

PDFlib PLOP: PDF Linearization, Optimization, Protection

**Page inserted by evaluation version
www.pdflib.com – sales@pdflib.com**

Age-Related Changes in the Prevalence of Smell/Taste Problems among the United States Adult Population

Results of the 1994 Disability Supplement to the National Health Interview Survey (NHIS)

HOWARD J. HOFFMAN,^a ERICK K. ISHII, AND ROBERT H. MACTURK

Epidemiology, Statistics and Data System Branch, National Institute on Deafness and Other Communication Disorders (NIDCD), National Institutes of Health (NIH), Executive Plaza South, Room 432, 6120 Executive Boulevard, MSC 7180, Bethesda, Maryland 20892-7180

ABSTRACT: Information about the prevalence of disorders of the chemical senses has been limited. In the late 1970s, the consensus among experts convened by the National Institutes of Health (NIH) was that more than 2 million adults in the United States had a disorder of smell or taste. A large, nonrandom survey conducted by the National Geographic Society in 1987 found that 1% of their 1.2 million respondents could not smell 3 or more of 6 odorants using a 'scratch and sniff' test. Age was an important factor, with a decline beginning in the second decade of life. No comparable data have been available for taste, although it has been suggested that the sense of taste remains more robust with age. The National Institute on Deafness and Other Communication Disorders (NIDCD), NIH, began collaborating with the National Center for Health Statistics (NCHS) in 1993 to acquire information on the prevalence of smell/taste problems using the Disability Supplement to the National Health Interview Survey (NHIS). This survey was administered to approximately 42,000 randomly-selected households (representing about 80,000 adults over 18 years of age) in 1994. Adjusted national estimates derived from this survey showed a prevalence of 2.7 million (1.4%) U.S. adults with an olfactory problem. Also, 1.1 million (0.6%) adults reported a gustatory problem. When smell or taste problems were combined, 3.2 million (1.65%) adults indicated a chronic chemosensory problem. The prevalence rates increased exponentially with age. Almost 40% with a chemosensory problem (1.5 million) were 65 years of age or greater. In a multivariate analysis, the individual's overall health status, other sensory impairments, functional limitations (including difficulty standing or bending), depression, phobia, and several other health-related characteristics were associated with an increase in the rate of chemosensory disorders.

INTRODUCTION

The chemical senses (olfaction, or the sense of smell, and gustation, or the sense of taste) detect and identify chemical stimuli in the environment. Such stimuli include foods, hazardous gases and pollutants, and pleasurable fragrances or aromas. Deficits in the chemosenses may contribute to the failure to recognize and consume nutritious food, avoid hazardous environments, or derive pleasure from a variety of personal ex-

^a Corresponding author. Tel: (301) 402-1843; fax: (301) 402-0390; email: HoffmanH@ms.nidcd.nih.gov

periences. Complaints regarding one's inability to smell or taste, whether partial or complete loss, account for thousands of visits to physicians' offices each year.¹ Increased understanding of risk factors and underlying causes of chemosensory problems should result in more effective prevention and treatment strategies.

In the 1980s and early 1990s, several academic and Federal scientists recognized the limitations of available data for health planning and policy formulation for people with disabilities. Responding to this need, the 1994 Disability Supplement to the National Health Interview Survey (NHIS) emerged from a combined planning effort on the part of four Federal entities: the Office of the Assistant Secretary for Planning and Evaluation (ASPE), Department of Health and Human Services (DHHS); two components of the Social Security Administration (the Office of Supplemental Security Income and the Office of Disability); and the Maternal and Child Health Bureau (MCHB), Health Resources and Services Administration (HRSA), DHHS.² The goals of this large comprehensive survey in the United States were to: (1) provide national prevalence estimates of major impairments, disabilities, and handicapping conditions, (2) characterize individuals having these conditions in the context of other health interview information that is already available for the U.S. population in general, and (3) determine the use of services by people with these conditions.

The only previous information available from a large sample of the United States population was from a survey of over 1.2 million persons conducted by the National Geographic Society.³⁻⁵ This selected, nonrandom sample of their readership completed a 'scratch-and-sniff' test and attempted to identify the correct odorant from among a short list of possible choices. About one percent of the respondents could not smell three or more of the odorants. Among those individuals able to smell an odorant, approximately one-half were unable to identify all six odorants. For example, nearly everyone could appreciate the odor of banana, but only one-half could correctly identify it. Age was an important factor, with overall sensitivity beginning to decline in the second decade of life and, then, deteriorating appreciably as age increased. Although this nonrepresentative survey cannot be relied on for national prevalence estimates, it has provided much useful information as well as suggestions for further research. There is no comparable data available for the sense of taste.

SURVEY METHODS

The National Health Interview Survey (NHIS) is administered through a continuing nationwide survey using household interviews.^{6,7} Each week a probability sample of the civilian, noninstitutionalized population of the United States is interviewed by staff of the U.S. Bureau of the Census. Multistage probability cluster sampling techniques are used to achieve a representative national sample. Since 1985, the NHIS has oversampled the U.S. Black population in order to improve the precision of statistical estimates. Also, the sample has been selected such that each quarter of the year yields a representative national sample.

Data for these analyses were obtained from a public use data set for the 1994 Disability Supplement to the National Health Interview Survey (NHIS), conducted from January through December 1994. Data from the 1995 Disability Survey were not yet available for analysis. In 1994, the number of households in the sample was approximately 42,000, containing a total of 107,469 individuals.⁸ The interview rate for the 1994 core questionnaire was 94.1%, with about 3% refusing to participate, while the remaining nonresponse was due to failure to locate an eligible respondent at home after repeated attempts. The response rate for the Disability Supplement was 92.5%, which

after multiplying by the 94.1% response rate achieved for the core questionnaire, yields an overall response rate for the Disability Supplement of 87.0%.

Questionnaire development involved extensive input from Federal agencies and from the academic and private research communities. Questions were thoroughly tested in the National Center for Health Statistics (NCHS) Questionnaire Design Research Laboratory and in field tests conducted by NCHS prior to inclusion in the final survey.

Prevalence estimates for the United States population were obtained after reweighting the sample responses to take into account the complex cluster design of the survey.⁸ Also, multiple logistic analyses have been performed using the Statistical Analysis System (SAS), after taking into account the complex survey design to properly adjust variances of sample estimates.⁹⁻¹¹

AGE-SPECIFIC TRENDS IN SMELL AND TASTE PROBLEMS

In 1994 there were approximately 259.6 million Americans, of whom 31.1 million (12%) were 65 years of age or older (TABLE 1). The prevalence of reported chronic (lasting three months or longer) problems with the sense of smell was greatest for those individuals who were 75 years of age or older at 46.0 per 1000. The next highest rate was 26.5 per 1000 for adults age 65-74 years. Together these two age strata accounted for 1.07 million (40%) of the 2.7 million adults in the United States who reported chronic problems with their sense of smell.

Very similar results were found for those who reported a chronic problem with their sense of taste. In adults 75 years of age or older, the prevalence was 20.4 per 1000 and for those aged 65-74 years, the prevalence was 10.5 per 1000. Together these two age strata accounted for 453,000 (41%) of the 1.1 million adults in the United States who reported chronic problems with their sense of taste.

When either set of the age-specific prevalence rates (for chronic smell or chronic taste problems) is graphed, there is an accelerating (exponential) increase with age. With each successive decade of life there is an increase in the reported prevalence rate

TABLE 1. Age Distribution of the United States Population in 1994 and Age-Specific Prevalence Rates (per 1,000) with Chronic (Lasting 3 Months or Longer) Chemosensory (Smell/Taste) Problems

Age (Years)	Number (Millions)	Population Distribution (Percent)	Chronic Smell Problems (Rate per 1,000)	Chronic Taste Problems (Rate per 1,000)
≤16	66.6	25.6	—	—
17-24	28.7	11.1	4.7 ^a	1.1 ^a
25-34	41.4	15.9	7.2	1.7
35-44	41.5	16.0	10.2	4.5
45-54	29.7	11.4	14.1	5.7
55-64	20.7	8.0	19.9	8.4
65-74	18.3	7.0	26.5	10.5
75+	12.8	4.9	46.0	20.4
Totals	259.6	100.0	14.2	5.5
No. of adults with chronic chemosensory problems (millions)			2.7	1.1

^a These rates are calculated for individuals 18-24 years of age.

of chemosensory problems. Alternatively, if plotted on a logarithmic scale, the graph is 'linear' with respect to age. This phenomenon has been found for other sensory systems and described with an elegant mathematical model.^{12,13}

MULTIVARIATE LOGISTIC ANALYSIS OF RISK FACTORS

In a multivariate model the effects of several variables can be estimated simultaneously. In TABLE 2, three separate multiple logistic models are shown in three adjacent columns: 1) the first column shows the estimated relative risks (odds ratios) for adults with chronic smell problems; 2) the second column shows similar results for adults with chronic taste problems; 3) the third column shows the results for adults with both a chronic smell and taste problem.

The odd ratios for the age variable show that, in each of the three models, there is a statistically significant increased risk of a chemosensory problem for age strata 55 years and above. In this case, the baseline age stratum is 25–34 years (odds ratio = 1.00), with all persons less than 25 years old omitted from the analysis. This age effect

TABLE 2. Relative Risk Estimates (Odds Ratios) from a Multivariate Logistic Analysis of Demographic and Other Health Problems Which May Affect the Risk of Chemosensory Problems (either a Chronic Smell Problem, a Chronic Taste Problem, or Both)

Risk Factor	Chronic Smell Problem	Chronic Taste Problem	Chronic Smell and Taste Problem
Age (years)			
25–34	1	1	1
35–44	1.12	2.13	2.42*
45–54	1.41	2.69*	2.05
55–64	1.76*	2.88*	2.70*
65–74	2.21**	3.20**	2.89*
75+	2.90**	3.77**	3.69**
Sex			
Female	1	1	1
Male	1.13	0.89	0.79
Race			
White	1	1	1
Black	0.61	1.30	0.77
Hispanic	0.75	1.06	0.54
Trouble with Hearing			
No	1	1	1
Yes	2.32**	1.95*	2.84*
Trouble with Vision			
No	1	1	1
Yes	1.24	2.16*	2.53*
Other limitations—all			
No	1	1	1
Yes	2.29**	6.99***	3.29**
Depression in last year			
No	1	1	1
Yes	2.25**	4.44***	4.05*

p* <0.05; *p* <0.01; ****p* <0.001.

is present even after adjusting for the remaining variables in the model, namely, sociodemographic variables (sex and race), other sensory problems (hearing or vision), all other limitations of activity (physical disabilities), and mental problems (depression).

No significantly different odds ratios were found for sex (female versus male). Also, the odds ratios for race or ethnicity (White, Black, or Hispanic) were not statistically significant.

Adults who reported trouble hearing were, however, more likely to have an increased risk for chronic chemosensory problems, with odds ratios (OR) ranging from 1.95 for chronic taste problems to 2.84 if both a chronic smell and taste problem was reported. Trouble with vision was not significantly associated with chronic smell problems, but was significantly increased for adults reporting chronic taste problems (OR = 2.16) and chronic smell and taste problems (OR = 2.53).

Individuals reporting any other physical limitations were also at an increased risk of chronic chemosensory problems. The increased odds ratios were largest for those with chronic taste problems (OR = 6.99). Similarly, individuals who had experienced depression during the last year also showed significantly increased risks of chronic chemosensory problems. Once again, the strongest association was with a chronic taste problem. Phobias were also associated with increased risks of chronic chemosensory problems, but were not included in the models shown in TABLE 2.

DISCUSSION

We conclude from these analyses that: 1) the prevalence of chronic taste problems increases with age and is also associated with other sensory, physical, and psychiatric difficulties, and 2) the prevalence of chronic olfactory problems in the general population may be smaller than has been suggested by previous investigation.¹⁴

With regard to chronic taste problems, some researchers have suggested that there may not be substantial change with age,¹⁵⁻¹⁷ while others have found evidence for age-related declines in thresholds.¹⁸ The questions asked in this survey permit us to distinguish responses for those reporting chronic taste problems by whether the problem was due to: 1) inability to taste salt, 2) inability to taste sweet, 3) presence of 'inappropriate' tastes in the mouth, or 4) other problems. The first two categories showed the smallest changes with age, while 'inappropriate' tastes were strikingly increased with age. Although we have not yet examined these data for effects of drugs or medications on chronic problems with taste, it appears likely from the scientific literature that this is an important contributor to the finding of 'inappropriate' taste problems as a function of age.¹⁹⁻²²

Some discussion of the relatively low prevalences (especially for elderly adults) of chronic smell problems found in the Disability Supplement data is also warranted. The prevalences reported in this representative sample of noninstitutionalized adults are far below that suggested by extensive 'scratch-and-sniff' tests conducted by some researchers.^{14,23} It is important to point out that the testing done on the elderly subjects to create the age-specific norms for the University of Pennsylvania Smell Identification Test (UPSIT) was on a sample of subjects selected from nursing homes, whereas the NHIS stratified random sample explicitly excludes institutionalized subjects. Nevertheless, there are probably several reasons why the results from the present interview study do not agree with data obtained from clinical testing of subjects.²⁴ However, the data obtained from the National Geographic Survey were based on a self-administered, albeit abbreviated, 'scratch-and-sniff' test. Results from that survey are closer to the prevalences found from the Disability Supplement data set.

The clinical problems of patients presenting with chronic chemosensory problems are beyond the scope of the present discussion. However, the well-known associations between chemosensory problems and Parkinson's and Alzheimer's diseases deserves mention, as these are rapidly advancing areas of clinical and epidemiologic research.²⁵ Finally, there is a need to communicate the prevalence of chronic chemosensory disorders and problems to physicians in clinical practice.²⁶ Advances in treatments for chemosensory disorders, knowledge of basic risk factors, including particular drugs or combinations of drugs and medications that may exacerbate chemosensory problems, is important for improving the quality of life for many, especially the elderly.

ACKNOWLEDGMENTS

We express our appreciation to the staff of the National Center for Health Statistics (NCHS) responsible for conducting the 1994 Disability Supplement and, in particular, thank Ms. Marcie Cynamon for her expert coordination and implementation of the questions on the chemosenses in this survey. We also thank Ms. Michele Adler, Office of the Assistant Secretary for Planning and Evaluation, Department of Health and Human Services, and Dr. Gerry Hendershot, NCHS, for their pivotal roles in overseeing the development of the Disability Supplement.

REFERENCES

1. National Institute on Deafness and Other Communication Disorders. 1995. National Strategic Research Plan. Smell, Taste and Touch and Chemosensory Disorders. NIH Publication No. 95-3711. : pp. 197-259. U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health. Bethesda, MD.
2. SIMPSON, G., D. KEER & M. CYNAMON. 1993. Plans for the 1993-1994 National Health Interview Survey on Disability. *Disabilities Stud. Quart.* **13**: 21-24.
3. GIBBONS, B. 1986. The intimate sense of smell. *Natl. Geogr.* **170**: 324-361.
4. GILBERT, A. N. & C. J. WYSOCKI. 1987. The smell survey results. *Natl. Geogr.* **172**: 514-525.
5. WYSOCKI, C. J. & A. N. GILBERT. 1989. National Geographic Smell Survey: Effects of age are heterogeneous. *Ann. N. Y. Acad. Sci.* **561**: 12-28.
6. KOVAR, M. G. & G. S. POE. 1985. The National Health Interview Survey Design, 1973-84, and Procedures, 1975-83. *Vital Health Stat.* **1**(18). National Center for Health Statistics. Hyattsville, MD.
7. MASSEY, J. T., T. F. MOORE, V. L. PARSONS & W. TADROS. 1989. Design and Estimation for the National Health Interview Survey, 1985-94. *Vital Health Stat.* **2**(110). National Center for Health Statistics. Hyattsville, MD.
8. ADAMS, P. F. & M. A. MARANO. 1995. Current Estimates from the National Health Interview Survey, 1994. *Vital Health Stat.* **10**(193). National Center for Health Statistics. Hyattsville, MD.
9. SAS Institute Inc. 1990. SAS/STAT User's Guide. Version 6. SAS Institute. Cary, NC.
10. SHAH, B. V. 1981. SESUDAAN: Standard Errors Program for Computing of Standardized Rates from Sample Survey Data. RTI/5250-00-01S. Research Triangle Institute. Research Triangle Park, NC.
11. SHAH, B. V., L. M. LAVANGE, G. B. BARNWELL, J. E. KILLINGER & S. C. WHEELLESS. 1989. Software for Survey Data Analysis. Research Triangle Institute. Research Triangle Park, NC.
12. HINCHCLIFFE, R. 1956. The pattern of the threshold perception for hearing and other special senses as a function of age. *Gerontologia* **2**: 311-320.
13. HINCHCLIFFE, R. 1962. Aging and sensory thresholds. *J. Gerontol.* **17**: 45-50.
14. DOTY, R. L., P. SHAMAN & S. L. APPLEBAUM. 1984. Smell identification ability: Changes with age. *Science* **226**: 1441-1443.

15. STEVENS, J. C., L. M. BARTOSHUK & W. S. CAIN. 1984. Chemical senses and aging: Taste versus smell. *Chem. Senses* **9**: 167-174.
16. BARTOSHUK, L. M. 1989. Taste robust across the age span. *Ann. N. Y. Acad. Sci.* **561**: 65-75.
17. COWART, B. J. 1989. Relationship between taste and smell across the adult life span. *Ann. N. Y. Acad. Sci.* **561**: 39-55.
18. STEVENS, J. C., L. A. CRUZ, J. M. HOFFMAN & M. Q. PATTERSON. 1995. Taste sensitivity and aging: High incidence of decline revealed by repeated threshold measures. *Chem. Senses* **20**: 451-459.
19. BISCHMANN, D. A. & K. L. WITTE. 1996. Food identification, taste complaints, and depression in younger and older adults. *Exp. Aging Res.* **22**: 23-32.
20. FRANK, M. E., T. P. HETTINGER & A. E. MOTT. 1992. The sense of taste: Neurobiology, aging, and medication effects. *Crit. Rev. Oral Biol. Med.* **3**: 371-393.
21. SCHIFFMAN, S. S. 1993. Perception of taste and smell in elderly persons. *Crit. Rev. Food Sci. Nutr.* **33**: 17-26.
22. SHIP, J. A. & J. M. WEIFFENBACH. 1993. Age, gender, medical treatment, and medication effects on smell identification. *J. Gerontol.* **48**: 26-32.
23. DOTY, R. L., P. SHAMAN & M. DANN. 1984. Development of the University of Pennsylvania Smell Identification Test: A standardized, microencapsulated test of olfactory function. *Physiol. Behav.* **32**: 489-502.
24. NORDIN, S., A. U. MONSCH & C. MURPHY. 1995. Unawareness of smell loss in normal aging and Alzheimer's disease: Discrepancy between self-reported and diagnosed smell sensitivity. *J. Gerontol. B Psychol. Sci. Soc. Sci.* **50**: 187-192.
25. GETCHELL, T. V., R. L. DOTY, L. M. BARTOSHUK & J. B. SNOW. 1991. *Smell and Taste in Health and Disease*. Raven Press, New York.
26. MATTES, R. D. 1993. A survey of physician knowledge and practices related to chemosensory disorders. *Chem. Senses* **18**: 77-82.