Smoking and psychiatric disorders: Have subthreshold disorders been overlooked?

Landolt, K; Ajdacic-Gross, V; Angst, J; Merikangas, K R; Gamma, A; Gutzwiller, F; Rössler, W
Smoking and psychiatric disorders: Have subthreshold disorders been overlooked?

Authors:

Karin Landolt

Vladeta Ajdacic-Gross

Jules Angst

Kathleen R. Merikangas

Alex Gamma

Felix Gutzwiller

Wulf Rössler

1 Zurich University Psychiatric Hospital, University of Zurich, Zurich, Switzerland

2 National Institute of Mental Health, National Institutes of Health, Department of Health and Human Services, Bethesda, MD, USA

3 Institute of Social and Preventive Medicine, University of Zurich, Zurich, Switzerland

Corresponding author:

Karin Landolt

Research Unit for Clinical and Social Psychiatry

Psychiatric University Hospital

Militärstrasse 8 / PO Box 1930

8021 CH-Zurich

Tel.: 0041 44 296 7431

Fax: 0041 44 296 7449

E-mail: klandolt@dgsp.uzh.ch
Abstract

Introduction

The association between smoking and mental disorders has been confirmed by several studies using cross-sectional and retrospective designs. The present study illustrates the need for differentiating subthreshold psychiatric disorders in the analysis.

Methods

The analysis is based on cumulative ("lifetime") prevalences of mental disorders and smoking in the Zurich Study. This is a longitudinal community study with a stratified sample of 591 participants and 6 interviews 1979-99.

Results

The percentage of "lifetime" smokers in the Zurich Study was higher both in persons with a "lifetime" psychiatric diagnosis (72%) and in persons with subthreshold disorders (60%) than in persons without any diagnosis (40%).

Discussion

The association between smoking and mental disorders turned out to be clearly stronger if subthreshold mental disorders were appropriately considered in the analyses. Constructing appropriate reference groups is as crucial for the analysis of mental disorders and their outcomes as constructing adequate diagnostic groups.
Introduction

It is well known that smoking is more frequent in people suffering from mental disorders (Hughes, Hatsukami, Mitchell, & Dahlgren, 1986) than in the general population. Associations have been found for nearly all diagnostic groups (Angst, Gamma, Benazzi, Ajdacic, & Rossler, 2007; Breslau & Klein, 1999; de Leon et al., 1995; de Leon & Diaz, 2005; Diaz et al., 2009; Fergusson, Goodwin, & Horwood, 2003; John, Meyer, Rumpf, & Hapke, 2004; Lawrence, Mitrou, & Zubrick, 2009; Mykletun, Overland, Aaro, Liabo, & Stewart, 2008; Paperwalla, Levin, Weiner, & Saravay, 2004; Richter, Ahluwalia, Mosier, Nazir, & Ahluwalia, 2002; Waxmonskey et al., 2005; Weitzman & Chen, 2005), except for obsessive-compulsive disorders, for which results are unequivocal (Bejerot & Humble, 1999; Lawrence et al., 2009). Smoking prevalence rates can reach 55% for any disorder in population-based samples (Black, Zimmerman, & Coryell, 1999; Grant, Hasin, Chou, Stinson, & Dawson, 2004; Hughes et al., 1986; Lasser et al., 2000; Lawrence et al., 2009; Morris, Giese, Turnbull, Dickinson, & Johnson-Nagel, 2006; Poirier et al., 2002; Vanable, Carey, Carey, & Maisto, 2003). However, little information is available on the association between smoking and subthreshold forms of mental disorders. The term subthreshold disorder refers to syndromes that do not fulfil common diagnostic criteria specified by DSM or ICD manuals. Empirical research has shown that subthreshold disorders are associated with increased disability and many other negative consequences such as days lost from work (Broadhead, Blazer, George, & Tse, 1990; McGruder & Calderone, 2000).

The aim of the present study was to examine smoking prevalence in association with mental disorders, and to include not only psychiatric disorders, but also subthreshold disorders in the analysis.
Methods

Zurich study

Data from the Zurich study (Angst, Dobler-Mikola, & Binder, 1984; Angst et al., 2005) was used for the present analyses. The Zurich study is a prospective longitudinal study in psychiatric epidemiology spanning 20 years in the life of young adults. In 1978, a representative stratified random sample of 591 persons (292 men and 299 women) was constructed from 1/3 low-scorers and 2/3 high-scorers on the GSI (global severity index) score of the SCL-90-R. The sample was followed up in 1979, 1981, 1986, 1988, 1993 and 1999 with a comprehensive semi-structured interview dealing with questions on symptoms and criteria of most psychiatric diagnoses. The Zurich study has played a major role in developing the concept of subthreshold disorders.

Diagnostic definitions

Diagnoses of mental disorders were made according to DSM-III or DSM-III-R (Angst et al., 2005). Dysthymia and bipolar disorders were based on DSM-IV criteria and were determinable only for the last four interviews. Subthreshold variables were constructed either with respect to fewer symptoms (but similar duration/frequency), or with respect to shorter duration/lower frequency (but with the same number of symptoms). Concerning alcohol and drug use, DSM-IV criteria for dependence and abuse were used; subthreshold dependence/abuse was defined as “daily use”. No data was available for schizophrenia, other psychotic disorders, and personality disorders.

Definition of smokers
"Lifetime" smokers were defined as those who regularly consumed any tobacco product at the time of any of the interviews. If the number of cigarettes smoked exceeded one pack per day, smokers were labelled “lifetime heavy smokers".

Prevalence calculation

The prevalence of smoking and mental disorders is based on “lifetime” variables; in the Zurich study these are cumulative frequencies based on the twelve-month prevalence data assessed in each interview. In the statistical analysis, the sample was weighted to offset the sample stratification, i.e., to provide population estimates (Levy & Lemeshow, 1999).

Calculation of associations between smoking and mental disorders

The odds ratios were derived from a series of bivariate logistic regression analyses. A dichotomous variable representing lifetime occurrence of (heavy) smoking was the dependent variable, and dichotomous variables representing different diagnostic entities were the independent variables. The analyses were carried out with the survey procedure and the logistic procedure of Stata (version 9.2 for Macintosh).
Results

The cumulative prevalence of any “lifetime” mental disorder was 50.4%, and 75.8% if subthreshold disorders were included. In persons with any "lifetime" disorder, the cumulative prevalence of smoking was 72.3%; in persons with any subthreshold disorder this was 60.5%; finally, in persons with neither a disorder nor a subthreshold disorder it was 40.4%. The cumulative prevalence of smoking was highest among users of illicit drugs and alcohol, persons suffering from bipolar disorders, and from dysthymia (Figure 1). Conversely, it was lowest in obsessive compulsive disorders.

Heavy smoking was found in 37.6% of participants who exhibited any disorder, in 20.7% of participants with any subthreshold disorder, and in 10.0% of the “healthy” participants.

Switching the perspective from columns to rows in the cross-tabulation reveals that 3 out of 4 "heavy smokers" had a lifetime threshold diagnosis. Heavy smoking was most prevalent in dysthymia, surpassing substance use disorders, and bipolar disorders.

In our study, the odds ratio for lifetime smoking in people with any “lifetime” mental disorder compared with people without a disorder was 2.5 (1.5-4.3). For heavy smoking, instead of smoking, the odds ratio increased to 3.3 (1.6-6.6). However, the odds ratios changed markedly after separating out the subthreshold disorders, and thus creating a reference group of (mostly) healthy people. The odds ratios regarding lifetime smoking increased to 3.9 (2.1-7.3), and regarding heavy smoking to 5.4 (1.8-16.6) in people with mental disorders vs. the healthy group. In people with subthreshold disorders (vs. the healthy group), the figures were 2.3 (1.1-4.6) and 2.3 (0.6-8.5) respectivel (see additional electronic table).
Discussion

It is well known from psychiatric epidemiology that tobacco use is more prevalent in people with mental disorders than in healthy men and women (Grant et al., 2004; Lasser et al., 2000; Lawrence et al., 2009). However, the analysis of longitudinal Zurich Study data 1979-1999 showed, among other things, that the smoking rate was distinctly higher if subthreshold disorders were included in the analyses.

Odds ratio of smoking is higher if subthreshold diagnoses are included

After differentiating subthreshold disorders from the reference group of healthy people, the odds ratio of smoking clearly increased. This result is paradoxical as much as revealing. Obviously the rate of smoking in subthreshold disorders is more similar to the rate in "threshold disorders" than to that in mostly healthy people. Otherwise, it is likely that the odds ratios would not have changed. The implications of this finding are threefold. First, as subthreshold disorders are definitely associated with a higher probability of being a smoker, it is also necessary to enhance efforts for smoking prevention and cessation in people suffering from subthreshold disorders. Regarded the other way round, not only threshold but also subthreshold disorders are more frequent in smoking populations. As subthreshold disorders also go along with considerable impairment (Broadhead et al., 1990; Magruder & Calderone, 2000), the pressure on smokers is actually higher than if only threshold disorders are discussed. Second, as almost all heavy smokers had a lifetime diagnosis (or subthreshold diagnosis), heavy smoking, being more easily detected than psychiatric illnesses, could serve as marker for poor mental health. As a third and methodological implication, the association between smoking and psychiatric disorders is commonly underestimated, as most studies rely on standard diagnostic criteria. Last but not least, the results raise the subtle question as to
whether the current diagnostic criteria provide an accurate framework for assessing the outcomes of psychiatric disorders.

**Technical remarks**

The percentage of smokers in people suffering from any mental disorder in the longitudinal Zurich sample was as high as in other population based studies with highest prevalence rates (Lasser et al., 2000). Given any occurrence of a mental disorder between age 20 and age 40, the odds of smoking were more than two times higher than in persons experiencing no mental disorder. As the association of smoking and mental disorders is influenced by methodological issues - for instance by the definition and assessment of smoking as well as of disorders – a direct comparison between results from different studies is difficult. There are several theoretical considerations that underline the importance of longitudinal data for a valid assessment. First, cross-sectional retrospective assessment of lifetime diagnoses or symptoms has been criticised for underestimating lifetime prevalences because of the recall bias (Kruijshaar et al., 2005; Moffitt et al., 2009; Patten, 2009). Longitudinal prospective studies are less susceptible to this bias because they do not demand respondents to remember events that occurred several years earlier in their lifetime. Secondly, the association between lifetime diagnoses comprises more information than concurrent association because the former does not require contemporaneity of the disorders. These arguments suggest that longitudinal prospective data are partly responsible for the higher associations found by this study.

**Further findings: heavy smoking and mental disorders**

In people with mental disorders, the association with heavy smoking (smoking more than 20 cigarettes per day) is particularly strong. Very few people without any "lifetime" psychiatric diagnosis turn out to be "lifetime" heavy smokers, and, conversely, "lifetime" heavy smokers typically have (had or will have) a "lifetime" diagnosis.
It is well known from previous research (Diaz et al., 2009; Vanable et al., 2003; Weitzman & Chen, 2005) that alcohol- and drug use disorders as well as bipolar disorders are accompanied by an increased prevalence of smoking. As to bipolar disorders, there appears to be a similar situation for tobacco use as for use of alcohol (Angst et al., 2006) seeing that bipolar disorders mainly account for the relation between alcohol use and mood disorders. In the light of previous research it was not surprising to find an increased prevalence of smokers in association with dysthymia as well (Dierker, Avenevoli, Stolar, & Merikangas, 2002), but a relatively low prevalence in people with OCD. Moreover, looking specifically at heavy smoking, the associations mostly become stronger. In dysthymia the change is particularly impressive.

**Strengths and Limitations**

A major strength of this study is the longitudinal prospective design in combination with the broad spectrum of diagnoses that have been assessed since the 1970s. However, high-risk diagnostic groups such as schizophrenia, personality disorders and ADHD, are lacking in the Zurich data. Thus, this study itself probably underestimates the odds of smoking in people with mental disorders – despite its advantages compared with previous research. Furthermore, more complex longitudinal analyses are required, to introduce confounding variables, as well as to account for comorbidity and the temporal sequence of diagnoses and smoking.

To summarize, the risk of smoking in people with mental disorders has clearly been underestimated in previous research. Thus we strongly recommend including subthreshold diagnoses in studies on smoking and poor mental health. In particular, heavy smoking occurs mainly in people encountering a threshold or subthreshold psychiatric disorder. Since the cumulative prevalences of mental disorders are considerably high, i.e., 50% if only threshold
disorders are considered, the consequences for public health are far-reaching. Among other things, it seems likely that improving early recognition, diagnosis and treatment of mental disorders might greatly contribute to the prevention of cancer, stroke and many other smoking-related disorders. If the association is regarded the other way round, heavy smoking can serve as marker for a high probability of mental disorders. This can be very useful in settings like general practice, where the recognition of psychological problems is often difficult, but nevertheless of outmost relevance for public mental health.
Funding
This work was supported by the Swiss National Science Foundation (grant #32-50881.97) and by the Swiss Cancer League / Swiss Federation Against Cancer (grant #01649-02-2005).

Competing interest
All authors declare that they have no competing interests.
References


Figure 1:

Table 1:
Odds ratios of smoking in the Zurich-Study, 1979 – 1999, in relation to psychiatric disorders and subthreshold disorders; odds ratios after adjustment for sample stratification

<table>
<thead>
<tr>
<th>DISORDER</th>
<th>THRESHOLD DIAGNOSES</th>
<th></th>
<th></th>
<th>THRESHOLD &amp; SUBTHRESHOLD DIAGNOSES</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>smokers vs. other</td>
<td>heavy smokers vs. other</td>
<td>smokers vs. other</td>
<td>heavy smokers vs. other</td>
<td>smokers vs. other</td>
<td>heavy smokers vs. other</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>OR¹</td>
<td>CI¹</td>
<td>uCI¹</td>
<td>N</td>
<td>OR¹</td>
</tr>
<tr>
<td>alcohol dep./ab.</td>
<td>111 – 14</td>
<td>7.23</td>
<td>2.8</td>
<td>18.4</td>
<td>63 – 62</td>
<td>5.73</td>
</tr>
<tr>
<td>other dx</td>
<td>158 – 81</td>
<td>1.70</td>
<td>1.0</td>
<td>3.0</td>
<td>60 – 179</td>
<td>2.24</td>
</tr>
<tr>
<td>no dx</td>
<td>127 – 100</td>
<td>ref.</td>
<td>21 – 206</td>
<td>ref.</td>
<td>48 – 56</td>
<td>ref.</td>
</tr>
<tr>
<td>drug dep./ab.</td>
<td>64 – 1</td>
<td>202.87</td>
<td>26.6</td>
<td>1550.</td>
<td>35 – 30</td>
<td>9.85</td>
</tr>
<tr>
<td>other dx</td>
<td>205 – 94</td>
<td>1.99</td>
<td>1.2</td>
<td>1</td>
<td>88 – 211</td>
<td>2.50</td>
</tr>
<tr>
<td>no dx</td>
<td>127 – 100</td>
<td>ref.</td>
<td>3.4</td>
<td>21 – 206</td>
<td>ref.</td>
<td>48 – 56</td>
</tr>
<tr>
<td>unipolar depression</td>
<td>105 – 40</td>
<td>2.05</td>
<td>1.0</td>
<td>4.1</td>
<td>40 – 105</td>
<td>1.79</td>
</tr>
<tr>
<td>other dx</td>
<td>164 – 55</td>
<td>2.87</td>
<td>1.6</td>
<td>5.2</td>
<td>83 – 136</td>
<td>4.20</td>
</tr>
<tr>
<td>no dx</td>
<td>127 – 100</td>
<td>ref.</td>
<td>21 – 206</td>
<td>ref.</td>
<td>48 – 56</td>
<td>ref.</td>
</tr>
<tr>
<td>bipolar disorder</td>
<td>34 – 10</td>
<td>4.03</td>
<td>1.2</td>
<td>13.7</td>
<td>19 – 25</td>
<td>7.62</td>
</tr>
<tr>
<td>other dx</td>
<td>235 – 85</td>
<td>2.41</td>
<td>1.4</td>
<td>4.1</td>
<td>104 – 216</td>
<td>2.85</td>
</tr>
<tr>
<td>no dx</td>
<td>127 – 100</td>
<td>ref.</td>
<td>21 – 206</td>
<td>ref.</td>
<td>48 – 56</td>
<td>ref.</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Range 1</td>
<td>Range 2</td>
<td>Range 3</td>
<td>Range 4</td>
<td>Range 5</td>
<td>Range 6</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>Dysthymia</td>
<td>40 – 7</td>
<td>2.4</td>
<td>1.3</td>
<td>9.1</td>
<td>35 – 7</td>
<td>13.9</td>
</tr>
<tr>
<td>Other dx</td>
<td>234 – 88</td>
<td>2.42</td>
<td>1.4</td>
<td>4.1</td>
<td>103 – 219</td>
<td>4.85</td>
</tr>
<tr>
<td>No dx</td>
<td>127 – 100</td>
<td>ref.</td>
<td>21 – 206</td>
<td>ref.</td>
<td>48 – 56</td>
<td>ref.</td>
</tr>
<tr>
<td>Generalized anxiety</td>
<td>77 – 27</td>
<td>3.26</td>
<td>1.4</td>
<td>7.4</td>
<td>36 – 68</td>
<td>3.24</td>
</tr>
<tr>
<td>Other dx</td>
<td>192 – 68</td>
<td>2.53</td>
<td>1.4</td>
<td>4.1</td>
<td>87 – 173</td>
<td>3.29</td>
</tr>
<tr>
<td>No dx</td>
<td>127 – 100</td>
<td>ref.</td>
<td>21 – 206</td>
<td>ref.</td>
<td>48 – 56</td>
<td>ref.</td>
</tr>
<tr>
<td>Simple phobia</td>
<td>57 – 15</td>
<td>2.14</td>
<td>0.9</td>
<td>5.1</td>
<td>29 – 43</td>
<td>4.55</td>
</tr>
<tr>
<td>Other dx</td>
<td>212 – 80</td>
<td>2.68</td>
<td>1.6</td>
<td>4.6</td>
<td>94 – 198</td>
<td>2.97</td>
</tr>
<tr>
<td>No dx</td>
<td>127 – 100</td>
<td>ref.</td>
<td>21 – 206</td>
<td>ref.</td>
<td>48 – 56</td>
<td>ref.</td>
</tr>
<tr>
<td>Social phobia</td>
<td>59 – 25</td>
<td>3.24</td>
<td>1.3</td>
<td>8.1</td>
<td>29 – 55</td>
<td>3.15</td>
</tr>
<tr>
<td>Other dx</td>
<td>210 – 70</td>
<td>2.45</td>
<td>1.4</td>
<td>4.2</td>
<td>94 – 186</td>
<td>3.30</td>
</tr>
<tr>
<td>No dx</td>
<td>127 – 100</td>
<td>ref.</td>
<td>21 – 206</td>
<td>ref.</td>
<td>48 – 56</td>
<td>ref.</td>
</tr>
<tr>
<td>Agoraphobia</td>
<td>37 – 11</td>
<td>2.41</td>
<td>0.7</td>
<td>8.2</td>
<td>20 – 28</td>
<td>5.51</td>
</tr>
<tr>
<td>Other dx</td>
<td>232 – 84</td>
<td>2.56</td>
<td>1.5</td>
<td>4.3</td>
<td>103 – 213</td>
<td>3.10</td>
</tr>
<tr>
<td>No dx</td>
<td>127 – 100</td>
<td>ref.</td>
<td>21 – 206</td>
<td>ref.</td>
<td>48 – 56</td>
<td>ref.</td>
</tr>
<tr>
<td>Panic disorder</td>
<td>34 – 12</td>
<td>2.84</td>
<td>0.8</td>
<td>10.0</td>
<td>16 – 30</td>
<td>6.79</td>
</tr>
<tr>
<td>Other dx</td>
<td>235 – 83</td>
<td>2.53</td>
<td>1.5</td>
<td>4.3</td>
<td>107 – 211</td>
<td>3.08</td>
</tr>
<tr>
<td>No dx</td>
<td>127 – 100</td>
<td>ref.</td>
<td>21 – 206</td>
<td>ref.</td>
<td>48 – 56</td>
<td>ref.</td>
</tr>
<tr>
<td>Obsessive compulsive</td>
<td>15 – 15</td>
<td>0.62</td>
<td>0.2</td>
<td>2.2</td>
<td>7 – 23</td>
<td>2.18</td>
</tr>
<tr>
<td>Other dx</td>
<td>254 – 80</td>
<td>2.90</td>
<td>1.7</td>
<td>4.9</td>
<td>116 – 218</td>
<td>3.37</td>
</tr>
<tr>
<td>No dx</td>
<td>127 – 100</td>
<td>ref.</td>
<td>21 – 206</td>
<td>ref.</td>
<td>48 – 56</td>
<td>ref.</td>
</tr>
<tr>
<td>Bulimia</td>
<td>7 – 5</td>
<td>1.10</td>
<td>0.1</td>
<td>8.2</td>
<td>5 – 7</td>
<td>8.30</td>
</tr>
<tr>
<td>Other dx</td>
<td>262 – 90</td>
<td>2.61</td>
<td>1.6</td>
<td>4.4</td>
<td>118 – 234</td>
<td>3.18</td>
</tr>
<tr>
<td>No dx</td>
<td>127 – 100</td>
<td>ref.</td>
<td>21 – 206</td>
<td>ref.</td>
<td>48 – 56</td>
<td>ref.</td>
</tr>
<tr>
<td>Diagnosis</td>
<td>Odds Ratio</td>
<td>1 SD</td>
<td>2 SD</td>
<td>3 SD</td>
<td>4 SD</td>
<td>5 SD</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Neurasthenia</td>
<td>2.43</td>
<td>0.8</td>
<td>7.4</td>
<td>2.1</td>
<td>18.3</td>
<td>100</td>
</tr>
<tr>
<td>Other dx</td>
<td>2.57</td>
<td>1.5</td>
<td>4.4</td>
<td>2.96</td>
<td>6.1</td>
<td>248</td>
</tr>
<tr>
<td>No dx</td>
<td>1.27 – 100</td>
<td>ref.</td>
<td>21 – 206</td>
<td>ref.</td>
<td>48 – 56</td>
<td>ref.</td>
</tr>
</tbody>
</table>

1) Odds ratios, after adjusting for sample stratification.
2) Lower confidence interval (95%)
3) Upper confidence interval
4) Diagnosis (DSM III or DSM IV)
5) Diagnosis of substance dependence or abuse