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Distributions of hallucinations in the population

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Summary. Hallucinations are often manifestations of severe psychiatric conditions seen clinically. However, little is known about the distribution of incident hallucinations in the community, nor whether there has been a change over the past century. Data from the NIMH Epidemiologic Catchment Area Program is used here to provide descriptive information on the community distribution, and data from the Sidgewick study from a century earlier provides comparative information. In the ECA data, the incidence of visual hallucinations was slightly higher in males (about 20 per 1000 per year) than females (about 13 per 1000 per year) across the age span from 18 to 80 years old, with a subsequent increase in the rate for females (up to about 40 per 1000 per year) after age 80. For auditory hallucinations there was an age 25–30 peak in males with a trough for females, and a later age 40–50 peak for females. Overall, there were substantial gender differences, and the effect of aging to increase the incidence of hallucinations was the most consistent and prominent. The Sidgewick study showed a much higher proportion of visual hallucinations than the ECA program. This might be due to factors affecting brain function as well as social and psychological changes over time, although methodological weaknesses in both studies might also be responsible.

Although not specific to any single disorder, hallucinations are an important type of psychiatric symptom. The occurrence of visual, auditory, olfactory, or somatic sensations without external stimuli suggests a significant mental disturbance. In clinical populations hallucinations are common and are associated with many factors which can affect brain function [1], but less is known about hallucinations in the community. Existing estimates of the prevalence of hallucinations in non-clinical samples suggest rates around 10% [2, 3, 4], but there are no known longitudinal incidence studies.

The largest of these studies, the Sidgewick study, was published in 1894, and is of interest because of its size and methodology. However, the Sidgewick study only assessed hallucinations at one point in time. In addition, although impressive in attention to detail (especially without computers), the Sidgewick study suffers from likely sampling and assessment biases. The Epidemiologic Catchment Area Program (ECA) provides data at two points in time, and employed a representative sampling structure and a highly standardized interview [5]. The longitudinal design allows estimates of incidence as well as prevalence. Questions which the ECA data can address include: What proportion of the general population experiences hallucinations? What are the age incidence distributions? Do different sensory modalities of hallucinations differ in distribution? Another question is whether the distribution of hallucinations has changed over the past century. Comparison of results from the Sidgewick study to the ECA Program provides information on this last question.

Methods

Data

Data are from two sources, the Sidgewick study carried out by the Society for Psychical Research, and the NIMH Epidemiologic Catchment Area Program (ECA) [2, 5]. The Sidgewick Study was carried out between 1889 to 1892, and studied 17000 adults (at least 21 years old) primarily in England, but also in Russia and in Brazil. A standard interview schedule was created and used by the study, but there was no standardized training. About 90% of the Sidgewick interviewers had a professional level of education, and many were psychologists or physicians. About a third were members of the Society for Psychical Research.

Between 1980 and 1984, the ECA Program studied subjects 18 years and older in New Haven, Baltimore, Durham, St. Louis, and Los Angeles [5]. To measure occurrence of psychiatric conditions, subjects were assessed twice using the NIMH Diagnostic Interview Schedule [DIS; 6]. The DIS was based on the DSM-III [7]. At ba-

seline 18572 neighborhood residents were assessed. At follow-up roughly one year later data was obtained on 15258 of the baseline participants. The ECA interviewers were not clinicians, but nearly all had at least some college education. At the New Haven site, interviewers received a total of 24 hours of training, while at the other four sites interviewers received an average of 53 hours of training. At all sites training consisted of lectures, videotapes, live demonstrations, homework exercises, mock interviews, and interactive practice sessions [8].

Confidentiality was explicitly provided in both studies. The DIS did not inquire about gustatory or olfactory hallucinations. Both studies made efforts to exclude sleep-related hallucinations. In the ECA, assessment of hallucinations began with a symptom question. For example:

ECA: "Have you ever had the experience of seeing something or someone that others who were present could not see – that is had a vision when you were completely awake?" In the Sidgewick study, the structure of the interview was similar to the DIS approach. A screening question ("Schedule A") inquired as to the occurrence of any hallucinations. The wording of Schedule A resembles wording of the DIS items. Sidgewick: "Have you ever, when believing yourself to be completely awake, had a vivid impression of seeing or being touched by a living being or inanimate object, or of hearing a voice; which impression, so far as you could discover, was not due to any external physical cause?"

In both studies, positive responses to these screening questions led to a set of probe questions which inquired in more detail about the nature of the experiences. Here there were more distinct differences. The Sidgewick study was interested in the content of the hallucinations because the study was motivated as an attempt to prove the existence of telepathic phenomena. For example, hallucinations of dying relatives were considered important for this question. Therefor, the probe questions take out were designed to detail the "particulars" of the hallucinations.

The ECA had no specific hypotheses and was motivated by questions on the occurrence of mental disorders; thus the probe questions attempted to determine whether reported hallucinations were due to alcohol or other drug use, any medical or physical disorder, and whether they caused distress or interfered with life. Each positive response to a DIS symptom question was followed by structured probe questions. The probe questions were designed to assess the severity and consequences of the symptom, and to exclude the possibility of an organic cause (i.e., use of drugs, medications, or medical conditions). There are 5 levels of response coding for hallucinations in the DIS. The first level is no reported occurrence of hallucinations. Level 2 indicated the occurrence of hallucinations but no distress or impairment of function, and no reported association with alcohol or drug use of medical or physical problems. Level 3 indicates the subject thinks the hallucination was due to alcohol or drug use, and level 4 was due to a medical or physical cause. Level 5 indicates the occurrence of a hallucination not due to drugs or medical problem but resulted in either telling a professional about it, taking medication more than once, or interfering with life or activities a lot (referred to subsequently in this paper as "distress"). The rates for level 3 and level 4 responses were very low (less than 10% of level 2 responses) and not studied further here.

Table 1. Exclusion reasons and numbers of excluded subjects: Sidgewick study (1894)

Number	Reasons for exclusions
18	The occurrence during illnesses in which delirium was known to occur, e.g., scarlet fever or typhoid.
7	Dream-images and nightmares, even when persisting into the waking state.
21	Voices or touches rousing the percipient from sleep.
3	Visions of objects seen with closed eyes.
4	Visual experiences seen when going to sleep or awakening hypnogogic and hypnopompic hallucinations.
11	Apparent illumination of the place where the percipient was or of real objects in the field of view.
24	Sounds of the human voice other than speech, including whispering when no distinct words can be made out, but not sounds of speaking aloud even if words were not distinguished.
10	Tactile impression not involving a sense of contact with any definite object.
9	Lights seen at a distance out of doors, when it was not possible to exclude real lights.
5	Objects seen out of the corner of the eye.
15	Other doubtful and excluded as not truly externalized.
32	Mere illusions or mistaken identity.
21	Other subjects totally excluded from the dataset because answers were too vague to be classified.

Raw age distribution data was not available from the Sidgewick study but estimates for the occurrence of different kinds of hallucinations across ten year age-groups were reported. The age of occurrence was dependent on the recall of the subjects, and the Sidgewick researchers noted considerable falling off in the numbers of reported hallucinations more than one year prior to interview, and even months prior to interview. The information was presented in terms of events of hallucination rather than individuals with hallucinations (cases). However, since the ratio of subjects reporting hallucinations to the number of hallucinations was close to 1, the age distribution of occurrence of hallucinations must be similar to what would have been estimated as the age distribution of cases of hallucinations.

Use of the Sidgewick data to estimate the absolute age distribution for occurrence is methodologically weak, although it probably provides information on relative rates for different types of hallucinations. In addition to recall problems, there were several potential biases. Sampling was unstructured, left largely up to the individual interviewers. Some of these collectors were noted to have shown an interest in obtaining positive answers. The entire study was motivated by a desire to prove the existence of telepathic phenomenon, which may have biased assessment of subjects, especially by those interviewers who were members of the Society for Psychical Research. However, the

Sidgewick researchers went to considerable effort to eliminate false positive occurrence of hallucinations.

The structure of the ECA data permits a stronger approach which lessens the effects of recall problems. By excluding subjects reporting hallucinations at the baseline interview, subsequent follow-up reports of hallucinations represent new occurrence. This approach also excludes subjects with a tendency for false positive responses shown by positive symptom reports at baseline. Furthermore, when subjects repeated the DIS there was a global decrease in frequency of reported symptoms suggesting that subjects were more conservative in reporting psychopathology [9]. The age distributions of incident DIS level 2 hallucinations were compared with incident level 5 hallucinations for each sensory modality. As the consequences of experiencing a hallucination may be distinct from the causes of a hallucination, DIS level 2 and level 5 hallucinations were combined together in comparing age distributions by gender, again for each sensory modality.

To estimate these age distributions of newly incident hallucinations in the ECA DIS data, a Generalized Additive Interactive Model (GAIM) program was used [10]. The GAIM approach is an extension of general linear models without the restriction of using only linear relationships to fit data. This permits estimating a non-linear age curve to better reveal underlying age variation.

Results

Sidgewick

Of 17000 subjects assessed, 2272 supplied affirmative responses. 353 of these were considered false positive due to errors in interviewing such as recording of dreams. A number of subjects were changed to negative based on further criteria, shown in Table 1.

Table 2 shows the lifetime prevalence of hallucinations in both studies, by gender and total. Data from both baseline and follow-up interviews in the ECA are shown. There are consistently higher rates for women than for men. In the Sidgewick study there was information on the proportion of visual hallucinations either occurring immediately after awakening or while lying in bed awake (423/1112). For auditory hallucinations the proportion was 169/494. For tactile hallucinations 79 of 179 occurred while the subject was in bed. These would probably be considered to be sleep-related and not true hallucinations

Table 2. Occurrence of hallucinations in two studies

Study		Male %	Female %	Combined %
Sidgewick (1894)	(n = 17,000)	7.8	12.0	9.9
Adjusted for sleep-related		5.3	8.4	6.9
NIMH ECA (1984)	Baseline (n = 18,572)	10.2	14.9	13.0
	Follow-up (n = 15,258)	8.6	12.8	11.1
New incidence at	follow-up (n = 13,622)	4.0	4.9	4.6

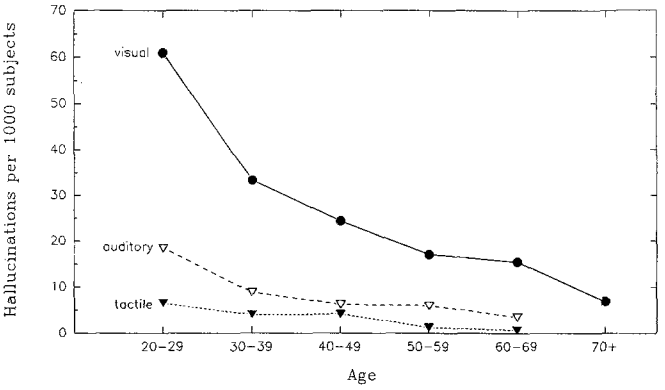

Fig. 1. Age occurrence of hallucinations. Data from Sidgewick study (denominator n = 15,316)

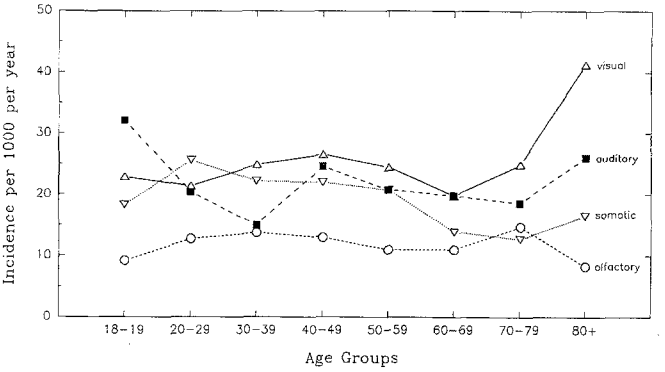

Fig. 2. Age incidence of hallucinations. Data from 5 ECA sites combined (denominator n = 15,258)

by modern criteria. Assuming equal proportions of sleep-related hallucinations in men and women, an adjustment in the prevalence rates of hallucinations in the Sidgewick study was made, also shown in Table 2. The prevalence rates in the ECA are lower at follow-up than at baseline interview. New incidence rates are much lower, but are not very different for males and females.

Figure 1 shows the estimated age distribution for occurrence of hallucinations in three sensory modalities in the Sidgewick data. The rate for visual hallucinations is much higher than auditory or tactile. Both visual and auditory hallucinations were highest at ages 20–29.

ECA

Figure 2 has the same format as Fig. 1, showing age-group incidence for visual, auditory, olfactory, and tactile hallucinations in the ECA data. Overall, the rates for visual, auditory, and tactile hallucinations were similar with olfactory somewhat less common. Auditory hallucination were most common in the 18–19 year-olds with a second peak in 40–49 year olds. Visual hallucinations appeared fairly constant except for increases in ages 70–79 and 80 + .

Figure 3 shows GAIM estimated age distributions and 95% confidence bands for each type of hallucination by DIS level 2 and DIS level 5. The proportion of non-distressing (DIS level 2) hallucinations is much higher than

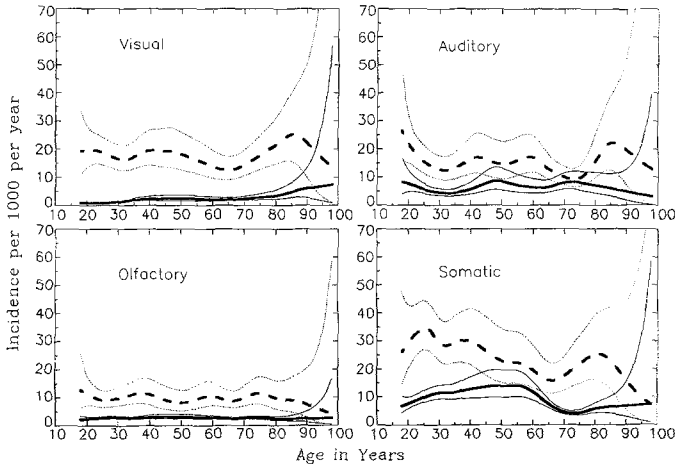

Fig. 3. Age by severity, incidence of hallucinations in 5 ECA sites combined. — DIS level 5; --- DIS level 2; thin lines are 95% confidence bounds

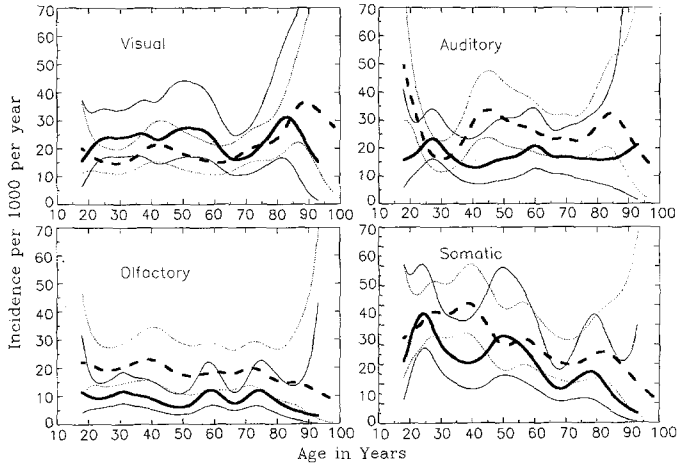

Fig. 4. Age by sex incidence of hallucinations in 5 ECA sites combined. — male; --- female; thin lines are 95% confidence bounds

those associated with distress or interference with function (DIS level 5) for all modalities. However, for auditory and somatic hallucinations, the ratio of distressing to nondistressing was greater than for visual or olfactory hallucinations. Rises in incidence after about age 65 or 70 occurred in all except olfactory hallucinations. The early adult rate for nondistressing somatic hallucinations was much higher than other kinds, and declined subsequently until about age 65.

Figure 4 shows GAIM estimated age by gender distributions and 95% confidence bands for incident visual, auditory, olfactory, and tactile hallucinations. For visual hallucinations, females showed a peak about age 42 and a subsequent trough about age 60. After age 60 the incidence of visual hallucinations in women continued to increase, from about 15/1000 per year to about 35/1000 per year. The final drop is not significant as the confidence band becomes very wide because the number of subjects over age 90 was very small. With the wider confidence band, there was little change in incidence of visual hallucinations in males until a drop after age 60, followed by a rise after age 70.

For auditory hallucination male-female differences were greater. The highest rate for females was before age 20 with a second peak at about age 44. This was about the age for the peak in visual hallucinations in females as well. There was also a rise after age 70. In contrast, there was a lower rate in males before age 20 with a peak about age 27 and a following decrease with a minimum about age 40.

Olfactory hallucination were more frequent in females than males across the age range studied. There was little age variation for either males or females. A small peak was visible for females about age 40.

Somatic hallucinations in males varied over the age range, with a first and highest peak about age 24, a second peak about age 50, and a third peak about age 77. The variation was less in females but showed a peak about age 39. For both genders there was a trend over the age range for decreasing incidence of somatic hallucinations.

Discussion

Sidgewick and ECA comparisons

In the ECA study, a substantial proportion of the population reports experiencing hallucinations, with prevalence at least 10–15%, and annual incidence 4–5%. The prevalence point estimates are higher than a century ago in the Sidgewick study, however the two estimates are not significantly different (statistical test for ratios). The gender ratios for prevalence appeared almost identical in the two studies, with about a 50% higher prevalence in females. However, the incidence estimate for females was close to that for males, suggesting that higher female prevalence rates might be due to gender differences in recall or reporting rather than higher incidence. There might also be a longer duration of hallucinations in females.

The Sidgewick study differs from the ECA study in finding a general decline in occurrence of hallucinations with age. However, the Sidgewick age-group sample sizes decreased sharply with age, and there may have been substantial bias in selecting the older subjects. The ECA data suggest general increases in hallucinations with advanced age. This is attributable to medical conditions of the brain related to age, e.g., psychosis has been observed and reported in dementia [11, 12]. A century ago, surviving elderly subjects may have been healthier due to higher mortality in less hale individuals.

The largest difference between the two studies is the higher rate of occurrence of visual hallucinations in the 20–29 year old group in the Sidgewick study. This difference might be due to methodological differences, but as the rate for auditory hallucinations is similar between the two studies, an explanatory methodologic bias would have to be specifically for visual hallucinations. Both studies began to inquire about hallucination by asking about visual hallucinations, but in the ECA DIS this occurs after over a hundred other questions, while in the Sidgewick study the very first question inquires about "a vivid impression of seeing..." However, the effect of order may not be major. Even with methodological weaknesses in the Sidgewick study (and perhaps also in the ECA study), the higher rate

of visual hallucinations may represent a real difference. A difference in reporting might be due to temporal-cultural differences in such ideas as belief in ghosts. A brain-based mechanism suggested by these results is that toxic effects of industrialization in England contributed to occurrence of visual hallucinations. In a clinical sample, noisome (i.e., noise, heat, fumes) occupational environments have been linked to increased probability of schizophrenia [13]. Avoiding Berkson's bias by use of the ECA community sample [14], the occurrence of DIS delusions or hallucinations was observed to be associated with a 1.2 times increased risk per scoring unit on a 12 point scale for "noisome working conditions" [15].

Another speculation is for a psychophysiological mechanism. Julian Jaynes has proposed that hallucinations are related to human social mental development, and that ancient peoples were not as conscious of their thinking processes as people are today. He theorizes that this lack of consciousness led to greater propensity to experience hallucinations, often interpreted as manifestations of gods [16]. If this process of evolutionary psychological development is related to occurrence of hallucinations, then perhaps shifts in modern sensory experience towards more visual stimulation, e.g., television and movies, have increased visual sensory sophistication and thus increased the threshold for experiencing or interpreting visual phenomenon as visual hallucinations. This possibility could be tested by comparing incidence of different types of hallucinations across present day cultures with different degrees of modern development.

ECA age distributions

The age distributions generated from the ECA data are descriptive, and summarize the effects of all causes of hallucinations in the community population. Of the four sensory modalities studied, auditory hallucinations had the highest proportion with reported negative effects. Across most of the age span, about a third of all incident auditory hallucinations resulted in telling a professional about them, receiving medication, or interfering with function. This ratio reached 50% at age 73, but then declined as the rate of level 2 auditory hallucinations increases sharply after age 73. Somatic hallucinations were second in this respect, with a similar decrease in this proportion after age 70, suggesting that while the incidence of auditory and somatic hallucinations increase after about age 70, a relatively smaller proportion are experienced as bothersome. It seems reasonable that hallucinations of smells might not bother most people, but it is unclear why visual hallucinations so rarely were reported to result in teling a professional, receiving medication, or interference with activities. Possibly the relationship of dementia to hallucinations explains this difference [17], in that the dementia decreases perceived impairment.

Hallucinations alone are not equivalent to schizophrenia, but episodes of psychotic symptoms in schizophrenia can be conceptualized as a product of interacting diathesis and stress [18]. Diathesis-stress models explain schizophrenia as an interaction between relatively fixed predisposing factors and more dynamic stresses later in life. Two types of vulnerability, developmental damage and genetic, are theorized to form a trimodal population distribution [19]. Those with both types of vulnerability are represented by high-risk mode, requiring no more than ordinary stress to develop schizophrenia. The third mode is individuals without vulnerability, resistant to schizophrenia or psychosis. The middle mode is composed of people with genotypic vulnerability who have somehow avoided exposure to intensity or duration of stress sufficient for transformation to schizophrenia. Given a prevalence of schizophrenia of about 1%, a prevalence of about 10% has been estimated for genotypically spectrum individuals [20]. This may account for a substantial part of population vulnerability for occurrence of hallucinations. It is likely that hallucinations alone are also the product of underlying vulnerabilities and adaptational events. Thus, in addition to age-related stresses on brain and mind, the age distributions may reflect age variation in vulnerability. If so, then the age distributions for incident hallucinations might resemble age distributions for onset of schizophrenia.

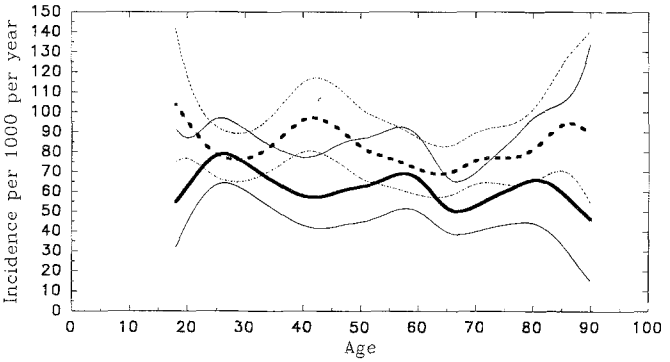

Fig. 5. Age-sex incidence for any hallucinations. Data from 5 ECA sites combined. — male; – – – female; thin lines are 95% confidence bounds

Registry based studies have observed a peak onset for males between the ages of 15 and 25 years, with a decline before the age of 50. For females, the rate of onset has been observed to peak about five years later than for males, with a second peak at around 50 years of age [21, 22]. Similar gender relative differences are seen here for auditory and somatic hallucinations, but with peak ages about 10 years later. Although auditory hallucinations are the most common in schizophrenia, other modalities also occur. Since a vulnerability to hallucinations might thus not be specific for any one type, the age-sex distribution for any hallucinations was estimated (Fig. 5). Peaks at age 25 for males and age 40 for females were present. Assuming that vulnerability to schizophrenia expressed by incidence of hallucinations and the onset of schizophrenia are related, one reason for the earlier appearance of schizophrenia could be a bias from need for hospitalization. Individuals more severely vulnerable may manifest symptoms earlier, especially if stressors have a cumulative effect over time.

One puzzling and interesting finding is a high incidence for auditory hallucinations in females before the age of 25.

The statistical precision of this estimate is good, but there is no known major psychiatric disorder with a similar age distribution which might explain this. One possibility is for false positive reports in histrionic women. However, since subjects with reported hallucinations at baseline were excluded to estimate incidence, this is less likely. Why the rate decreases about age 30 is also unclear, and does not fit with a hypothesis of histrionic personality.

Conclusions

Making allowances for methodologic problems in the Sidgewick study, there does not appear to have a significant change in the overall prevalence of hallucinations in the community population in the last century. There does appear to have been a decrease in the occurrence of visual versus other modalities of hallucinations. Although speculative, both biological (affecting the brain) and psychological (affecting the mind) factors could account for this apparent difference.

A fairly common underlying vulnerability to hallucinations in the population is suggested by the general incidence of 10–30 cases per 1000 people per year. The age and gender variations also suggest different etiologic stressors as well as perhaps gender related vulnerabilities for different modalities of hallucinations. The results strongly point to the importance of aging or age-related brain disorders for increased hallucinations in the elderly. The increases in visual and auditory hallucinations in particular may be partly due to sensory loss with advancing age. It would be of interest to learn which characteristics may be associated with varying incidence of hallucinations in older people. These differences could be further studied by using the results here to define age categories with lower and higher incidence of hallucinations and subsequent risk factor analysis in regression models. Although limited, there is information in the ECA data on education, occupation, alcohol and drug use, and cognitive status which might account for some of this age and gender variation.

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