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Applicability of Sniffin' Sticks Identification Test as a Screening Tool for Olfactory Dysfunction in Northeast China

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Study Design A
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Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Background: Because most case of smell loss are unrecognized, a valid and reliable screening test for olfactory function is needed. The Sniffin' Sticks test is one of the most widely used olfactory tests. As olfaction can be affected by environment and social background, we investigated the regional applicability of Sniffin' Sticks identification subtest as a screening tool.

Material/Methods: Normosmic volunteers were recruited between May 2021 and August 2021. We collected data on participants' age, sex, and educational level. The Self-Reported Mini-Olfactory Questionnaire and identification test of Sniffin' Sticks test battery were used to assess their olfactory function.

Results: A total of 688 subjects (316 male, 371 female) volunteered for the screening test. The mean age of participants was 30±7.69 years (range, 15-63 years), and the average score of all subjects was 12.7±0.81 points. The 3 least recognized items among all 16 tests were lemon (correct identification rate 5.4%), clove (correct identification rate 1.5%), and apple (correct identification rate 0.7%). For Self-Reported Mini-Olfactory Questionnaire, 48 of the 687 subjects (7%) stated that they could not recognize the smell of freshly mowed grass.

Conclusions: We investigated the applicability of using Sniffin' Sticks Identification test and Self-MOQ as a screening tool for olfactory dysfunction in northeast China. Most of the subjects enrolled in this study failed to reach the normative standard for their age groups in the Sniffin' Sticks test. We suggest the deletion or replacement of items with extremely low correct identification rates and that physicians who use the Sniffin's Sticks test in clinical practice test the applicability in advance to avoid misdiagnosis.

Keywords: Olfaction Disorders

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Background

The sense of smell significantly influences quality of life and human well-being. Olfaction plays an important role in promoting appetite and avoiding dangerous situations [1-3], and it also is demonstrated to be a risk factor for neurodegenerative diseases [4,5]. Because of the COVID-19 pandemic, more people began to realize the importance of olfactory dysfunction, but unlike visual and hearing disorders, a large proportion of smell loss goes unrecognized or unreported. According to Doty et al, fewer than 25% of persons with demonstrable smell loss, including those with loss from neurodegenerative diseases, are cognizant of their loss until tested quantitatively [6]. For one thing, olfactory loss appears gradually, and patients may adapt to their limited ability to detect odors. For another, self-reports of smell dysfunction are unreliable and often underestimate the level of dysfunction obtained using quantitative testing. Therefore, a valid and reliable screening test for olfaction is needed.

Olfaction is mainly tested in 3 domains: threshold, discrimination, and identification. Threshold detects the lowest concentration of odor that can be perceived by the subject, and threshold test results gives information of the subject's sensitivity to an odor. Whereas the discrimination and identification subtests are both suprathreshold tests, the former assesses one's ability to discriminate between stimuli of different quality, and the latter requires the subject to identify an odor with the help of verbal or visual cues [7]. Although a recent study revealed that the Sniffin' Sticks threshold subtest alone provides the most correlative information about patients [8], the identification test is the most convenient to conduct and is an effective tool for screening of olfactory dysfunction [9,10]. A variety of clinical olfactory tests have been described in the literature and applied in certain countries and regions. However, among these tests, only a few have achieved worldwide acceptance and are available commercially. Our department has been utilizing the Sniffin' Sticks test to evaluate patients' olfactory function for over 1 year. Our experience shows that some questions of the identification subtest have rather low correct identification rates. Such low correct identification rates might be explained by dysfunction in olfaction. To investigate the applicability of the screening test, a larger population of healthy subjects were included in this study.

Material and Methods

Participants

A total of 688 volunteers were recruited from May 2021 to August 2021. Exclusion criteria included self-reported loss of smell, refusal to provide personal information (eg, age or educational level), history of sinonasal diseases, head trauma, neuropsychiatric disorder, or upper airway infection within 6 months, and use of nasal decongestants and other factors that can impair olfactory function. The Ethics Committee of the Second Hospital of Jilin University approved the research and all subjects provided written informed consent.

Table 1. Self-reported olfactory questionnaire.

Please spontaneously answer each question that applies to you	Yes	No
1. In perfumeries, I hardly perceive the fragrance		
2. I do not perceive the smell of coffee and fresh bread		
3. I like to look around the flower shop, but I cannot smell anything		
4. I do not smell the fresh tar at a road construction site		
5. I do not recognize the smell of freshly mowed grass		

Self-Reported Mini-Olfactory Questionnaire

Since most questionnaires used for functional evaluation of the nose focus on breathing and its influence on quality of life and olfactory function normally makes up a small proportion of the evaluation, we selected the olfactory-focus questionnaire. The questionnaire was first proved to be reliable and valid in screening olfactory dysfunction by Hummel et al [11], and a version of the original Self-Reported Mini-Olfactory Questionnaire (Self-MOQ) translated into Mandarin was used (**Table 1**). Participants were asked to choose the correct item for each smell presented.

Psychophysical Test of Olfactory Function

A 16-item odor identification subtest of the Sniffin' Sticks test battery kit was used in the study to objectively evaluate participants' olfactory function. The test was performed in a quiet, well-ventilated room, and all subjects were given a few minutes to adapt to the testing environment. Odor identification was assessed by means of 16 odors. The test was performed according to the manufacturer's instructions. Briefly, for odor presentation, the cap of the felt-tip pen was removed by the physician who performed the test for approximately 3 seconds and the tip is placed 2 cm in front of both nostrils. Subjects were then asked to make a forced choice among 4 options presented for each pen. The subjects' scores ranged from 0 to 16.

Based on previous tests we have made in our department, the most controversial option was cinnamon, as patients were not

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Table 2. Identification test scores for different groups.

Variables	N	Mean score	SD
Sex			
Male	316	12.73	0.043
Female	371	12.67	0.044
Age groups			
15-24 yrs	177	12.62	0.069
25-34 yrs	346	12.72	0.041
35-44 yrs	126	12.81	0.055
≥45yrs	37	12.59	0.171
Educational level			
≤Senior high	149	12.75	0.059
Bachelor	495	12.69	0.036
≥Master	42	12.62	0.167

familiar with this spice. Therefore, we added an extra question at the end of the test: Do you know exactly what cinnamon is and if you do, please describe the smell of it.

Results

Demographics

A total of 688 subjects (316 male, 371 female) volunteered for the screening test. One subject did not finish the mini questionnaire and was therefore elucidated from further analysis. The mean age for participants was 30±7.69 years (range, 15-63 years), with the median age being 28 years. As for the educational level, 149 finished high school (21.7%), 495 went to college and got a bachelor's degree (72.1%), and 42 got a master's degree or higher (6.1%). The Pearson correlation test was used to investigate the potential relationship between age and smell identification score, and no significant correlation was found (p=0.328). The *t* test was utilized to analyze whether a correlation existed between gender and smell identification test score, and one-way ANOVA was used to assess variations in educational background, but no correlations were found (*P*=0.31 and *P*=0.746, respectively).

Psychophysical Olfactory Test

Identification test score ranged from 7 to 14 points, the average score of all subjects was 12.7±0.81 points, and the median score was 13 points. No significant differences were found for gender, age, or educational level (**Table 2**). The Sniffin' Sticks test provides a cutoff point of total scores (threshold, discrimination, and identification) to differentiate normal from abnormal scores, with slight differences among age groups. According to the updated version of normative data provided by Hummel et al, subjects from various age groups scored 10.99-13.63/16 in an identification test [12]. Applying the same standard for our participants, the vast majority (625/687) would be assessed as being hyposmia.

Table 3. Correct identification rate of each item of the identification test.

Item	Correct identification rate
Orange	99.7%
Leather	94.6%
Cinnamon	92.9%
Peppermint	99.9%
Banana	99.7%
Lemon	5.4%
Licorice	98.1%
Turpentine	88.6%
Garlic	98.8%
Coffee	99.3%
Apple	0.0%
Clove	1.5%
Pineapple	97.1%
Rose	98.8%
Anise	95.1%
Fish	99.6%

Table 3 shows the rates of correct identification for each item of the identification test, most of which were over 90%. Contrary to the average high correct identification rate, 3 items – lemon, apple, and clove – were correctly identified by less than 10% of all the participants. When participants perceived the odor lemon, they tended to choose grapefruit (93%) instead of lemon (5.4%). For clove, 1.5% of participants identified it correctly, another 1.5% chose mustard or pepper, while the vast majority of participants chose cinnamon (97.1%). The least recognized odor was apple, with only 5 of the 687 subjects making the correct choice; 2 chose orange, while the rest misidentified apple as being either melon (31.3%) or peach (67.7%).

The result of the cinnamon question was quite interesting. First, in the third identification test, 92.9% of subjects (638 subjects) made the right choice. However, among these participants, 626 also chose cinnamon in the 12th test, for which the correct answer was clove. Second, 41 individuals said that they knew exactly what cinnamon is, whereas only 31 (75.6%) chose cinnamon in the third question, while the other 10 chose vanilla; 51 participants said that had never even heard of cinnamon, and yet 44 of them identified it correctly. Most

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participants said that they were somewhat familiar with cinnamon, but they cannot describe the smell, and 563 of them made the right choice regarding cinnamon.

Self-Reported Mini-Olfactory Questionnaire

All participants answered negatively to the first 4 statements. However, 48 of the 687 subjects (7%) stated that they could not recognize the smell of freshly mowed grass. After the test, they were asked whether they had encountered such situations in their daily life, and all of them said that they had never seen grass being mowed. To confirm whether their inability to perceive the odor of freshly mowed grass was due to undiagnosed olfactory dysfunction, the average scores of the Sniffin' Sticks Identification test were compared. There was no significant difference in identification scores between participants who claimed not able to recognize freshly mowed grass (12.75±0.67) and those who were able to (12.70±0.82).

Discussion

The current study aimed to validate the applicability of Sniffin' Sticks Identification test as a screening tool for olfactory dysfunction, and almost 90% of participants who claimed normosmia were hyposmia judging by the same standard. While some of these cases might be explained by the undiagnosed olfactory dysfunction among participants, since self-reported olfactory assessments are unreliable, most subjects must have been misdiagnosed. The rather low scores in identification testing are consistent with findings in previous clinical testing for sinonasal diseases, and our results indicates that certain items of the identification test are not suitable for some local populations.

The correct identification rates for apple, lemon, and clove were extremely low compared to other odors presented. Most people chose pomelo instead of lemon and peach/melon rather than apple. This may be explained by the fact that apples in different countries and regions differ; we have several kinds of apples locally, as well as imported ones. In addition, the correct and incorrect choices are similar and it is hard to distinguish one from the other. Fornazieri et al also found that identification drops considerably with similar foils in the UPSIT test [13]. For the odor clove, when we asked some participants to compare fresh lilac and the odor from the 12th pen, all of them said that they smelled of 2 different odors. Unlike the rest of the choices of the 12th test, cinnamon is not commonly used in our region; as a result, participants might have ruled out the other 3 choices (clove, mustard, and pepper) because the identification test is a forced choice test. Further research should take into consideration the difference between natural and commercial odors when applying the identification test. A small number of participants were presented blindfolded with the odor 'date' (a commonly consumed food in local area); most of them identified the item correctly before options were provided, which further confirmed the importance of familiarity in identifying odors.

In previous studies, multiple factors have been shown to influence olfactory function, including socioeconomic status (income, occupation, and education level), environmental exposure, lifestyle factors, and ethnicity. Fornazieri et al found a positive correlation between olfactory function assessed by UPSIT and the levels of education and socioeconomic status among people in Brazil [13]. Participants with higher educational level can identify odors at a significantly lower concentration than their less educated peers [14]. Other studies also found that people with higher educational level scored better in the UPSIT and Sniffin' Sticks test [15,16]. However, in our study, none of the above factors have induced significant differences regarding item recognition or self-assessment of olfactory function. The above-mentioned study involved elder participants suffering from psychiatric disorders, so the result might have been different for healthy subjects. In addition, most participants in our study either work or live in urban areas. Therefore, data collected concerning educational background started at least at high school. Differences may exist between the current sample and those who were less educated (ie, with elementary education only), since they may have limited access to certain items like coffee or cinnamon.

According to several previous studies, self-assessment of olfactory function is not reliable. Landis et al investigated the accuracy of self-reported ratings of olfactory function using quantitative measurements, and found that ratings of olfactory function prior to quantitative assessment correlated only with nasal airway patency but not with measured olfactory function [17]. Therefore, the current study did not use the visual analog scale (VAS) to rate subjective olfactory ability, although it has been applied in many studies to estimate subjective olfactory function. Unlike other questionnaires that concentrate more on breathing and quality of life changes, questions involving different odors are more susceptible to be affected by environment and lifestyle changes. Many Western families have their own lawns and they mow them themselves, so freshly mowed grass is a common odor they would perceive. Some of our participants have never smelled that odor, so an incorrect answer does not necessarily mean that they have a deficit in olfaction. The 5th statement should be replaced if the Self-MOQ test were to be a standard tool for olfactory dysfunction screening.

Limitation of the Study

The current study was carried out at a single hospital; therefore, the participants were region-specific, so our results may

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not be applicable nationwide. Multicenter studies should be conducted to further validate our findings.

Conclusions

We investigated the applicability of using the Sniffin' Sticks Identification test and Self-MOQ as screening tools for olfactory dysfunction in northeast China. Results demonstrated that some items should be replaced or deleted from the current version of the test due to low correct identification rates. Given that environment and social background play pivotal roles in olfaction, physicians should test the applicability of the Sniffin' Sticks test with the local population prior to clinical application. Further studies are needed to find proper substitutes and create a suitable screening test for local citizens. The 13-item version of the Sniffin' Sticks Identification test could be used before proper substitutes are identified.

References:

1. Seo HS, Pramudya RC, Singh A, Hummel T. Recent evidence for the impacts of olfactory disorders on food enjoyment and ingestive behavior. Current Opinion in Food Science. 2021;42:187-94
2. Croy I, Nordin S, Hummel T. Olfactory disorders and quality of life-an updated review. Chem Sens. 2014;39(3):185-94
3. Oleszkiewicz A, Kunkel F, Larsson M, Hummel T. Consequences of undetected olfactory loss for human chemosensory communication and well-being. Philos Trans R Soc B Biol Sci. 2020;375(1800):20190265
4. Haehner A, Hummel T, Hummel C, et al. Olfactory loss may be a first sign of idiopathic Parkinson's disease. Mov Disord. 2007;22(6):839-42
5. Hoyles K, Sharma JC. Olfactory loss as a supporting feature in the diagnosis of Parkinson's disease: A pragmatic approach. J Neurol. 2013;260(12):2951-58
6. Doty RL. Epidemiology of smell and taste dysfunction. Handb Clin Neurol. 2019;164:3-13
7. Hummel T, Sekinger B, Wolf SR, et al. 'Sniffin' Sticks': Olfactory performance assessed by the combined testing of odor identification, odor discrimination and olfactory threshold. Chem Senses. 1997;22(1):39-52
8. Shih MC, Soler ZM, Germroth M, et al. Comparison of validated psychophysical olfactory tests and olfactory-specific quality of life. Int Forum Allergy Rhinol. 2022;12(11):1428-31
9. Nogi S, Uchida K, Maruta J, et al. Utility of olfactory identification test for screening of cognitive dysfunction in community-dwelling older adults. PeerJ. 2021;9e12656
10. Eibenstein A, Fioretti AB, Lena C, et al. Olfactory screening test: Experience in 102 Italian subjects. Acta Otorhinolaryngol Ital. 2005;25(1):18-22
11. Zou L-Q, Linden L, Cuevas M, et al. Self-reported mini olfactory questionnaire (Self-MOQ): A simple and useful measurement for the screening of olfactory dysfunction. Laryngoscope. 2020;130(12):E786-90
12. Oleszkiewicz A, Schriever VA, Croy I, et al. Updated Sniffin' Sticks normative data based on an extended sample of 9139 subjects. European Archives of Oto-Rhino-Laryngology. 2019;276(3):719-28
13. Fornazieri MA, Doty RL, Bezerra TFP, et al. Relationship of socioeconomic status to olfactory function. Physiol Behav. 2019;198:84-89
14. Seo HS, Jeon KJ, Hummel T, Min BC. Influences of olfactory impairment on depression, cognitive performance, and quality of life in Korean elderly. Eur Arch Otorhinolaryngol. 2009;266(11):1739-45
15. Coleman E, Goetz RR, Leitman D, et al. Odor identification impairments in schizophrenia: Relationship with demographic measures, clinical variables, and diagnostic subtypes. CNS Spectrums. 2002;7(1):43-48
16. Chen B, Zhong XM, Mai NK, et al. Interactive effect of depression and cognitive impairment on olfactory identification in elderly people. J Alzheimers Dis. 2018;66(4):1645-55
17. Landis BN, Hummel T, Hugentobler M, et al. Ratings of overall olfactory function. Chem Senses. 2003;28(8):691-94

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