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Original Article

Olfactory Identification Test Using Familiar Distracters for Koreans

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Objectives. Odors used in an odor identification test should be familiar to the subject, but there are some unfamiliar distracters in Korean version of Sniffin' stick (KVSS) II identification test. In this study, we used the results of the original version of KVSS II identification to modify the KVSS II identification test.

Methods. Eighty-three participants took an original version of KVSS II identification test and a visual analogue scale of subjective odor function. KVSS II identification which has 16 items was performed to choose one out of four odors items. And visual analogue scale was checked from 0 to 10 points of their subjective olfactory function. Two weeks later they took the modified version of KVSS II identification test. Hyposmic or anosmic patients were excluded.

Results. The mean score of the original version of KVSS II identification and modified version of KVSS II identification were 11.3 and 12.5, respectively ($P<0.05$). The KVSS II identification test and subjective olfactory function were positively correlated ($r=0.247$, $P<0.05$), as were the modified KVSS II identification test and subjective olfactory function ($r=0.329$, $P<0.05$).

Conclusion. After modification of distracters, KVSS II identification test appears to be suited for assessment of olfactory function.

Keywords. *Korean version of Sniffin' stick test, Odor identification test, Olfactory test, Distracter*

INTRODUCTION

With recent changes in Korea from the ancient agricultural life to an urban culture, the effect on quality of life of smell is also changing. Olfaction as an important function for sensing the world can be reduced by problems such as infection, trauma, or neurodegenerative diseases. Therefore, tests that can accurately assess olfactory function are needed [1]. Olfactory function can be assessed through examination such as olfactory threshold, olfactory discrimination, and olfactory identification test [2]. Of these, olfactory identification test has advantages in that the test is easy for both examiner and subjects, can be performed in a relatively short time, and can be useful in early diagnosis of illnesses such as Alzheimer's disease or Parkinson's disease [3,4]. To improve the accuracy of the identification test, each culture should develop the test to match the environment of their culture.

T & T olfactometer test, developed in Japan, has odor items that are easily recognizable to many people [5], and University of Pennsylvania smell identification test (UPSIT) has items that are easily recognizable to people of various groups in the United States [6]. The supplemental cross-cultural smell identification test (CC-SIT) was introduced that chose the 12 odor items that show a high detection rate in a different culture [7]. Sniffin' stick test, developed by Kobal [8], chose items that are familiar to Germans, and is used for olfactory assessment in many countries of Europe. Scandinavian odor-identification test (SOIT) was developed with familiar items for Scandinavian cultures independently, although they share the European cultural area [9].

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In Korea, we developed Korean version of Sniffin' sticks (KVSS) to evaluate olfactory function by modifying the Sniffin' Stick test with odors familiar to Koreans [10]. Recently developed odor stick identification test for Japanese (OSIT-J) asks not only for the correct answer but for the distracters on the basis of familiarity [11]. To compare with other culture areas, the choice of the distracters is important as well as the correct answers.

Thus the items of olfactory identification test should be as familiar as possible to the subjects. CCSIT, widely used in Korea, did not include Koreans during its development. The identification test of KVSS, created by using odors familiar to Koreans, contained unfamiliar items such as lime, coconut, and blackberry, making it difficult to assure the accuracy of the test.

Accordingly, the authors modified distracters based upon research about familiar olfactory impressions for Koreans, and then compared the results of the identification test with the previously used one.

MATERIALS AND METHODS

Subjects

We recruited people aged 20s to 40s and over 60 years who reported having no olfactory dysfunction or symptom of nasal obstruction or disease which may cause olfactory dysfunction. The older age group did the mini-mental status examination (MMSE), and people who scored less than 24 points were excluded from the study. All age groups did a written assessment using the visual analogue scale (VAS) from 0 to 10 points of their subjective olfactory function, and performed the KVSS II identification test. After two weeks all participants performed the modified KVSS II identification with distracters replaced by familiar items without reference to the answer. The study protocol was reviewed and approved by the Konkuk University Institutional Review Board, and informed consent was obtained from all subjects.

KVSS II identification test

KVSS II identification has 16 items. Subjects are to choose one out of four odors items without knowing the correct one. Interviewers wore gloves and the odor sticks were presented 2-3 cm in front of the nose for the subject to smell for 1-2 seconds. The interval between tests of various odors was 30 seconds. The modified KVSS II identification test used the same odorants and replaced distracters based on research about familiar olfactory impressions for Koreans (Table 1).

Research on familiar olfactory impressions for Koreans

Research on familiar olfactory impressions was performed using 30 items which are used in a commercially available olfactory identification test. Four hundred seventy-nine subjects were enrolled. A questionnaire was given about the familiarity of each item scaling from 1 point to 5 point. We chose 24 items from 30 based on the results of the familiarity score. These 24 items were coffee, soap, orange, garlic, mint, lemon, cucumber, apple, fish, banana, rose, alcohol, cinnamon, soy sauce, peach, pain relieving spray, grass, gasoline, chocolate, vanilla, rubber burning, black tea, tree, and naphthalene (Fig. 1).

Statistical analyses

A paired *t*-test was used for comparing KVSS II identification and modified KVSS II identification test. Pearson correlation co-

Table 1. The list of odor from the Sniffin' sticks odor identification test with ratings of correct identification rates

Odorant	Rates of correct identification (%)	Distractors (original ver.)			Rates of correct identification (%)	Distractors (modified ver.)		
Orange	75	Blackberry	Strawberry	Pineapple	96	Fish	Cheese	Smoke
Leather	67	Smoke	Glue	Grass	51	Grass	Pineapple	Apple
Cinnamon	82	Honey	Vanilla	Chocolate	90	Coffee	Black tea	Vanilla
Mint	78	Spring onion	Fir tree	Onion	77	Gasoline	Soy sauce	Garlic
Banana	75	coconut	Walnut	Cherry	84	Rose	Tree	Rubber burning
Lemon	53	Peach	Apple	Plum	55	Alcohol	Cucumber	Pain relieving spray
Licorice	16	Cherry	Chewing gum	Cookle	36	Peach	Cheese	Mint
Resin	51	Mustard	Rubber	Menthol	70	Chocolate	Naphthalene	Coffee
Galic	93	Onion	Cabbage	Carrot	98	Apple	Rose	Smoke
Coffee	77	Tobacco	Wine	Smoke	83	Lemon	Mint	Fish
Apple	28	Melon	Peach	Orange	66	Soy sauce	Cinnamon	Saop
Soy sauce	87	Pepper	Cinnamon	Mustard	90	Orange	Tree	Mustard
Pineapple	65	Melon	Plum	peach	80	Chocolate	Rose	Leather
Rose	77	Green tea	Strawberry	Cherry	76	Mint	Cucumber	Apple
Sesame oil	88	Rum	Honey	Fir tree	96	Orange	Coffee	Grass
Fish	84	Bread	Cheese	Ham	92	Lemon	Banana	Mint

Original and modified distracters are shown that are used together with target item.

efficients tested the strength of the association between KVSS II identification and subjective olfactory functions whenever appropriate. Results were analyzed with SPSS ver. 17.0 (SPSS Inc., Chicago, IL, USA) and null hypotheses of no difference were rejected if *P*-values were less than 0.05.

RESULTS

Results of olfactory identification ability by changing distracter

The correct answer rate of each item of KVSS II identification test was 16%-93% but after distracters were modified, correct answer rate were improved to 36%-98% (Table 1). The average correct answer rates were 68.5% and 77.5%, respectively. The average correct answer rate of modified KVSS II identification test was significantly higher ($P<0.05$) than that of KVSS II identification test.

Age distribution

A total 83 subjects were enrolled. Thirty-five were men and forty-eight were women. Age ranged from 25 to 85 years, mean age was 45.6 years. As age increased, scores of KVSS II identification and modified KVSS II identification were significantly decreased (Table 2).

Comparison of results of KVSS II identification test and modified KVSS II identification test

The mean scores of KVSS II identification test and modified KVSS II identification test were 11.3 and 12.5, respectively. The mean score of modified KVSS II identification test was significantly higher ($P<0.05$) than that of KVSS II identification test calculated from each age group excepting the 30s. The mean scores from the age groups 20s and 40s were 12.1, 14.2, and 10.4, 11.8, respectively. The scores from the 30s age group were 11.9 and 12.8, so mean score of modified KVSS II identification test was higher but not statistically significant. In the old age group, mean scores were 9.6 and 11.6 (Fig. 2).

Correlation of the KVSS II identification test, modified KVSS II identification test and subjective olfactory function

The KVSS II identification test and subjective olfactory function were positively correlated ($r=0.247$), as were the modified KVSS II identification test and subjective olfactory function ($r=0.329$) (Fig. 3). Those associations tended to be higher in the younger age groups, although the 30s age group and the old age groups did not show statistically significant associations (Fig. 4).

DISCUSSION

Choosing odorants for an olfactory test has several limitations

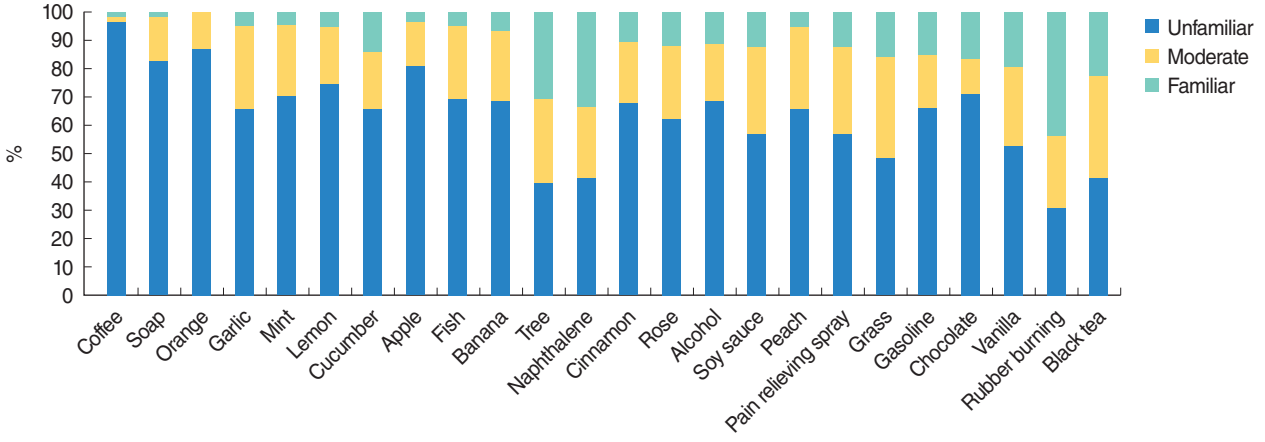

Fig. 1. Results of research on familiar olfactory impressions for Koreans.

Table 2. Distribution of odor identification scores by age group

Variable	20s (n=19)		30s (n=19)		40s (n=23)		Old age (n=22)	
	A	B	A	B	A	B	A	B
Average age (year)	26.6 (25-29)		32.9 (30-39)		44.4 (40-49)		74.2 (65-85)	
Mean±SD	12.1±1.8	14.2±1.9	11.9±2.5	12.8±1.4	10.4±1.6	12.7±1.8	9.9±2.4	11.6±1.7
Median (range)	12 (8-15)	15 (10-16)	12 (7-15)	13 (10-15)	11 (7-13)	12 (8-15)	10.5 (5-14)	12 (8-14)
10 Percentile	10	10	7	10	8	8	6.1	8

A, original version of Korean version of Sniffin' stick (KVSS) II identification; B, modified version of KVSS II identification.

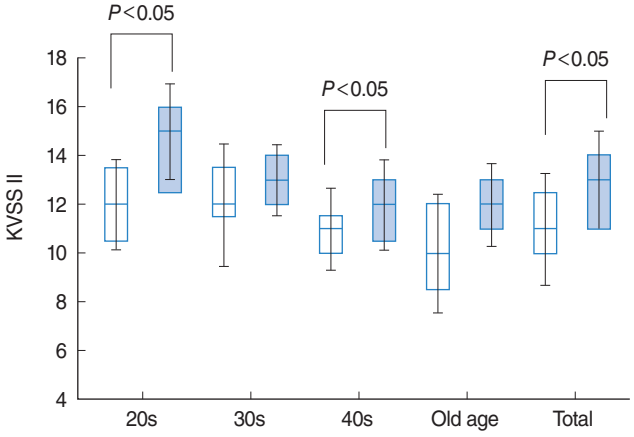

Fig. 2. Mean score of original version of Korean version of Sniffin' stick (KVSS) II identification (empty box) and modified version of KVSS II identification (filled box). Error bars, standard deviation.

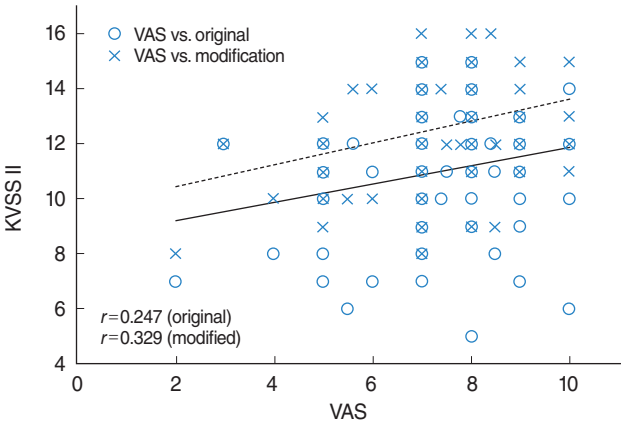

Fig. 3. Correlation of visual analogue scale (VAS) with original version of Korean version of Sniffin' stick (KVSS) II idenitification (O, black line) and modified version of KVSS II identification (X, dotted line).

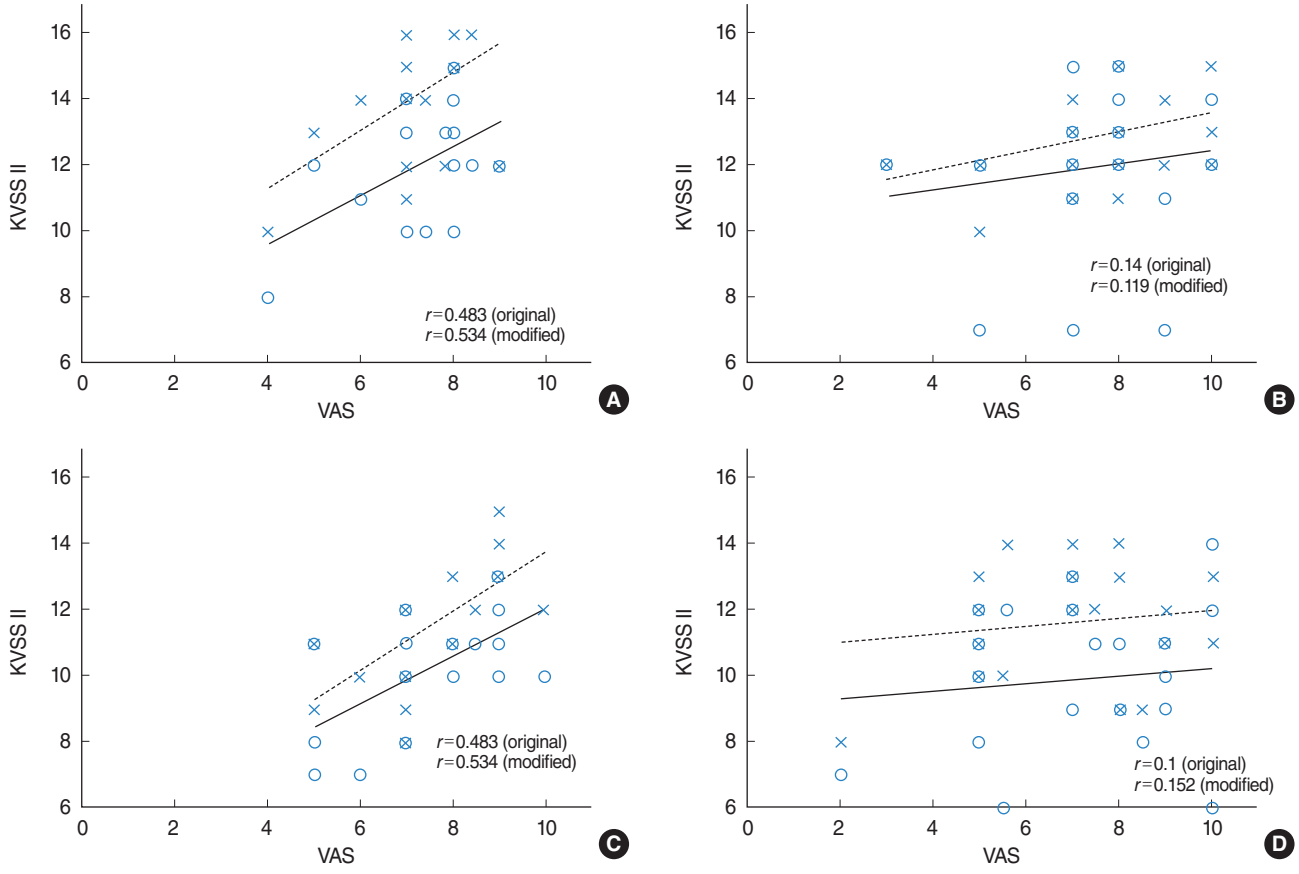

Fig. 4. Correlation of visual analogue scale (VAS) with original version of Korean version of Sniffin' stick (KVSS) II idenitification (O, black line) and modified version of KVSS II identification (X, dotted line). 20s (A), 30s (B), 40s (C), and old age (D).

when used in different nations or cultural areas [12]. In this study, we compared the results of olfactory identification test by changing not only the items but the distracters into those which are familiar to subjects.

After changing the distracters, the identification rates of licorice, apple, and rosin increased from 16%, 28%, 51% to 36%, 66%, 70%, respectively. This shows the same results as Shu's, who noted that his identification rate increased from 52%, 62% to 79%, 100%, respectively by substituting familiar items for leather, cinnamon, and licorice [13] (Table 1). Nordin developed

a test suitable for people of Scandinavian, SOIT, which had commonly used odor items and the examples through the Confusion matrix [9]. By comparing the Japanese and American OSIT-J, there is an obvious contrast in the familiarity of odorants and there was also a significant difference in analysis of distracters. Therefore in order to increase the accuracy of the olfactory test, replacement of the less familiar distracters is necessary. In comparison with Japanese and American with OSIT-J, different familiarity to the odor items and the analysis of distracters were noted. Hence the accuracy of the olfactory test can be increased by replacing the distracters which have low familiarity [13]. We investigated odorants familiar to Koreans and those having low differences of recognition between ages or occupation, and raised the accuracy by adding them to KVSS-II odor items. On the other hand, the similarity of the correct answer is also an important factor for influencing the correct answer rate. But we focused on familarity of distracters in this study. So we discarded the distracters which had extremely low or high similarity with the odorant for increasing familiarity of distracters.

With increasing age, olfactory function tends to decrease even with more familiar distracters, compared with subjects in their 20s to 40s. The older subjects' scores of olfactory identification test were statistically significantly different from the younger age groups ($P<0.05$) (Table 2, Fig. 2). The modified KVSS II identification test well reflected the effect of age on olfactory function, a result similar to the original version of KVSS II identification test.

The scores of the original version of olfactory test which has distracters with lower familiarity underestimated olfactory function. The correlation of the relationship between subjective olfactory function and the score of olfactory function test was improved by replacing the distracters (Figs. 3, 4). In the case of CC-SIT which was made for UPSIT multiculturalism, there are some items of low familiarity even though Japanese people participated in the development of the test, since the scores were not very high for middle aged subjects with normal olfactory identification test [14], a result similar to the authors' findings.

The items on olfactory identification tests undergo various influences by their cultures and changing the distracters by familiarity lead to a more valid test. Thus the identification olfactory test in KVSS-II which is used widely in Korea would be more accurate by changing to more familiar items to Koreans.

In conclusions, we suggest that the olfactory function will give more precise results if some items replace others more familiar to people to raise the accuracy of the olfactory identification test, and with this, we can improve our own test.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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