



## Age and Gender Differences in the Recognition of 12 Different Odors Results for Ten Years (2009-2018) In the Yakumo Study

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### Abstract

For ten years(2009-2018), we have conducted olfactory examination by using the Odor Stick Identification Test in Yakumo town inhabitant medical examination. The Odour Stick Identification Test (OSIT-J) was used to assess odour perception. This test possesses high reliability and validity. The OSIT-J includes 12 different odorants to be identified. As we have already reported, the olfactory test results decrease in the number of correct answers as the age increases. However, from 40's to 80's, few studies have clarified the distribution of the number of correct answers according to age. Therefore, this study aimed to compare of recognition of 12 different odors in olfactory test results for the past 10 years according to age and sex. A total of 3275 people (1308 males and 1967 females) had a total number of people is who participated in the Yakumo town resident health examination in 2009-2018. The Odour Stick Identification Test (OSIT-J) was used to assess odour perception. The aromas used in the OSIT-J includes curry, perfume, Japanese cypress, India ink, menthol, rose, wood, stinky socks/sweaty, roasted garlic, condensed milk, gas for cooking, and Japanese mandarin orange.

From all the data, the odour that male recognition was high was in the order of steamed socks /sweaty, wood, curry. As same as female recognition was high was in the order of roasted garlic, gas for cooking, rose. Males and females differed in perception of odour type. We compared odors with high recognition by gender by age. In males in their 40's, odors with high recognition were in the order of roasted garlic, rose, curry. In females in their 40's, odors with high recognition were in the order of rose, roasted garlic, steamed socks / sweat. In males in their 80's, odorous with high recognition were in the order of wood, steamed socks / sweat, rose. In females in their 80's, odors with high recognition were in the order of steamed socks / sweat, roasted garlic, curry. Although the types of odors with high awareness differed by gender and age, roasted garlic, steamed socks / sweat, wood, gases of cooking, rose and

curry were almost on top in all. In the future, when many patients are examined by screening, the examination will be performed with six types of odors (roasted garlic, steamed socks / sweat, wood, gas of cooking, rose and curry). If patients don't know these three odors, more detailed examinations can be used to test many patients in a short time.

**Keywords:** Aging; Gender; Healthy Elderly People; Olfactory Function; Yakumo Study

## **Introduction**

The population of Japan has been flat in recent years, and it is in a phase of population decline. By 2060, the total population will interrupt 90 million, and the aging rate is estimated to be close to 40 %. There is a concern that with increasing age, individuals would soon be unable to identify through the sense of smell. Furthermore, nasal congestion and olfactory disorders occurring after inflammation that are caused by allergic rhinitis, modern-day hay fever, and common colds also inhibit the sense of smell [1-3].

Present in a narrow region of the mucosa that covers the inside of the nose (olfactory epithelium) are the olfactory receptor neurons. The dendritic ends (olfactory cilia) of these neurons detect odour molecules that enter the nose via currents of air, which produces an electrical signal. This signal travels up through the bone that forms the ceiling of the nasal cavity (the cribriform plate) via nerve fibres that converge on the olfactory bulb, an enlarged area of nerve cells of the brain that also form olfactory nerves. Signals passing through the olfactory bulb travel to the brain along these olfactory nerves, where the signals are interpreted, and the smell is recognized [4]. The medial aspect of the temporal lobe that remembers smells is also stimulated at this point, and the brain can identify the odour based on a memory of previously experienced smells. In other words, smell identification requires an already-accumulated set of experienced smells [5, 6].

Both olfaction and gustation start to decline in humans around the age of 50-59 years, with 40% of the elderly experiencing a noticeable decline [7]. A person's first awareness of decline in olfaction as our primary dependence for identification of flavour occurs when one is unable to distinguish foods by taste alone.

Olfaction also performs an important and essential role in our ability to detect dangers, including the smell of leaking gas, the burning odour of fire, and the putrid smell of rotten food. Olfaction is also responsible for enrichment and psychological stimulation in our everyday lives, such as with the scents and smells of foods and flowers [8]. In an already aged society, healthy olfaction is a necessary part of creating a safe and fertile living environment and for improving an individual's quality of life.

Considering these circumstances, this study aims to understand the age-related decline in olfactory function in participants aged 40-49 years, 50-59 years, 60-69 years, 70-79 years, and 80-89 years. We identified the odours particularly difficult to distinguish for individuals of these age and sex groups past our short-term findings [9-12]. We settled olfactometry result in the Yakumo-cho inhabitant's examination for 10 years this time. This results might help draw attention to issues faced by individuals in their daily lives and facilitate improvement in their quality of life. If a cognitive test of 12 different odors is performed at the time of screening, it takes too much time. We think that it is necessary to select the odor to be examined in order to conduct an olfactory cognitive test for the large number of examinees in a short time at the screening.

## **Material and Methods**

### **Participants**

The participants were community dwellers who voluntarily participated in the Yakumo Study and had managed their everyday life themselves. The Yakumo Study has been conducted since 1981 as a joint project between the town of Yakumo in Hokkaido and the Nagoya University Graduate School of Medicine. Professionals in the fields of epidemiology, internal medicine, orthopaedics, neuropsychology, ophthalmology, otolaryngology, and urology have joined to the Yakumo Study. The analysed data here were based upon the database from 2005 from the neuropsychology and otolaryngology teams. The participants had been engaged in a variety of jobs, not only white collar but also in agriculture, fishery, and forestry. Therefore, this town can be regarded as representative of today's Japanese society. From the database, a 3275 olfactometry participant (1967 female and 1308male) was selected from data in August, 2009-2018.

### **Assessment of Odour Identification**

The Odour Stick Identification Test (OSIT-J) was used to assess odour perception. This test possesses high reliability and validity [13]. The OSIT-J includes 12 different odorants to be identified. As odour perception is not necessarily culture-free, the Japanese

version was employed [14, 15]. The basic procedure resembles that of the San Diego Odour Identification Test [16]. The aromas used in the OSIT-J includes curry, perfume, Japanese cypress, India ink, menthol, rose, wood, stinky socks/sweaty, roasted garlic, condensed milk, gas for cooking, and Japanese mandarin orange. Each fragrance was enclosed in microcapsules made of melamine resin. These microcapsules were mixed with an odourless solid cream and then shaped to look like a lipstick. During the inspection test, the examiner applied each odorant to a piece of paraffin paper. After application, the examiner handed the paper to the participant, who would then sniff the paper and identify the odour. Participants selected each answer from a set of cards, each of which listed the name of an odorant, including the correct answer.

## Ethical Review Board

This study was conducted with the approval of the Ethical Review Board (Nagoya women's university 'hitowomochiitakennyuu ni kansuruiinkai'). The approval number is 29-22.

## Results

### Participants Age Distribution

We united olfactometry data for ten years and had a table according to sex and the age of the participant. The distribution of gender by age group was as follows. In the 40's, 323 participants were 225 females and 98 males. In the 50's, 594 participants were 396 females and 198 males. In the 60's, 1371 participants were 786 females and 585 males. In the 70's, 809 participants were 472 females and 337 males. In the 80's, 178 participants were 88 females and 90 males. A total of 3275 participants performed olfactory cognitive tests during the decade.

### Assessment of Odour Identification

The results of the olfactory cognition test for all participants are shown in (Table 1). In both male and female, the odor of correct answer rate was less than 50% in 12 different of olfactory cognitive tests matched. It is the smell that mandarin orange, Japanese cypress and menthol were the less than 50% of recognition rate. There were five odors with high recognition rates for both male and female.

It is the smell that stinky socks/sweaty, roasted garlic, rose, curry and wood were the more than 57% of recognition rate. However, the recognition rates for the remaining four odors differed slightly between male and female. It is the smell that perfume, gas for cooking, condensed milk and India ink were about 50~55% of recognition rate.

	Male (n=1308)	Female (n=1964)
1st.	Stinky socks/sweaty (62.8%)	Roasted garlic. (64.9%)
2st.	Roasted Garlic (61.9%)	Stinky socks/sweaty (61.0%)
3st.	Rose (61.7%)	Gas for cooking (60.3%)
4st.	Curry (61.3%)	Rose (60.1%)
5st.	Wood (60.5%)	Wood (59.2%)
6st.	Perfume (56.3%)	Curry (57.3%)
7st.	Gas for cooking, (54.4%)	India Ink (55.7%)
8st.	Condense Milk (53.3%)	Perfume (53.9%)
9st.	India ink (50.8%)	Condense Milk (49.0%)
10st.	Menthol (46.8%)	Menthol (48.5%)
11st.	Japanese Cyprus (46.6%)	Japanese Cyprus (45.5%)
12st.	Mandarin orange (45.2%)	Mandarin orange (44.0%)

**Table 1:** Rank of smell with high recognition by gender (Recognition %).

Therefore, the results of olfactory cognitive tested for female were evaluated by age group (Cf. Table 2). Both the 40's and 50's had all 12 different types of odors recognition rate is more than 50%. However, the recognition rate declined from the 60's to 80's. In

the 60's, condensed milk, Japanese cypress and mandarin orange were less than 50% recognition rate. In the 70's, condensed milk, Japanese cypress, perfume, menthol and mandarin orange were less than 50%. In the 80's, only stinky socks/sweaty was barely recognized at 50%.

	40's (n=98)	50's (n=198)	60's (n=585)	70's (n=337)	80's (n=90)
1st.	Roasted Garlic (79.6%)	Stinky socks/sweaty (74.2%)	Wood (64.3%)	Wood (56.1%)	Wood (57.8%)
2st.	Rose (76.5%)	Rose (72.7%)	Stinky socks/sweaty (63.9%)	Stinky socks/sweaty (55.2%)	Stinky socks/sweaty (52.2%)
3st.	Curry (75.5%)	Perfume (72.2%)	Roasted Garlic (62.4%)	Curry (54.0%)	Rose (51.1%)
4st.	Perfume (74.5%)	Roasted Garlic (70.2%)	Curry (61.5%)	Gas for cooking (50.1%)	Curry (50.0%)
5st.	Stinky socks/sweaty (65.4%)	Wood (66.2%)	Rose (61.2%)	Roasted Garlic (49.6%)	Roasted Garlic (47.8%)
6st.	Japanese Cypress (65.3%)	Curry (65.7%)	Perfume (59.5%)	Rose (47.2%)	Condense Milk (46.7%)
7st.	Mandarin orange (62.2%)	Gas for cooking (60.3%)	Gas for cooking (56.4%)	Condense Milk (47.2%)	India ink (42.2%)
8st.	India ink (61.2%)	Condense Milk (61.1%)	India ink (56.1%)	Perfume (46.6%)	Gas for cooking (41.1%)
9st.	Condense Milk (61.2%)	Menthol (58.1%)	Condense Milk (50.4%)	India ink (41.2%)	Japanese Cypress (40.0%)
10st.	gas for cooking (60.2%)	Japanese Cypress (56.1%)	Menthol (47.2%)	Mandarin orange (39.8%)	Menthol (31.1%)
11st.	Wood (58.2%)	Mandarin orange (55.1%)	Japanese Cypress (42.7%)	Menthol (39.5%)	Perfume (28.9%)
12st.	Menthol (58.2%)	India ink (53.0%)	Mandarin orange (41.4%)	Japanese Cypress (38.9%)	Mandarin orange (27.8%)

**Table 2:** Rank of smell with high recognition by male (Recognition %).

As well, the results of olfactory cognitive tested for male were evaluated by age group (Cf. Table 3). Both the 40's and 50's had all 12 different types of odors recognition rate is more than 50%. However, the recognition rate declined from the 60's to 80's. In the 60's, menthol, Japanese cypress and mandarin orange were less than 50% recognition rate. In the 70's, roasted garlic, rose, condensed milk, perfume, India ink. Mandarin orange, menthol and Japanese cypress were less than 50% recognition rate. In the 80's, wood, stinky socks/sweaty, rose and curry were recognized at 50%. The smells with high olfactory recognition rate were wood, roasted garlic, stinky socks/sweaty and currying all ages for both male and female. And in order to avoid dangers such as gas explosions, and the smell of flowers, are being asked in the olfactory cognitive test as odors related to quality of life. Gas for cooking and rose smells may be less recognized when older.

	40's (n=225)	50's (n=396)	60's (n=786)	70's (n=472)	80's (n=88)
1st.	Rose (82.7%)	Roasted Garlic (73.2%)	Gas for cooking (69.6%)	Wood (71.6%)	Stinky socks/sweaty (50.0%)
2st.	Roasted Garlic (78.2%)	Rose (72.5%)	Roasted Garlic (68.2%)	Roasted Garlic (58.5%)	Roasted Garlic (46.6%)
3st.	Stinky socks/sweaty (70.7%)	Gas for cooking (69.2%)	Stinky socks/sweaty (63.4%)	Stinky socks/sweaty (58.3%)	Curry (44.3%)
4st.	Gas for cooking (70.2%)	Perfume (73.1%)	Rose (62.7%)	Curry (54.7%)	Wood (42.0%)

5st.	Perfume (69.3%)	Stinkysocks/sweaty (62.9%)	India ink (62.3%)	Gas for cooking (52.5%)	Gas for cooking (39.8%)
6st.	Curry (68.0%)	India ink (61.4%)	Wood (58.0%)	Rose (51.9%)	Perfume (37.5%)
7st.	Menthol (67.1%)	Curry (62.1%)	Curry (57.6%)	India ink (51.7%)	India ink (35.2%)
8st.	India ink (66.7%)	Wood (59.1%)	Perfume (55.7%)	Condense Milk (48.9%)	Condense Milk (35.2%)
9st.	Mandarin orange (65.8%)	Mandarin orange (57.8%)	Menthol (53.1%)	Japanese Cypress (44.9%)	Rose (30.7%)
10st.	Wood (65.3%)	Condense Milk (56.6%)	Condense Milk (49.5%)	Perfume (43.9%)	Menthol (58.1%)
11st.	Japanese Cypress (59.1%)	Menthol (52.0%)	Japanese Cypress (48.5%)	Menthol (41.7%)	Japanese Cypress (25.0%)
12st.	Condense Milk (54.7%)	Japanese Cypress (50.0%)	Mandarin orange (43.6%)	Mandarin orange (33.3%)	Mandarin orange (19.3%)

**Table 3:** Rank of smell with high recognition by female (Recognition %).

## Discussion

Japan is a super-aged society. From now on, screening for health maintenance for the elderly will be increasingly required. Many researchers have reported the decline in olfactory cognition as an early symptom of Alzheimer-type dementia in elderly people with dementia. Many previous studies used the number of perceived odors to assess awareness [17, 18]. Of course, we have also reported and evaluated in the past research by the number of odors that could recognize the recognition level by age and sex.

However, it is not suitable for a large-scale screening because it takes time to perform a test using 12 different odors in a simple olfactory cognitive test as before.

Therefore, this study evaluated the results by focusing on the recognition of each of 12 different odors in a simple olfactory cognitive test conducted for the elderly. For large-scale screening, we wanted to select an odour that was highly recognized by the elderly from 12 different odors. The purpose was to provide basic data to enable large-scale screening work using the selected odour.

As a result, it was found that in the 40's and 50's, all 12 different odors for both male and female had a recognition rate of over 50%. In the 60's and 70's, there were multiple odors for both male and female with recognition, the perception of several different odors falls below 50%. In the 70's female, roasted garlic, rose, condensed milk, perfume, India ink. Mandarin orange, menthol and Japanese cypress were less than 50% recognition rate. In the 70's male, roasted garlic, rose, condensed milk, perfume, India ink. Mandarin orange, menthol and Japanese cypress were less than 50% recognition rate. In the 80's female, wood, stinky socks/sweaty, rose and curry were recognized at 50%. In the 80's male, wood, stinky socks/sweaty, rose and curry were recognized at 50%. But throughout, the types of odors with high awareness differed by gender and age, roasted garlic, steamed socks / sweat, wood, gass of cooking, rose and curry were almost on top in all. In the future, when we perform large-scale screening, the examination will be performed with six types of odors (roasted garlic, steamed socks / sweat, wood, gas of cooking, rose and curry). If the six different odors selected this time are not known, it is necessary to confirm the recognition level with the remaining six odors. Of course, if there is enough time, it is important to conduct a simple olfactory cognitive test with 12 different odors as before. Form the results of this study, it became clear that the recognition of 12 different odors differed by age and gender. Furthermore, in the future large-scale screening in the odor recognition test, it is considered that the olfactory recognition test can be performed by using six different odors. In the future, we would like to screen more screening recipients using six different odors in a short time.

## Conclusion

We performed an examination of olfactometry in Yakumo-cho inhabitant medical examination. Odour results of female had better recognition than male. As a result, it was found that in the 40's and 50's, all 12 different odors for both male and female had a recognition rate of over 50%. In the 60's and 70's, there were multiple odors for both male and female with recognition, the perception of several different odors falls below 50%. But throughout, the types of odors with high awareness differed by gender and age, roasted garlic, steamed socks / sweat, wood, gas of cooking, rose and curry were almost on top in all. In the future, when we perform large-scale screening, the examination will be performed with six types of odors (roasted garlic, steamed socks / sweat, wood, gass of cooking, rose and curry). If the six different odors selected this time are not known, it is necessary to confirm the recognition level with the remaining six odors. In the future, we would like to screen more screening recipients using six different odors in a short time.

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