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Cultural Adaptation of the Iranian Version of the "Sniffin' Sticks" Olfactory Test

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Abstract

Background: Psychophysical tests are typically used for clinical assessment of human smelling function. Given that olfactory identification is linked to the regional culture, the main aim of this study was to provide the comprehensive "sniffin' sticks" olfactory test, culturally adapted on the Iranian population as well as to examine the discriminatory power of this test between normal people and patients with olfactory disorder.

Methods: This cross-sectional study consisted of 3 steps. A total of 200 healthy people were recruited to determine odor familiarity (using Likert- scale) for the first step. In the second step, based on the original sniffin' sticks test and odor familiarity, 16 odor items were selected. Odor modification was performed and the identification part of the sniffin' sticks test was created. Then, 99 patients with olfactory disorders and 214 healthy participants were tested using the Iranian sniffin' sticks test (Ir-SST). After 2 to 4 weeks, participants were reexamined and test reliability was evaluated by using a Pearson correlation coefficient test.

Results: The Ir-SST showed that scores of patients with smell loss were significantly lower than normosmic participants (13.6 ± 5.24 vs 34.3 ± 3.41, P < 0.001). The sensitivity (95.2%) and specificity (93.5%) of the test were also found to be high. Test-retest reliability was as follows: composite score: r = 0.8; odor identification: r = 0.83; odor threshold: r = 0.77; and odor discrimination test: r = 0.56; P < 0.001.

Conclusion: The results suggest that the Ir-SST can be effectively adapted to the Iranian population. The current study validates that the sniffin' sticks olfactory test is applicable as a useful screening tool for comprehensive assessment of olfactory function in an Iranian population.

Keywords: Olfaction, Sense of Smell, Smell Disorders, Cultural Adaptation, Sniffin' Sticks Test

Conflicts of Interest: *None declared*
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Introduction

The smell sense is one of the most important senses in daily life. It is essential for the perception of flavors, so-

↑What is "already known" in this topic:
Olfactory tests are most commonly used for assessing olfactory function as a measurement of threshold, discrimination, and identification ability. With the Sniffin' stick test, these 3 components of olfaction could be assessed, whereas the University of Pennsylvania Smell Identification Test is only able to evaluate the identification ability.

→What this article adds:
Given that olfactory identification is linked to the regional culture, the main aim of this study was to provide the comprehensive olfactory test culturally adapted on the Iranian population. We aimed to provide a more trustworthy clinical assessment of the olfactory function in people who malinger to lose their sense of smell as well as to distinguish olfaction-related disorders in our community.

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cial communications (including sexual relations), and the detection of dangers, suc h as fire, smoke, poisonous foods, or gas leaks (1, 2). Several studies have reported that patients with olfactory disorders exhibit a higher level of disability and lower quality of life than those without such impairment. Besides, the prevalence of mild to severe symptoms of depression in these patients is higher than the general population (3-6). Furthermore, the activation of some part of the olfactory system in the brain of these patients is lower than that of the normosmic people (7, 8).

Approximately 5% of people are unable to smell and nearly 20% of people older than 50 years exhibit a significant smell loss. (9, 10) Apart from aging (11-13), there are 3 major reasons for olfactory disorders: sino-nasal diseases (eg, nasal polyp), (14, 15) upper respiratory tract infections, (16, 17) and head trauma (18-20). In addition, the olfactory loss manifests in neurodegenerative disorders like Alzheimer and Parkinson disease (21, 22).

The assessment of olfactory function is crucial for the evaluation and diagnosis of olfactory dysfunction (23). The quantitative assessment of the smell function in a clinical setting is typically conducted using psychophysical tests (13, 24-27). Examples of such tests include the Connecticut Chemosensory Clinical Research Center test (28, 29), and the University of Pennsylvania Smell Identification Test (UPSIT) (30, 31). A comprehensive test of olfactory function is the sniffin' stick test, which comprises tests of odor threshold, odor discrimination, and odor identification. As one of the most frequently used and reliable test batteries (32), it has been validated in several countries throughout the world (33-37). Importantly, it is reusable and thus economical (38). However, in light of the effect of regional preferences, lifestyles, ethics, and cultures on the olfactory perception, an adaptation seems necessary (39-42).

The tests that are most commonly used for assessing olfactory function are measurement of threshold, discrimination, and identification. With the sniffin' stick test, these 3 components of olfaction could be assessed, whereas the identification tests, such as UPSIT, could only be able to evaluate the identification ability (34, 43). According to previous studies, odor thresholds mainly draw on the function of peripheral structures of the olfactory system, whereas odor discrimination and odor identification deal with the complex processing of olfactory information (44, 45).

There is no standardized comprehensive smell test in our country to assess the olfactory performance as the ability to detection threshold, discrimination, and identification of odors. The previous olfactory test prepared in our country was only capable of evaluation of the odor identification ability (42, 43). We performed this study to culturally adapt the sniffin' sticks test in the Iranian population. In accordance with Islamic laws enforced in Iran and given the importance of smell loss after a head trauma in contention or accident, the bodily injury liability is equivalent to the blood money of an adult. As the main problem currently being dealt with by the forensic experts is recognizing the people's malingering to lose their sense of smell, we aimed to provide a more trustworthy clinical tool to assess the olfactory function as well as to distinguish olfaction-related disorders in our community. This test is also especially important for specialists before and after performing rhinoplasty.

Methods

Ethics Statement

The study was conducted according to the principles of the Declaration of Helsinki. A written informed consent was obtained from both patients and healthy participants before beginning the tests. The study protocol was approved by the Research Ethics Committee of Iran University of Medical Sciences (IR.IUMS.REC.1398.208).

Participants and Inclusion Criteria

The population of this cross-sectional study consisted of patients with olfactory disorders in the age range of 15-80 years. A total of 513 people participated in this study, and 200 healthy participants helped determine odor familiarity for the first step of the test. A total of 313 participants (214 healthy volunteers as controls [79 men, mean age, 34.70 ± 3.4; range, 16-79 years] and 99 patients with olfactory disorder [66 men, mean age 35.92 ± 3.6; range, 17-71 years]) were recruited for the normative step of the test. The control participants were chosen from among healthy volunteers. Patients who complained of olfactory disorders with different etiologies (head trauma, upper tract respiratory infection, sino-nasal inflammation [chronic rhinosinusitis with/without polyposis]) were included in our study. The control group was selected from normosmic participants with no history of olfactory disorder who also did not have a current upper respiratory tract infection, diabetes, sinusitis, psychiatric or neurological diseases, serious head trauma, and neurodegenerative disorders (eg, Parkinson and Alzheimer disease).

Experimental Protocols:

The experiment was performed in 3 steps.

First Step: Determination of Odor Familiarity

To determine the odor familiarity of the Iranian population, 200 healthy participants were asked to rate 87 odor descriptors based on the familiarity of each odor using a 5-poit Likert scale in the range of 0 to 5 (0 = unfamiliar, 5 = highly familiar).

Second Step: Establishing Odors and Multiple-Choice Lists for the Odor Identification Test

After the first step and based on the original version of the test, we considered a list of 16 selective odorants with multiple distractors for the identification part of the Iranian version of the Ir-SST. The original distractors with a low familiarity rate (<75%) were replaced with more familiar odorants. Participants were asked to identify the odor within a multiple forced-choice task among a list of 4 odor descriptors. If the majority of participants were unable to identify the odor correctly, it was replaced with other familiar descriptors. The odorant samples were purchased from Adonis Gol Darou company with a su-

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prathreshold concentration.

Third Step: Establishing Normative Data and Test Validity in Patients With Olfactory Loss

Two other components (odor threshold and discrimination tests) were added to the identification part. Then, all 3 subtests of the Ir-SST were performed for 214 control participants and 99 patients with olfactory loss to obtain normative data and assess the validity of the test. To examine the test-retest reliability of the Ir-SST, 39 volunteers out of 214 controls who had participated in the third step were selected randomly and reexamined after 2 to 4 weeks.

Sniffin' Sticks Test

The sniffin' sticks test comprises 3 subtests: odor threshold, odor discrimination, and odor identification tests. The test is based on pen-like odor dispensers and performed in a quiet and ventilated room. All participants should be reminded not to smoke, eat, or drink anything but water for at least 15 minutes before the test. Each pen is presented only once for 3 to 4 seconds, and placed about 2 cm beneath both nostrils. Information about the results is not given to participants during the test. The sum of the threshold, discrimination, and identification scores is considered as the TDI score. The description of olfactory tests is briefly given in the following (for more detail see the study presented by Hummel and et al (34)). All olfactory tests are performed in a forced choice design.

Threshold Test

This test comprises 16 triplets of pens (48 pens totally) with red numbers from 1 to 16. The 3 pens in each triplet are distinguished by the color of their cap (red, green, and blue). The participants is asked to identify the red pen, which is impregnated with N-butanol diluted in water to establish the different concentrations from the 2 pens only filled with solvent. The odor threshold score (T) is the average of the last 4 turning points and has a range of 1 to 16.

Discrimination Test

In this test, 16 triplets of pens are presented to the participant; then, he/she is asked to recognize the green pen that has an odor different from the blue and red ones. The participants are blindfolded. The discrimination score (D) according to the number of correct responses ranges from 1 to 16.

Identification Test

This test consists of 16 pen-like odor dispensers. Using lists of 4 items for each odor of the odor items, the participants select the descriptor that best describes the odor presented. The identification score (I) according to the correct response number ranges from 1 to 16.

Statistical Analysis

The results are presented as mean ± SD and range (min-max) for continuous variables. Frequency and percentage are provided for categorical variables. The Kolmogorov-Smirnov test was used to check the normal distribution of data. The analysis of variance (ANOVA) was performed to compare TDI scores among the 3 age groups (16-35, 36-55, >55 years). Also, an independent sample t-test was performed to compare TDI scores between men and women. The Pearson correlation coefficient test was performed to explore the relationship between continuous variables. Data analysis was done using SPSS 24 software and significance level was set at 0.05.

Results

Odor Familiarity

A total of 200 healthy participants (125 men, 75 women, mean age, 35.5 ± 20.25) were recruited in the first step of the study. The percentages of odor familiarity rate for 87 odor descriptors, as rated on a Likert-type scale, are presented in Table 1.

Odor Identification Test

Based on the original version, 16 odorants were selected (see the original answering sheet in Table 2) and the identification part of the sniffin' sticks test was modified according to the results of the familiarity survey. We re-

Table 1. Survey results for familiarity of odor descriptors. After using a Likert type scale ranging from 0 to 5 (0=unknown, 5=highly familiar), average results are presented in a percentage scale.

Percent of correct answers (%)	Odor samples (percent of correct answers, %)
<75	Asparagus (10), Berry (19), Amber (27), Cedar (30), Fir (31), Cloves (34), Blackberry (36), Liquorice (45), Tea (46), Shrimp (47), Rum (50), Curry (51), Anise (52), Sauerkraut (53), Chamomile (54), Spinach (55), Menthol (56), Mustard (57), Sumac (57), Almond (59), Turpentine (60), Raspberry (61), wine (62), Olive (63), Grapefruit (64), Ginger (65), Cherry (65), Sour cherry (67), Paper (68), Pennyroyal (72), Cumin (72), Rum (74), Wine (74), Gummy bear (75)
75-90	Plum (76), Apricot (78), Crud (78), Angelica (78), Fava Beans (78), Leather (79), Walnut (79), Turmeric (79), Milk (80), Butter (80), Candle Smoke (81), Tomato (81), Rubber (81), Chewing gum (83), Hazelnut (83), Pepper (83), Grass (83), Carrot (83), Rose (84), Pineapple (84), Coconut (84), Vanilla (84), Chives (84), Pear (85), Cheese (87), Cardamom (88), Ham (88), Strawberry (88), Cookie (88), Chocolate (89), Honey (89), Melon (89), Saffron (89), Peach (90), Lemon (90),
>90	Glue (92), Banana (94), Smoke (94), Cantaloupe (94), Vinegar (94), Apple (95), Peppermint (95), Cinnamon (95), Watermelon (95), Bread (96), Cucumber (97), Fish (97), Coffee (97), Orange (98), Vinegar (98), Onion (98), Cigarette (98), Garlic (99)

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Table 2. Original version of answering sheet for the Iranian adaptation of the 16-item Odor Identification part of Ir-SST

1	Orange (98%)	Blackberry (36%)	Strawberry (88%)	Pineapple (84%)
2	*Leather (79%)	Smoke (94%)	Glue (92%)	Grass (83%)
3	Cinnamon (95%)	Honey (89%)	Vanilla (84%)	Chocolate (89%)
4	Peppermint (95%)	Chives (85%)	Fir (31%)	Onion (98%)
5	Banana (94%)	Coconut (84%)	Walnut (79%)	Cherry (65%)
6	Lemon (90%)	Peach (90%)	Apple (95%)	Grapefruit (64%)
7	*Liquorice (45%)	Gummi bear (75%)	Chewing gum (83%)	Cookie (88%)
8	*Turpentine (60%)	Mustard (57%)	Rubber (81%)	Menthol (56%)
9	Garlic (99%)	Onion (98%)	Sauerkraut (53%)	Carrot (83%)
10	Coffee (97%)	Cigarette (98%)	Wine (62%)	Candle Smoke (81%)
11	Apple (95%)	Melon (89%)	Peach (90%)	Orange (98%)
12	*Cloves (34%)	Pepper (83%)	Cinnamon (95%)	Mustard (57%)
13	Pineapple (84%)	Pear (85%)	Plum (76%)	Peach (90%)
14	Rose (84%)	Chamomile (54%)	Raspberry (61%)	Cherry (65%)
15	*Anise (52%)	Rum (50%)	Honey (89%)	Fir (31%)
16	*Fish (97%)	Bread (96%)	Cheese (87%)	Ham (88%)

Numbers in brackets indicate the percentage of correct answers based on Likert scale. Bold words indicate correct answers. Items marked with asterisk were replaced. Also, the descriptors that are familiar less than 75% were replaced more familiar ones (Italic fonts).

placed 6 sample odors (leather, liquorice, turpentine, cloves, anise, and fish) in the original answer sheet. Leather and fish odorants were not accessible in Iran and their procurement was highly expensive. Also, the 4 remaining odorants were unfamiliar for the Iranian population. Therefore, these odors were replaced with vanilla, cantaloupe, vinegar, smoke, cardamom, and honey odors. After administering the modified version to the healthy people, we found that the identification percentage of 4 odors (honey, apple, orange, and cantaloupe) was lower than 75%. Therefore, we changed distractors in the verbal lists for the identification of these odors and created a new list. The final version of the answer sheet for the identification part of the Ir-SST is presented in Table 3. The odor identification percentage of the Ir-SST is shown in Figure 1.

Table 3. Final version of answering sheet in Iranian adaptation of 16-item Identification part of Ir-SST. All descriptors were familiar to more than 75% of the subjects.

Number	Original English descriptor (Persian Translation)	Descriptor 1	Descriptor 2	Descriptor 3
1	Orange*(پرتقال)*	Fish	Onion	Milk
2	Vanilla *(وانیل)*	Onion	Peppermint	Grass
3	Cinnamon *(دارچین)*	Honey	Vanilla	Chocolate
4	Peppermint *(نعناع)*	Chives	Curd	Onion
5	Banana *(موز)*	Coconut	Walnut	Apple
6	Lemon *(لیموشیرین)*	Peach	Apple	Pear
7	Cantaloupe *(طالبی)*	Carrot	Plum	Apple
8	Vinegar *(سرکه)*	Curd	Bread	Butter
9	Garlic *(سیر)*	Onion	Fava beans	Carrot
10	Coffee*(قهوه)*	Vinegar	Cinnamon	vanilla
11	Apple *(سیب)*	Garlic	Coffee	Grass
12	Smoke*(دود)*	Hazelnut	Milk	Coconut
13	Pineapple *(آناناس)*	Pear	Plum	Peach
14	Rose *(گل رز)*	Apple	Lemon	Angelica
15	Cardamom *(هل)*	Honey	Cinnamon	Saffron
16	Honey*(عسل)*	Bread	Peppermint	Lemon

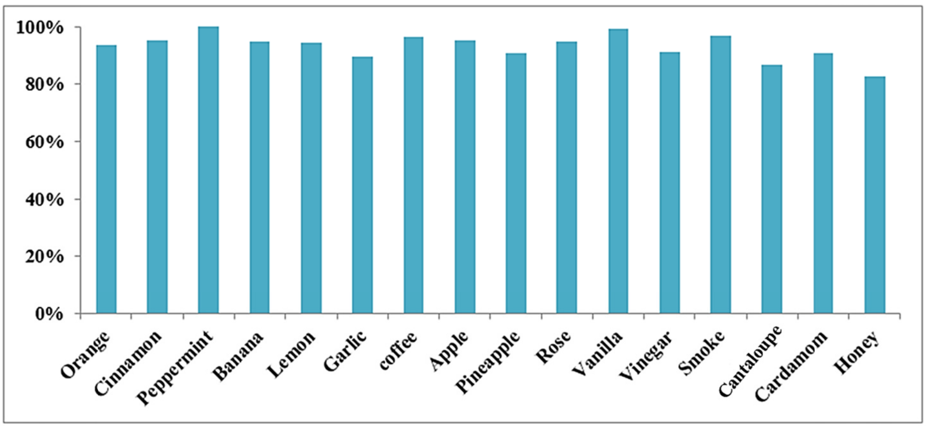

Fig. 1. Percentage of Identification Items in Ir-SST

Normative Data and Validation of Ir-SST

The Ir-SST was administered to 214 control participants and 99 patients with olfactory disorder to examine normative values and testing validation in the Iranian population. Most of patients (66 out of 99) explained that their olfactory dysfunction was caused by head trauma and the rest of them had dysfunction after sino-nasal diseases and post-viral infection. The demographic characteristics of these patients are shown in Table 4.

The mean values of each part of identification, discrimination, and threshold tests and the mean TDI score among healthy participants in 3 age groups (15-35, 36-55, > 55 years) and patients are depicted in Table 5. Our results revealed that the mean TDI score was significantly lower in patients than in controls (13.6 ± 5.24 vs 34.3 ± 3.41; $p < 0.001$) (Fig. 2). The Kolmogorov Smirnov test was used to check the normality of the TDI scores. After confirming normal distribution, we compared the mean TDI scores between men and women in 3 age groups in the healthy participants. According to the results, age and gender were not significantly related to the TDI score (Fig. 3). The comparison of mean TDI scores in different age groups indicated a nonsignificant difference.

Test-Retest Reliability

To investigate the reliability of the test, of 214 healthy participants, 39 were randomly selected. After 2 to 4 weeks, the mean TDI score changed from 35.91 ± 3.20 in the first test to 35.71 ± 2.70 in the second one. The test-retest correlation was 0.81 ($p < 0.001$) (Fig. 4).

Sensitivity and Specificity

The results of the study showed a TDI sensitivity of 95.2% (95% CI, 96.34-99) and a specificity of about 93.50% (95% CI, 89.27-96.38), with a positive predictive value of 87.61% and a negative predictive value of 89.7%. Receiver operating characteristic curve (ROC) analysis confirmed the high accuracy of the Ir-SST (95.53) (95% CI, 92.61-97.53) (Fig. 5).

One-way ANOVA was also conducted to investigate the influence of age on olfactory function. No significant difference was observed between different age groups (Fig. 6).

Discussion

Normative data for the Iranian version of the sniffin` sticks test indicates the desirable validity and reliability of this test. The sensitivity of the 3 subtests, which distin-

Table 4. Demographic characteristics of patients with olfactory disorders

Etiology	Number	Age range	Gender: Male	Gender: Female
Post-traumatic	41	17-69	25	16
Post-infection	22	20-71	10	12
Sino-nasal inflammation (chronic rhinosinusitis with and without polyposis)	36	18-61	16	20

Table 5. Ir-SST normative data from healthy participants in three age ranges and patients with self-reported olfactory loss

15-35 years (n=111)		Identification	Discrimination	Threshold	TDI
Mean		15.1±1.1	12.9±1.4	7.4±2.9	35.4±3.3
Range (Min- Max)		6 (10-16)	7 (9-16)	12.5 (2.5-15)	15.2 (29.2-44.5)
Percentiles	10	13.2	11.0	4.5	31.5
	25	15.0	12.0	4.7	33.0
	75	16.0	14.0	10.0	37.5
	90	16.0	15.0	11.5	40.2
36-55 years (n= 49)		I	D	T	TDI
Mean		14.8±1.2	12.9±1.2	7.1±3.0	34.8±3.4
Range (Min-Max)		4 (12-16)	7 (9-16)	11.0 (3.5-14.5)	13.50 (30-43.5)
Percentiles	10	13.0	11.8	4.5	31.4
	25	14.0	12.0	4.5	32.5
	75	16.0	14.0	10.0	37.2
	90	16.0	14.2	11.7	39.7
>55 years (n=54)		I	D	T	TDI
Mean		12.6±2.0	11.4±1.2	7.7±3.16	31.8±3.4
Range (Min-Max)		8 (8-16)	5 (10-15)	12.0 (2.5-14.5)	17.9 (24.3-42.2)
Percentiles	10	9.4	10.0	4.5	30.9
	25	12.2	11.0	4.8	32.0
	75	16.0	13.0	10.2	35.2
	90	16.0	14.0	13.2	38.1
Patient group (n=99)		I	D	T	TDI
Mean ± SD		5.8±3.3	6.1±2.6	2.3±2.7	13.6±5.2
Range (Min-Max)		14 (0-14)	13 (0-13)	14.2 (0.5-14.75)	22.5 (4-26.5)
Percentiles	10	2.0	3.0	1.0	7.5
	25	3.0	5.0	1.0	10.0
	75	8.0	8.0	2.7	16.7
	90	11.0	10.0	6.0	22.5

TDI: total score (sum of threshold, discrimination, identification scores). SD = standard deviation

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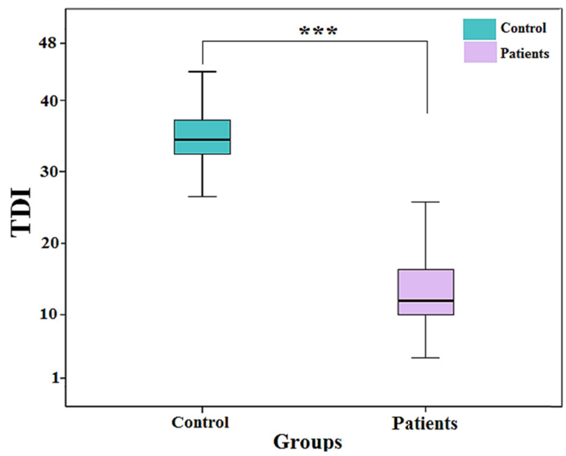

Fig. 2. Box plot comparing TDI scores between healthy controls and patients. TDI= composite score of T, D and I. T = threshold; D = discrimination; I = Identification. Significant differences were observed between two groups (****P*< 0.001). The lower borders of boxes indicate the 25th percentile of the data distribution, the upper border of the box indicates the 75th percentile, and the bold horizontal line inside the box indicates the median. The upper and lower whiskers show the maximum and minimum TDI scores, respectively.

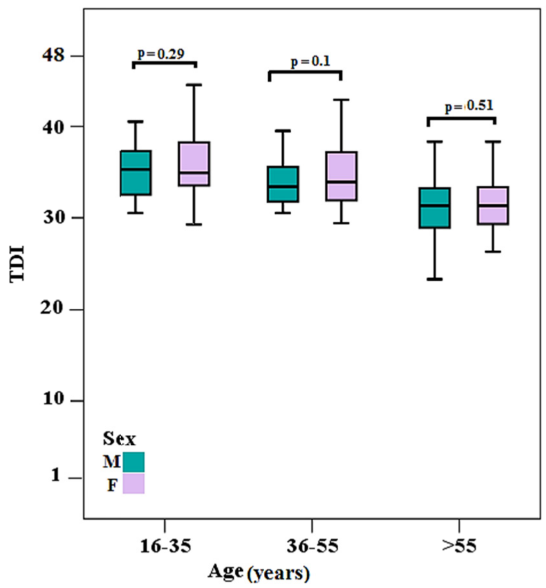

Fig. 3. Box plot of TDI score for the three age groups and for male and female participants in the healthy group. The lower borders of the boxes indicate the 25th percentile of the data distribution, the upper border of the box shows the 75th percentile, the bold horizontal line inside the box indicates the median (TDI = composite score of T, D and I. T = threshold; D = discrimination; I = Identification).

guish patients with olfactory disorders from healthy individuals based on the TDI score, has been evaluated separately for the main sniff stick test and its Iranian version. The Iranian sniff-stick test can evaluate the human olfactory system with 95.2% sensitivity. The sensitivity of 3 subtests, discriminating patients with olfactory disorders from healthy participants based on the TDI score, was assessed separately for the original SST test and the Ir-SST test. Ir-SST can accurately assess the human olfactory system with a high sensitivity of 95.2%.

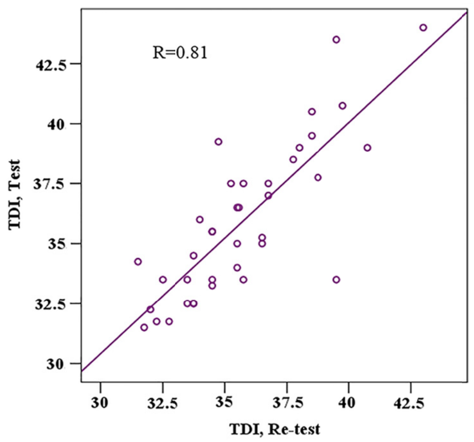

Fig. 4. Test-retest reliability of Iranian Sniffin' Stick test. Pearson correlation of test scores (TDI: r= 0.81, P<0.001).

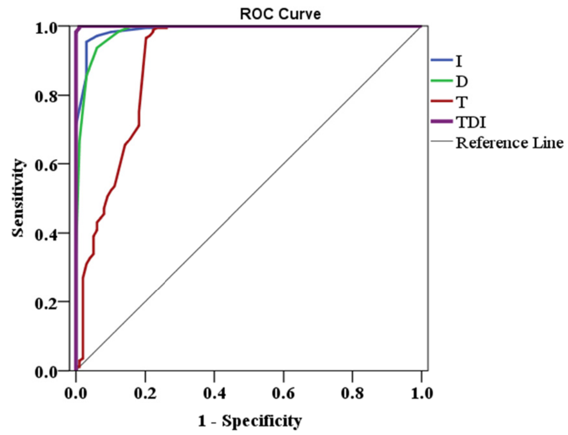

Fig. 5. Area under the curve (AUC) for TDI 0.95 (95% CI: 0, 98); Threshold 0.90 (95% CI: 0.86, 0.94); Discrimination 0.98 (95% CI: 0.97, 0.99) and Identification 0.98 (95% CI: 0.97, 0.99), p<0.001. TDI = composite score of T, D and I. T = Threshold; D = Discrimination; I = Identification.

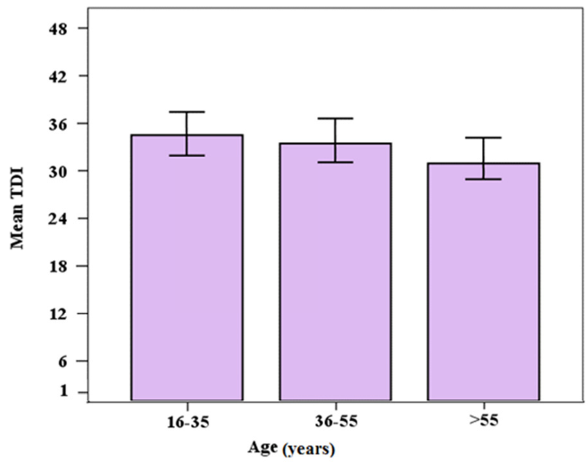

Fig. 6. Bar graph shows TDI score in different age groups in healthy people. There was no significant difference between age groups (Data presented as mean ± SEM).

Olfactory tests have been shown to possess strong cultural affinities (46, 47). Based on the results of the familiarity survey, in the original version of the identification smell test, some odors were replaced with familiar odorants for the Iranian population for the sake of cultural

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adaptation. Some distractors were also modified to decrease cultural bias factors. Finally, we ended up with odor identifiability of up to 75%.

Our modified version of the sniffin' stick test, culturally adopted for Iranian population, can evaluate all 3 components of olfaction (threshold, discrimination, and identification) (34, 46), despite its time-consuming nature for application in a crowded clinical setting (30, 31, 43, 48). However, the UPSIT presented by Taherkhani and et al (43) is only able to assess the odor identification ability. Our results were also consistent with previous findings (44, 45), suggesting that the odor detection threshold represents basic olfactory function, The other 2 tests (detection and differentiation) are related to higher levels of olfactory processing.

The Ir-SST revealed a significant difference between TDI scores of normosmic participants and patients with olfactory disorders. The results showed that the TDI score in patients was significantly lower than in healthy controls, as matched for age and gender ($p < 0.001$). TDI scores of the Iranian sniffin' sticks test were significantly high in normal participants.

The olfactory function declines with advancing age, as demonstrated by Doty et al and Hummel et al. (11, 49). In our study, the mean TDI score dropped with aging, but this fall was not significant. Also, no significant relationship was observed between gender and TDI score. The Ir-SST had high sensitivity and specificity. Overall, the reliability of the complete Ir-SST test was higher than the reliability of odor identification or odor threshold tests reported in the previous studies (35).

The TDI score indicated that the Ir-SST was a clinically suitable test with favorable test-retest reliability ($r = 0.81$; $p < 0.001$) and an area under the ROC curve of 0.98.

The identification test correlation ($r = 0.83$) was considerably higher than that of the German version of sniffin` sticks ($r = 0.73$) (34, 35). Compared with odor identification tests, few studies have investigated the reliability of threshold tests (50, 51). We surveyed the reliability of all 3 components. According to our results, the reliability of the discrimination subtest was $r = 0.56$, which is lower than that of the identification and threshold subtests ($r = 0.77$). The results demonstrated the high accuracy (95.53) of the Ir-SST test.

This study had a limitation. The lack of variety in cultural background, ethnic origin, climate, and geographic location could influence the olfactory function. Further studies with sample sizes from different cultures (including all ethnicities in diverse climatic conditions) are required to achieve more accurate results.

Conclusion

This study provided distinct normative data for all 3 age groups and both genders. According to the results, the Ir-SST (the SST test culturally adapted to the Iranian population) allows to distinguish "normosmic" people from patients with "hyposmia" and "anosmia" with high sensitivity and specificity. It offers a reliable screening tool that can be used in clinical settings or for research purposes. The accurate and reliable assessment of the olfactory function is particularly important, considering its clinical, safety, and medico-legal implications.

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Conflict of Interests

The authors declare that they have no competing interests.

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