

# Visual Impairment and Olfactory Acuity

Exploring the relationship between visual impairment and smelling ability in a population of visually impaired individuals in India

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Visual impairment can have an adverse effect on an individual's social life, economic status and emotional well-being.<sup>1-7</sup> Many impaired individuals, however, are able to maintain a degree of independence. Crucial for this autonomy, stability and general health and well-being is gainful employment.<sup>8</sup> Unfortunately, the visually impaired may find themselves limited in terms of available employment opportunities.

A common theory regarding senses and perception is that other senses become more acute as a compensatory measure after one sense is lost or impaired. Whether this is an actual physical improvement in acuity, or simply an improvement in cognitive awareness of the input from the remaining senses, is outside the scope of this article, and has been debated elsewhere.<sup>9, 10</sup> The end result is the same in either case: a perceived improvement in acuity, which can be subjected to appropriate tests and measured.

A comparative improvement in a visually impaired individual's sense of smell could potentially lead to employment opportunities within the fragrance industry, where such skills are highly valued.

The results of the authors' investigation into the smelling abilities of a group of visually impaired individuals in Mumbai, in comparison with a control group of normally sighted Indian nationals, is presented here. Measurement of smelling ability was conducted using the "smelling test," a standard test used within the fragrance industry. The study was conducted by CPL Aromas' Dubai and India offices, in association with the National Association for the Blind (India), Mumbai, and Anthea Aromatics, Mumbai.

## Materials and Methods

**Participants:** Two hundred eighty three visually impaired participants were recruited via a request for volunteers from the National Association for the Blind (India), Mumbai. Four of these were excluded from the study as they were unable to complete the smelling tests due to mental health-related conditions. Age distribution of the remaining 279 participants was 18–61 years (mean: 30, standard deviation: 8.5). Two hundred three of these were male and 76 female. All participants were of a low to medium educational background. The

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degree of visual impairment of participants was rated in percentage terms, with 100% representing total blindness. The age at which the participant suffered the visual impairment was also recorded.

Sixty two normally sighted participants were recruited as a control group from Consolidated Shipping in Dubai. Controls selected were Indian nationals, and were of a low to medium educational background. Age distribution of the control group was 22–50 years (mean: 31, standard deviation: 6.6). Sixty of these were male and two were female (**T-1**).

## Smelling Test

The test used was an industry standard smelling test, comprising two elements, the triangle test and the strength test.

**Triangle test:** The participant is presented with three scents and asked to identify whether: a) they are identical; b) one is an "odd-one-out" (and, if so, to identify which one); or c) all three are different scents. The test comprises eight such triangles, with one point available for each correct triangle.

**Strength test:** The participant is presented with five different dilutions of the same scent, and is asked to rank the five samples in order of strength. Five points are available for the correct ordering of the samples.

The aim of the study was to measure the smelling ability of a group of visually impaired Indian nationals, to establish whether the sense of smell is effectively more acute in the visually impaired. The smelling ability of a group of visually impaired Indian nationals was tested using a fragrance industry standard smelling test. A group of normally sighted Indian nationals were used as controls. The authors concluded that smelling, a highly valued skill within the fragrance industry, may provide a credible route of employment for the visually impaired.

<sup>a</sup> B. Singh prepared fragrance samples and administered the smelling tests. K. Mago administered the smelling tests. S. Sonavadekar, S. Bankhele, S. Babu, S. Deshpande, D. Sahu and L. Mirkar administered the smelling tests. G. Dix wrote the manuscript, performed statistical analysis, and prepared all summary tables therein.

**Marking:** A total of 13 points are available from the completed smelling test (eight from the triangles, five from the strength test). A score of nine points or greater is considered to be a pass. The expected pass rate within the fragrance industry for non-trained personnel is typically 10%.<sup>b</sup>

<sup>b</sup> Personal communication, C. Marshall, March 14, 2011.

Summary of age and gender characteristics for case group (visually impaired) and control group (normally sighted)			T-1
	Case group (visually impaired)	Control group (normally sighted)	
<b>Total</b>	279	62	
<b>Male</b>	203 (72.8%)	60 (96.8%)	
<b>Female</b>	76 (27.2%)	2 (3.2%)	
<b>Mean age</b>	30 (SD 8.5)	31 (SD 6.6)	

Summary of smelling test results (pass/fail) for case group (visually impaired) and control group (normally sighted)			T-2
	Case group (visually impaired)	Control group (normally sighted)	
<b>Total</b>	279	62	
<b>Pass</b>	66 (23.7%)	7 (11.3%)	
<b>Fail</b>	213 (76.3%)	55 (88.7%)	

The tests were administered by staff from CPL Aromas' Dubai and India offices, and staff from Anthea Aromatics, Mumbai. Staff from CPL Aromas Dubai have been previously trained and have experience in administering the tests. Staff from CPL Aromas India and Anthea Aromatics Mumbai were trained to administer the tests by staff from CPL Aromas Dubai, who also acted as observers when not administering the tests.

## Results

**Smelling test results:** A total of 13 points are available from the completed smelling test (eight from the triangles, five from the strength test). A score of nine points or greater is considered to be a pass.

From the control group of 62 participants, seven individuals achieved a score of nine or greater, giving a pass rate of 11.3%. This is consistent with the typical pass rate within the fragrance industry of 10%.

From the visually impaired group of 279 participants, 66 individuals achieved a score of nine or greater, giving a pass rate of 23.7% (summarized in T-2).

**Statistical analysis:** As the outcome measured is binary (pass/fail), a 2 x 2 contingency table can be used for statistical analysis. The online statistical calculator StatPages<sup>c</sup> was used to calculate the results from the 2 x 2 table (T-3) and obtain the odds ratio (OR) and chi-squared statistic. Chi-squared (Pearson uncorrected) of 4.61

<sup>c</sup> JC Pezzullo, 2-way Contingency Table Analysis; retrieved May 29, 2011, from <http://statpages.org/ctab2x2.html>

( $p = 0.032$ ) and two-tailed Fisher's exact test ( $p = 0.039$ ) indicate a statistically significant difference in outcome between the visually impaired and control groups (T-4). The OR of 2.44 (95% CI 1.01 to 6.16) indicates that the odds of achieving the outcome are almost two and a half times higher for the visually impaired group (T-4)—thus a visually impaired individual is almost two and a half times more likely to pass the smelling test than a normally sighted individual.

## Discussion

In an Indian population, visual impairment was shown to significantly increase the odds of passing the fragrance industry smelling test. Indeed the OR of 2.44 shows that the visually impaired are more than twice as likely to pass the test as the normally sighted.

These results support the theory that the sense of smell is more acute in the visually impaired. Furthermore, the results also suggest the fragrance industry as a credible route of employment for the visually impaired. With a pass rate significantly higher than the normally sighted, the visually impaired are clearly an untapped resource for the industry, and more effort should be made to recruit from this group of people, particularly in areas of the world where these individuals are severely restricted in terms of employment opportunities.

**Limitations/future studies:** Due to location this study recruited exclusively from an Indian population, and thus the results are only generalizable to that population. This study could be repeated in other areas of the world, following the same protocol. A meta-analysis collating results from a number of such studies conducted at different sites around the world would be of great interest.

In terms of related future studies, it would also be of interest to establish whether the increase in smelling ability in the visually impaired is a physical increase in acuity, or an increase in perceptual awareness and cognition. Further research and scientific consensus on the nature and mechanisms of smell receptors and recognition processing would be required prior to such a study, however.

In summary, this study shows that the visually impaired are more likely to possess a heightened smelling ability in comparison with the normally sighted. Such ability is useful within the fragrance industry, and this should be seen as a credible employment route for the visually impaired.

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### 2 x 2 Contingency table showing results of the smelling tests for case group (visually impaired) and control group (normally sighted)

T-3

	Outcome occurred	Outcome did not occur	Totals
Risk factor present	66	213	279
Risk factor absent	7	55	62
Totals	73	268	341

Notes: Outcome occurred = smelling test pass, score of nine or greater; outcome did not occur = smelling test fail, score of eight or lower; risk factor present = visually impaired, case group; risk factor absent = normally sighted, control group

### Summary of statistics calculated from the 2 x 2 contingency table

T-4

Test	p-value
Chi-square (Pearson uncorrected) = 4.610	0.032
Two-tailed Fisher's exact test	0.039
	95% Confidence interval
Odds ratio (OR)	2.435
Relative risk (RR)	2.095
	1.006
	6.159
	1.005
	4.868

## References

- EM Chia, P Mitchell, E Rochtchina, S Foran and JJ Wang, Unilateral visual impairment and health-related quality of life: the Blue Mountains eye study, *Br J Ophthalmol* 87(4) 392–395 (2003)
- EM Chia, JJ Wang, E Rochtchina, W Smith, RR Cumming and P Mitchell, Impact of bilateral visual impairment on health-related quality of life: the Blue Mountains eye study, *Invest Ophthalmol Vis Sci* 45(1) 71–76 (2004)
- PK Nirmalan, JM Tielsch, J Katz, RD Thulasiraj, R Krishnadas, R Ramakrishnan and AL Robin, Relationship between vision impairment and eye disease to vision-specific quality of life and function in rural India: the Aravind comprehensive eye study, *Invest Ophthalmol Vis Sci* 46(7) 2308–2312 (2005)
- R Nutheti, BR Shamanna, PK Nirmalan, JE Keeffe, S Krishnaiah, GN Rao and R Thomas, Impact of impaired vision and eye disease on quality of life in Andhra Pradesh, *Invest Ophthalmol Vis Sci* 47(11) 4742–4748 (2006)
- HTV Vu, JE Keeffe, CA McCarty and HR Taylor, Impact of unilateral and bilateral vision loss on quality of life, *Br J Ophthalmol* 89(3), 360–363 (2005)
- M Pinquart and JP Pfeiffer, Psychological well-being in visually impaired and unimpaired individuals: A meta-analysis, *Br J Vis Impair* 29(1) 27–45 (2011)
- M Thurston, A Thurston and J McLeod, Socio-emotional effects of the transition from sight to blindness, *Br J Vis Impair* 28(2) 90–112 (2010)
- D Shah, Healthy worker effect phenomenon, *Indian J Occup Environ Med* 13(2) 77–79 (2009)
- M Beaulieu-Lefebvre, FC Schneider, R Kupers and M Ptito, Odor perception and odor awareness in congenital blindness, *Brain Res Bull* 84(3) 206–209 (2011)
- O Schwenn, I Hundorf, B Moll, S Pitz and WJ Mann, Do blind people have a better sense of smell than normal sighted people? *Klin Monbl Augenheilkd* 219(9) 649–654 (2002)

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