPV) and Negative Predictive Value (NPV) for the defining characteristics of ineffective airway clearance. Fortaleza-CE, 2009

Defining characteristics	Sensitivity	Specificity	PPV	NPV
Diminished breath sounds	32.93	-	-	54.17
Adventitious respiratory sounds	98.78	38.46	66.94	96.15
Ineffective cough	49.06	70.77	81.25	63.01
Absent cough	35.37	89.23	80.56	52.25
Excessive sputum	67.07	83.08	83.33	66.67
Difficulty vocalizing	9.76	-	-	46.76
Change in respiratory frequency	65.85	69.23	72.97	61.64
Change in respiratory rhythm	25.61	95.38	87.5	50.41
Restlessness	25.61	93.85	84	50
Dyspnea	70.73	63.08	70.73	63.08
Orthopnea	48.78	87.69	83.33	57.58
Wide-eyed expression	3.66	98.46	75.00	44.76

The defining characteristic with the greatest sensitivity for the IAC diagnosis was "adventitious respiratory noises" (98.78%). The other characteristics presented low sensitivity values. On the other hand, the characteristic that presented the greatest level of specificity was "wide-eyed expression" (98.46%). Other characteristics presented high values of specificity and should be considered important for the addressed diagnosis. Regarding the predictive values, adventitious respiratory noises had a high negative predictive value and the characteristics ineffective cough, absent cough, excessive sputum, change in respiratory rhythm, and orthopnea has moderate positive prediction values.

DISCUSSION

A diagnosis is identified by defining characteristics that describe how patients develop the related group of signs and symptoms. Because some characteristics determine more than one diagnosis, nursing professionals must receive proper training to avoid making wrong diagnoses in error.

In this sense, this study identified the most important determining characteristics for the nursing diagnosis IAC.

According to literature,[5] male children are more likely to develop asthma, considering that their airways are smaller in diameter and greater in tonicity compared to female children of the same age, which results in a lower pulmonary flow. One reported study[12] found that of the 434 children evaluated, 62.7% were male, which agrees with another study[13], which found a 54.2% male prevalence among the 48 children with asthma who were analyzed. These data are similar to those found in the present study, in which 64.3% of the children were male.

The mean age of the studied children was 24.42 months (±19.667), which agrees with another study with a similar population,[14] which found a mean age of 28.5 months. According to literature,[15] for 78.7% of children the first hospital admission occurs before the age of 24 months, and the first symptoms also occur before 24 months in 86.2% of children.

A 55.8% prevalence was found for the IAC diagnosis and the most prevalent defining char-

acteristics were "adventitious respiratory sounds" (82.3%), "dyspnea" (55.8%), and "change in respiratory rhythm" (50.3%). These values are similar to those found in another study[14] of children with asthma, which found a 66.7% prevalence for the diagnosis, with the most prevalent characteristics being adventitious respiratory sounds (76.2%) and change in respiratory frequency (61.9%).

The significant defining characteristics were: diminished breath sounds, adventitious respiratory sounds, excessive sputum, dyspnea, orthopnea, ineffective cough, absent cough, difficult vocalizing, change in respiratory frequency and change in rhythm, different from results found in another study of children with asthma, in which the greatest prevalence was for dyspnea, orthopnea and accessory muscle use.[14]

In addition to the identification of prevalence and significance, it is also important to determine sensitivity, specificity, the positive predictive value and the negative predictive value of the defining characteristics. To do this, it is necessary to establish a specific population to avoid changing the parameters in order to better guide nursing care.

In the literature,[14] the defining characteristic that is sensitive for the identified diagnosis is "adventitious respiratory sounds" and there is no data regarding high specificity. In the present study, the most sensitive defining characteristic was the same, but "wide-eyed expression" was also considered specific, which was different from the study stated above. There were no characteristics with high positive or negative predictive values for the referred diagnosis. It should be highlighted that the characteristic "wide-eyed expression" presented high specificity. This indicates that when this characteristic is absent, the IAC diagnosis will also be absent in populations with characteristics similar to those of the present study, because specificity refers to the capacity that the absence of a defining characteristic has to indicate the absence of the diagnosis. No other IAC studies that identified defining characteristics with high specificity values were located.

It should be highlighted that studies regarding nursing diagnoses and their relationships with the defining characteristics as predictors of a diagnosis remain in their infancy. Children with asthma are more susceptible to developing responses such as ineffective airway clearance. The deficiency of these types of studies reveals that studies focused on nursing care plans regarding this diagnosis are particularly relevant.

CONCLUSION

In this study a 55.8% prevalence was found for the ineffective airway clearance diagnosis in children with asthma. All the diagnosis characteristics were considered statistically significant ($p<0.005$), except "wide-eyed expression" ($p=0.63$).

The most sensitive characteristic for the diagnosis was "adventitious respiratory sounds", which is also the characteristic with the highest negative predictive value. The characteristic with greatest specificity was "wide-eyed expression".

Studies that collaborate to outline the profiles of the most frequent defining characteristics for a specific population should be encouraged, considering that few studies exist in the literature. Furthermore, these studies could serve as guides for nursing practice, thus contributing to an accurate identification of the diagnosis as well as for the systematization of nursing care in order to make the NANDA language more accessible for use among nursing professionals.

The analysis of the accuracy of the defining characteristics of the IAC nursing diagnosis is relevant for nursing because it provides nurses with better clarity when establishing the diagnosis of asthma in children.

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