Smell Detection Threshold in Thai Adults

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The objective of this study was to prospectively find the normal values of smell detection threshold (SDT) in Thai adults using glass sniff bottle technique. The authors studied 131 healthy Thai adults (65 male and 66 female, aged 20 to 60 years, median 26 years). In this test, different concentrations of phenyl ethyl alcohol (PEA) were applied according to a pre-established order. The SDT values were estimated using a 7-reversal initially ascending single staircase procedure and presented as log values of lowest concentration of PEA that could be detected. The results of the present study showed that the median value of SDT in Thais was -12.3 and both male and female were equally -12.3. The value from the present study can be used as a standard reference for patients who have olfaction problems both in routine clinical practice and in research study.

Keywords: *Olfaction disorders, Phenyl ethyl alcohol, Sensory thresholds, Smell*

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The sense of smell largely determines the flavor of foods and beverages and serves as an early warning system for the detection of environmental hazards, including spoiled foods, leakage of natural gas, smoke and various airborne pollutants. This primary sensory system contributes significantly to the quality of life, allowing for the full appreciation of flowers, perfumes, spices, and a vast array of foods and beverages. Thus, it is no wonder that losses or distortions of smell sensation are of considerable significance to patients, particularly those dependent on this sense for their livelihood or safety (*e.g.* cooks, plumbers, firefighters, perfumers, wine tasters). Indeed, altered smell function can adversely influence food preferences, food intake, and appetite.

Numerous tests have been developed to assess the ability to smell, although many are too unreliable or time consuming to be practically setting. A popular clinical mean of assessing smell function has been asking a patient to sniff small vials containing one or two odorants, such as coffee or cinnamon, and to report whether or not an odor is perceived. Unfortunately, this procedure is a crude testing. Careful clinical practice needs a quantitative and repeatable test that can document olfactory ability during the course of treatment. The most widely used tests for assessing the ability to smell are those of odor identification and odor threshold[1].

Identification test allows the subject to smell a number of odorants and name them correctly. The test is a suprathreshold test, which the stimuli are presented at concentration above threshold that the subject considers normal for that odorant. The example of this test is the University of Pennsylvania Smell Identification Test (UPSIT)[2].

Detection threshold[3] is a popular mean for assessing olfactory function by measuring of the lowest concentration of a stimulus that can be detected. This test is a simple method of assessing the olfactory problems and used by clinicians to determine their severity from anosmia to hyposmia by comparing with the normal values. Moreover, it can be used for evaluation of improvement after treatment. This test has been wildly used to find smell detection threshold (SDT) in many countries[4]. However, the SDT values in normal Thai people have never been reported. The authors used this test to find SDT in Thai adults.

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Material and Method

Subjects

The authors performed a prospective study finding SDT in normal Thai adults from October 2002 to February 2003. The authors recruited 131 subjects who were non-smokers, healthy and had no previous olfactory dysfunction. The present study was approved by the Ethics Committee of the Faculty of Medicine Siriraj Hospital, Mahidol University, and written informed consent was obtained from each subject prior to study entry.

Experimental protocol

The authors used the single staircase procedure that incorporated phenyl ethyl alcohol (PEA) (S.M. Chemical, Bangkok, Thailand)[3]. A given trial consisted of the presentation of two 100-ml glass sniff bottles to the patient in rapid succession. One bottle contained 20 ml of a given concentration of PEA dissolved in light mineral oil (propylene glycol), whereas the other contained only mineral oil to serve as control. The patient was asked to report which of the two bottles provided the strongest sensation. The preparation of PEA at different concentrations has previously been described[3]. The first trial was presented with a -6.0 log (liquid volume/volume) concentration of PEA (the concentration of this solution was equal to $1/10^6$ fold of PEA). If a mistake in identifying the right bottle occurred on any trial before completion of five trials, the process was repeated with one higher step of log concentration. When five consecutive correct trials occurred at any given concentration level, the staircase was "reversed", and the next pair of trials was conducted at 0.5-log concentration ($1/10^{0.5}$ fold of PEA) step lower. From this point onwards, only one or two trials were presented at each step *i.e.* if the first trial was missed, the second one was not given, and the staircase was moved to the next a half higher step of log concentration. When correct performance occurred on both trials, the next trial was given 0.5-log concentration step lower. The geometric mean of the last four of seven staircase reversal points was the SDT estimate (Fig. 1).

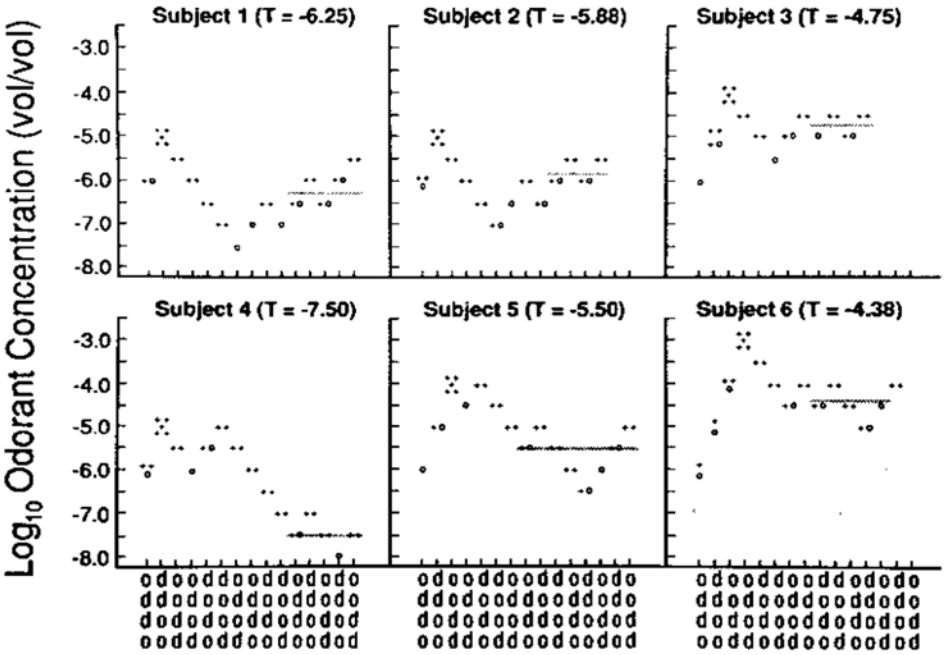

Fig. 1 Single staircase procedure. Data illustrate single staircase detection threshold determinations. Each plus (+) indicates a correct detection when an odorant vs. a blank is presented. Each minus (-) indicates incorrect report of an odorant. Threshold value (T; vol/ vol in light mineral oil) is calculated as the mean of the last four of seven staircase reversals. The "o" and "d" on the abscissa indicate the counterbalancing order of the presentation sequences for each trial and are read downward (o = odorant presented first, then diluent; d = diluent presented first, then odorant)

Statistical analysis

The data were analyzed with the use of nonparametric statistics because they were not normal distribution. Primary variable was SDT. Comparison of SDT values between male and female were done by the Mann-Whitney U-test. The statistical analysis was done using SPSS version 11.0 (Statistical Package for the Social Sciences, Chicago, USA). A p value (two-tailed) < 0.05 was considered to indicate significance. All data were reported as median (25^{th}-75^{th} percentile) values for descriptive purposes.

Results

The present study groups consisted of 65 males and 66 females. Age ranged from 20 to 60 years with the median of 26 years. The median value of SDT in 131 Thais was -12.3. The median values and ranges of age and SDT in male and female are shown in Table 1. There were no significant differences in age and SDT between the male and female group.

Discussion

Despite the fact that clinical otorhinolaryngologists are often faced with complaints of olfactory dysfunction, they have limited means to diagnose these problems, possibly because of the lack of a practical, objective standardized and generally approved technique. In the present study, the authors used glass sniff bottle technique to study SDT in normal Thai adults.

The olfactory test has been developed because of increased litigation. Physicians and insurance carriers are now, more than ever, aware that objective chemosensory assessment is essential for: (1) establishing the validity of a patient's complaint, (2) characterizing the specific nature of the chemosensory problem, (3) accurately monitoring medical or surgical interventions, (4) detecting malingering, (5) counseling patients to cope with their problems, and (6) assigning disability compensation. Evidence that olfactory testing may be helpful in the diagnosis of some neurological diseases will increase the importance of quantitative olfactory testing in medical practice.

Glass sniff bottle technique in the present study is one of quantitative measures for identifying olfactory function that can solve any limitation and offer benefit as described. The general format of this detection threshold test is to use a series of bottles containing a range of concentrations in predetermined steps. The patient is asked to indicate, on a given trial, which of two or more stimuli (*e.g.* an odorant and one or more blanks) smells strongest. This test is relatively easy to administer, sensitive to olfactory deficits that accompany a wide variety of disease states and of practical use in the clinic. Such "forced-choice" procedures are less susceptible to contamination by response bias than non-forced choice procedures. In addition, they are more reliable and produce lower threshold values[5]. The instructions provided to a subject are critical in measuring a detection threshold because, if the subject is instructed to report which stimulus is stronger, a spuriously high threshold value may result because the subject's attention is diverted away from subtle differences in the presented stimuli (odor quality is present only at higher perithreshold concentrations).

For all olfactory tests, especially those measuring threshold, control of stimulus concentration is obviously important. This glass sniff bottle technique can be designed with a gradient of concentrations. They are conveniently portable. The closed-bottle technique prevents odorant concentration to be changed by oxidation or evaporation. Another variable in olfactory testing is the presentation of the odorant to the olfactory receptors. Normal sniffing is by far the easiest and most practical method, providing optimal perception,

Table 1. Comparison of age and smell detection threshold (SDT) values (log phenyl ethyl alcohol threshold values) between male and female. Data are presented in median and range of 25^{th}-75^{th} percentile values

	Male	Female	p-value*
Number	65	66	
Age (25^{th}-75^{th})	26 (22-38)	27 (22-40)	0.9
SDT (25^{th}-75^{th})	-12.3 [-12.8-(-11.5)]	-12.3 [-12.8-(-11.5)]	0.8

* By Mann-Whitney U test
Data in parenthesis were 25^{th}-75^{th} percentile

avoiding the subjects to be confused with other sensations by puffing or blasting the odorant into the nose. Moreover, the first sniff provides the most significant information. Optimal sniff durations of PEA noted for cranial nerve I perception are 0.39 to 0.64 seconds[6].

Although pyridine and n-butyl alcohol (l-butanol) are two of the most widely used test chemicals because of their water solubility, easy identifiability, and history of successful use, the authors used PEA, which has a rose like smell, because it has less trigeminal stimulation[7].

Because of aforementioned advantages of this glass sniff bottle technique, the authors used it to study the normal values of SDT in Thai adults. All subjects cooperated and could tolerate the tests without any adverse events. Median values of SDT in both males and females were the same *i.e.* -12.3, which was not statistically different.

Many studies suggest that women have a better sense of smell than men, as reflected by test scores on a variety of olfactory tests[8,9]. However, in the present study, there was no difference between men and women, which could be attributable to inadequate sample size or sex did not affect sense of smell in Thais. Therefore, further studies that include more subjects are needed to solve and prove this hypothesis.

With this technique, the authors can evaluate the severity of olfactory problems or follow-up the improvement of odor detection after any treatment by comparing SDT with the normal values obtained from this study. Our data also showed that there was no statistically significant difference in SDT between males and females.

Conclusion

The authors have adopted the glass sniff bottle technique to measure SDT, which is easy to do and less time consuming and revealed that a normal value of SDT in Thais is -12.3. There was no significant difference in SDT between male and female in this age group (20 to 60 years). The normal values of SDT from the present study can be used as the reference in clinical practice and in other studies.

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การศึกษาความสามารถในการรับกลิ่นในผู้ใหญ่คนไทยปรกติ

ปารยะ อาศนะเสน, ประยุทธ ตันสุริยวงศ์, วิพร พลพรพิสิฐ, เมธิพจน์ ชาตะเมธีกุล, ฉวีวรรณ บุนนาค

จุดประสงค์ของการศึกษานี้ คือ หาค่าปรกติของความสามารถในการรับกลิ่นในผู้ใหญ่คนไทยที่ปรกติ โดยใช้วิธีสูดดมจากขวดแก้ว โดยได้ทำการศึกษาในผู้ใหญ่คนไทยที่ปรกติจำนวน 131 คน (ชาย 65 คน หญิง 66 คน โดยมีอายุตั้งแต่ 20 ถึง 60 ปี มีค่ากลางของอายุ เท่ากับ 26 ปี) สารที่นำมาใช้ทดสอบความสามารถในการรับกลิ่น คือ phenyl ethyl alcohol (PEA) ที่มีความเข้มข้นต่าง ๆ กัน ความสามารถในการรับกลิ่น คำนวณจากการเปลี่ยนแปลงของสมรรถภาพในการรับกลิ่น 7 ค่า และแสดงด้วยค่าล็อกของความเข้มข้นที่ต่ำที่สุดของ PEA ที่คนสามารถรับกลิ่นได้ ผลการศึกษาพบว่าค่ากลางของความสามารถในการรับกลิ่นในคนไทย 131 คน เท่ากับ -12.3 ซึ่งเท่ากัน ทั้งเพศชายและเพศหญิง ค่าดังกล่าวที่ได้สามารถใช้เป็นค่าปรกติในการตรวจผู้ป่วยที่มีปัญหาเรื่องการรับกลิ่น ในงานประจำวันและใช้เป็นค่าอ้างอิงในการทำงานวิจัยได้ด้วย