CULTURAL ADAPTATION OF SNIFFIN' STICKS TEST FOR A MALAYSIAN POPULATION

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Abstract

Introduction: Sniffin' Stick test is a quantitative olfactory test first introduced in the 1990s and has since been used in several countries after cultural-based modifications.

Objective: To develop a culturally adapted Sniffin' Stick test suitable for a Malaysian population.

Methods: The study was done in 3 phases. The first phase involved a questionnaire rating the familiarity of 70 odors based on a Likert scale. Sixteen items were then selected for the second phase where subjects were tested on the identification of the 16 odors. Odors recognized by less than 75% of the subjects or their distractors were replaced. These steps were repeated until all 16 odors were recognized by more than 75% of the subjects. In the final phase, the mean Odor Identification (OI) scores utilizing the newly selected 16 odors were collected among healthy individuals.

Results: A total of 417 subjects participated in the study**.** In the first-phase, 5 odors from the original Sniffin' Stick Test which were unfamiliar were replaced for the phase 2 of the study. In the second-phase, modifications were performed 3 times requiring change of 41 distractors and an additional odor. Finally, using the modified Sniffin Stick test version-4, preliminary results of the mean odor identification scoring for the age groups 16-35,36-55 and more than 55 years of age were obtained which showed age-related variations.

Conclusion: Our study revealed cultural modifications to the original Sniffin' Stick Test are required to validate its use in a Malaysian population.

Keywords: Sniffin' Sticks Test, Quantitative Olfactory Test, Cultural Adaptation

Introduction

Sniffin' Sticks test (SST) have been used since the 1990s and was first introduced by Kobal and team (1). It is now a well-established quantitative olfactory test, being used in several countries in Europe as well as in Asian countries such as Taiwan and Korea after certain cultural-based modifications (2-4). This test utilizes portable, pen-like odor-dispensing sticks as a tool to score the olfactory status. As the equipment is reusable, it is cost-effective as opposed to single-use scratch and sniff tests. This test also differs from other test such as the University of Pennsylvania Smell Identification Test (UPSIT), Connecticut Chemosensory Clinical Research Center test, T&T Olfactometer etc. as it tests the olfactory threshold, discrimination, and identification at the same setting (5). The Sniffin' Sticks tests the orthonasal olfactory function which is the perception of odors entering the nostrils stimulating the olfactory neurons (6).

Specific odor identification is not universally similar and is shaped by factors such as culture, prior to exposure and experience (6). Therefore, a single battery of tests cannot be used for all and each population requires normative data that may be different across different cultural backgrounds, gender and age (2, 7, 8). Normative data for the SST includes information on odor identification, discrimination, and threshold. These data are available in several countries, including Germany and Australia, where differences in olfactory status based on gender and age were observed (9, 10). As for the other countries such as Egypt, Taiwan and Turkey, normative data were collected

after applying cultural-based modifications (4, 11, 12). These normative data would serve as a database for routine clinical evaluation of patients with olfactory dysfunction for that specific population.

In Malaysia, we have yet to have an established quantitative test suitable for the local population that can be routinely used to test the patients' olfactory status. The aim of this study was to identify odors in the original SST that were unfamiliar to a Malaysian population and apply cultural adaptation to the SST. The modified SST which consists of odors which are familiar can then be used to test the olfactory status of Malaysians. This would then serve as a tool for normative data collection for future studies.

Methodology

The quantitative study was performed between December 2015 and December 2016 to assess the need for cultural adaptation of the SST to the Malaysian population. Ethics committee approval (MECID NO: 2015121928) was obtained from University Malaya Medical Centre (UMMC) prior to the initiation of the study and the study was conducted according to the Declaration of Helsinki. Healthy subjects who accompanied patients to our otorhinolaryngology outpatient clinics and any healthy volunteers were approached to participate in the study. Subjects who were unwilling to comply with the requirements of the protocol and subjects with a history of neuropsychiatric disorders, head trauma, and sinonasal disease or who had undergone prior nasal, skull base, or neurosurgery were excluded from the study. Each participant was informed regarding the steps involved and written consent was obtained from all the participants prior to the study.

This study was divided into three different phases. In the first phase, a survey on the familiarity of odor was performed using a simple questionnaire in the English language and the Malay language. Subjects were asked to rate their familiarity of odors using a Likert scale ranging from 1 to 5, with 1 being not at all familiar and 5 being extremely familiar. The questionnaire contained 70 items including all the original odors of SST and some of the distractors in the original SST and other odors likely to be familiar for the local population. Items that were rated from the scale of 3 to 5 (moderately familiar to extremely familiar) were considered 'familiar'.

Prior to phase 2 of the study, a set of 16 odors that were recognized as 'familiar' by more than 75% of the subjects were selected for testing, replacing the 'unfamiliar' ones (rated 1 to 2) constituting the modified SST version 1. Once the odors have been changed, the distractors were changed accordingly so they matched the odor category, for example: if a fruit was an odor, other fruits would be chosen as a distractor. Some of the distractors were replaced as these items were not local ingredients such as fir, sauerkraut, mustard and cherry. As Malaysia is a predominantly Muslim country, certain distractors such as wine, rum, and ham were also replaced to be more culturally sensitive.

In phase 2, participants were selected for odor identification with this modified SST version 1. The SST was performed in a well-ventilated room. The sticks were held 2 cm in front of the nostril for not more than 3 to 4 seconds and patients were asked to smell. The subjects were asked to identify a smell and forced to choose an answer from four choices. Any odor which was recognized by less than 75% of subjects was replaced or their distractors changed if participants were confused with the answer choices. Distractors that were replaced were the ones that participants were confused of or found it difficult to differentiate from the odors that were given. In cases where two different distractors were equally selected rather than odors, both distractors were placed. These steps were repeated until all the 16 odors were recognized by more than 75% of the participants, which will constitute the final version of the modified SST. This final version consisting of 16 odors will then be used to in the next phase for calculation of the odor identification (OI) scores. As there were 16 odors tested in the, the subjects were given 1 point for each correctly identified odor. A total score of 16 was given if all odors were correctly identified.

In phase 3, The Statistical Package for the Social Sciences version 23 (IBM SPSS Statistics 23) and the Microsoft Excel 2011 version 14.6.9 for the Macintosh platform was utilized for statistical analysis. The data were expressed as mean and standard deviation for continuous data or frequency and percentages for categorical data. The subjects were then divided in three groups according to their age: <35 years, 36-55 years or >55 years.

Mann-Whitney U test was used to analyze non-parametric data while Student T-Test were used for comparison of parametric data. Spearman's Rank Order Correlation was used to analyze the relationship between subject's age and their OI scores. A value of $p<0.05$ was considered significant. A One-way ANOVA test was used to compare the OI scores obtained in subjects from all three age groups. A value of $p<0.05$ was considered significant. A schematic diagram of the study design is shown in Figure 1.

Results

A total of 417 subjects aged between 18-76 years old were recruited between December 2015 and December 2016. In phase 1, a total of 98 subjects participated and completed the survey. The 70 items and their rate of familiarity are shown in Table 1. Items that were recognized by more than 75% are considered familiar. 16 of these familiar odors were chosen and unfamiliar distractors (scale 1 to 2) were replaced by familiar odors. A total of 5 odors from the original Sniffin sticks odor identification test had to be replaced as they were not recognized by more than 75% of the participants.

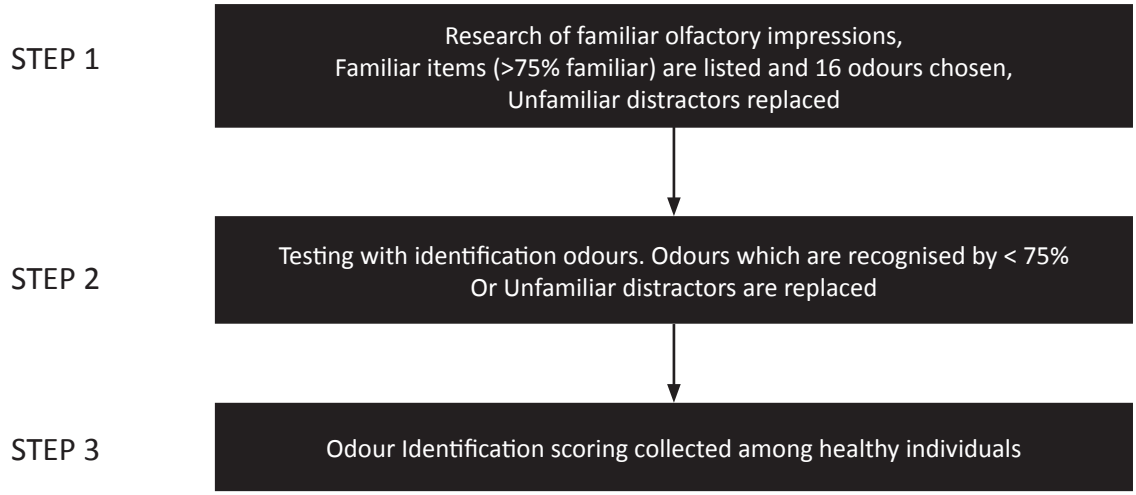

Figure 1: A schematic diagram of the study design

Table 1: Familiarity of odors among Malaysian population

No	Odor	%	No	Odor	%	No	Odor	%
1	Coffee	98.98	25	Chocolate	89.80	49	Grass	82.65
2	Curry	98.98	26	Banana	88.78	50	Strawberry	82.65
3	Fish	97.96	27	Coconut	88.78	51	Cinnamon	81.63
4	Petrol	97.96	28	Honey	88.78	52	Rubber burning	80.61
5	Garbage	96.94	29	Vinegar	88.78	53	Sesame oil	80.61
6	Ginger	96.94	30	Menthol	87.76	54	Sugar Cane	80.61
7	Onion	96.94	31	Newspaper	87.76	55	Coriander	79.59
8	Smoke	96.94	32	Pineapple	87.76	56	Incense	78.57
9	Durian	95.92	33	Sea	87.76	57	Pear	77.55
10	Garlic	95.92	34	Caramel	86.73	58	Mushrooms	76.53
11	Screwpine/Pandan	95.92	35	Chlorine	86.73	59	Peach	76.53
12	Gas	94.90	36	Lavender	86.73	60	Grapefruit	75.51
13	Orange	94.90	37	Rose	86.73	61	Mud	75.51
14	Apple	93.88	38	Smoke meat	86.73	62	Leather	74.49
15	Cempedak	93.88	39	Lamb	85.71	63	Clove	73.47
16	Lemongrass	93.88	40	Peppermint	85.71	64	Turpentine	73.47
17	Soy sauce	93.88	41	Cola	84.69	65	Star Anise	72.45
18	Lemon	92.86	42	Moth balls	84.69	66	Cumin	71.43
19	Mango	91.84	43	Wood	84.69	67	Basil	70.41
20	Medicated oil	91.84	44	Ink	83.67	68	Raspberry	68.37
21	Pepper	91.84	45	Jasmine Flower	83.67	69	Liquorice	65.31
22	Shrimp paste	91.84	46	Watermelon	83.67	70	Eucalyptus	57.14
23	Sweat	91.84	47	Cucumber	82.65			
24	Vanilla	91.84	48	Glue	82.65			

Familiar odors are odors recognized by more than 75% of the subjects

In the second phase of the study, the modified SST version 1 failed to produce 75% detectability rate for some of the odors and the process was then repeated three times before a final version was produced, consisting of 16 odors identifiable by more than 75% of subjects tested. During the second and third rounds of testing in phase 2, 2 extra odors were also tested along with the other 16. Table 2 shows the rate of identification for each odor, highlighting the ones with less than 75% recognition during each version of the modified SST testing. Finally, six odors and 41 distractors had to be changed from the original set to suit the Malaysian cultural setting and the final version 4 of modified SST was produced (Table 3). A total of 199 subjects participated in the second phase of the study.

For the final phase, 120 participants were included in this phase and divided into three separate groups according to their age. Group 1 (16-35 years old) consisted of 70 subjects, Group 2 (35-55 years old) had 29 subjects and

Table 2: The rate of identification of each odor in the 3 versions of modified SST for evaluation of odor identification

No	Odor	% identified First Version	% identified Second Version	% identified Third Version
1	Orange	97.7	95.83	92
2	Chocolate	***67.8****	83.3	84.1
3	Cinnamon	86.2	70.8	94.3
4	Peppermint	97.7	95.83	96.6
5	Banana	79.3	91.67	75
6	Lemon	88.5	95.83	83
7	Coconut	86.2	70.83	94.3
8	Soy Sauce	85.1	91.7	***72.7****
9	Garlic	96.6	100	100
0	Coffee	81.6	79.17	93.2
11	Apple	***50.6****	75	83
12	Ginger	81.6	83.3	79.5
13	Pineapple	***67.8****	***66.7****	***69.3****
14	Rose	***72.4****	95.8	94.3
15	Onion	***67.8****	***66.7****	77.3
16	Fish	96.6	100	95.5
17	Grass		95.8	92.1
18	Lavender		***70.8****	76.1

Percentages marked with * are less than 75%

Table 3: Original Sniffin' Sticks Test and modified final version of Sniffin' Sticks for evaluation of identification of odor

Original Sniffin' Sticks Test									
1	**ORANGE**	Blackberry	Strawberry	Pineapple	10	Onion	Sauerkraut	**GARLIC**	Carrot
2	Smoke	Glue	***LEATHER****	Grass	11	Cigarette	**COFFEE**	Wine	Smoke
3	Honey	Vanilla	Chocolate	**CINNAMON**	12	Melon	Peach	Orange	**APPLE**
4	Chive	**PEPPERMINT**	Fir	Onion	13	***CLOVE****	Pepper	Cinnamon	Mustard
5	Coconut	**BANANA**	Walnut	Cherry	14	Pear	Plum	Peach	***PINEAPPLE****
6	Peach	Apple	**LEMON**	Grapefruit	15	Camomile	Raspberry	**ROSE**	Cherry
7	***LIQUORICE****	Cherry	Spearmint	Cookies	16	***ANISE****	Rum	Honey	Fir
8	Mustard	Rubber	Menthol	***TURPENTINE****	17	Bread	**FISH**	Cheese	Ham
Modified Sniffin' Sticks Test final version									
1	**ORANGE** Oren	Watermelon Tembikai	Strawberry Strawberi	Pineapple Nanas	9	Cucumber Timun	Lemongrass Serai	**GARLIC** Bawang putih	Carrot Lobak merah
2	Coffee Kopi	Cola Kola	**CHOCOLATE** Coklat	Banana *Pisang*	10	Honey Madu	**COFFEE** Kopi	Cola Kola	Cinnamon Kayu manis
3	Garlic Bawang putih	Pepper Lada putih	Peppermint Pudina	**CINNAMON** ***Kayu manis***	11	Screwpine leaf Pandan	Coconut Kelapa	Cempedak Cempedak	**APPLE** Epal
4	Coriander ketumbar	**PEPPERMINT** Pudina	Cucumber Timun	Onion *Bawang merah*	12	**GINGER** Halia	Pepper Lada putih	Coriander Ketumbar	Screwpine leaf Pandan
5	Pineapple Nanas	**BANANA** Pisang	Mango Mangga	Pear *Buah pir*	13	**LAVENDAR** Lavendar	Orange Oren	Cinnamon Kayu manis	Mango Mangga
6	Peach Buah Pic	Apple Epal	**LEMON** ***Limau***	Strawberry *Strawberi*	14	Vanilla Vanila	Honey Madu	**ROSE** Ros	Sugar cane *Tebu*
7	**COCONUT** Kelapa	Ginger Halia	Lemongrass *Serai*	Curry *Kari*	15	**ONION** Bawang merah	Curry Kari	Fish Ikan	Sesame oil *Miyak bijan*
8	Garlic *Bawang putih*	**GRASS** ***Rumput***	Curry *Kari*	Rose *Ros*	16	Menthol *Mentol*	**FISH** ***Ikan***	Cola *Kola*	Sugar cane *Tebu*

Items in **BOLD** are odors tested while the remaining three in the same row are distractors.
Items in ***ITALIC**** were original odors that were replaced.
Items in the second line of the modified Sniffin' Sticks Test are the Malay translation of the odors.

Group 3 (>55 years old) had 21 subjects. Overall, the median age of subjects (at the time of study) was 30.5 years (mean: 34.9 ± 16.2, range: 18-76) where 43.3% (52) of the subjects were male and 56.7% (68) were female.

The mean OI scores for all participants and for subjects in each age group are shown in Table 4. The 10th percentile value of all normal subjects was 11 for OI. The olfactory function scores were also compared according to the subjects' gender. There were no statistically significant differences in the mean OI scores between male and female subjects (p>0.05) (Table 5). The correlations between the mean scores for OI with age are also illustrated in Figure 2. Age was found to be inversely and significantly correlated with OI (Spearman's correlation, r=-0.285, p=0.002). One-way ANOVA test showed statistically significant difference between age of participants and their OI scores (p=0.012, <0.001 and <0.001 respectively).

Table 4: Values of Sniffin' Sticks obtained from healthy subjects in Malaysia

Parameters Analysed (Overall)	Odor Identification (OI) Score
Mean	13.40 ± 1.56
Range	8-16
10th percentile	11
25th percentile	12.75
50th percentile	14
75th percentile	15
90th percentile	15
Parameters Analysed (Age Groups)	
16-35 yr (n=70)	
Mean	13.74 ± 1.29
Range	11-16
10th percentile	12
25th percentile	13
50th percentile	14
75th percentile	15
90th percentile	15
36-55 yr (n=29)	
Mean	13.48 ± 1.63
Range	10-16
10th percentile	11
25th percentile	12
50th percentile	14
75th percentile	15
90th percentile	15
>55 yr (n=21)	
Mean	12.14 ± 1.61
Range	8-14
10th percentile	10
25th percentile	11
50th percentile	13
75th percentile	13
90th percentile	14

Sniffin' Sticks odor identification scores obtained from healthy subjects in Malaysia (overall and according to age groups) presented as mean ± standard deviation

Table 5: Comparison of olfactory function scores according to gender of subjects

Parameters Analysed	Gender	Odor Identification (OI) Score
Gender Mean (SD)	Male (52)	13.25 ± 1.47
	Female (68)	13.51 ± 1.61
P-value		0.241

Comparison of odor identification scores according to gender of subjects. There were no statistically significant differences in the mean OI scores between male and female subjects (p>0.05).

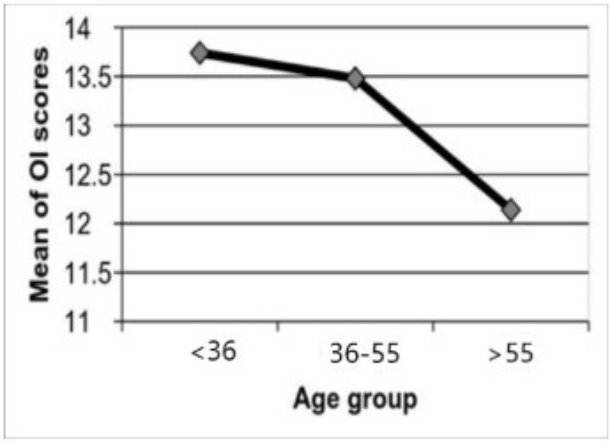

Figure 2: Correlation between OI scores and age group

Discussion

Availability of a test for smell assessment is imperative in otorhinolaryngology practice. However, due to the variation of cultures in different countries, one universal test is unfortunately difficult to achieve. As with many studies that have been performed in numerous countries, a cultural adaptation is necessary to obtain a smell assessment suitable to the country's population. These cultural adaptations have been done in countries such as Taiwan, Greece, Arab and Denmark (7, 8, 11, 13), and more than 100 published studies have used this SST to measure patients' olfaction (9).

In our study, we observed that many alterations were required to make the odors identifiable to our Malaysian population. In comparison to the original Sniffin' Sticks, we have had to alter 6 odors and 41 distractors. Accommodations had to be made to be more sensitive to religious practices, for example, odors and distractors that are linked to forbidden foods in different religions were changed.

There were some rather unexpected findings during the study. Two odors that were considered familiar and which are common items eaten as food such as the pineapple

(familiarity of 87.76%) and onion (96.94%) were not recognized repeatedly in the second phase of odor testing. The pineapple was eventually removed from the list, but the onion was retained. Similarly, chocolate and apple were also not identified by 75% participants during the first round of testing, but the detection rate improved in the subsequent rounds of the second phase. This finding shows that successful alterations in the distractors are particularly important to reduce the error in identifying the odor rather than assuming non-recognition of odors.

The other observation is noted for the identification of the smell of lavender. Although lavender is not a native plant in Malaysia, and many may not even have encountered the plant, but the odor was familiar to the majority. A likely cause is the extensive use of the artificial and natural lavender fragrance in household items, toiletries, and cosmetics. Familiarity is affected by multiple factors and includes experience naturally accumulated over time and training as demonstrated by the study by Rabin in 1988 (14).

On the other hand, anise and clove are routine spices used in Malaysia by all ethnic groups. However, odor detection was less than expected. One possible reason could be due to the style of cooking that uses multiple spices in most cooking and the blending of the spices into powder/paste forms that makes it unfamiliar for a person to identify the specific smell of each spice especially if the person is not involved in the process of cooking. Stevenson (15) reported in his experimental study that looked at the ability of participants to discriminate between components in a mixture and observed that odors previously experienced together as a mixture were less discriminable than controls.

Soy sauce, another common ingredient, was also another surprise deletion from the final list of odors tested. We assume that the salty taste is probably more dominant and familiar than the smell. This is perhaps the case for pineapple too. Orthonasal and retronasal olfaction has been suggested to function differently. The orthonasal olfaction functions through stimulation of the olfactory neurons via perception of odors entering through the nostrils, for example via sniffing; whereas the retronasal olfaction stimulates the olfactory neurons via perception of odors introduced orally when eating or drinking and transported to the nasopharynx (16). Therefore, it is possible that participants could not identify this odor via the method of Sniffin Stick that tests the orthonasal olfaction.

In the study done in Taiwan, leather, cinnamon, and liquorice were not recognized. As there were no alternative descriptors available, thorough changes were made to the distractors to exclude the unlikely answers. A total of 23 distractors were changed to produce a culturally adapted Sniffing Sticks (8). In the Korean Version of Sniffing sticks, a total of 4 odors namely turpentine, cloves, cinnamon, and anise were replaced (2). Even though we have some similarities with these Asian countries in terms of familiar odors, however, there are still certain odors in their adapted Sniffin' Sticks that are not well recognized by our population for example liquorice or not suitable for usage due to it being forbidden by religion for example ham or wine. This could be due to Malaysia being more culturally diverse in terms of the races, religion, food, and cultural practices.

This preliminary study shows that the mean OI scores are comparable to other countries such as Taiwan and Germany. The mean OI scores in our study for the age groups of 16-35 years, 36-55 years and more than 55 years were 13.74, 13.48 and 12.14 respectively while the mean OI scores for females in Germany were 13.68, 13.49, 12.06 and males were 13.48, 13.10, 12.20 (8, 9). However, our OI scores are not ready for use until the further normative data is collected which will constitute the limitation of this study.

The potential limitation of this study is an urban setting in which test were done therefore experience and exposure may be different from a person from rural setting. The multicultural setting in Malaysia, as well as different religious practices, increases the complexity in the process of developing a smell assessment test that fits all.

Conclusion

In Malaysia, we currently do not have a standardized test which is culturally adapted to evaluate olfaction status. This study will provide a baseline odor identification test to collect data from the population. The availability of a culturally adapted test kit will be essential in helping clinicians identify normosmic, hyposmic and anosmic patients.

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Competing interests

The authors declare no conflict of interest.

Funding

None.

Ethical Clearance

Ethics committee approval (MECID.NO: 2015121928) was obtained from University Malaya Medical Centre (UMMC) prior to the initiation of the study and the study was conducted according to the Declaration of Helsinki. Written informed consent was obtained from all individual participants included the study. The participants provided informed consent to publish their data.

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