Research

Cultural adaptation and normative data for olfactory testing in the Indonesia's older adult population

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ABSTRACT

Background: The olfactory sense plays a vital role in well-being and cognitive health, particularly in the older adults. Olfactory dysfunction is linked to neurodegenerative diseases, and geriatric syndromes like frailty. Existing cognitive tests are education-biased, limiting their applicability. Cultural adaptation of olfactory tests enhances diagnostic accuracy, necessitating region-specific normative data for Indonesia. **Purpose:** To establish normative olfactory scores for Indonesia's older adult population using a culturally adapted odor identification test. **Method:** A descriptive study was conducted on 205 healthy participants aged 60 and above, in Jakarta. Eight culturally familiar odors were used in a forced-choice identification test. Normative data were generated based on percentiles, with the 10th percentile serving as the cut off for hyposmia. Data were analyzed using Statistical Package for the Social Sciences (SPSS). **Result:** Olfactory function was found to decline with age. Hyposmia thresholds were determined: individuals aged 60-64 years were considered hyposmic if they identified fewer than five odors, while those aged 80+ were hyposmic if they identified fewer than two odors. No significant differences were found between education levels, as both groups shared the same hyposmia thresholds. **Conclusion:** The study provided normative olfactory data specific to the Indonesia's older adult population. These results supported the use of culturally adapted tests in clinical practice to detect olfactory dysfunction, which might indicate early cognitive decline. Further research should include longitudinal studies to capture changes over time.

Keywords: cognitive, educational level, older adults, normative data, olfactory

ABSTRAK

Latar belakang: *Olfaktori, sebagai indra penciuman memiliki peran penting dalam kesejahteraan dan kesehatan kognitif, terutama pada lansia. Disfungsi penciuman berkaitan dengan penyakit neurodegeneratif dan sindrom geriatri seperti kelemahan tubuh. Tes kognitif yang ada cenderung bias terhadap tingkat pendidikan, sehingga membatasi penerapannya. Adaptasi budaya pada tes olfaktori meningkatkan akurasi diagnostik, sehingga diperlukan data normatif spesifik untuk populasi Indonesia.* ***Tujuan:*** *Untuk menetapkan skor normatif fungsi penciuman pada lansia di Indonesia, menggunakan tes identifikasi bau yang telah disesuaikan secara budaya.* ***Metode:*** *Studi deskriptif dilakukan pada 205 peserta sehat, berusia 60 tahun ke atas, di Jakarta. Sebanyak delapan bau yang sudah dikenal secara umum, digunakan dalam tes identifikasi bau dengan pilihan ganda. Data normatif ditentukan berdasarkan persentil, dengan persentil ke-10 sebagai batasan untuk hiposmia. Analisis data dilakukan menggunakan* Statistical Package for the Social Sciences (SPSS). ***Hasil:*** *Fungsi olfaktori ditemukan menurun seiring bertambahnya usia. Ambang batas hiposmia ditentukan sebagai berikut: individu berusia 60-64 tahun dianggap hiposmik jika mengidentifikasi kurang dari lima bau, sedangkan mereka yang berusia 80 tahun ke atas hiposmik jika mengidentifikasi kurang dari dua bau. Tidak ditemukan perbedaan signifikan berdasarkan tingkat pendidikan, karena kedua kelompok memiliki ambang batas hiposmia yang sama.* ***Kesimpulan:*** *Studi ini menyediakan data normatif fungsi penciuman yang spesifik*

untuk populasi lansia di Indonesia. Hasil ini mendukung penggunaan tes yang disesuaikan secara budaya dalam praktik klinis untuk mendeteksi disfungsi penciuman, yang dapat menjadi indikator awal penurunan kognitif. Penelitian lebih lanjut diperlukan, terutama studi longitudinal, untuk memahami perubahan fungsi penciuman dari waktu ke waktu.

Kata kunci: *kognitif, tingkat pendidikan, lansia, data normatif, olfaktori*

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INTRODUCTION

The olfactory sense holds considerable implications for the well-being of older adult, including enjoyment of life, emotional well-being, and cognitive health. Even slight impairments should be taken into account. Compromised olfactory function is often intertwined with alterations in taste, potentially leading to decreased appetite, and increased vulnerability to nutritional deficiencies and weakness. One prominent factor in the decline of olfactory capabilities is age. Research has shown that olfactory thresholds are higher in the older adult population, and there is also a reduction in odor identification.[1,2] The prevalence of the impairment varies highly among researchers, mainly due to different methodologies and olfactory profiles. A meta-analysis of more than 170,000 subjects showed an overall olfactory dysfunction of 34.5% in the group greater than 55 years of age, compared with 7.5% in the 55 years of age or less.[3]

The extent of health disadvantages due to olfactory impairment cannot be overstated. Olfactory dysfunction is also linked with depression and social withdrawal.[4–6] Decades of research also showed that olfactory dysfunction could be an early marker of several cognitive disorders like Alzheimer's dementia and Parkinson's disease, even when using only simple olfactory tests.[7,8] Moreover, other geriatric syndrome includes sarcopenia and frailty have been linked with olfactory dysfunction.[9]

The existing tests, such as Mini-Mental State Examination (MMSE) and Montreal Cognitive Assessment (MOCA), the two most common used tests for cognitive impairment, often have educational biases, which imply participants need a certain level of education to be able to answer the question.[10] As a consequence, there is a limitation in providing objective results among populations with varying educational background. The olfactory test has filled this gap, particularly in Indonesia, the gap between educated and uneducated individuals is relatively huge.[11]

We would like to comprehend the diversity of olfactory profiles in different regions.

Recent studies have shown a growing interest in the influence of racial and ethnic-geographic backgrounds on olfactory function. Studies have revealed differences in olfactory performance between racial groups, indicating that a universal olfactory test may not be suitable for all geographic populations.[12] This is because olfactory performance is influenced by cultural background. Therefore, it is recommended that odor tests be culturally adapted in regions and countries with different cultures, climates, and other factors.[13,14] For instance, research has demonstrated that individuals from different areas and countries have varying levels of familiarity with specific odors. For example, Germans may be more familiar with odors such as leather, cinnamon, licorice, rose, and clove, while Danish

people may be more familiar with vanilla, cinnamon, cheese, and bacon. Similarly, Chinese people may be more familiar with odors like watermelon, cherry, carrot, and peanut, while Japanese people may be more familiar with odors like chocolate, coffee, and peanut butter. These findings emphasize the need for cultural adaptation of olfactory tests to ensure their relevance and accuracy in diverse populations. There have also been findings where standardized olfactory tests, such as University of Pennsylvania Smell Identification Test (UPSIT), have performed poorly in the United Kingdom.[15-17]

Adaptation on olfactory tests has been attempted in other regions as well. The Sniffin' Sticks test, another standardized olfactory test, has been adapted to Malaysia, South Kivu, the United Kingdom, Iran, China, and Germany.[13–15,18,19]

In Indonesia, the aromatic landscape is a deep-seated part of its heritage. Scents such as jasmine are not only prevalent in daily life, but are also integral to ceremonial traditions. Aromatic ginger spans culinary uses to traditional medicine, reflecting its importance in the Indonesian smell and taste. Some odors administered are also analogous to those used in the UPSIT. Similarly, the familiarity of menthol, coffee, citrus, eucalyptus, and lemongrass scents is entrenched in the Indonesian lifestyle, making them ideal candidates for cultural olfactory assessment and its accessibility.[9,20]

According to the odor prism hypothesis, odors are classified into six primary categories: flowery, foul, fruity, aromatic, burnt, and resinous. Hence, in developing an olfactory test, it is essential to consider the different categories of smell and implement them correspondingly.[21,22]

The primary goal of this study was to develop normative data delineating normal and abnormal olfactory functioning within the Indonesia's older adult population. The development of this olfactory baseline was pivotal for enhancing clinical evaluations for screening tests regardless of educational status, and advancing our understanding of sensory health in aging populations.

METHOD

Ethical considerations

The study protocol was reviewed and approved by an ethics committee. All participants provided written informed consent prior to their inclusion in the study.

Study design and participants

We conducted a descriptive study using convenience sampling to evaluate olfactory function in the Indonesia's older adult population. A total of 205 individuals aged 60 years and above participated in the study, and all participants were presumed to be healthy.

Inclusion and exclusion criteria

Participants were included if they were 60 years of age or older, able to give informed consent, and willing to participate in the olfactory testing procedure. Exclusion criteria included individuals with a history of nasal surgery, significant nasal or sinus disease, neurological disorders affecting the sense of smell, current smokers, and those with upper respiratory tract infections at the time of testing.

Selection of odorants

Jasmine (flowery), lemon and orange (fruity), lemongrass, aromatic ginger, coffee (aromatic), menthol, and eucalyptus (resinous) were chosen as the essential oils for the olfactory tests, to provide clinicians with simple olfactory measurements for patients.

Test administration and procedure

A trained researcher administered the olfactory test in an outdoor setting, taking advantage of natural ventilation to prevent odorant cross-contamination. Participants

were presented with eight essential oils representing familiar odors: jasmine, aromatic ginger (*kencur*), menthol, coffee, orange, lemon, eucalyptus oil, and lemongrass. Each odorant was presented sequentially in a non-transparent bottle. Participants were instructed to sniff the bottle and then describe the odor. A 10-second interval was allowed between presentations to minimize olfactory fatigue. The exposure duration to each odorant was 15 seconds.

Odorant presentation and response measurement

Due to the nature of the essential oils used, the concentration of the odorants was not specified. Participants were given four multiple-choice options to identify each odorant correctly. Based on this forced-choice identification method, responses were documented as correct or incorrect, and a checklist was used to record the responses. Positive screens for hyposmia were used if subjects were under the 10th percentile.

Statistical analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) software. Normative tables were created for male and female participants, stratified into age groups (60-64, 65-69, 70-74, 75-79, 80+). Descriptive statistics were computed for demographic variables, and odor identification scores. Percentile ranks for olfactory function were established, and the 10^{th} percentile score was determined as the threshold for hyposmia, a condition characterized by impaired olfactory perception. Chi-square tests were used to analyze the categorical data.

Data collection and management

Participant responses were recorded on standard data sheets and subsequently entered into an SPSS database for analysis. Personal identifiers were removed to maintain participant confidentiality, and data was stored securely in accordance with ethical guidelines.

Sociodemographic and health data

It was assumed that all participants were generally healthy. Sociodemographic information, including age and sex, was collected to allow for stratification in the normative tables.

RESULT

Demographics

Data were collected from a total of 205 participants between 60-85 years of age (median ± IQR: 71.00 ± 8). All participants reported being healthy and denied any olfactory dysfunction. The participants were divided based on gender and into five age groups (<64, 65-69, 70-74, 75-79, 80+).

To assess the normality of the age distribution within our sample, we conducted a One-Sample Kolmogorov-Smirnov Test. The results indicated that the distribution was not normal (asymptotic significance of 0.001).

The smallest group of participants was those aged between 60 and 64, with 14 (6.8% of the total sample), while the 65-69 age group was the most represented, with 72 individuals (35.1% of the total sample), as shown in Table 1.

Table 1. Distribution of participants by age group

Age group	Frequency	Percent	Cumulative percent
60-64	14	6.8	6.8
65-69	72	35.1	41.9
70-74	61	29.8	71.7
75-79	42	20.5	92.2
≥80	16	7.8	100.0
Total	205	100.0	

Table 2. Distribution of participants by educational level

	Frequency	Percent	Cumulative percent
<12 years	51	24.9	24.9
≥12 years	154	75.1	100.0
Total	205	100.0	

Table 2 also showed the distribution of participants according to their educational level. Out of a total of 205 participants, 24.9% (n=51) had less than 12 years of education, while the majority, 75.1% (n=154), had 12 or more years of education. This distribution reflected a higher proportion of participants with extended educational attainment.

Effect of age on olfactory results

The analysis of the olfactory test scores had been stratified into age groups and percentile ranks to establish normative data for the Indonesia's older adult population, encompassing both males and females. The scores ranged from 0 to 8, with higher scores indicating better olfactory function. The cutoff point for hyposmia is defined as a score under the 10th percentile.

In our study, we established specific cutoff points to define hyposmia. For individuals aged 60-64 years, we set the threshold at identifying fewer than five odors. Conversely, participants aged 65-69 years, the threshold is fewer than four odors. For those aged 70-74 and 75-79 years, the cutoff for hyposmia was set at identifying less than three odors. Finally, for individuals aged 80 years and above, identifying fewer than two odors indicated hyposmia. These age-specific cutoff points in Table 3 allowed us to accurately diagnose and distinguish between normal and impaired olfactory function across different age groups.

Table 3. Normative data for olfactory scores in female and male participants (n=205)

Olfactory score	60-64	65-69	70-74	75-79	≥80
8	100	100	100	100	100
7	85.7	90.3	91.8	92.9	87.5
6	42.9	56.9	68.9	76.2	75
5	28.6	38.9	37.7	59.5	62.5
4	7.1	19.4	26.2	31	56.5
3		8.3	18	11.9	31.3
2		1.4	8.2	7.1	25
1			3.3		6.3
0			1.6	2.4	

Effect of educational level on olfactory result.

Our study divided the results of the olfactory test based on education level as presented in Table 4. Education levels were divided into below 12 years of education, and 12 years of education or more. In older person with less than 12 years of education, hyposmia was determined if they could detect fewer than three types of odors. Similarly, the same cutoff was seen in individuals with 12 years of education or more.

Table 4. Normative data for olfactory scores based on educational level (result on percentile)

Olfactory score	Educational level <12 years (n=51)	Educational level ≥12 years (n=154)
8	100	100
7	88.2	91.6
6	58.8	67.5
5	49.0	43.5
4	31.4	24.0
3	13.7	13.0
2	3.9	7.1
1		2.6
0		1.3

DISCUSSION

This study aimed to explore olfactory function within the Indonesia's older adult population using culturally-adapted olfactory tests. The results added significant value to the understanding of the decline in olfactory ability with aging and differences in gender, regarding olfactory abilities. They also highlighted the importance of cultural relevance in assessments in olfactory testing.

Our findings confirmed that olfactory function decreases with age. This trend is consistent with existing literatures, which documented a decrease in sensitivity, discrimination, and identification as characteristic of olfactory function in relation to increasing age.[23,24]

The underlying mechanisms of age-related olfactory decline are complex. In the peripheral and central olfactory systems, structural and functional changes are thought to occur with aging within the olfactory epithelium, the olfactory bulb, and the olfactory cortex. The factors implicated in olfactory function impairments with age, include cumulative insults from the environment, reduced neurogenesis, and modifications in synaptic organization and neurotransmitter systems.[25,26]

The cutoff points for hyposmia in different age groups are applicable to clinical settings. They provide insights into what might be normal olfactory function among the Indonesia's older adult population at different age groups. These cutoffs are very important in relation to the early identification of olfactory dysfunction, an issue that our study strongly stresses, as olfactory dysfunction is found to be an early marker of cognitive decline.

Our study showed that there was no difference in olfactory scores between respondents with different levels of education, whether less than 12 years, or 12 years and above. Both education level groups had the same cutoff values for hyposmia (identifying fewer than three types of odors). This finding contrasted with most other studies, which stated that education level had a significant positive effect on olfactory score.[12,27]

Although most studies stated a correlation between lower education levels and decreased olfactory scores, Gul et al.[27] reported findings that lower education levels were associated with older age, indicating that no clear correlation could be drawn between decreased olfactory scores and education levels in certain populations.

Several limitations should be acknowledged. Firstly, our study design limited our ability to infer causality. Longitudinal studies would better track changes in olfactory function within individuals as they age. Secondly, our study utilized convenience sampling, which could limit the representativeness of the Indonesia's older adult population. A more randomized sampling strategy might make the results more generalized.

In conclusion, for our study, we developed an olfactory test with culturally specific odors for Indonesia's older adult population, and determined cutoffs for hyposmia. Eight essential oils were used to represent familiar odors to the Indonesian population. We confirmed a trend that as the age group increases, olfactory function decreases. Future research should use longitudinal designs to capture changes in olfactory function over time, and employ random sampling strategies to enhance representativeness. Further research may benefit from adding other parameters, such as diet, lifestyle, or environmental exposure, to encapsulate a more holistic light on olfactory dysfunction in older people.

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