Olfactory hallucinations and olfactory identification ability in patients with schizophrenia and other psychiatric disorders

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Abstract

Olfactory identification ability and the prevalence of olfactory hallucinations were examined in 183 hospitalized patients from three diagnostic groups. One hundred and thirty-one patients with schizophrenia, 21 patients with major depression, 31 women with eating disorders along with 77 normal control subjects were examined using the University of Pennsylvania Smell Identification Test (UPSIT) and were questioned regarding the presence of olfactory hallucinations. Olfactory identification deficits were observed only in patients with schizophrenia. In contrast, olfactory hallucinations were reported by members of all psychiatric diagnostic categories (34.6% of patients with schizophrenia; 19% of depressed patients and 29% of eating disorders patients). For patients with schizophrenia, women were more likely to report olfactory hallucinations and had higher UPSIT scores than men.

Key words: Olfactory identification; Olfactory hallucinations; Major depressive disorder; Eating disorder; (Schizophrenia)

1. Introduction

Olfactory hallucinations have been reported in patients with schizophrenia since Kraepelin’s time (Kraepelin, 1919). Subsequently, other investigators have confirmed the presence of olfactory hallucinations in schizophrenia and extended the observation to patients with depression (Mueser et al., 1990; Pearlson et al., 1989; Meats, 1988). In a sample of psychiatric and neurological patients who reported olfactory hallucinations, Meats (1988) noted that one-quarter had received a diagnosis of schizophrenia, one third were depressed whereas the remaining patients had diagnoses of olfactory reference syndrome or epilepsy. More recently, Mueser et al. (1990) reported olfactory or gustatory hallucinations in 11% of patients with schizophrenia.

Meats (1988) described olfactory hallucinations as common in schizophrenia but subordinate to hallucinations in other sensory modalities. He also stated that while patients with schizophrenia may develop secondary delusional interpretations to explain their olfactory hallucinations, patients with temporal lobe epilepsy recognized this phenomenon as being related to their illness. Furthermore, Pryse-Phillips et al. (1975) observed that the olfactory hallucinations reported by patients with depression were typically foul in nature with two thirds of the patients believing that the smells came from their own bodies.

Olfactory function in patients with schizophrenia...
nia has been assessed, and olfactory identification
deficits reported for male patients with this disor-
der (Hurwitz et al., 1988; Kopala et al., 1989;
1990; 1992). Although olfactory hallucinations had
been documented in both neuroleptic naive and
medicated male and female patients in these
studies, a systematic analysis of these phenomena
had not been undertaken. Therefore, the present
study was designed to address several questions:
first, does the prevalence of olfactory hallucina-
tions differ according to diagnosis; second, what
is the relationship between psychiatric diagnosis,
olfactory hallucinations and olfactory identifica-
tion ability; third, are the olfactory identification
deficits seen in patients with schizophrenia also
present in patients with other psychiatric diagno-
ses; fourth, in schizophrenia, is there a sex effect
for the prevalence of olfactory hallucinations; and
lastly, in patients with schizophrenia, is there a
relationship between olfactory hallucinations, olfac-
tory identification deficits and gender.

To accomplish this, olfactory identification abil-
ity was examined in patients with different psychi-
atriic diagnoses along with a normal control group.
Patients hospitalized for the treatment of acute
episodes of schizophrenia, major depression, or
severe forms of eating disorders were studied.
Olfactory hallucinations were previously reported
in patients with depression, while identification
was reported to be normal (Warner et al., 1990).
Neither olfactory hallucinations nor identification
ability appear to have been studied in eating
disorders.

2. Materials and methods

2.1. Patients

One hundred and eighty-three hospitalized
patients from three different diagnostic groups
were examined. One hundred and thirty-one met
DSM-III-R criteria for a diagnosis of schizophre-
nia, while 21 received a diagnosis of major depre-
sive episode. A further 31 were diagnosed as having
severe eating disorders (anorexia nervosa, bulimia
nervosa or combined anorexia nervosa/bulimia
nervosa). All were between the ages of 14 and 64
and required hospitalization as part of their treat-
ment. Diagnoses were made independently by two
psychiatrists.

Patients were excluded from the study if they
had a history of a head injury with significant loss
of consciousness, facial trauma, nasal cocaine
abuse, allergic rhinitis, upper respiratory tract
infection, electroconvulsive therapy, feeding via
nasogastric tube (for the eating disordered women)
or other medical conditions (e.g. hypothyroidism)
which might interfere with their sense of smell. As
well, any patients who had serious street drug or
alcohol abuse or were older than 65 years or
younger than 14 were excluded.

The three patient groups and a normal control
group were examined using the University of
Pennsylvania Smell Identification Test (UPSIT).
The patients with schizophrenia consisted of 38
female and 92 male patients who were either
neuroleptic naive or receiving neuroleptic medica-
tion. In a previous communication, the UPSIT
results showed that the distribution of olfactory
deficits did not differ between neuroleptic naive
patients with schizophrenia and those receiving
neuroleptic medication (Kopala et al., 1992).
Thirteen female and 8 male patients with major
depressive illness and 31 females with severe eating
disorders were also examined. For the latter group,
19 received a diagnosis of anorexia nervosa, 5 with
bulimia nervosa and 7 with combined
anorexia/bulimia nervosa. None of the eating dis-
ordered women met criteria for any other Axis I
diagnosis. Although males with eating disorders
were not excluded, only female patients were
referred to the hospital. The last group included
47 normal female and 30 male control subjects.
The normal control subjects were volunteers from
the hospital and university community and met
the same exclusion criteria as did the patients. No
normal control subject reported receiving a diagno-
sis of a psychiatric disorder. All subjects gave
informed consent after having the procedure
explained in full and the study was approved by
the University of British Columbia Human
Research Committee. No subject was excluded on
the basis of UPSIT scores and none received
financial remuneration for participating.

The mean ages for the patient groups and
normal control subjects along with smoking habit are presented in Table 1.

### Measures and administration

The UPSIT is a well standardized, widely used test of olfactory identification. It consists of 4 booklets, each booklet containing 10 cards. On each card, there is a microencapsulated patch which is activated by scratching; a four choice array of answers is provided. Subjects were examined individually with the examiner scratching the scented strip and handing the booklet to the subject who would then smell the released odour and choose one of the four alternatives. This procedure was used instead of the standard, self-administered procedure (Doty et al., 1984) in order to ensure compliance and comprehension. Examiners were blind to the correct response.

Prior to administering the UPSIT, each subject was asked whether he or she had ever experienced olfactory hallucinations. If the subject responded in the affirmative and further questioning confirmed that the phenomenon was indeed a hallucination, then additional information was obtained by asking the patient to describe what scents were perceived and whether they were pleasant or unpleasant.

### 3. Results

The mean ages, UPSIT scores and percentage of patients describing olfactory hallucinations in each diagnostic group are presented in Table 1. The mean age among all four groups was significantly different ($F_{(3,250)} = 20.3, p < .0001$). Tukey's post hoc test demonstrated that the eating disorder patients were younger than subjects in the three other groups at the 0.05 level. Additionally, the patients with schizophrenia were younger than those with depression and the normal control subjects. The patients with depression were not different in age from the normal control subjects.

Smokers were found in all patient groups and the normal control group. The patients with schizophrenia had the highest percentage of smokers (57.3%), followed by the depressed group (47.6%), the eating disordered women (32.3%), and finally the normal control group (13.0%). A Chi square analysis ($X^2_{(3)} = 40.8, p < 0.0001$) indicated that the distribution of smokers among the four groups was not random (see Table 1). Within the group of patients with schizophrenia, 60.9% of the males and 48.7% of the females were smokers. However, Chi square analysis suggested that there was no difference in prevalence of smoking between the males and females with schizophrenia ($X^2_{(1)} = 1.19, n.s.$).

Patients in each diagnostic category reported olfactory hallucinations (Schizophrenia: 34.6%, Depression: 19.0%, Eating disorder: 29.%, see Table 1). A Chi square analysis ($X^2_{(2)} = 2.16, n.s.$) revealed that the prevalence of olfactory hallucinations did not differ according to diagnosis.

A one way ANOVA was performed on all four groups to determine the effect of diagnostic category on UPSIT score. A significant overall ANOVA ($F_{(3,252)} = 14.1 p < 0.0001$) was followed up with Tukey's post hoc test and the patients with schizophrenia had significantly lower scores on the UPSIT than the normal control and eating

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>n</th>
<th>Age</th>
<th>Age</th>
<th>UPSIT</th>
<th>UPSIT range</th>
<th>% Olf hall</th>
<th>% Smokers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schizophrenia</td>
<td>131</td>
<td>27.3(7.8)*</td>
<td>16–52</td>
<td>34.6(5.0)*</td>
<td>14–40</td>
<td>34.6</td>
<td>57.3</td>
</tr>
<tr>
<td>Depression</td>
<td>21</td>
<td>37.0(9.6)</td>
<td>21–56</td>
<td>36.9(2.0)</td>
<td>33–40</td>
<td>19.0</td>
<td>47.6</td>
</tr>
<tr>
<td>Eating disorder</td>
<td>31</td>
<td>20.9(5.0)</td>
<td>14–40</td>
<td>38.5(1.5)</td>
<td>35–40</td>
<td>29.0</td>
<td>32.3</td>
</tr>
<tr>
<td>Normal controls</td>
<td>77</td>
<td>32.5(11.1)</td>
<td>19–64</td>
<td>37.4(1.5)</td>
<td>34–40</td>
<td>0.0</td>
<td>13.0</td>
</tr>
</tbody>
</table>

*a Mean (standard deviation).*
Table 2

UPSIT scores and the prevalence of olfactory hallucinations for patients with schizophrenia

<table>
<thead>
<tr>
<th></th>
<th>Male (n = 92)</th>
<th>Range</th>
<th>Female (n = 38)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Olfactory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hallucinations</td>
<td>27.2</td>
<td>N/A</td>
<td>52.6</td>
<td>N/A</td>
</tr>
<tr>
<td>UPSIT scores</td>
<td>33.5 (5.5)*</td>
<td>14-40</td>
<td>37.5 (1.4)*</td>
<td>34-40</td>
</tr>
</tbody>
</table>

* Mean (standard deviation).

disordered subjects. The resultant mean UPSIT scores were also classified as normosmic or microsmic according to standardization data from the UPSIT manual (Doty et al., 1984). Only the patients with schizophrenia were classified as microsmic (35/40 or lower). As none of the normal control subjects reported experiencing olfactory hallucinations, this group was excluded from the following analysis. A two way analysis of variance tested the relationship between psychiatric diagnosis, presence of olfactory hallucinations and olfactory identification scores. Again, a significant main effect for diagnostic category was found ($F_{1,176} = 11.3, p < 0.001$) but no effect was found for olfactory hallucinations nor was the interaction between the two significant.

For the patients with schizophrenia, women were more likely than men to report olfactory hallucinations ($X^2_{(1)} = 6.16, p < 0.01$). Additionally, a two way ANOVA was performed to determine the effect of the presence of olfactory hallucinations and sex on UPSIT score. A significant main effect for sex was observed ($F_{(1,126)} = 18.3, p < 0.001$) (see Table 2) with the females scoring significantly higher on the UPSIT than the males (37.5 versus 33.5 respectively). The main effect for olfactory hallucinations, and the interaction between the two factors on UPSIT scores were not significant.

4. Discussion

The results of the present study permit an analysis of the relationship between olfactory hallucinations and olfactory identification ability in patients with several psychiatric disorders. Olfactory hallucinations were reported by members of all patient groups. Although more patients with schizophrenia reported olfactory hallucinations, the differences in prevalence among the patient groups were not statistically significant. The patients with schizophrenia reported olfactory hallucinations at a rate higher than those previously published. By comparison, of the patients with depression in the current study 19% reported olfactory hallucinations compared with rates of 30% in the study by Meats. No previous studies have documented the presence of olfactory hallucinations in patients with eating disorders. The finding of a prevalence rate of 29% for the eating disordered patients was surprising and was comparable to the rate for patients with schizophrenia and depression. All of the eating disordered patients were females but none met DSM-III-R criteria for major depressive episode and none was psychotic.

As other investigators have reported olfactory hallucinations in patients with depression (Meats, 1988) this finding was not unexpected. The members of this group seemed to be aware that these experiences were abnormal and related to their illness. The olfactory hallucinations reported were perceived as unpleasant and were mood congruent (for example, ‘death in the air’, ‘rotten food’). Similarly, patients with schizophrenia described experiencing unpleasant odours (‘stale cigarettes’, ‘feces’). By comparison, the hallucinations described by the eating disordered women were food related and perceived as pleasant. Additionally, the women were aware of the fact that this would be an unusual experience and related it to their eating disorder. In contrast, patients with schizophrenia who experienced olfactory hallucinations demonstrated little or no insight into this perceptual abnormality. No
Regarding the relationship between psychiatric diagnosis, olfactory hallucinations and olfactory identification ability, patients with schizophrenia had significantly lower scores on the UPSIT than did normal control subjects or patients with eating disorders. This analysis further revealed that patients with depression performed similarly to normal control subjects. A caveat to the interpretation of these data for the depressed group is the smaller number who were tested and the fact that patients with depression were older than those with schizophrenia. Anyone who had received electroconvulsive treatment in the past was not included in the current study. This restriction was responsible for the exclusion of a large number of patients with depression treated at this center. Hence, only larger numbers will determine whether the sample of patients with depression in the current study is representative of patients with depression in general. Others (Warner et al., 1990) have not found olfactory identification deficits in patients with depression.

Employing Doty's standardization data for the UPSIT (Doty et al. 1984) only patients with schizophrenia would be classified as microsmic (a score of 35/40 or less). This finding is in keeping with previously reported olfactory identification deficits in male patients with schizophrenia (Hurwitz et al., 1988; Kopala et al., 1989, 1990, 1992). Furthermore, in the current study, when the data for patients with schizophrenia was analyzed by sex, the males with schizophrenia had statistically significantly lower UPSIT scores than did their female counterparts (33.5 versus 37.5). In contrast, more females with schizophrenia than males reported experiencing olfactory hallucinations. However, there appeared to be no relationship between the presence of olfactory hallucinations and olfactory identification ability within this diagnostic group, or in the sample as a whole.

Regarding smoking habit, more patients with schizophrenia smoked than did any other patient group. However, within the schizophrenia group, men and women smoked at similar rates. This finding is consistent with those reported in a previous communication (Kopala et al., 1992) where smoking habit and UPSIT scores were examined and found to be unrelated. More recently, Wu et al. (1993) reported similar findings. Therefore, it is unlikely that smoking alone could account for the lower UPSIT scores amongst the male patients with schizophrenia.

The eating disordered patients were significantly younger than the members of the three other groups. It could be argued that their uniformly excellent performance on the UPSIT was on the basis on their younger age. However, Doty's standardization data (Doty et al. 1984) reveals that there is no appreciable difference on UPSIT score between normal control subjects aged 20 to 40 years. Olfactory identification ability does decline with age but not until the sixth decade. The patients with schizophrenia were on average 10 years younger than the normal control group. Again it is not likely that this age difference would account for the lower UPSIT scores for this group.

Given that olfactory pathways involve structures known to be abnormal in some patients with schizophrenia (Bogerts et al., 1985; Jacob and Beckman, 1986; Falkai et al., 1988) it is understandable that olfactory hallucinations form part of the clinical presentation for these patients. In this regard, it is known that olfactory hallucinations are frequently associated with temporal lobe epilepsy (Walsh, 1987). As well, the olfactory tubercle is richly dopaminergically innervated and dopamine dysregulation has consistently been implicated in the pathogenesis of schizophrenia (Kandel and Schwartz, 1985). Why eating disordered women, who are not depressed or psychotic, would experience olfactory hallucinations but not experience other hallucinations remains unclear.

The finding of higher UPSIT scores in women with schizophrenia along with the greater number reporting olfactory hallucinations, suggest that intact olfactory identification ability may be a prerequisite for abnormal perception. The corollary, as may be evidenced by the male patients with schizophrenia, is that if the central olfactory processing systems are not functional, then olfactory hallucinations are less likely to be experienced. The apparent lack of association between olfactory hallucinations and olfactory identification deficits in the present study could have implications...
for understanding regional brain mechanisms in schizophrenia. Regarding hallucinations in this disorder, functional and structural brain imaging studies implicate the superior temporal gyrus as a site involved in auditory hallucinations (Barta et al., 1990; Cleghorn et al., 1992). However, the neurobiology of olfactory hallucinations has not been systematically studied. Depth electrode stimulation studies in humans with epilepsy indicate that olfactory hallucinations can occur with left amygdala stimulation (Gloor et al., 1982). Therefore, medial temporal structures could be involved in the production of olfactory hallucinations in schizophrenia. Olfactory identification ability is likely to be a more complex process involving the prefrontal cortex, medial temporal structures and the thalamus (Potter and Butters, 1986; Jones-Gotman and Zatorre, 1988). Furthermore, the activation component of this process appears to specifically involve the piriform cortex bilaterally, and the orbitofrontal cortex on the right (Zatorre et al., 1992). Olfactory identification ability may serve as a probe for orbito-frontal function (Seidman et al., 1992). However, impaired basal ganglia and thalamic function may also be involved (Clark et al., 1991). Olfactory hallucinations and olfactory identification ability may involve overlapping but largely distinct neural circuitry. Only further investigation will allow for a more complete understanding of how perceptual abnormalities relate to the functional integrity of the olfactory system in patients with psychiatric and neurological disorders.

5. Acknowledgments

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6. References


deficits in patients with damage to prefrontal cortex. Neuropsychologia 18, 621–628.


