



## Test for screening olfactory function in children

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### ARTICLE INFO

#### Article history:

Received 1 August 2012

Received in revised form 3 December 2012

Accepted 4 December 2012

Available online 9 January 2013

#### Keywords:

Smell

Odor

Olfactory screening

Children sense examination

Smell identification test

### ABSTRACT

**Objective:** The research determining odors recognizable by children from Poland and Eastern Europe has not been widely described in the literature. The aim of the study was to determine the odors recognizable by Polish children which could be used in a screening olfactory test.

**Methods:** The study was performed in Children's Hospital in Warsaw. Ninety-one children aged from 2.9 years to 10 years (SD = 5.6 years) were examined, 85 (93.4%) of which completed a full olfactory test. Children were separated into three age groups. The olfactory test consisted of 21 odors.

**Results:** The analysis of the results of all children's examinations showed statistically significant influence of age on the number of odors identified ( $p = 0.0001$ ;  $r = 0.676$ ).

The olfactory test score enabled identification of 6 odors to be included in the screening test: bubble gum, lemon, cola, mint, toffee, fish. Correct identification of at least 4 out of them was accepted as a norm and was achieved by 96.5% of children.

**Conclusions:** Olfactory evaluation is possible for children as young as 3 years old. Child's age influences the number of odors recognized and the specific odors recognition depends also on the home place geographic location and eating habits. Eastern European children most often recognized the following odors: bubble gum, lemon, cola, mint, toffee and fish, as so these odors were considered for olfactory screening test. The 6 odors test has good ability to generalize performance to olfactory status, has normative data and good validity and reliability, is fast, easy and inexpensive to administer.

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## 1. Introduction

Reception of smell information in children undergoes alterations that begin in early childhood. Research indicates that humans develop the ability to react to olfactory stimuli already during their fetal life. Infants and little children are able to smell and distinguish odors [1], that are a major source of information about food and the surrounding environment [2,3]. Contact with an increasing number of various aromas during human's lifetime stimulates development and improvement of olfactory function. Scent's learning lasts the whole life. It is acknowledged that child's ability to name and remember olfactory stimuli is less developed than in adults as children's lexicon is too little to define scents [3].

There has never been a census to count the number of people who complain of problems with their senses of smell, but researchers estimate that about 6% percent of the population have loss of smell [4] As yet, there does not appear to have been any

reports of the prevalence of anosmia in children but that appears to be substantially lower than that reported for adults.

Whether congenital anosmia (include Kallman's syndrome) accounts for many cases of children with anosmia remains to be determined. There are a number of conditions occur in early childhood that can lead to either partial or total loss or distortion in olfactory ability. For example, the olfactory system is particularly sensitive to head injuries which may sever the olfactory nerve and result in a complete loss of olfactory ability. Roberts and Simcox [5] found 75% of children with a severe traumatic brain injury suffering from anosmia. Many cases of significant nasal obstructions, such as allergies or enlarged adenoids may also impair olfactory sensitivity. Beyond these known risk factors, there may be additional disease or environmental factors that can impact olfactory ability among young children as dust in their home, chronic rhinosinusitis disease and cystic fibrosis [6].

Olfactory examinations are most frequently conducted in grown or older children. Doctors seldom undertake to assess olfaction in small children. It results from the lack of tools adjusted to examine olfaction in this age group, as well as from the difficulties connected with cooperation with a small patient. Therefore, the methods for olfaction evaluation in children are most frequently borrowed from the methodology applicable to

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adults who are equipped with rich and perfectly developed lexicon for defining scents [7,8].

Diagnosis conducted in such a way, however, raises various doubts, as it is known that all tests for examining a population in developmental age should take into consideration stages of child's mental development, child's ability to focus attention as well as possessed lexicon. Thus, by using odor identification tests for adults or older children, younger patients are deliberately excluded. It is frequently the case that doctors do not examine the olfactory function in small children considering the results to be not very reliable [9]. It seems, however, that an adequately designed olfactory test may serve as a dependable assessment of olfactory function in children [10]. For these reasons, we are interested in development of test to screen children at an early age for olfactory function.

A grave problem while conducting an olfactory examination in the group of children is selecting test odors. The stimuli have to be well-known and frequently encountered in the child's surroundings for the possibility of recognizing them by a little patient. Aromas surrounding a child in its everyday life differ depending on the country of origin and culinary traditions of a certain region of the world. Tests based on odors easily recognizable by residents of a certain country may cause trouble for children from a different region of the world [11]. Research determining odors recognizable by children from Poland and Eastern Europe has not been widely described in the literature. Therefore, the aim of the study was to determine the odors recognizable by Polish children which could be used in a screening olfactory test. Moreover, the correlation between olfactory test results and child's age was examined.

## 2. Methods

Ninety one children admitted to the Prof. Jan Bogdanowicz Children's Hospital in Warsaw were included in the analyses, that

after a case history and laryngology examination showed no symptoms of olfaction disorders or any illnesses that could influence the functioning of olfaction.

The examined children range from 2.9 years to 10 years, 85 children (93.4%) completed a full olfactory test and only those were put through the analysis (43 girls, 42 boys). The remaining 6 persons did not complete the examination due to either parent's shortage of time (3 persons) or impossibility of further concentration of child's attention (3 persons). Having taken the age of children into consideration, they were separated into three groups:

- Group I – (37 persons; 20 girls, 17 boys) children below the age of 5, (av. 4 years, SD = 0.48);
- Group II – (30 persons; 14 girls, 16 boys) children from 5 years to 7 years old, (av. 5.74 years, SD = 0.52)
- Group III – (18 persons; 9 girls, 9 boys) children over 7 up to 10 years old, (av. 8.87 years, SD = 0.64)

Different quantity of children in these groups is a result that nasal patency disturbances have been more often noticed in older children which excluded them from the study (e.g. nasal septum deviation, chronic rhinosinusitis, antrochoanal polyps).

The test consisted of 21 odors (Table 1), chosen from stimuli used in the most well-known olfactory tools: Sniffin Stick test [12], UPSIT [13], CCCRC [14], CC-SIT [11]. The aromas were placed in bottles made from dark glass which were labeled with codes. After having unscrewed a cap, a bottle was moved for 3 s over nostrils, in a distance of about 2 cm from nostrils. At the same time a child was shown 3 pictures and was asked to indicate a picture that best illustrates the odor. The name of the odor under the picture was read out loudly each time.

The olfactory stimuli were presented in 20 s intervals at the minimum, in a different order for each child. The test was done each time by the same doctor. The examination was conducted in a quiet room and took about 10 min. For the results to be more reliable, a parent provided information on the things a particular

**Table 1**  
Odor identification by children in three age groups.

Odors	GROUP I <5 years old (37 persons)				GROUP II 5–7 years old (30 persons)			GROUP III 7–10 years old (18 persons)				
	2 years 2 persons	3 years 14 persons	4 years 21 persons	Summary persons (% of the group)	5 years 16 persons	6 years 14 persons	Summary persons (% of the group)	7 years 4 persons	8 years 6 persons	9 years 6 persons	10 years 2 persons	Summary persons (% of the group)
Strawberry	0	6	17	23 (62.2%)	12	12	24 (80.0%)	4	2	4	0	10 (55.6%)
Pineapple	1	6	10	17 (45.9%)	10	14	24 (80.0%)	4	2	6	2	14 (77.8%)
Lemon	1	9	21	31 (83.8%)	16	9	25 (83.3%)	4	2	6	2	14 (77.8%)
Apple	0	7	9	16 (43.2%)	3	7	10 (33.3%)	2	6	4	0	12 (66.7%)
Rose	0	5	2	7 (18.9%)	5	9	14 (46.7%)	2	6	4	0	12 (66.7%)
Chocolate	1	6	14	21 (56.8%)	11	12	23 (76.7%)	4	6	6	2	18 (100%)
Cola	1	10	19	30 (81.1%)	16	14	30 (100%)	4	6	6	2	18 (100%)
Vanilla	0	8	12	20 (54.1%)	10	12	22 (73.3%)	4	6	6	2	18 (100%)
Cinnamon	1	7	16	24 (64.9%)	14	14	28 (93.3%)	4	6	6	2	18 (100%)
Toffee	2	12	15	29 (78.4%)	16	14	30 (100%)	4	6	6	2	18 (100%)
Licorice	2	8	13	23 (62.2%)	12	10	22 (73.3%)	4	6	6	2	18 (100%)
Anise	2	6	4	12 (32.4%)	5	5	10 (33.3%)	4	6	6	2	18 (100%)
Bubble gum	1	13	20	34 (91.9%)	11	14	25 (83.3%)	4	6	6	2	18 (100%)
Garlic	0	11	14	25 (67.6%)	13	10	23 (76.7%)	4	6	6	2	18 (100%)
Mint	1	9	19	29 (78.4%)	14	14	28 (93.3%)	4	6	6	2	18 (100%)
Banana	1	10	13	24 (64.9%)	9	12	21 (70.0%)	2	4	6	2	14 (77.8%)
Peach	1	5	12	18 (48.6%)	13	11	24 (80.0%)	2	2	6	2	12 (66.7%)
Orange	1	9	15	25 (67.6%)	11	7	18 (60.0%)	4	2	6	2	14 (77.8%)
Coffee	1	7	17	25 (67.6%)	13	11	24 (80.0%)	4	6	6	2	18 (100%)
Cake	1	8	17	26 (70.3%)	7	12	19 (63.3%)	4	6	6	2	18 (100%)
Fish	1	14	13	28 (75.7%)	14	11	25 (83.3%)	4	6	6	2	18 (100%)
An average number of recognized aromas			13.16			15.63				18.67		

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