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Prevalence of hallucinations and their pathological associations in the general population

Maurice M. Ohayon*

Sleep Disorders Center, Stanford University, School of Medicine, 401Quarry Road, Suite 3301, Stanford CA 94305, USA

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Abstract

Hallucinations are perceptual phenomena involved in many fields of pathology. Although clinically widely explored, studies in the general population of these phenomena are scant. This issue was investigated using representative samples of the non-institutionalized general population of the United Kingdom, Germany and Italy aged 15 years or over ($N = 13\,057$). These surveys were conducted by telephone and explored mental disorders and hallucinations (visual, auditory, olfactory, haptic and gustatory hallucinations, out-of-body experiences, hypnagogic and hypnopompic hallucinations). Overall, 38.7% of the sample reported hallucinatory experiences (19.6% less than once in a month; 6.4% monthly; 2.7% once a week; and 2.4% more than once a week). These hallucinations occurred, (1) At sleep onset (hypnagogic hallucinations 24.8%) and/or upon awakening (hypnopompic hallucinations 6.6%), without relationship to a specific pathology in more than half of the cases; frightening hallucinations were more often the expression of sleep or mental disorders such as narcolepsy, OSAS or anxiety disorders. (2) During the daytime and reported by 27% of the sample: visual (prevalence of 3.2%) and auditory (0.6%) hallucinations were strongly related to a psychotic pathology (respective OR of 6.6 and 5.1 with a conservative estimate of the lifetime prevalence of psychotic disorders in this sample of 0.5%); and to anxiety (respective OR of 5.0 and 9.1). Haptic hallucinations were reported by 3.1% with current use of drugs as the highest risk factor (OR = 9.8). In conclusion, the prevalence of hallucinations in the general population is not negligible. Daytime visual and auditory hallucinations are associated with a greater risk of psychiatric disorders. The other daytime sensory hallucinations are more related to an organic or a toxic disorder.

Keywords: Drugs; Epidemiology; Medication; Mental disorders; Organic diseases; Sleep

* Corresponding author. Tel.: +1-650-723-6601; fax: +1-650-251-0076.
E-mail address: mrcohayon@aol.com (M.M. Ohayon).

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1. Introduction

Descriptions of hallucinatory phenomena have figured prominently in written documents since the beginning of recorded history. The word 'hallucinatory' has its roots in the Latin *hallucinari* or *allucinari*, which means to wander in mind. Lavater introduced 'hallucination' in the English language in 1572 to refer to 'ghostes and spirites walking the nyght.' The word was first used in its current sense by Jean Etienne Esquirol in 1837. In the Middle Ages, hallucinations were thought to be manifestations of demons or angels. A religious person who experienced such phenomena was seen as a saint, whereas a commoner was believed to be possessed by the devil. In certain cultures today, hallucinations are still perceived as the work of Satan or as a result of magic (Wahass and Kent, 1997).

Normally, hallucinations are perceptions that occur in the absence of corresponding sensory stimuli. From the subjective point of view of the individual who experiences these phenomena, they are indistinguishable from normal perceptions. Something is perceived yet, objectively, there is nothing to perceive. In this sense, hallucinations are different from illusions, which are distortions or misperceptions of a perceivable object. However, people having hallucinations are confronted by other people dismissing their perceptions. Therefore, the estimation of hallucinations in the general population is based on people having experienced perceptions not confirmed by others.

In the general population, using the data from the NIMH epidemiological catchment area survey, Tien (1991) found an incidence of visual hallucinations of 2% among men and 1.3% among women. In a comparative study of hallucinations in the general population and among schizophrenics, Lindal et al. (1994) observed that the former mainly reported visual hallucinations involving persons, whereas the latter were more likely to report other types of hallucinations. However, schizophrenia is relatively infrequent in the general population. In the United States, the Epidemiological Catchment Area study (Regier et al., 1988) found a lifetime prevalence of schizophrenia of 1.5%. This prevalence was 0.7% in the National Comorbidity Survey (Kendler et al., 1996). An Israeli survey found a prevalence of 0.7% in individuals aged 35–45 years (Levav et al., 1993). Therefore, It appears that the prevalence of reported hallucinations has rarely been assessed in the general population. Furthermore, the association between hallucinations and their causes, namely organic pathologies and psychoactive substances, has never been explored in subjects in the general population.

The purpose of this study is to provide additional data on the prevalence of hallucinations in the general population of three European countries and to study their association with organic diseases, mental disorders and psychoactive substance use.

2. Methods

2.1. Sample

The samples are composed of respondents from three countries: the United Kingdom, Germany and Italy. The UK study was undertaken in 1994 with a representative sample of 4972 individuals from the non-institutionalized general population aged 15 years or over. The German study was carried out in 1996 and involved 4115 like individuals. The Italian survey was conducted in 1997 and involved 3970 like individuals.

Each sample was drawn using a two-stage sampling design. At the first stage, official census data from each country were used to divide the population according to its geographical distribution, and telephone numbers were then randomly drawn. At the second stage, the individual to be interviewed in each household was selected as a function of age and gender by the Kish method (Kish, 1965) in order to maintain the representativeness of the sample.

Individuals had to grant their verbal consent before being interviewed. Excluded were those with insufficient fluency in the national language, with a hearing or speech impairment or with an illness precluding the feasibility of an interview.

The participation rate was 79.6% (4972 of 6249 eligible individuals) in the UK; 68.1% (4115 of

6047 eligible individuals) in Germany; and 89.4% (3970 of 4442 eligible individuals) in Italy. Overall, 13 057 subjects participated in the studies. This sample is representative of 158 690 882 inhabitants. The overall participation rate was 78%.

2.2. Interviews

Forty interviewers from a company specializing in nationwide telephone surveys (BPS Teleperformance) performed the United Kingdom interviews. Thirty-seven native German-speaking interviewers (from Teleperformance) conducted the German study and 30 interviewers (from Grandi Numeri) performed the Italian study. These interviewers were inexperienced in psychiatric assessment but received special training in the use of the Sleep-EVAL Knowledge Based System.

The duration of interviews ranged from 28 to 150 min. The longest interviews involved subjects with multiple disorders. Interviews could be completed over two or more sessions if the duration exceeded 60 min or if requested by the subject. The team of interviewers was monitored daily by two supervisors who listened in on calls in progress. This was done to ensure that questions were asked correctly and that data were entered properly.

2.3. Instrument

Sleep-EVAL is a non-monotonic, level-2 expert system endowed with a causal reasoning mode capable of formulating diagnostic hypotheses and then validating these through further queries and deductions (Ohayon, 1994, 1999). It was specially designed to conduct epidemiological studies of sleep habits and sleep and mental disorders in the general population.

Interviews typically began with a standard questionnaire applied to the whole sample covering sociodemographic information, sleep/wake schedule, health status and health care utilization. From the responses to this standard set of questions, the system formulated initial diagnostic hypotheses and allowed concurrent diagnoses in accordance with the DSM-IV classification. Mental health questions appeared only after approximately 15 min of interview and were asked in order from the less threatening (sleep disorders) to the most private (hallucinations). This organization may have changed from one subject to another, depending on the presented symptoms. For example, a subject with enough criteria to trigger the exploration of DSM-IV primary insomnia was first asked about other mental disorders because such disorders needed to be eliminated before the system could conclude the presence of insomnia. Therefore, the differential process was based on a series of key rules allowing or prohibiting the co-occurrence of two diagnoses. The system terminated the interview once all diagnostic possibilities were exhausted. The expert system's questionnaire was designed so that the decision about the presence of a symptom was based on the interviewee's responses rather than on the interviewer's judgment. This approach has been shown to yield better agreement between lay interviewers and psychiatrists on the diagnosis of minor psychiatric disorders (Lewis et al., 1992).

The system selected and phrased the questions to be administered and provided examples and instructions on how to ask them. The interviewer simply read them out as they appeared on a computer monitor and entered the responses. Most questions were close-ended (e.g., yes-no, present-absent-unknown, five-point scale), although some were open-ended (e.g., name of illness, duration). Further details on the methodology and on how the Sleep-EVAL system worked and how it was validated can be found elsewhere (Ohayon et al., 1997; Ohayon, 1999; Ohayon et al., 1999).

2.4. Variables

The phenomena under study included visual, auditory, olfactory, haptic, and gustatory hallucinations and out-of-body experiences. The following questions were used to assess these experiences:

- Have you ever seen things, objects or persons which other people can't see?
- Do you smell things which other people can't

smell (for example, chemical odors, urine, smoke) for no apparent reason?

- Do you feel something is under your skin or on your skin (for example, as though bugs are crawling on you)?
- Do you have a strange taste in your mouth (for example, a metallic taste) for no apparent reason?
- Do you have the sense that you are outside of your body and watching yourself?
- Have you ever heard sounds, music or voices which other people can't hear?

Each of these were answered as follows: Never; less than once a month; one to three times a month; one time a week; two to five times a week; six to seven times a week.

As the main purpose of the three national studies was the investigation of sleep disorders, hypnagogic and hypnopompic hallucinations were also explored.

Hallucinations were classified into two groups: frequent (at least once a week) and infrequent (once a month or less).

The presence of hallucinations was analyzed relative to sociodemographic data, use of drugs (amphetamines, cocaine, opiates, etc.), alcohol and medication (hypnotics, anxiolytics, antidepressants and neuroleptics), DSM-IV mental disorders, sleep complaints and organic diseases (based upon ICD-10 classification). The latter included brainstem pathology, ocular or optic nerve pathologies, neurological illnesses and epilepsy.

Treatments, and current and past consultations were used for the assessment of severity and confirmation of diagnoses by the physicians.

2.5. Data analyses

The data were weighted to compensate for disparities between the sample and the national census figures for the non-institutionalized popu-

Table 1
Prevalence of visual, auditory, olfactory, haptic, and gustatory hallucinations

	Frequency of the hallucinations			
	< 1 time/ month	at least 1 time/ month	at least 1 time/ week	Several times/ week
Daytime hallucinations				
Auditory	0.2	0.2	0.1	0.1
Haptic	2.5	0.6	0.2	0.3
Olfactory	8.6	3.5	1.5	0.9
Gustatory	7.2	2.4	1.1	0.8
Visual	2.7	0.3	0.1	0.1
Out-of-body experience	4.4	0.9	0.3	0.2
At least one type of hallucination ($N = 13057$)	16.3	6.2	2.5	2.0
Hypnagogic hallucinations				
Auditory	1.1	0.4	0.4	0.1
Visual	3.5	1.0	0.5	0.3
Haptic	16.9	3.5	1.7	1.1
At least one type of hallucination ($N = 13057$)	18.0	3.7	1.8	1.1
Hypnopompic hallucinations				
Auditory	0.3	0.1	0	0
Visual	1.1	0.2	0.1	0.1
Haptic	4.2	0.7	0.5	0.3
At least one type of hallucination ($N = 13057$)	4.9	0.8	0.5	0.4

lation aged 15 and over. Logistic regression (Hosmer and Lemeshow, 1989) was used to compute the odds ratios (*OR*) associated with each type of hallucination. Co-linearity between variables (i.e. information redundancy) was verified beforehand. Logistic regressions were performed using the SUDAAN software, which makes it possible to compute an appropriate estimate of standard error in stratified samples by means of the Taylor series linearization method. Reported differences were significant at 0.05 or less.

3. Results

The overall sample consisted of 6263 (48%) men and 6794 (52%) women ranging in age from 15 to 100 years, with no differences across countries.

Based on the report of current and past medical consultations, a conservative estimate of 0.5% was calculated for the lifetime prevalence of psychotic disorders in this sample. There were no significant differences across the countries. Prevalence rates were comparable in terms of gender and age.

3.1. Overall prevalence of hallucinations

The hallucinations were first grouped according to the sensory systems involved: auditory, visual, olfactory, gustatory and haptic systems; then divided according to the time of their occurrence: during the daytime, at sleep onset (hypnagogic) or upon awakening (hypnopompic). They were further divided according to their frequency. The most prevalent daytime hallucinations were olfactory and gustatory (Table 1), while haptic hallucinations were the most frequent hypnagogic and hypnopompic hallucinations. Overall, 38.7% of the sample reported hallucinatory experiences: 19.6% less than once in a month; 6.4% monthly; 2.7% once a week and 2.4% more than once a week. Daytime hallucinations occurred several times per week in 2% of the population. Another 22.5% reported daytime hallucinations occurring once a month or less.

3.2. Daytime auditory hallucinations

Daytime auditory hallucinations were reported by 0.6% of the sample. Fourteen subjects reported having at least once a week daytime audi-

Table 2
Significant factors related to hallucinations occurring at least one time per week (reference absence of hallucinations)[c]

	Types of hallucinations (odds ratio)							
	Aud.	Hap.	Olf.	Gus.	Vis.	O-B	HH	HP
Current use of drugs[a]	–	9.8	3.0	2.2	11.2	–	2.1	2.1
Current use of hypnotics[a]	–	4.4	–	2.9	–	–	–	–
Current use of alcohol[a]	3.8	–	2.3	–	–	–	–	–
Past use of alcohol[a]	–	–	–	2.1	–	–	2.0	2.1
Anxiety disorders[a]	9.1	3.1	2.2	2.5	5.0	2.9	2.2	2.1
Bipolar disorders[a]	9.8	5.0	2.3	5.3	–	4.0	2.4	2.6
Depressive disorders[a]	5.6	–	–	2.0	–	2.7	1.9	–
Psychotic disorders[a]	5.1	5.2	–	–	6.6	–	–	–
Adjustment disorders[a]	–	5.7	2.2	–	–	–	1.4	–
Organic diseases[a]	3.6	5.8	–	–	12.7	–	–	–
Sleep duration[b]								
Too long	–	–	–	–	–	6.0	–	–
Too short	–	–	1.7	2.0	–	–	1.3	1.2

[a]Absence of the symptom or disorder.
[b]Sleep of normal duration. Non-significant factors: past use of drugs, current use of anxiolytics, current use of antidepressants.
[c]Aud.: Auditory hallucinations; Hap.: Haptic hallucinations; Olf.: Olfactory hallucinations; Gus.: Gustatory hallucinations; Vis.: Visual hallucinations; O-B: Out-of-body experience; HH: Hypnagogic hallucinations; HP: Hypnopompic hallucinations.

Table 3
Significant factors related to hallucinations occurring less than one time per week (reference absence of hallucinations)[c]

	Types of hallucinations (odds ratio)							
	Aud.	Hap.	Olf.	Gus.	Vis.	O-B	HH	HP
Current use of drugs[a]	–	4.1	2.0	2.7	5.0	2.2	2.5	2.5
Current use of alcohol[a]	–	1.5	1.3	–	–	1.6	–	–
Past use of alcohol[a]	–	2.0	1.7	2.2	2.1	2.2	2.2	2.3
Anxiety disorders[a]	–	2.3	2.1	2.2	1.8	1.8	2.3	2.2
Bipolar disorders[a]	–	4.1	2.2	2.2	4.2	3.5	2.5	3.3
Depressive disorders[a]	–	2.8	2.1	1.9	3.4	2.6	2.5	1.6
Psychotic disorders[a]	–	–	–	2.4	6.2	–	–	2.2
Adjustment disorders[a]	–	–	2.1	1.8	–	2.5	2.2	–
Organic diseases[a]	3.6	1.5	–	1.3	–	–	–	–
Sleep duration (too short)[b]	–	1.4	1.7	1.3	2.0	–	1.3	1.2

[a]Absence of the symptom or disorder.
[b]Sleep of normal duration. Non-significant factors: Past use of drugs, current use of anxiolytics, antidepressants or hypnotics.
[c]Aud.: Auditory hallucinations; Hap.: Haptic hallucinations; Olf.: Olfactory hallucinations; Gus.: Gustatory hallucinations; Vis.: Visual hallucinations; O-B: Out-of-body experience; HH: Hypnagogic hallucinations; HP: Hypnopompic hallucinations.

tory hallucinations. Multivariate analyses revealed six variables significantly associated with these hallucinations. These included current use of alcohol, anxiety disorders, bipolar disorders, depressive disorders, psychotic disorders and organic diseases (Table 2). All these cases had an associated mental disorder or pathology, with anxiety, sleep and psychotic disorders being the most frequent (Table 4).

Subjects with daytime auditory hallucinations occurring monthly or less frequently also had important rates of associated mental disorders or pathologies (Table 4), but only the presence of an organic disease emerged as a significant factor in the multivariate analyses (Table 3).

3.3. Daytime haptic hallucinations

Daytime haptic hallucinations were found in 2.6% of the sample (Table 1). Thirty-seven respondents reported experiencing haptic hallucinations at least once a week during the daytime. Variables significantly associated with this type of hallucination included current use of drugs, current use of hypnotics, anxiety disorders, bipolar disorders, adjustment disorders, psychotic disorders and organic diseases (Table 2). Only nine cases (24%) had no associated disorder or pathology. Again, the proportion of associated bipolar disorders was up to 15 times higher in subjects with weekly haptic hallucinations compared with subjects without hallucinations; anxiety disorders were up to eight times and depressive disorders up to five times higher. The most frequent anxiety disorders were panic disorder and posttraumatic stress disorder (Table 4).

Variables associated with daytime haptic hallucinations occurring monthly or less frequently were about the same, with the exception of psychotic and adjustment disorders that were not significant. Current or past use of alcohol, age and gender appeared in the model (Table 3).

Subjects with weekly haptic hallucinations significantly more frequently had an organic pathology, a psychotic disorder or an adjustment disorder than those with monthly haptic hallucinations (Table 3).

3.4. Daytime olfactory hallucinations

Overall, 200 respondents reported experiencing olfactory hallucinations at least once a week. Variables significantly associated with this type of hallucination included being female, current use of alcohol, current use of drugs, anxiety disorders, bipolar disorders, adjustment disorders and sleep duration perceived as too short (Table 2). More specifically, women made up 64.1% of respon-

Table 4
Associations between organic pathology, sleep and mental disorders and daytime hallucinations

	Daytime hallucinations										
	Auditory		Haptic		Olfactory		Gustatory		Visual		No hall.[a]
	= 1/month $n = 36$	= 1/wk $n = 14$	= 1/month $n = 299$	= 1/wk $n = 37$	= 1/month $n = 1020$	= 1/wk $n = 200$	= 1/month $n = 843$	= 1/wk $n = 158$	= 1/month $n = 252$	= 1/wk $n = 14$	$n = 8005$
Organic pathology	23.7*	40.8*	7.6	26.4*	8.8	13.0	9.1	13.9	7.7	14.3	9.3
Use of a psychoactive substance[b]	13.8	42.8*	23.8*	40.3	17.9	21.6*	19.3*	21.8*	24.9*	28.6	15.1
Psychotic disorder	13.8*	50.0*	1.8*	10.0**,*	1.3*	1.8*	1.5*	3.0*	3.4*	7.1*	0.1
Depressive disorder	20.3*	35.2*	9.8*	12.2*	6.8*	7.2*	7.5*	12.5*	12.3*	21.4*	2.1
Bipolar disorder	29.6*	36.1*	9.2*	21.7*	5.5*	7.5*	5.8*	15.2**,*	10.9*	7.1	1.2
Anxiety disorder	55.0*	78.4*	18.7*	35.5*	14.6*	18.4*	15.5*	25.4**,*	17.8*	35.7*	4.1
Sleep disorder	31.7*	67.5*	17.4*	24.2*	11.7*	16.7*	13.0*	25.6*	12.8*	35.7*	6.4
Adjustment disorder	6.1*	12.1*	3.8*	15.5**,*	3.4*	6.8*	3.4*	5.0*	4.7*	0.0	1.1
No disorder or pathology	0.0	0.0	48.1*	24.0*	54.5*	44.2**,*	53.0*	33.6**,*	42.5*	7.1*	69.9

[a] Subjects without any kind of hallucinations.
[b] Include current use of alcohol, current use of drugs and current use of hypnotics, anxiolytics or antidepressants.
*$P = 0.01$ with the no hallucination group.
**$P = 0.01$ with = 1 month.

dents with weekly olfactory hallucinations, compared with 49.2% of the remaining sample. The proportion of subjects with weekly olfactory hallucinations and mental disorders was lower than that observed in the other types of daytime hallucinations. It ranged from 6.8% (adjustment disorder) to 18.4% (anxiety disorder) (Table 4).

Variables associated with daytime olfactory hallucinations occurring monthly or less were the same plus three other variables: past use of alcohol, presence of a depressive disorder or an organic pathology (Table 3).

Subjects with olfactory hallucinations occurring monthly or less did not differ significantly from those having these hallucinations at least weekly (Table 4).

3.5. Daytime gustatory hallucinations

In total, 158 respondents reported experiencing gustatory hallucinations at least once a week. Multivariate analyses revealed that the following variables were significantly associated with this type of hallucination: current use of drugs, current use of hypnotics, past use of alcohol, anxiety disorders, bipolar disorders, depressive disorders and sleep duration perceived as too short (Table 2). Approximately 66% of subjects with weekly gustatory hallucinations had either a mental disorder or an organic pathology or used a psychoactive substance (Table 4). Nearly half (45.4%) the respondents with gustatory hallucinations perceived their sleep duration as too short, compared with 23.6% of the rest of the sample.

Similar associations were found in the multivariate analyses with subjects having gustatory hallucinations monthly or less, but three other variables were also significant: psychotic disorders, adjustment disorders and organic pathology (Table 3).

Subjects with weekly gustatory hallucinations more often had bipolar, anxiety or sleep disorders than those with monthly gustatory hallucinations (Table 4).

3.6. Daytime visual hallucinations

Only 14 respondents overall reported experiencing visual hallucinations at least once a week. Variables significantly associated with this type of hallucination included current use of drugs, anxiety disorders, psychotic disorders and organic diseases (Table 2). All cases except one had an associated mental disorder, organic or toxic pathologies. Anxiety and sleep disorders were found in approximately one-third of the cases (Table 4). The most frequent anxiety disorders were generalized anxiety and social phobia. In the other visual hallucination group (monthly or less) the presence of mental disorders or organic or toxic pathologies involved less than half of the cases (Table 4).

In subjects with monthly visual hallucinations, the following variables emerged as significant factors in the multivariate model: current use of drugs, past use of alcohol, anxiety, bipolar, depressive and psychotic disorders, and too short sleep duration (Table 3).

3.7. Out-of-body experience

In all, 36 respondents reported having an out-of-body experience at least once a week. Variables significantly associated with this type of hallucination included anxiety disorders, bipolar disorders, depressive disorders and sleep duration perceived as too long (Table 2). More specifically, anxiety disorders were observed in 10 of 36 (25.4%) respondents with weekly out-of-body experiences, compared with 6.9% of those without; bipolar disorders in five of 36 (13.9%), compared with 2.5% without; and depressive disorders in five of 36 (14.5%), compared with 4.4% without. The perception of sleeping too long was reported by six of 36 (16.6%) respondents with out-of-body experiences, compared with 2.8% of those without.

In addition to the previously mentioned variables, current and past use of alcohol, current use of drugs, adjustment disorders and too short sleep were significantly related to out-of body experiences occurring monthly or less (Table 3).

3.8. Hypnagogic hallucinations

Almost everyone has experienced at least once

in his or her life some form of hallucination at sleep onset or upon awakening. In our combined sample, 3204 respondents reported hypnagogic hallucinations. The feeling of falling down an abyss was the most frequent hypnagogic hallucination mentioned (15.5%), followed by the feeling that someone or something is present in the room (8.9%). German and Italian respondents were asked whether they were frightened by these experiences. Three types of hypnagogic hallucinations were frightening for half the respondents: about to be attacked, being caught in a fire, and seeing or hearing persons.

As was the case for other hallucinations, multivariate analyses revealed that mental disorders were significant predictors of hypnagogic hallucinations. However, as seen in Table 2, the odds ratios were lower than for other hallucinations. Gender and age, too, emerged as significant predictors. The likelihood of reporting hypnagogic hallucinations was higher for women ($OR = 1.7$) and younger subjects ($OR = 2.4$ for the 15–44 age group vs. 1.4 for the 45–64 age group). More specifically, the prevalence of hypnagogic hallucinations was 29.2% for women, compared with 20.2% for men. In the 15–44 age group, the prevalence of hypnagogic hallucinations was 31.1%. The rate decreased to 19.7% in the 45–64 age group and to 15.5% in the 65 + age group. For 58.2% of subjects reporting hypnagogic hallucinations, no use of psychoactive substances, organic pathology, or sleep or mental disorders were found.

Finally, frightening hypnagogic hallucinations were assessed in a multivariate model. The significant predictors were the same as above, except that odds ratios were higher. In addition, narcolepsy and use of alcohol emerged as significant. Sixteen cases of narcolepsy were found, which yielded a prevalence of 1.2 cases per 1000 individuals.

3.9. Hypnopompic hallucinations

Overall, 862 respondents reported hypnopompic hallucinations. Here, too, the feeling of falling down an abyss was the most frequently reported hallucination (3.3%). We asked the German and Italian respondents whether they were frightened by these experiences. Three types of hypnopompic hallucinations were frightening for approximately one third of the respondents: about to be attacked, seeing or hearing persons, and someone or something present in the room.

Multivariate analyses were also carried out on hypnopompic hallucinations. Here, the likelihood of reporting hypnopompic hallucinations was higher for younger respondents, current drug users, past alcohol users, sufferers of anxiety or bipolar disorders, and those who perceived their sleep duration as too short (Table 2).

In the 15–44 age group, the prevalence of hypnopompic hallucinations was 8.2%. The rate decreased to 5.1% in the 45–64 age group and to 4.8% in the 65 + age group.

The multivariate model for frightening hypnopompic hallucinations yielded similar results as above, but with higher odds ratios and the exception of current use of drugs replaced with past use of drugs. For 55.1% of subjects reporting hypnopompic hallucinations, no use of psychoactive substance, organic pathology, or sleep or mental disorders were found.

3.10. Co-occurrence of daytime hallucinations and hypnagogic hypnopompic hallucinations

Regardless of the frequency of occurrence, approximately half of the respondents who reported daytime hallucinations also experienced hypnagogic hallucinations. The prevalence in this group (24.1%) was twice as high as in the rest of the sample. Similarly, approximately 17% of respondents with daytime hallucinations also reported hypnopompic hallucinations, compared with 5.1% in the remaining sample. Furthermore, 5.1% of the sample reported having two daytime hallucinations, 1.3% reported three daytime hallucinations and 0.5% reported four or five daytime hallucinations regardless of frequency.

4. Discussion

The purpose of this study was to investigate hallucinatory phenomena in the general population of three European countries (Germany, Italy

and the United Kingdom), taking into account all possible causes. Aside from psychotic disorders, many other conditions may trigger hallucinatory phenomena, namely, use of drugs such as cocaine and opiates, brainstem pathology, neurological diseases and other mental disorders such as mood disorders. Certain hallucinations can be considered normal phenomena. This is the case for hypnagogic and hypnopompic hallucinations: They were unrelated to any of these pathologies in approximately half of the cases. For individuals who are frightened by their hypnagogic hallucinations, the risk of a concomitant mental disorder is four times as high and the risk of narcolepsy is six times as high as in the remaining sample.

4.1. Limits of the study

The prevalence of hallucinations is a conservative estimate for several reasons. First, it can be the result of the social desirability effect and a reluctance to speak about intimate matters, which leads certain subjects to remain silent about symptoms considered shameful or that may indicate they are mentally disturbed. However, the anonymity granted by the telephone may have mitigated such bias as respondents may have felt less embarrassed to be truthful than in face-to-face interviews (Aneshensel et al., 1982). Second, many individuals with hallucinations are unaware of their problem and will fail to report such experiences. Third, the sample included only the non-institutionalized population; many psychotic individuals are hospitalized or homeless. Therefore, they were not included in our study. Furthermore, demented individuals or those with hearing loss were not included in the study because they were unable to understand or to answer the questions. However, using only a non-institutionalized population allowed us to determine how many individuals with psychosis and hallucinations are living in society and have, at least, minimal social functioning. This group would be very interesting to study because it may provide some indications about the protective factors that prevent social withdrawal.

To limit problems related to the inquisitive nature of the questions about private feelings or perceptions, the questionnaire was quite extensive to ensure a smooth progression of the investigation in order to avoid an unexpected termination of the interview and to allow the differentiation between illusions and hallucinations; and the identification of organic mental and toxic disorders that may be responsible for the hallucinatory phenomena.

4.2. Factors related to hallucinations

The results of this study show that 2% of the sample reported having frequent daytime hallucinations (visual, auditory, olfactory, haptic or gustatory hallucinations, or out-of-body experiences) and 16.3% infrequent daytime hallucinations (less than once a week). Proportions were comparable across the three countries. Use of drugs (opiates, cocaine, amphetamines, etc.) was significantly associated with almost all the types of hallucinations investigated, with the exception of auditory hallucinations. Haptic and gustatory hallucinations were significantly associated with the use of hypnotic medication. More specifically, gustatory hallucinations were more prevalent among respondents who took zopiclone. One of the main side effects of this hypnotic is the impression of a strange or a metallic taste in the mouth. Haptic hallucinations, instead, were associated with hypnotics as a whole.

Clearly, hallucinations affected individuals with a mental disorder more often than those without. Approximately one-third of mentally disordered respondents had experienced infrequent hallucinations, and approximately 12% reported having them at least on a weekly basis. Similarly, respondents with an organic disease were more likely than others to report hallucinations.

The risk factors for hallucinations identified in this study are similar to those reported in clinical studies. Accordingly, use of drugs such as cocaine or opiates is a significant risk factor for virtually all types of hallucinations, especially for visual and tactile hallucinations that are frequent in the case of intoxication. Similarly, auditory hallucinations have been reported relative to alcohol withdrawal. Psychotic disorders were significantly associated with auditory, haptic and visual hallu-

cinations, which are the three most common forms of hallucinations in psychotic patients.

4.3. Significance of hypnagogic and hypnopompic hallucinations

Hypnagogic hallucinations were very frequent (24.8%) in this sample but can be considered non-pathological in most cases (Ohayon et al., 1996). We frequently found frightening hypnagogic hallucinations associated with narcolepsy. Hypnagogic and hypnopompic hallucinations need to be differentiated from other types of hallucinations in the sense that they occur solely in the transitional period from wake to sleep (hypnagogic) or from sleep to wake (hypnopompic). Most individuals who experience these hallucinations know that the perception is not true. However, if an individual is terrified by what he perceives, he may attempt to escape the hallucination and severely injure himself or others. Furthermore, there are case reports in the literature of narcolepsy being misdiagnosed as a psychotic disorder (Douglass et al., 1991, 1993; Shapiro and Spitz, 1976). This may occur if an individual complains only of frightening hypnagogic hallucinations. Moreover, as sudden sleep episodes occur in the daytime and are often preceded by hypnagogic hallucinations, distinguishing between the two diagnoses can be difficult. The hallucinations of psychotic individuals occur at any moment of the day, including at sleep onset. It is important, therefore, to ensure that hallucinatory phenomena occur outside of sleep onset periods in order to rule out narcolepsy.

The presence of hallucinations is not equivalent to schizophrenia. Life conditions such as sensory or sleep deprivation and even stress can trigger these phenomena. Hallucinations are a symptom of a psychotic disorder only when individuals firmly believe them to be true despite what the people around them say.

From a theoretical point of view, someone could ask whether hypnagogic and hypnopompic hallucinations are true hallucinatory perceptions. In our opinion, they are, even if their frequency relates them more to a dreamy state than to a pathological condition. The main difference between hypnagogic, hypnopompic and visual or auditory hallucinations relies on the significance the individual gives to the perceptual phenomenon: following the hallucinatory experience, a subject with hypnagogic or hypnopompic hallucinations knows, in most of cases, that the perceived object did not exist. In psychotic individuals, the hallucinations become the reality and are integrated as such; the interpretations about their meaning reinforce the pathological character of the hallucination.

4.4. Significance of olfactory and gustatory hallucinations

Olfactory and gustatory hallucinations also pose a problem. They are rather a strange perception that is often not associated with a pathological interpretation. As our results show, they are frequently associated with the use of psychoactive substances such as street drugs (cocaine, amphetamines, opiates, etc.), alcohol and medication. Therefore, we can understand these types of hallucinations as being rather like a pathological effect on the sensory organ itself. Although we have found psychiatric disorders associated with these types of hallucinations, the first question to ask is how many of these psychiatric subjects also received a treatment that could explain the hallucinatory phenomena. For some drug users, olfactory and gustatory hallucinations could be a dysosmia or a dysgeusia. Furthermore, haptic, gustatory hallucinations and out-of-body experiences are difficult to distinguish from illusions. In visual and auditory hallucinations, other individuals may witness the presence or absence of the hallucinatory phenomenon. In the other types of hallucinations, the hallucinatory character relies on the description and on the interpretation given to this experience.

In conclusion, hallucinations are symptoms involved in many fields of pathology. Where mental disorders are concerned, they are at the root of delusional themes. They can also be specific to certain types of drugs or neurological diseases. This study showed that the prevalence of hallucinations in the general population is not negligible.

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