pISSN 2460-9684, eISSN 2476-8863, Accredited number 36/E/KPT/2019
Volume 9, Number 1, June 2024
doi.org/10.21460/bikdw.v9i1.631

Research

DEVELOPMENT OF STANDARDIZED OLFACTORY TEST AS A COGNITIVE IMPAIRMENT SCREENING TOOL IN INDONESIAN ELDERLY: A PRELIMINARY STUDY

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Received: 22-03-2024 / Accepted: 27-08-2024

ABSTRACT

The decline of olfactory function is an early indicator of neurodegenerative diseases, such as Alzheimer's and Parkinson's disease. An olfactory function assessment instrument using ten familiar scents with multiple-choice answers has been developed, but several items were inapplicable and had not been standardized. This study aimed to identify various scents that have not been standardized for the aging population with normal cognitive function. This research was a preliminary study with a descriptive cross-sectional approach conducted in Kalianyar village, Jakarta, involving 23 elderly participants with normal cognitive function. An instrument consisting of a list of scents was employed in two steps, with or without assistance. Initially, participants had one chance to smell and try to guess the type of scent given. If the scent was not guessed correctly, participants were then provided with multiple-choice options as a hint. Based on the assessment of twelve scents from the existing research, only nine scents were recognizable. Among them, coffee, lemongrass, oranges, eucalyptus, and menthol were the scents with the most correct answers without assistance. Additionally, there were four scents recognized with or without assistance, such as jasmine, lemon, aromatic ginger, and lime. This study found that only nine scents were familiar and had the potential to be utilized in the future as a screening tool for cognitive impairment.

Keywords: neurodegenerative diseases, cognitive impairment, elderly, olfactory function, screening tool, scents

INTRODUCTION

The olfactory function in human is characterized by the ability to detect, identify, discriminate, and memorize odors. In regard of the ageing process, olfactory function is reported to deteriorate across the lifetime, with the prevalence of 10% in older people over 65 years to 60-80% in over 80 years.[1]

A decline of olfaction ability in older people may not only be a part of normal ageing, but also several pathological conditions that are commonly unrecognized. The presence of olfactory dysfunction (OD) in older people has been associated to the risk of several neurodegenerative diseases, including Alzheimer's Disease (AD), Parkinson's Disease (PD) [1-3], Lewy-Body (LB) Diseases, as well as numerous other mental health problems[2,4]. Furthermore, OD is also reported to be an early manifestation of the neurodegenerative diseases and has been proposed as an important clinical indication to detect the underlying condition earlier before the disease progresses, such as cognitive impairment and dementia in the case of AD.[4]

Assessment of the olfactory function has been recognized as a convenient and affordable screening tool to assess the neurodegenerative conditions.[2] Currently, there are various instruments that can be used to test the smell ability, for instance the University of Pennsylvania Smell Identification Test (UPSIT) and Sniffin-Sticks Test. As the gold standard, UPSIT has been widely used and commonly accepted as a self-administered, scratch-and-sniff method instrument to test the olfactory functioning.[1-3,5]

However, the relative time-consuming and large number of scents that are tested in UPSIT are inconvenience to be used in certain conditions[1,3,6], therefore numerous instruments adapted from the test have been made, namely the Brief Smell Identification Test (BSIT), San Diego Odor Identification Test (SDOIT), Barcelona Smell-Test-24 (BAST-24), and Italian Olfactory Identification Test (IOIT).[1-3] In Asia, Cross Cultural Smell Identification Test (CC-SIT) is another modification of UPSIT that is commonly used to measure scent identification among Asians, including Indonesia.[5] Despite all of the twelve scents that were thought to be familiar toward Asians, several scents that are included in CC-SIT are still considered unfamiliar and

inconvenient among Indonesians.[5] On top of that, there is no standardized olfactory function test instrument to date in Indonesia, while the assessment is also still considered uncommon toward the Indonesian older people, regardless of its importance.[3,5,7]

Regarding this matter, several studies have proposed the importance of standardized assessment of olfactory function among Indonesians, particularly the older people.[5,7] A research by Luhur et al.[5] has shown the ten familiar scents that can be included in the olfactory function assessment toward Indonesian elderly people. The scents were eucalyptus, coffee, jasmine, menthol, cloves, gasoline, pandanus, camphor, chocolate, and oranges. These items are currently used in the assessment of olfactory function in Indonesia, particularly due to its familiarity and convenience, along with other tests.[8,9]

Unfortunately, there were several items in the familiar scents that are unpleasant toward the older people, such as gasoline[10] and camphor[11]. Despite of the familiarities of the scents, the acceptance of the scents from the participant should be considered, in order to establish a standardized olfactory function assessment that is appropriate in regular setting in Indonesia.

Therefore, this study was conducted to seek various familiar scents that are potential to be utilized in Indonesia in the future. Later, using these selected scents, standardization could be taken place, and a cut-off could be developed as a screening tool to predict cognitive impairment in older adults before the disease progresses.

METHODS

This research was a descriptive cross-sectional study conducted in Kalianyar Village, Jakarta. We used the Slovin Formula (Z=1,96, p=0,6; q=0,4 and d=0,2) to estimate the sample size considering this was a preliminary study for validating an olfactory function test. The subjects were selected through purposive sampling from a database of locals in Kalianyar Village who had participated in Atma Jaya Active Ageing project. The inclusion criteria for this study were: (1) Indonesian people of 65 years old or older; (2) Normal cognitive function, indicated by MMSE score of ≥ 24; (3) Able to communicate. Meanwhile, the participants were excluded if there were: (1) Pathological conditions of upper respiratory tract; (2) History of trauma along upper respiratory tract.

Prior to the test, we used MMSE to screen participants to enforce the inclusion criteria. It is important to emphasize that the odor identification assessment in this study was carried out using twelve scents commonly found in Indonesia according to Luhur et al[5]. They were coffee, eucalyptus, jasmine, oranges, rose, coconut, menthol, lemon, lemongrass, aromatic ginger, lime and turmeric. To avoid bias, participants were initially asked to do a one-time identification of the scents given in ten seconds then mentioning the name. However, if the respondents were not sure about the scent they had smelled, a multiple-choice answer was then offered. Participants were not allowed to change the answer afterward.

The result of this test would be considered by analyzing several top scents that had been correctly answered the most by participants, which would later be classified on whether assistance was required (with assistance) or not (without assistance). The result was then collected and analyzed descriptively.

This study was approved by Ethical Committee of School of Medicine, Atma Jaya Catholic University Indonesia No. 04/07/KEP-FKIKUAJ/2022.

RESULTS

Participants were predominantly female (56.5%), in line with global data which states female population possess higher life expectancy. The average age within participants was 68 years old and most of them graduated from elementary school (47.8%). The MMSE showed that all participants were within normal range scoring 27- 30, with average score of 27 hence no exclusion needed. Characteristics of respondent are shown in Table 1.

A total of 23 elderly participants with normal cognitive function were included in the study. All participants were informed about the study and given their consent to participate. Based on the assessment of twelve scents, only nine scents were recognizable. Additionally, coffee, lemongrass, oranges, eucalyptus, and menthol were the ones with most correct answers without assistance. Besides, there were four additional scents that were answered correctly the most, with or without assistance, namely jasmine, lemon, aromatic ginger, and lime (Table 2). Analysis result of scores answered and unanswered based on gender shows that the average for men is higher in unanswered scores (53.81%) compared to women (45.36%). Conversely, the average for women is higher in answered scores (58.54%) compared to men (41.46%) (Table 3).

Table 1. Characteristic of Respondents (n=23)

Characteristic	N (%)	Mean ± SD
Age		68.3 ± 4.665
Gender		
Male	10 (43.5)	
Female	13 (56.5)	
MMSE score		27.48 ± 2.086
Answered scent		6.522 ± 2.254
>= 7	12 (52.2)	
< 7	11 (47.8)	

Characteristic	N (%)	Mean ± SD
Education		
No Education	7 (30.5)	
Graduated from Elementary School	11 (47.8)	
Graduated from Junior High School	2 (8.7)	
Graduated from Senior High School	3 (13.0)	
Graduated from College- Diploma	0	

The average scores for answered and unanswered questions also differ based on education level. For respondents with an educational background, the average score for answered questions is higher (70.41%) compared to those without an education (29.2%) (Table 4).

Table 2. Number of people (%) who were able and not to answer based on the list of scents (n=23)

No.	List of Scents	Without assistance	%	With assistance	%	Unanswered	Percentage
1.	Coffee	11	47.8	3	13.0	9	39.1
2.	Eucalyptus	8	34.8	4	17.4	11	47.8
3.	Jasmine	6	26.1	6	26.1	11	47.8
4.	Orange	9	39.1	8	34.8	6	26.1
5.	Rose	2	8.7	4	17.4	17	73.9
6.	Coconut oil	2	8.7	7	30.4	14	60.9
7.	Menthol	8	34.8	6	26.1	9	39.1
8.	Lemon	0	0.0	16	69.6	7	30.4
9.	Lemongrass	11	47.8	4	17.4	8	34.8
10.	Aromatic ginger	0	0.0	11	47.8	12	52.2
11.	Lime	0	0.0	15	65.2	8	34.8
12.	Turmeric	2	8.7	7	30.4	14	60.9

Table 3. Number of people (%) who were able and not to answer based on gender

No.	List of Scents	Unanswered				Answered			
		Male (n=10)		Female (n=13)		Male (n=10)		Female (n=13)	
		n	%	n	%	n	%	n	%
1.	Coffee	5	55.6	4	44.4	6	42.9	8	57.1
2.	Eucalyptus	8	44.4	10	55.6	3	60	2	40
3.	Jasmine	7	53.6	4	36.4	4	33.3	8	66.7
4.	Orange	2	33.3	4	66.7	9	52.9	8	47.1
5.	Rose	8	47.1	9	52.9	3	50	3	50
6.	Coconut oil	7	50	7	50	4	44.4	5	55.6
7.	Menthol	4	44.4	5	55.6	7	50	7	50
8.	Lemon	5	71.4	2	28.6	6	37.5	10	62.5
9.	Lemongrass	5	62.5	3	37.5	6	40	9	60
10.	Aromatic ginger	8	66.7	4	33.3	3	27.3	8	72.7
11.	Lime	4	50	4	50	7	46.7	8	53.3
12.	Turmeric	10	66.7	5	33.3	1	12.5	7	87.5
Average		**53.81**		**45.36**		**41.46**		**58.54**	

Table 4. Number of people (%) who were able and not to answer based on educational level

No.	List of Scents	Unanswered				Answered			
		No Education (n=15)		With Education (n=8)		No Education (n=15)		With Education (n=8)	
		n	%	n	%	n	%	n	%
1.	Coffee	4	44.4	5	55.6	4	28.6	10	71.4
2.	Eucalyptus	7	38.9	11	61.1	1	20	4	80
3.	Jasmine	3	27.3	8	72.7	5	41.7	7	58.3
4.	Orange	4	66.7	2	33.3	4	23.5	13	76.65
5.	Rose	6	35.3	11	64.7	2	33.3	4	66.7
6.	Coconut oil	7	50	7	50	1	11.1	8	88.9
7.	Menthol	4	44.4	5	55.6	4	28.6	10	71.4
8.	Lemon	5	71.4	2	28.6	2	18.8	13	81.3
9.	Lemongrass	3	37.5	5	62.5	5	33.3	10	66.7
10.	Aromatic ginger	3	25	9	75	5	45.5	6	54.5
11.	Lime	3	37.5	5	62.5	5	33.3	10	66.7
12.	Turmeric	5	33.3	10	66.7	3	37.5	5	62.5
Average		**42.6**		**57.36**		**29.2**		**70.4**	

DISCUSSION

The characteristics of respondents in this study align with global data regarding the elderly population based on gender.[12,13] This happens because men have a lower life expectancy due to biological, ethnic, and socio-cultural factors. From a biological perspective, several hypotheses have been proposed to explain gender differences in longevity, such as better protection from oxidative stress in women, compensatory effects of the second X chromosome, telomere length, more active female immune function, and the protective effects of estrogen in women.[14]

Apart from that, this research also found that the educational history of the majority of respondents had completed elementary school, more or less than 12 years of education. Groups with a history of low education will increase the risk of having cognitive problems in the future.

In terms of olfactory test, there are numbers of scents that are found to be the most familiar ones to the participants. In general, there were types of scents that could be answered correctly without assistance, which included coffee, lemongrass, oranges, eucalyptus, and menthol. However, without considering the assistance required, jasmine, lemon, aromatic ginger, and lime were the scents that were answered correctly the most by all participants. Furthermore, these scents could be classified as fruity, woody, floral, citrus, and spicy[15,16], and therefore indicating the familiarity of the respondents toward those type of scents[16].

Similar to some previous studies, for instance, Khamsi[16] provided several previous studies that associate odor identification (OI) in humans with emotional memories. The study suggested that olfactory bulb (OB), as the nerve responsible of odor reception, redirects smell signals to certain region of the brain, called olfactory cortex (OC). The transmitted signals are later known to not only activate the olfactory cortex, but also the hippocampus simultaneously. Moreover, further similar study using rats also demonstrated that piriform cortex (PC) and entorhinal cortex (EC) were also activated through the release of dopamine from the hippocampus as a respond to the scent stimuli from OB. This may explain specific emotional and spatial memories may be triggered, in line with the activation of those specific regions of the brain.[16,17]

Another study by Wilson et al.[17] also presented the association of OD in AD, through post-mortem pathological examination and found accumulation of neurofibrillary tangles, plaques and Lewy-bodies in the EC and hippocampus region, as well as in the OB. In line with this finding, OD in older people may also indicate deterioration in EC that is commonly found in early AD, which is marked by cognitive decline.[16] These findings, nevertheless, suggested that diminished cognitive function in older people may suggest the inability to identify odor through several conditions that need to be considered, namely cognitive decline due to semantic memory deterioration and OD due to EC and OB dysfunction, as well as other cofounding factors that affect the results.[8,16,17]

Human learning process is also thought to depend on dopamine transmitted in the specific part of the brain. The release of dopamine in PC, EC, as well as hippocampus is known to found to be associated with the ability to retain information and emotional functioning which are essential in learning, as well as memory recollection. Hence, this indicates that OI may be related to the perception of previous retained memories about the scents, and the familiarity of the respondents with the smells given would be necessary, besides merely their ability to recollect the memories from the past experience.[8,16]

While OI was strongly associated with episodic and emotional memories, the ability to name the scents is also linked to the function of the semantic memory.[17,18] Regarding this matter, Backman[18] found that the ability of identify the smell given to older people may remain intact, but the ability to label the specific names of the odor may decrease similarly as the function of semantic memory degraded. Therefore, the presence of answer choices may be beneficial in distinguishing the impairment of general ability to retrieve the name of the scents with the diminished ability to smell, particularly in older people.

In this study, the presence of supplementary assistance in the form of multiple choices may benefit to reduce the influence of semantic memory declining in older people, thus giving a more precise result in which olfactory disturbance more likely to occur. Apart from being opted in participants with normal cognitive function, the selected scents given to the participants also considered to be the ones that commonly found and acceptable toward general population of older people in Indonesia.

Finally, the result of this research has also revealed the most familiar scents among representative respondents in the light of general older people population in Indonesia. The scents are found to be mainly classified as fruity, floral, woody, citrus and spicy odors. Therefore, it is important to use familiar odors between countries as it has own unique odor familiarity.[19]

Limitations

This study has observed several possible scents as a basic item suggested for the standardization purpose of the olfactory function assessment instrument. However, several important factors, including the multiple-choice answers provided in the process, the reliability and validity of the test as well as the items to be generally applied and accepted should be considered to generate a well-establish, standardized instrument of the olfactory function assessment, especially in older people in Indonesia. Hence, further study to support a better understanding toward practical aspects and relevancy of this study in broader application is still needed.

CONCLUSION

In conclusion, this study has discovered nine most familiar items that are possible to be proposed in establishing a standardized older people's olfactory function assessment. The scents are coffee, lemongrass, oranges, eucalyptus, menthol, jasmine, lemon, aromatic ginger, and lime. Future research is to determine normative values of aforementioned scents.

ACKNOWLEDGEMENT

We would like to thank people of Kalianyar urban village, Jakarta, for participating this study.

CONFLICT OF INTEREST AND FUNDING RESOURCES

Statement of Consent

All participants in this study have been provided with information and voluntarily agreed to participate in the study.

Funding Details

This work was supported by Institute for Research and Community Service (LPPM) Atma Jaya Catholic University of Indonesia under grant number 422/LL3/AK.04/2022.

Declaration of Interest

The authors report that there is no competing interest to declare.

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