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Olfactory screening test: experience in 102 Italian subjects

Test di screening olfattorio: nostra esperienza in 102 soggetti italiani

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Summary

Development of the olfactory screening test has given the physician a fast and easy instrument to assess olfactory function. This study evaluated the odour identifiability and familiarity of the 12 items of the Sniffin' Sticks Screening test in 102 normal Italian subjects (54 female, 48 male), age range 13-88 years (mean 46.4), classified as normosmics. The Sniffin' Sticks Screening test is an olfactory identification multiple-forced-choice test widely used in Europe. The Italian subjects showed a high familiarity for the odorants of the Sniffin' Sticks Screening test, except for cloves, even if 89.3% of the subjects correctly identified cloves in the multiple (four) choice of answers. On the basis of the results obtained, it is suggested that the Sniffin' Sticks Screening test should be used in routine clinical practice to assess olfactory function in the Italian population.

Riassunto

La diffusione di tests olfattometrici di screening fornisce al medico uno strumento diagnostico rapido e di semplice utilizzo per valutare la funzione olfattoria. In questo studio gli Autori hanno valutato la capacità d'identificazione e la familiarità ai 12 odori dello Sniffin' Sticks Screening (SSS) test in 102 soggetti italiani normosmici (54 femmine e 48 maschi) di età compresa tra 13 e 88 anni (età media 46,4 anni). L'SSS test è un test di identificazione olfattoria a scelta multipla largamente diffuso in Europa. I soggetti testati hanno mostrato un'elevata familiarità per tutti gli odori dell'SSS test eccetto il chiodo di garofano anche se l'89,3% dei soggetti lo ha identificato correttamente con l'aiuto delle 4 alternative. I nostri risultati suggeriscono l'utilizzo del SSS test nella pratica clinica al fine di valutare la funzione olfattoria nella popolazione italiana.

Introduction

The most frequent causes of olfactory deficit are history of upper respiratory tract infections, such as nasal and/or sinus diseases [1] and head trauma [2]. Disorders of olfactory function have also been reported after exposure to toxic chemicals [3], alcoholism [4], in the presence of endocrine disorders (hypothyroidism, diabetes, Kallmann's syndrome, renal failure and liver diseases), neurodegenerative disorders (Alzheimer's disease, Parkinson's disease, multiple sclerosis, etc.) [5-7], schizophrenia [8], intranasal/intracranial tumours and following surgery (nasal and endoscopic sinus surgery) [9]. In a large number of patients, the cause of the loss of smell remains unknown (idiopathic smell dysfunction). In man, olfaction plays an important role in the quality of life, but sometimes smell disorders are undervalued by physicians that underestimate the olfactory deficit. Furthermore, patients themselves are often unaware of their smell dysfunction.

In order to assess the presence of smell disorders many psychophysical tests are now available for a quantitative measure of olfactory function. Since the first Zwaardemaker draw tube olfactometer, many devices have been developed to present odorants: bottles with blasts of saturated air [10], glass sniff bottles, perfumist's strip, plastic squeeze bottles [11], microencapsulated "scratch and sniff" odourized strips [12], felt-tip pens impregnated with different smells [13] and the sophisticated air-dilution olfactometer.

The University of Pennsylvania Smell Identification Test (UPSIT) and the Sniffin' Sticks (SS) test are now widely employed. The UPSIT [14] is a scratch and sniff identification test widely used in the USA. This test consists of 40 odorants embedded in microencapsulated crystals in four booklets, each containing 10 odorants. The test is also a multiple-forced-choice test since the subject is required to choose one of the four alternative answers for each odorant even if no smell is perceived. As pointed out by Parola and Liberini, a culturally adapted test version of the UPSIT is suggested for Italian population [15] since some odours are unfamiliar to Italian subjects (root beer is easily identified by Americans but not by Europeans). The authors tested the odour familiarity of the UPSIT in 30 normal Italian subjects. More than 20% of these sub-

jects did not identify 6 odours which are unfamiliar to Italians: wintergreen, rootbeer, cheddar cheese, turpentine, pickle and gingerbread. These odours were excluded from the culturally-adapted version of the UPSIT which comprises only 34 odours. This is actually the only investigation focusing on the familiarity of the UPSIT odorants regarding the Italian population. The odour familiarity is very important since it is strongly related to the measure of olfaction [16].

The SSS test was developed in Germany in order to develop a test culturally adapted to the European population. It has been available since 1996 [13] and is one of the most widely used olfactory tests in Europe. The odours were selected for the high degree of familiarity in the middle European population. The SS test consists in a two-level test: the first level is the SSS test in which odour identification is assessed using 12 felt-tip pens (sticks); the second level is the Sniffin' Sticks Extended (SSE) test which is composed of 112 sticks to evaluate odour threshold, discrimination and identification [17-19].

In recent years, olfactory assessment has been included in the neurological evaluation of patients with neurodegenerative diseases when a smell dysfunction is present.

Aim of the present study was to verify the familiarity and the identifiability of the 12 odours of the SSS test in Italian normosmic subjects.

Material and methods

This study was performed on 102 healthy Italian subjects, 54 female, 48 male (mean age 46.4 years; range 13-88) without otorhinolaryngologic or neurological diseases. A detailed case history was collected in all subjects who underwent ENT examination with fiberoptic examination of the upper airways. Neurological diseases were excluded with the Mini-Mental State Examination (MMSE). Considered as exclusion criteria were all those conditions that could potentially develop an olfactory dysfunction. Thus, patients with disorders of the nasal cavities and paranasal sinuses (rhinosinusitis, polyposis, allergic rhinitis), patients who had undergone surgery on the nasal septum, turbinates or paranasal sinuses, patients with head trauma, with neuro-psychiatric disorders (Parkinson's disease, Alzheimer's disease, schizophrenia, multiple sclerosis and depression), with chronic obstructive pulmonary disease, asthma, active hepatitis, cirrhosis, chronic renal failure, vitamin B12 deficiency, alcohol, tobacco or drug abuse, cerebral vascular accidents, insulin dependent diabetes mellitus, hypothyroidism and Cushing syndrome, were not included in the study. In addition, patients were screened for exposure to chemical agents and the pharmacological history was studied (Table I) [20-21].

Olfactory function was tested with the SSS test. The SSS test is very fast and requires approximately 4 minutes to be carried out. The 12 sticks contain common odorants: orange, leather, cinnamon, peppermint, banana, lemon, liquorice, coffee, cloves, pineapple, rose and fish. The stick, without the cap, is positioned 2 cm from the nose and presented for 3-4 seconds: the subject is asked to sniff. An interval of at least 30 seconds between each stick presentation is recommended to prevent olfactory adaptation. The test is performed in a quiet, well-ventilated room. Like the UPSIT, the SSS test is a multiple-forced choice test: the patient has to choose only one of the four answers presented in a list, for each odorant (Table II). The correct answers are added together and the final score is related to age and sex. The final score classifies subjects into three groups: normosmic, hyposmic or anosmic. Test-retest reliability is $r = 0.77$ [22]. All 102 subjects evaluated with the SSS test were normosmic with a score of 11 or 12.

We aimed to evaluate two main parameters: odour familiarity and identifiability. Odour familiarity was deduced from the number of normosmic subjects that did not recognise the odour tested when it was presented before the multiple choice. The identifiability for each odour of the SSS test was reported as a percentage of correct identification with the aid of the four possible choices.

Results

Of the 102 normal Italian subjects tested with the SSS test, 50 (28 female, 22 male) achieved a score of 12, while 52 (26 female, 26 male) achieved a score of 11. All 102 participants were classified as normosmics. All the subjects recognized the odorants with a high familiarity (100%), except for the cloves. Of the 102 subjects, 23 did not know the odour of cloves. It was correctly identified, by 12 of the 23 subjects, by exclusion between the four possible answers ("It isn't cinnamon, it isn't mustard, it isn't pepper … it could be cloves"). These findings suggest that the familiarity of cloves is the lowest, in an absolute sense (77.4%), while its identifiability is high (89.2%). Odour identifiability is shown in Table III. All participants correctly identified peppermint, fish, coffee, banana, orange, rose and liquorice, implying that these 7 stimuli are very easy to identify. Identifiability was lower for lemon (94.2%), pineapple (91.2%), cinnamon (90.2%), cloves (89.2%) and leather (84.4%). Females showed a higher identifiability than males for pineapple (94.5% *vs.* 87.5%) and cinnamon (92.6% *vs.* 87.5%).

Cinnamon, leather and lemon showed a perceptual similarity to the incorrect response alternatives. In fact, 6 subjects confused cinnamon with vanilla, 14

Table I. Medications associated with smell and taste disorders.

Antibiotics	Ampicillin, Azithromycin, Ciprofloxacin, Clarithromycin
Antihistamines and decongestants	Chlorpheniramine, Loratadine, Pseudoephedrine
Anti-hypertensives	Acetazolamide, Betaxolol, Captopril, Diltiazem, Enalapril, Hydrochlorothiazide, Nifedipine, Nitroglycerin, Propanolol, Spironolactone
Lipid-lowering drugs	Fluvastatin, Pravastatin
Antidepressants	Amitriptyline, Clomipramine, Desipramine, Imipramine, Nortriptyline
Anti-thyroid agents	Methimazole
Anti-inflammatory drugs	Auranofin, Colchicine, Dexamethasone, Gold, Hydrocortisone, Penicillamine
Anticonvulsants	Carbamazepine, Phenytoin
Anti-neoplastics	Cisplatin, Doxorubicin, Methotrexate, Vincristine

Table II. Multiple choices for the 12 Sniffin' sticks.

1 **Orange**, blackberry, strawberry, pineapple
2 Smoke, glue, **leather**, grass
3 Honey, vanilla, chocolate, **cinnamon**
4 Chive, **peppermint**, fir, onion
5 Coconut, **banana**, walnut, cherry
6 Peach, apple, **lemon**, grapefruit
7 **Liquorice**, gum, spearmint, cookies
8 Cigarette, **coffee**, wine, smoke
9 **Cloves**, pepper, cinnamon, mustard
10 Pear, plum, peach, **pineapple**
11 Camomille, raspberry, **rose**, cherry
12 Bread, **fish**, cheese, ham

Correct answers in bold

Discussion

The result of this study implies that the SSS test contains only one odour stimulus which is not very familiar to Italian subjects. Familiarity of cloves is the lowest but, with the choice of four answers, 91 out of 102 subjects correctly identified the odour. Furthermore, perceptual similarity to the incorrect answers has also been found for cinnamon, lemon and particularly for leather. In spite of these findings, the Italian subjects correctly identified the 12 items with a high score. When a smell disorder is present, we always suggest collecting a detailed case history and to use an olfactory screening test to evaluate the presence of normosmia or hypo-anosmia. In the presence of hypo-anosmia, the SSE test must be used in order to assess the sensory component of the smell with the odour threshold, discrimination and identification. In order to distinguish a sensorineural from a conductive olfactory loss other examinations are required such as rhinomanometry, nasal cytology, endoscopy and high-resolution computerized tomography (CT) scan or magnetic resonance imaging (MRI) of the nose, paranasal sinuses and olfactory pathways. An accurate neurological examination is always suggested when a neurodegenerative disease (Alzheimer, Parkinson, multiple sclerosis), associated with olfactory loss, is suspected.

Our results also confirm that smell identification decreases with age. In the elderly, the surface of the olfactory epithelium is reduced and interlaced with clumps of respiratory epithelium [26] and the number of mitral cells in the olfactory bulb is greatly decreased [27].

subjects confused leather with glue, 5 subjects confused lemon with grapefruit. A perceptual similarity to the incorrect answers is also found for pineapple: 4 subjects confused pineapple with plum and 3 subjects with peach. Our results imply that the identifiability of leather is the lowest (84.4%) out of the 12 odours of the SSS test, in an absolute sense, related to its perceptual similarity to glue (incorrect answer).

The 102 subjects were also divided into 7 age groups. In agreement with reports in the literature [22], we found the lowest mean SSS test score in the elderly with 11.33 and 11 in the two older age groups (Table IV). This result confirms the decrease of olfactory function with increasing age particularly after 60 years [23-25].

Table III. Identifiability of 12 odorants of SSS test.

Odorant	Females % identifiability	Males % identifiability	Total % identifiability
Peppermint	100	100	100
Fish	100	100	100
Orange	100	100	100
Coffee	100	100	100
Banana	100	100	100
Rose	100	100	100
Liquorice	100	100	100
Lemon	94.5	93.8	94.2
Pineapple	94.5	87.5	91.2
Cinnamon	92.6	87.5	90.2
Cloves	88.9	89.6	89.2
Leather	83.4	85.5	84.4

Percentage shows correct identification for each odorant with aid of 4 alternative answers.

Table IV. Mean score of SSS test obtained in 102 healthy subjects divided into 7 age groups.

Age (years)	13-23	24-33	34-43	44-53	54-63	64-73	74-88
Subjects (n. 102)	11	16	18	23	14	15	5
Mean SSS test score	11.45	11.50	11.50	11.61	11.64	11.33	11
SD	0.52	0.51	0.51	0.49	0.49	0.48	0
Female (n. 54)	4	4	8	15	11	9	3
Mean SSS test score	11.75	11.50	11.37	11.60	11.63	11.44	11
SD	0.50	0.57	0.52	0.51	0.50	0.53	0
Male (n. 48)	7	12	10	8	3	6	2
Mean SSS test score	11.28	11.50	11.60	11.62	11.66	11.16	11
SD	0.48	0.52	0.52	0.52	0.57	0.41	0

In conclusion, we suggest the use of routine clinical assessment of smell disorders with an olfactory screening test. The SSS test is a standardized and validated olfactory test adapted to European conditions. Furthermore, the SSS test is reusable with a shelf life of approximately 6-12 months, whilst the UPSIT is mono-use. The SSS test also has the advantage of being an easy-to-use, low-cost, portable-test. In our experience, the SSS test is culturally valid for Italian people since all the 12 odour stimuli have been correctly identified by more than 80% of the normal subjects, with high familiarity for all the odours, except cloves. Investigations on larger groups are necessary to confirm the sensitivity and specificity of the SSS test in the Italian population.

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