Global Journal of Medical Research: K Interdisciplinary
Volume 24 Issue 4 Version 1.0 Year 2024
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4618 & Print ISSN: 0975-5888

Gender Differences in Olfactory Recognition: A Comparative Study of Odour Stick Tests in High School Students

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Abstract- There are two types of olfactory testing methods that can be used for screening in Japan. Both methods test detection and recognition of 12 odors commonly found in Japan. It has also been reported that the detection and recognition abilities of the sense of smell gradually decline with age. It has also been noted that the results of odor tests tend to be poorer in male than in female as they get older, from their 40s onwards. However, odour tests are not often conducted on younger generations. Therefore, this study aimed to compare whether there are gender differences in odour tests in high school students.

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GJMR-K Classification: NLMC Code: BF232

Strictly as per the compliance and regulations of:

Gender Differences in Olfactory Recognition: A Comparative Study of Odour Stick Tests in High School Students

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Abstract- There are two types of olfactory testing methods that can be used for screening in Japan. Both methods test detection and recognition of 12 odors commonly found in Japan. It has also been reported that the detection and recognition abilities of the sense of smell gradually decline with age. It has also been noted that the results of odor tests tend to be poorer in male than in female as they get older, from their 40s onwards. However, odour tests are not often conducted on younger generations. Therefore, this study aimed to compare whether there are gender differences in odour tests in high school students.

After receiving an explanation of the study and signing a consent form, 114 high school students (47 boys and 67 girls) were given an odour test using odour sticks. Participants smelled 12 different odours and wrote the number of the option they thought was correct from six options (numbers 1 to 4 list various specific odors name, five indicates that the particular odour is unknown but that it smells like something, and number 6 indicates that it has no odour) in the answer box.

The olfactory test results of boys and girls students were compared using statistical methods (chi-square test).

As a result, there was no statistically significant difference between boys and girls high school students who could recognize six or more of the 12 odours familiar to Japanese people (P=0.482). However, when the results of each odour were analyzed separately, boys students recognized statistically significantly fewer doors than girls students for the odours of India ink (P=0.031*), mandarin orange (P=0.0001**), and roasted garlic (P=0.047*). The sense of smell develops little by little from infancy, peaking in the teens, and then gradually declines. Therefore, testing teenagers' olfactory perception abilities is important. From these results, we believe it is necessary to check the smells individually, not just to count the number of correct answers. We also believe that more data is needed to see the difference in olfactory recognition between boy (male) and girl (female).

Keywords: olfactory perception, odour stick, japanese odours, gender differences, high school students.

I. Background

Odour tests vary from country to country, but in Japan, 12 different types of odours (ink, wood, perfume, menthol, mandarin oranges, curry, household gas, roses, cypress, sweaty socks, condensed milk, fried garlic) that are familiar in Japanese life are used. Odour tests produce results by examining both detection and recognition. Many researchers have reported that it becomes harder to detect odours because of aging [1-12]. The sense of smell develops little by little from infancy, Peaking in the teens, and then gradually declines. Female are less likely to experience a decline than male, and the sese of smell gradually weakens in male from their 60s and in female from their 70s, but it is said that olfactory disorders become ecident in more than 70 to 80 percent of people over the age of 80. We have also reported that test results from age 40 onwards show that both male and female can detect odours but their recognition declines with age, and that after age 60, male recognition declines more than female [11-18]. On the other hand, there are few reports of odour test results among younger generations. Despite the established research on aging, there is a scarcity of data on gender differences in olfactory performance in younger populations. Therefore, the purpose of this study was to conduct odour tests on young boy (male) and girl (female) and compare the results to confirm whether there are any gender differences.

II. Materials and Methods

The participants in this study were 47 boys and 67 girls aged between 15 and 17 years who had attended the cultural festival of our university (This study was reviewed and approved by the Ethics Committee of Nagoya Women's University). Informed consent was obtained from all participants following an explanation of the study's purpose and procedures. High school students voluntarily participated in this study. They were taking an olfactory test for the first time. They answered in a subjective pre-test questionnaire that they had no problems with their sense of smell. Participants tested 12 different smells using the smell stick smell test kit and wrote down the results in the answer column. The twelve different types of odors closely related to the lives of Japanese people (ink, wood, perfume, menthol, mandarin oranges, curry, household gas, roses, cypress, sweaty socks, condensed milk, fried garlic). The smell sticks are manufactured by Daiichi Pharmaceutical Industry Co., Ltd., and participants are asked to open a smell-soaked filter paper in front of their

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nose while looking at the answer options. To compare the results of boys and girls odour tests, the number of correct and incorrect answers for each of the 12 odours was statistically compared using the chi-square test.

III. Results

The 114 high school students aged between 15 and 17 years (mean age ±standard deviation: 15.7±0.9) (See Table1).

Table 1: Age Distribution of High School Students

	15s	16s	17s
Boys	36	10	1
Girls	26	11	30

All 114 high school students who participated took two types of odour tests and wrote their results in the answer column (See Table 2)

Table 2: Number of Correct Answers given by High School Girls and Boys

Number of Corredt Answer	0 Points	1 Points	2 Points	3 Points	4 Points	5 Points	6 Points
Odour Stick (Girls = 67)	0	0	3	2	2	5	3
Odour Stick (Boys = 47	0	0	1	0	4	1	2
Number of Corredt Answer	**7 Points**	**8 Points**	**9 Points**	**10 Points**	**11 Points**	**12 Points**	
Odour Stick (Girls = 67)	3	8	11	22	7	1	
Odour Stick (Boys = 47)	9	8	4	7	6	5	

The results of the chi-square test for the number of correct answers and incorrect answers in boys and girls odour tests are shown in Table 3. There was no statistically significant difference between the results of the two odour tests (P=0.482).

Table 3: Comparison of the Results of Odour Stick Tests (P=0.482)

The Maximum score is 12 points	Less than Six correct answers	Six more correct answer
Odour Stick (Girls = 67)	15	52
Odour Stick (Boys = 47)	8	39

The results of the chi-square test comparing the results of the 12 different types of odour test are shown in Tables 4 to 15.

Table 4: x^2 Test Comparison of the Results of Odour Tests (India Ink) High School Girls and Boys (P=0.331*)

India ink	Correct answer	Incorrect answer	Total
Odour Stick (Girls = 67)	32	35	67
Odour Stick (Boys = 47)	13	34	47
Total	45	69	114

Table 5: x^2 Test Comparison of the Results of Odour tests (Timber) High School Girls and Boys (P=0.530)

Timber	Correct answer	Incorrect answer	Total
Odour Stick (female = 67)	41	26	67
Odour Stick (male = 47)	26	21	47
Total	67	47	114

Table 6: x^2 Test Comparison of the Results of Odour Tests (Perfume) High School Girls and Boys (P=0.250)

Perfume	Correct answer	Incorrect answer	Total
Odour Stick (Girls = 67)	40	27	67
Odour Stick (Boys = 47)	33	14	47
Total	73	41	114

Table 7: x^2 Test Comparison of the Results of Odour Tests (Menthol) High School Girls and Boys (P=0.054)

Mentho	Correct answer	Incorrect answer	Total
Odour Stick (Girls = 67)	47	20	67
Odour Stick (Boys = 47)	40	7	47
Total	87	27	114

Table 8: x^2 Test Comparison of the Results of Odour Tests (Mandrain Orange) High School Girls and Boys (P=0.0001**)

Mandarin Orange	Correct answer	Incorrect answer	Total
Odour Stick (Girls = 67)	50	17	67
Odour Stick (Boys = 47)	0	47	47
Total	50	64	114

Table 9: x^2 Test Comparison of the Results of Odour Tests (Curry) High School Girls and Boys (P=0.441)

Curry	Correct answer	Incorrect answer	Total
Odour Stick (Girls = 67)	46	21	67
Odour Stick (Boys = 47)	29	18	47
Total	75	39	114

Table 10: x^2 Test Comparison of the Results of Odour Tests (Household Gas) High School Girls and Boys (P=0.164)

Household Gas	Correct answer	Incorrect answer	Total
Odour Stick (Girls = 67)	40	27	67
Odour Stick (Boys = 47)	34	13	47
Total	74	40	114

Table 11: $\hat{x}^2$ Test Comparison of the Results of Odour Tests (Rose) High School Girls and Boys (P=0.610)

Rose	Correct answer	Incorrect answer	Total
Odour Stick (Girls = 67)	44	23	67
Odour Stick (Boys = 47)	33	14	47
Total	77	37	114

Table 12: x^2 Test Comparison of the Results of Odour Tests (Cypress) High School Girls and Boys (P=0.147)

Cypress	Correct answer	Incorrect answer	Total
Odour Stick (Girls = 67)	56	11	67
Odour Stick (Boys = 47)	34	13	47
Total	90	24	114

Table 13: x^2 Test Comparison of the Results of Odour Tests (Stinky Socs/Sweaty) High School Girls and Boys (P=0.996)

Stinky Socs / Sweaty	Correct answer	Incorrect answer	Total
Odour Stick (Girls = 67)	57	10	67
Odour Stick (Boys = 47)	40	7	47
Total	97	17	114

Table 14: x^2 Test Comparison of the Results of Odour Tests (Condensed Milk) High School Girls and Boys (P=0.446)

Condensed Milk	Correct answer	Incorrect answer	Total
Odour Stick (Girls = 67)	47	20	67
Odour Stick (Boys = 47)	36	11	47
Total	83	31	114

Table 15: x^2 Test Comparison of the Results of Odour Tests (Fried Garlic) High School Girls and Boys (P=0.047)

Fried Garlic	Correct answer	Incorrect answer	Total
Odour Stick (Girls = 67)	56	11	67
Odour Stick (Boys = 47)	39	18	47
Total	95	29	114

Moreover, only the chi-square test results for the 12 different types of odours are shown in Table 16. Of the 12 different odours, there was a statistically significant difference between the results of boys and girls for the odours of India Ink (P=0.031*), mandarin orange (P-0.0001**) and fried garlic (P=0.047*). In both cases, the boys answer was shown to have a harder smell to discern that the girls answer.

IV. Discussion

In previous studies, females performed better on olfactory tests than males[1-10], with a statistically significant decline in olfactory perception with increasing age[1-12,]. In recent years, there have been reports of cases showing abnormalities in the sense of taste and smell due to the COVID-19 epidemic [13-23]. In most cases, olfactory test results are obtained from middle-aged and older people, and there few results are reported for younger people. In this study, we conducted olfactory test using odour sticks on high school students who visited a university festival, and obtained the results.

For the 12 different odours, the average number that the boys high school students were able to recognize was 8.38, and for the girls students the average was 8.30. There was no statistically significant difference between the number of correct odour answers between boys and girls high school students. A chi-square test was used to compare the number of correct answers given by boys and girls high school students for each odour. The results showed that there was no statistically significant difference between the odours of wood, perfume, menthol, curry, household gas, roses, cypress, stinky socks/ seaty, and condensed milk. However, when comparing the individual smells, the smell of india ink was recognized by only 13 out fo 47 boys high school students, but by 32 out of 67 girls high school students. Statistically, the result of the chi-square test was P=0.031*, making it clear that there was a significant difference. Similarly, when comparing the smell of mandarin oranges, none of the 47 boys high school students were able to recognized the smell, while 50 of the 67 girls high school students were able to recognize it. Therefore, the results of the chi-square test showed a statistically significant difference between the two groups (P=0.0001**). Furthermore, for the smell of roasted garlic, 33 out of 47 boy high school students could recognize the scent, while 4 out of 67 girls high school students could recognize the scent. Statistically, the chi-square test results showed a significant difference (P-0.047*).

The smell of India ink is something that students remember because they used it during Japanese calligraphy classes in elementary and junior high school. Still it seemed that the smell did not stick in the boys' minds as sassily as it did in the girls. It was a shocking, result that none of the boy high school students could recognize the scent of mandarin oranges, it seems that it is difficult for them to distinguish the smell of fruits. As for the scent of fried garlic, since it is difficult for junior high school students to recognize it, it may be necessary to have them make an effort to remember the smell by being conscious of it while eating. Compared to girls high school students, boys high school students tend to belong to more sports clubs and less to cultural clubs (cooking club, tea ceremony club, flower arrangement club, calligraphy club, etc.). Boys high school students also tend to have fewer opportunities to help with household chores such as cooking compared to girls high school students. Therefore, there is a possibility that they have fewer opportunities to come into contact with the smell of food on a daily basis. In the future, it will be necessary to investigate student life and eating habits through questionnaires and other means, and correlate this with the results of olfactory tests.

V. Conclusion

This study explored olfactory test results among high school students, a population that has not been widely studied in olfactory research. Twelve types of odours familiar to Japanese people were tested for high school students using odour sticks. As a result, there was no statistical difference in the number of correct

answers between boys and girls high school students (chi-square test). However, when comparing individual odours, boy high school students had statistically lower recognition rates than girls for the odors of India ink, mandarin oranges, and roasted garlic. There may be a possibility, boys are less familiar with these specific smells due to cultural or lifestyle factors.

Ethics Statement

The studies involving human participants were reviewed and approved by the Ethics Committee of Nagoya Women's University (approval number 2019-26). The participants provided their written informed consent to participate in this study.

Funding

This study was supported by Nagoya Women's University education and Research Fund.

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