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Interference of variables sex and age in olfaction and taste of children with and without allergic rhinitis

Interferência das variáveis sexo e idade no olfato e no paladar em crianças com e sem rinite alérgica

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ABSTRACT

Purpose: To associate smell and taste with age and sex of children with and without allergic rhinitis. **Methods:** This is an observational, comparative, analytical and cross-sectional study with a sample of 127 children, 85 without allergic rhinitis and 42 with allergic rhinitis aged 7-12 years attended at the Clinics Hospital of Pernambuco. The research started on January 2012 and was approved by the Ethics Research Committee. The Free and Informed Consent Form was applied, then, medical report review, interview with parents / caregivers, nasal cleaning, evaluation of smell using a test based on literature developed for this study, oral hygiene and taste evaluation using the taste strip test were performed. Data were analyzed using the SPSS 17.0 software, considering 0.05 significance level using the Chi-square or Fisher's exact test, in addition to absolute and relative frequency data. **Results:** The study highlights similarities between levels of olfactory and gustatory discrimination between different sexes and age groups of children (with and without allergic rhinitis), as there is lack of statistically significant associations under these conditions. **Conclusion:** The study results contradict literature findings, but contribute in establishing olfactory and gustatory quantification scores for different ages and sexes of children with and without allergic rhinitis.

Keywords: Sex; Child; Smell; Taste; Rhinitis

RESUMO

Objetivo: Investigar associação de olfato e paladar com a idade e o sexo, em crianças com e sem rinite alérgica. **Métodos:** Estudo observacional, comparativo, analítico e transversal. Amostra composta por 127 crianças, sendo 85 sem rinite alérgica e 42 com rinite alérgica, entre 7 e 12 anos de idade, atendidas no Hospital das Clínicas da Universidade Federal de Pernambuco. Foi realizada revisão de prontuário, entrevista com os responsáveis, limpeza nasal, avaliação do olfato por meio de teste embasado na literatura - desenvolvido para esta pesquisa -, higienização bucal e avaliação do paladar, mediante teste das tiras gustativas. Os dados foram tabulados e analisados no programa estatístico SPSS 17.0 e considerou-se o nível de significância de 5%. Utilizou-se o Teste Qui-quadrado ou exato de Fisher, além da frequência absoluta e relativa dos dados. **Resultados:** O estudo evidenciou semelhanças entre os níveis de discriminação olfatória e gustatória em sexos e faixas etárias diferentes, nas crianças com e sem rinite alérgica, observada ausência de associações estatisticamente significativas nestas condições. **Conclusão:** Os resultados do estudo se contrapõem à literatura pesquisada, porém contribuem no estabelecimento de escores da quantificação olfatória e gustativa para sexos e idades diferentes, em crianças com e sem rinite alérgica.

Palavras-chave: Sexo; Criança; Olfato; Paladar; Rinite

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INTRODUCTION

Allergic rhinitis (AR) is one of the most common inflammatory diseases of the upper respiratory tract, affecting approximately 20% to 25% of the world population and its prevalence continues to increase. Cellular inflammation of the nasal mucosa is a hallmark of allergic rhinitis, a disease mediated by immunoglobulin. It is characterized by accumulation of eosinophils, expression of increased adhesion molecules, release of chemokines, cytokines, histamine and leukotrienes[1].

Allergic rhinitis is diagnosed based on the history of two or more nasal symptoms (sneezing, pruritus, nasal obstruction and coryza) and confirmation of sensitization suspicion by puncture test, or specific immunoglobulin-E (IgE) tests[2]. It is one of the most common diseases in adults and the most common chronic diseases in children. In the United States, it is estimated that it generates two to five billion dollars in expenditures annually[3].

The presence of allergic rhinitis increases the probability of asthma by 40% and its treatment is related to greater asthma control[4].

Although often considered a trivial disease, rhinitis can lead to susceptibility to other diseases and reduce quality of life due to conditions such as fatigue, headaches, cognitive impairment, sleep disturbances and chemo-sensitive disorders. Regarding these disorders, food consumption and social interactions may be affected by reduced olfactory, gustatory and trigeminal function[5].

Therefore, the perception of smell can occur in two ways. The first and main is the orthonatal route, in which, through the inhalation of air, the odor molecules reach the olfactory epithelium, located in the nasal cavity. The second mode of olfactory perception occurs via retronasal route, in which the odors produced in the oral cavity, during chewing of food reach the posterior region of the pharynx up to the nasal cavity, reaching the olfactory epithelium[6,7].

On the other hand, taste plays an important role in safety, since the loss or diminution of the gustatory function creates an environment conducive to domestic accidents, such as the risk of food poisoning when eating spoiled foods[8]. In addition, taste influences food choices, allowing the individual to select adequate foods based on sensorial characteristics provided by substances contained in foods[9].

In this way, taste perception occurs in taste buds, the primary sensory cells responsible for taste, and that are able to recognize basic tastes such as sweet, sour, salty, bitter and umami[10].

However, there is lack of published scientific articles regarding alterations in the olfactory and taste functions in children with oral breathing, which make it difficult to establish standards of normality and the knowledge of health professionals involved in these aspects. As a consequence, the early evaluation of this population and possible preventive intervention aiming at reducing these changes in adolescence and even in adulthood, are reduced and even absent.

Therefore, this research and speech therapy have much to contribute to the reflection in clinical practice, regarding the evaluation and early intervention of oral respirators with possible alterations in the olfactory and taste functions, providing an improvement in patients' quality of life.

The aim of this study was to investigate the association of smell and taste with age and sex in children with and without allergic rhinitis, considering the differences between sexes and age groups in olfactory and gustatory discrimination.

METHODS

This is an observational, comparative, analytical and cross-sectional study started in January/2012 and completed in August / 2013, approved by the Ethics Research Committee - CEP - UFPE (CAAE: 06844412.9.0000.5208), with a non-probabilistic sample, composed of two groups.

Initially, statistical calculation was performed with results of the pilot study, using the BioEstat software, version 5.0. The proportions test for sample calculation with 80% test power and 5% significance defined the sample with 170 children, 110 in the comparison group and 60 in the study group, divided into a 2: 1 ratio. However, after data analysis, some children evaluated were excluded from the study, reducing the sample to 127 children, 85 of whom without allergic rhinitis (comparison group) and 42 with allergic rhinitis (study group). The sample was reduced because the profile of the service chosen to perform the evaluation of patients presented repetition, since they returned for a new consultation in the service due to the treatment periodicity. Thus, the researchers chose the convenience sample.

The inclusion criteria of children for the study group were: medical diagnosis of allergic rhinitis in medical records; age between 7 and 12 years; attended at the allergy and immunology outpatient clinic of a university hospital. For the comparison group, criteria were: medical diagnosis of no allergic rhinitis in medical records; age between 7 and 12 years; followed at the pediatric outpatient clinic of the same hospital.

Children with neurological, psychic or cognitive commitments, with visual, auditory or motor deficiencies that could impair data collection, craniofacial abnormalities, diabetes or epilepsy, previous nasal surgery, nasal polyps or nasal tumors, turbinate hypertrophy, tonsils or adenoids in high degrees and bilaterally, infection of the upper airways, lesions in the tongue and with prior or ongoing speech-language intervention related to aspects of interest were excluded from the study.

Data collection was performed after parents / guardians signed the Informed Consent Form. Subsequently, a review of medical records and interview with parents / guardians were carried out to collect data on the child's health status, as well as exposure to intervening factors.

Aiming to eliminate mechanical impediments to the arrival of odoriferous molecules to the olfactory nerve, a nasal cleaning procedure was performed by means of Isofarma® flacons with 10 ml of 0.9% sodium chloride solution at room temperature, 5 ml for each nostril. Physiological saline was applied to the patient's nostril using Descarpack® disposable syringe and then he was asked to blow the nose. This process was performed in each nostril, separately, according to procedure proposed by some authors[11].

For the smell evaluation, the aqueous solutions test created in a university manipulation pharmacy, exclusively for this research, was used to identify the different odors and the discrimination of different concentrations of the same odor. The test was adapted from previous studies[12,13] and the choice of this methodology was based on its considerable applicability to the study population.

A total of 13 aqueous solutions (lemongrass, strawberry, mint, sundown®, eucalyptus, chocolate, tutti-frutti, lemon, cinnamon, cherry, coffee, coconut and rose) were chosen, according to criteria of probable exposure of the study population and easy application in a standardized way. Of these, three odoriferous solutions (strawberry, mint and coffee) were chosen for reproduction, also in a lower concentration and were presented in two filter paper strips soaked in distilled water. The odor discrimination test was performed with the help of representative figures to aid olfactory memory, according to studies performed with children[14,15].

Filter paper strips are composed of two parts: the rod, with 8 cm in length and the end, with 0.2 cm^2 in area, for the placement of the different aqueous solutions. For the identification of odors, after placing one drop of solution on a filter paper strip, the individual was asked to feel the odor indefinitely, until feeling sure to point the figure that he believed corresponded to the odor to which was he was exposed. The filter paper strip was spaced about 5 cm horizontally and vertically from nostrils, as seen in Figure 1.

The study had as variable the use of medicines, defined as the use of medications at the time of evaluation, with the possibility of a positive or negative response.

The olfactory test results were based on a percentage classification of the proposed study [16], with the following results: 0 - 50% (between 0 and 8 correct answers); 51%-100% (between nine and 16 correct answers), considering, for classification and non-diagnostic level, normosmia from 51% of correct answers and hyposmia, below 50% of correct answers.

Oral hygiene procedure was then performed by brushing teeth with water before all evaluations in order to eliminate confounding factors such as reduced tooth brushing time, food residues and oral acidity by the ingestion of liquids. For this, disposable tooth brush and mineral water at room temperature were used. Tooth brushing was performed by the evaluated child; however, with constant supervision of the researcher.

Finally, taste was evaluated with the taste strips test[16]. Filter paper strips were composed of two parts: the rod, with 8 cm in length and the end, with 0.2 cm^2 in area, for the application of the four different concentrations of basic tastes: salty, sweet, bitter and sour and two solutions containing distilled water (without flavor), totaling 18 strips. The following concentrations were used: sour - 0.3 g/ml, 0.165 g/ml, 0.09 g/ml and 0.05 g/ml citric acid; bitter - 0.006 g/ml, 0.0024 g/ml, 0.0009 g/ml and 0.0004 g/ml quinine hydrochloride; sweet - 0.4 g/ml, 0.2 g/ml, 0.1 g/ml and 0.05 g/ml sucrose; salty - 0.25 g/ml, 0.1 g/ml, 0.04 g/ml and 0.016 g/ml sodium chloride. Strips were positioned in the middle of the child's tongue, at a distance of approximately 1.5 cm from the tongue tip, and the test started with the lowest concentration.

After the administration of each strip, the subject was instructed to close the mouth and choose from five possible responses (salty, sweet, bitter, sour and tasteless), pointing to the figure that he believed represented the taste to which he was exposed (Figure 2). During the evaluation of each strip, mouth

Figure 1. Material used and procedure performed for olfactory evaluation

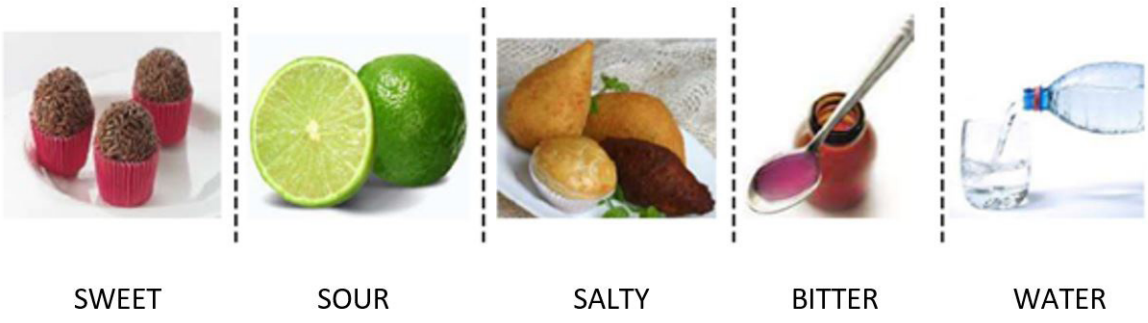

Figure 2. Representative figures for taste evaluation

was rinsed with water to remove the previously experienced taste (Figure 3). In the end, a score from 0 to 16 was attributed, considering that the two strips with water were not considered and that scores less than or equal to 8 characterized hypogeusia and note 0 (zero), ageusia.

Data were organized and analyzed in the SPSS software, version 17.0. Descriptive analysis of data was carried out by means of absolute and relative frequency, and for the establishment of the association between sex, age and olfactory and gustatory discrimination, the Chi-square test or the Fisher's exact test was used, and 5% significance level was adopted.

RESULTS

In the study group, 52.4% children aged 7-9 years and 6 months and 52.4% were male. In the comparison group, 51.8% children aged between 7 years and 7 months and 12 incomplete years and 61.2% were female (Table 1). There were no statistically significant differences between groups with respect to sex ($p = 0.147$) and age ($p = 0.660$).

There were no statistically significant associations among age, sex, olfactory and gustatory discrimination variables in the study groups (Table 2 and 3).

In the evaluation of the gustatory discrimination, no statistically significant associations were found between groups for the tastes presented. However, greater predominance of errors for salty and sweet tastes was found, respectively, when compared to bitter and sour, in both groups.

DISCUSSION

At birth, human olfaction is already functional and odors produce behavioral and psychophysiological responses. For example, newborns exhibit facial expressions of disgust in response to odors classified as unpleasant by adults and exhibit signs of olfactory preferences. In the age group of 4-10 years, naming and memorizing odors are less developed than in adults, although children already have a established odor vocabulary (ability to identify smell, aroma, perfume or fragrance)[17].

Despite this context of differences in olfactory discrimination among age groups, statistically significant associations were not observe in this study, probably due to the fact that the age groups established for analysis were not distanced by long periods of time or by extremely different stages of global development.

In addition, children can detect, discriminate and respond to odors. For them, olfactory stimuli are an important source of information about food, social partners and the environment in general[17]. Thus, among children with greater consolidation of cognitive and linguistic aspects, such as those of this study, it is possible that the identification and discrimination of odors are determined as tasks of easy execution, a determining factor for the absence of statistically significant differences among the different age groups.

Several studies have demonstrated the decline of the olfactory function with age[18,19]. The reasons for this decline could be classified into two hypotheses: morphological, with reduction in the number of olfactory neurons, and functional, with the decrease of metabolic activities related to the reception of the sensory stimulus and/or its neurotransmission[20]. Overall, this

Figure 3. Material used and procedure performed for taste evaluation

Table 1. General distribution of the sample regarding group, age group and sex

Variables	Study Group n (%)[1]	Comparison group n (%)[1]	*p* – value
Age group			0.660[2]
7:0 a 9:6	22 (52.4)	41 (48.2)	
9:7 a 12:0	20 (47.6)	44 (51.8)	
Sex			0.147[2]
Female	20 (47.6)	52 (61.2)	
Male	22 (52.4)	33 (38.8)	

[1]Absolute and relative frequency; n = number of children; [2]Chi-square test; p <0.05 (statistically significant); p = p-value; 9: 7 to 12: 0 = children aged 7-12 years; 7: 0 to 9: 6 = children aged 7-9 years and 6 months

Table 2. Association between age groups regarding olfactory and gustatory discrimination in children with and without allergic rhinitis

Age group 7:0 to 9:6		Olfactory Discrimination		Total	*P* - value
		≤ 50% (n) (%)[1]	> 50% (n) (%)[1]		
Group	Without Allergic Rhinitis	4 (9.8)	37 (90.2)	41	0.650[2]
	With Allergic Rhinitis	1 (4.5)	21 (95.5)	22	
	Total	5 (7.9)	58 (92.1)	63	
		Gustatory Discrimination		Total	*p*
		Hypogeusia (n) (%)[1]	Normogeusia (n) (%)[1]		
Group	Without Allergic Rhinitis	13 (31.7)	28 (68.3)	41	0.709[3]
	With Allergic Rhinitis	8 (36.4)	14 (63.6)	22	
	Total	21 (33.3)	42 (66.7)	63	
Age group 9:7 to 12:0		Olfactory Discrimination		Total	*p*
		≤ 50% (n) (%)[1]	> 50% (n) (%)[1]		
Group	Without Allergic Rhinitis	1 (2.3)	43 (97.7)	44	1.000[2]
	With Allergic Rhinitis	0 (0.0)	20 (100.0)	20	
	Total	1 (1.6)	63 (98.4)	64	
		Gustatory Discrimination		Total	*p*
		Hypogeusia (n) (%)[1]	Normogeusia (n) (%)[1]		
Group	Without Allergic Rhinitis	5 (11.4)	39 (88.6)	44	0.697[2]
	With Allergic Rhinitis	3 (15.0)	17 (85.0)	20	
	Total	8 (12.5)	56 (87.5)	64	

[1]Absolute and relative frequency; n = number of children; [2]Fisher's exact test; [3]Chi-Square Test; p <0.05 (statistically significant); p = p-value; 9: 7 to 12: 0 = children aged 7-12 years; 7: 0 to 9: 6 = children aged 7-9 years and 6 months; ≤ 50% = number of correct answers between 0 and 8; > 50% = number of correct answers between 9 and 16

Table 3. Association between sexes regarding olfactory and gustatory discrimination in children with and without allergic rhinitis

Female		Olfactory Discrimination		Total	*P* - value
		≤ 50% (n) (%)[1]	> 50% (n) (%)[1]		
Group	Without Allergic Rhinitis	4 (7.7)	48 (92.3)	52	0.570[2]
	With Allergic Rhinitis	0 (0.0)	20 (100.0)	20	
	Total	4 (5.6)	68 (94.4)	72	
		Gustatory Discrimination		Total	*p*
		Hypogeusia (n) (%)[1]	Normogeusia (n) (%)[1]		
Group	**Without Allergic Rhinitis**	13 (25.0)	39 (75.0)	52	0.666[3]
	With Allergic Rhinitis	6 (30.0)	14 (70.0)	20	
	Total	19 (26.4)	53 (73.6)	72	
Male		Olfactory Discrimination		Total	*p*
		≤ 50% (n) (%)[1]	> 50% (n) (%)[1]		
Group	Without Allergic Rhinitis	1 (3.0)	32 (97.0)	33	1.000[2]
	With Allergic Rhinitis	1 (4.5)	21 (95.5)	22	
	Total	2 (3.6)	53 (96.4)	55	
		Gustatory Discrimination		Total	*P*
		Hypogeusia (n) (%)[1]	Normogeusia (n) (%)[1]		
Group	**Without Allergic Rhinitis**	5 (15.2)	28 (84.8)	33	0.475[3]
	With Allergic Rhinitis	5 (22.7)	17 (77.3)	22	
	Total	10 (18.2)	45 (81.8)	55	

[1]Absolute and relative frequency; n = number of children; [2]Fisher's exact test; [3]Chi-Square Test; p <0.05 (statistically significant); p = p-value of; ≤ 50% = number of correct answers between 0 and 8; > 50% = number of correct answers between 9 and 16

decline occurs in old age, which may justify the absence of differences in olfactory discrimination found in the population analyzed in this study.

One study[21] pointed out age differences as a strong factor in olfactory discrimination, when it raised the hypothesis about the influence of language development and semantic learning on the child's hedonic ability to perceive odors as pleasant and unpleasant.

The authors[21] believe that at intermediate stages of development, such as age between 3 and 5 years, when children begin to master language, semantic representations of objects become strong organizers of odor perception. Confirming the initial idea, this study found that, at 5 years of age, children categorize odors more as pleasant, and that this change was more significant as language production skills were more developed.

Statistically significant associations between olfactory discrimination and age may not have occurred, taking into account what has been reported by authors[21], because children above 6 years of age already have language mastery similar to that of adults, and only improvement in their language development is expected from that age on, regardless of age group and stage of language development on the olfactory and gustatory discrimination results found[20].

Another study[22] found that the child's cognitive development, which allows the verbalization of what is felt, is also at an equal stage among children, and therefore does not constitute an interfering factor for the capacity of olfactory and gustatory discrimination.

The literature also reported that, using odor identification tests performed with adults, older children presented better results compared to younger ones[23,24]. In contrast, an odor identification task was used with 30 odors and it was found that children under 5 years of age are likely to produce significant olfactory discrimination results[25].

Perhaps this is the justification for the absence of statistically significant differences between gustatory discrimination and the age groups proposed in the study, considering the young age of the study population.

Authors[26] have stated that differences between sexes can be observed in anatomical characteristics, in physiology and behavior of several species.

Another author[27] reported that differences between sexes are consolidated around 5 to 6 years of age. Such differences are perceived in the preference for plays, in the ways of playing, of interacting and behaving, in a broader sense.

There are findings in literature reporting that in boys at 4 years of age, testosterone levels double, reflecting in more agitated behavior and plays. At the age of 5 years, testosterone falls by half and the child tends to calm down a little, but maintaining preferences for more turbulent activities. As for brain development, boys have their brains developed more slowly and with fewer connections between the left and right hemispheres due to the reduced action of estrogen. In the age group of 6-7 years, the mental development of male children is 6 to 12 months late compared to females[28].

Based on this assertion, both olfactory and gustatory discrimination was expected to have statistically significant differences between sexes, since the agitated behavior and slower development of boys could make it difficult to understand and perform activities, while girls would obtain better rate of correct answers.

Other authors [29] have demonstrated results that contrast to those found in this study when reporting that the gustatory sensitivity scores for bitter and sweet tastes were higher in girls. Likewise, higher scores of gustatory discrimination of the four basic tastes (sweet, salty, sour and bitter) were also found in girls of the study population[30].

Although literature indicates great differences in olfactory and gustatory discrimination between sexes and different age groups, this result was not found in this study. However, it is noteworthy that, although the evaluation tools used in this research are based on literature, they are not validated for the Brazilian population, which may have compromised the results.

Another important and possibly determining factor for the results of this study was the sample loss after the application of the inclusion and exclusion criteria. The results may also have been influenced by variable "medication use".

Greater control of possible interfering variables in the ability to identify smells and tastes is recommended, but this study contributed to establish limits for the quantification of olfactory and gustatory discrimination in the children population, with and without allergic rhinitis.

CONCLUSIONS

There were no associations of smell and taste when related to sex and age in children with and without allergic rhinitis. The results of this study contradict the researched literature, but contribute to the establishment of olfactory and gustatory quantification scores for different sexes and ages in children with and without allergic rhinitis. It is important to highlight the relevance of the smell and taste categorization in children at different ages and sexes exposed to pathology common among children.

REFERENCES

1. Mion O. Como diagnosticar e tratar rinite. RBM. 2013;70(5):154-63.
2. Hellings PW, Fokkens WJ, Bachert C, Akdis CA, Bieber T, Agache I, et al. Positioning the principles of precision medicine in care pathways for allergic rhinitis and chronic rhinosinusitis - an EUFOREA-ARIA-EPOSAIRWAYS ICP statement. Allergy. 2017;72(9):1297-305. http://dx.doi.org/10.1111/all.13162. PMid:28306159.
3. Seidman MD, Gurgel RK, Lin SY, Schwartz SR, Baroody FM, Bonner JR, et al. Clinical practice guideline: allergicrhinitis. Otolaryngol Head Neck Surg. 2015;152(1, Suppl):S1-43. http://dx.doi.org/10.1177/0194599814561600. PMid:25644617.
4. Wheatley LM, Togias A. Clinical practice: allergic rhinitis. N Engl J Med. 2015;372(5):456-63. http://dx.doi.org/10.1056/NEJMcp1412282. PMid:25629743.
5. Pellegrino R, Walliczek-Dworschak U, Winter G, Hull D, Hummel T. Investigation of chemosensitivity during and aer an acute cold. Int Forum Allergy Rhinol. 2017;7(2):185-91. http://dx.doi.org/10.1002/alr.21869. PMid:28177594.
6. van As-Brooks CJ, Finizia CA, Kerle SM, Ward EC. Rehabilitation of olfaction and taste following total laryngectomy. In: Ward EC, van As-Brooks CJ. Head and neck cancer: treatment, rehabilitation, and outcomes. San Diego: Plural Publishing; 2014. p. 421-45.

7. Leon EA, Catalanotto FA, Werning JW. Retronasal and orthonasal olfactory ability after Laryngectomy. Arch Otolaryngol Head Neck Surg. 2007;133(1):32-6. http://dx.doi.org/10.1001/archotol.133.1.32. PMid:17224519.

8. Boesveldt S, Lindau ST, McClintock MK, Hummel T, Lundström JN. Gustatory and olfactory dysfunction in older adults: a national probability study. Rhinology. 2011;49(3):324-30. PMid:21858264.

9. Palheta FX No, Targino MN, Peixoto VS, Alcântara FB, Jesus CC, Araújo DC, et al. Anormalidades sensoriais: olfato e paladar. Arq Int Otorrinolaringol. 2011;15(3):350-8. http://dx.doi.org/10.1590/S1809-48722011000300014.

10. Dias VR, Brazil JM, Almeida JAR, Silva CS, Milagres MP. Avaliação da percepção sensorial ao gosto doce em pessoas com Diabetes Mellitus tipo 2. Rev Rene. 2016;17(4):483-9. http://dx.doi.org/10.15253/2175-6783.2016000400007.

11. Cunha DA, Silva HJ. Terapia fonoaudiológica em respiração oral (como eu trato). In: Marchesan IQ, Silva HJ, Berretin-Felix G. Terapia fonoaudiológica em motricidade orofacial. São Paulo: Pulso Editorial; 2012. p. 87-109.

12. Assumpção FB Jr, Adamo S. Reconhecimento olfativo em adolescentes. Mudanças Psicol Saúde. 2005;13(2):271-471. http://dx.doi.org/10.15603/2176-1019/mud.v13n2p406-419.

13. Der CM, Larach FF, Hananías NP, Cohen MV, Salin MPV, Mesina A. Olfatómetro práctico: propuesta de una nueva herramienta clínica. Rev. otorrinolaringol. cir. cabeza cuello. 2002;62:129-36.

14. Fossey E. Identification of alcohol by smell among young children: an objective measure of early learning in the home. Drug Alcohol Depend. 1993;34(1):29-35. http://dx.doi.org/10.1016/0376-8716(93)90043-P. PMid:8174500.

15. Noll RB, Zucker RA, Greenberg GS. Identification of alcohol by smell among preschoolers: evidence for early socialization about drugs occurring in the home. Child Dev. 1990;61(5):1520-7. http://dx.doi.org/10.2307/1130761. PMid:2245743.

16. Mueller C, Kallert S, Renner B, Stiassny K, Temmel AF, Hummel T, et al. Quantitative assessment of gustatory function in a clinical context using impregnated "taste strips". Rhinology. 2003;41(1):2-6. PMid:12677732.

17. Hummel T, Bensafi M, Nikolaus J, Knecht M, Laing DG, Schaal B. Olfactory function in children assessed with psychophysical and electrophysiological techniques. Behav Brain Res. 2007;180(2):133-8. http://dx.doi.org/10.1016/j.bbr.2007.02.040. PMid:17418432.

18. Spielman AI. Chemosensory function and dysfunction. Crit Rev Oral Biol Med. 1998;9(3):267-91. http://dx.doi.org/10.1177/10454411980090030201. PMid:9715366.

19. Sacre Hazouri JA, Davidson T, Jalowayski A, Murphy C. Disfunción del olfato. Rev Alerg Mex. 2000;47(3):87-93. PMid:10887768.

20. Kaneda H, Maeshima K, Goto N, Kobayakawa T, Ayabe-Kanamura S, Saito S. Decline in taste and odior discrimination abilities with age, and relationship between gustation and olfaction. Chem Senses. 2000;25(3):331-7. http://dx.doi.org/10.1093/chemse/25.3.331. PMid:10866991.

21. Rinck F, Barkat-Defradas M, Chakirian A, Joussain P, Bourgeat F, Thevenet M, et al. Ontogeny of odor liking during childhood and its relation to language development. Chem Senses. 2011;36(1):83-91. http://dx.doi.org/10.1093/chemse/bjq101. PMid:20956736.

22. Zorzi JL. A intervenção fonoaudiológica nas alterações da linguagem infantil. 2. ed. Rio de Janeiro: Editora Revinter; 2002.

23. Piaget J. A construção do real na criança. São Paulo: Editora Ática; 2008. Original publicado em 1937.

24. Doty RL, Shaman P, Dann M. Development of the University of Pennsylvania Smell Identification Test: a standardized microencapsulated test of olfactory function. Physiol Behav. 1984;32(3):489-502. http://dx.doi.org/10.1016/0031-9384(84)90269-5. PMid:6463130.

25. Laing DG, Segovia C, Fark T, Laing ON, Jinks AL, Nikolaus J, Hummel T. Tests for screening olfactory and gustatory function in school-aged children. Otolaryngol Head Neck Surg. 2008;139(1):74-82. http://dx.doi.org/10.1016/j.otohns.2006.11.058. PMid:18585565.

26. Richman RA, Sheehe PR, Wallace K, Hyde JM, Coplan J. Olfactory performance during childhood. Part 2. Developing a discrimination task for children. J Pediatr. 1995;127(3):421-6. http://dx.doi.org/10.1016/S0022-3476(95)70074-9. PMid:7658273.

27. Menezes ABC, Brito RCS, Figueira RA, Bentes TF, Monteiro EF, Santos MC. Compreendendo as diferenças de gênero a partir de interações livres no contexto escolar. Estud Psicol. 2010;15(1):79-87. http://dx.doi.org/10.1590/S1413-294X2010000100011.

28. Silva LI. Papagaio, pira, peteca e coisas do gênero [doutorado]. Belém: Universidade Federal do Pará; 2006.

29. Biddulph S. Criando meninos. In: Menezes ABC, Brito RCS, Figueira RA, Bentes TF, Monteiro EF, Santos MC. Compreendendo as diferenças de gênero a partir de interações livres no contexto escolar. São Paulo: Fundamento; 2010. p. 79-87. Estudos de Psicologia.

30. Furquim TRD, Poli-Frederico RC, Maciel SM, Gonini-Júnior A, Walter LRF. Sensitivity to bitter and sweet taste perception in schoolchildren and their relation to dental caries. Oral Health Prev Dent. 2010;8(3):253-9. PMid:20848003.