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An international systematic review of smoking prevalence in addiction treatment

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ABSTRACT

Aims Smoking prevalence is higher among people enrolled in addiction treatment compared with the general population, and very high rates of smoking are associated with opiate drug use and receipt of opiate replacement therapy (ORT). We assessed whether these findings are observed internationally. **Methods** PubMed, PsycINFO and the Alcohol and Alcohol Problems Science Database were searched for papers reporting smoking prevalence among addiction treatment samples, published in English, from 1987 to 2013. Search terms included tobacco use, cessation and substance use disorders using and/or Boolean connectors. For 4549 papers identified, abstracts were reviewed by multiple raters; 239 abstracts met inclusion criteria and these full papers were reviewed for exclusion. Fifty-four studies, collectively comprising 37 364 participants, were included. For each paper we extracted country, author, year, sample size and gender, treatment modality, primary drug treated and smoking prevalence. **Results** The random-effect pooled estimate of smoking across people in addiction treatment was 84% [confidence interval (CI) = 79, 88%], while the pooled estimate of smoking prevalence across matched population samples was 31% (CI = 29, 33%). The difference in the pooled estimates was 52% (CI = 48%, 57%, $P < .0001$). Smoking rates were higher in programs treating opiate use compared with alcohol use [odds ratio (OR) = 2.52, CI = 2.00, 3.17], and higher in ORT compared to out-patient programs (OR = 1.42, CI = 1.19, 1.68). **Conclusions** Smoking rates among people in addiction treatment are more than double those of people with similar demographic characteristics. Smoking rates are also higher in people being treated for opiate dependence compared with people being treated for alcohol use disorder.

Keywords Addiction, co-substance use, global health, priority/special populations, smoking, surveillance and monitoring, tobacco.

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INTRODUCTION

Each year, nearly 6 million people world-wide die from tobacco-related causes. Tobacco use accounts for approximately 18, 11 and 4% of deaths in high-, middle- and low-income countries, respectively [1]. Economic damages from global tobacco use are estimated at more than one-half trillion dollars per year [2]. To address the global health and economic costs of tobacco, the World Health Organization (WHO) approved the Framework Convention on Tobacco Control (FCTC), an international treaty that monitors global tobacco consumption and tobacco control policies and crafts measures to reduce tobacco supply and demand. The FCTC's six principal strategies, called 'MPOWER', include smoke-free environments, cessation programs, warning labels, mass anti-tobacco media, tobacco advertising bans and taxation [2].

In concert with the FCTC, the Global Adult Tobacco Survey (GATS) has become an important tool for cross-national studies of smoking prevalence and tobacco policies. A recent analysis of GATS data demonstrated high variability in smoking rates across 14 low- and middle-income countries, with smoking prevalence ranging from 21.6 to 60.2% among men and from < 1 to 24.4% among women [3]. Similar to the GATS, European researchers developed the Tobacco Control Scale (TCS) to evaluate smoking prevalence across European Union nations [4–7]. While both the GATS and TCS evaluate

smoking prevalence cross-nationally, there are no systematic approaches to compare international smoking rates in subgroups where smoking is most prevalent. These subgroups include, but are not limited to, people with mental health and substance abuse disorders [8,9].

Concerning substance abuse specifically, studies in the United States indicate that smoking rates are two to four times higher in people with substance use disorders than in the general public [9,10]. Smoking rates are highest, however, among those with substance use disorders who also enter addiction treatment, with smoking prevalence in this subgroup estimated at approximately 67% [11]. Smokers with comorbid substance abuse are more likely to die from tobacco-related causes than from other substance-related causes [12,13], and quitting smoking is associated with longer-term maintenance of recovery from other addictions [14].

We previously conducted a systematic review of smoking in addiction treatment in the United States from 1987 to 2009 [15]. Focusing on 42 papers, and aggregating samples by year, we found annual smoking rates ranging from 65 to 87.2% with a median of 76.3%. This was consistent with National Survey on Drug Use and Health (NSDUH) data, where smoking prevalence among people who received recent addiction treatment ranged from 68.9% in 2000 to 74.2% in 2011 [15,16]. The current study estimates smoking prevalence for people entering addiction treatment internationally, using studies published between 1987 and 2013, and compares prevalence reported in treatment samples to national epidemiological estimates. Such a review may be useful for directing tobacco control resources and policies to concentrations of smokers who seek treatment for other addictions.

METHODS

Article identification and selection

Search procedures

PubMed, PsycINFO and the ETOH Alcohol and Alcohol Problems Science Database (an archived database of alcohol-related research) were searched for published papers reporting smoking prevalence for addiction treatment samples. These sources contain the title and abstract for each paper in the database, so the electronic search was limited to titles and abstracts in each database. Specific search terms were used for each database, reflecting their respective search term mapping, and we identified the broadest search terms relevant to our goals. PubMed MeSH terms and Boolean connectors included 'smoking OR tobacco use cessation OR tobacco use disorder OR tobacco OR nicotine' AND 'substance-related disorders OR substance abuse treatment centers' AND 'patients'. PsycINFO Thesaurus descriptors used included: 'addiction OR drug usage' AND 'client attitudes OR clients OR patients' AND 'nicotine OR tobacco smoking OR smoking cessation'. The Alcohol and Other Drug (AOD) Thesaurus descriptors were used for the ETOH search and consisted of: '(tobacco in any form or smoking or nicotine)' AND '(survey or questionnaire or interview or self-report)'. Search results were limited to papers published in English. Papers from all countries were included in the screening process. A total of 4541 papers were identified electronically, and 20 additional papers were identified through bibliographic review of the final selected papers. After removing duplicates, abstracts for 4549 articles were screened for inclusion. Systematic review procedures were conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, and Fig. 1 shows the PRISMA flow diagram [17].

Rating abstracts for inclusion

Abstracts were reviewed using three inclusion criteria: (a) the paper reported data gathered in an addiction treatment setting, (b) patient-level data were reported and (c) tobacco use was mentioned in the abstract. Only abstracts meeting all three criteria were reviewed further. Abstract review procedures were conducted for two time-periods, first for the years 1987–2009, and again for the period 2009–June 2013.

To assess inter-rater reliability for the first period (1987–2009), six raters were trained on inclusion criteria and then rated the same set of 30 abstracts [international consensus criteria (ICC) = 0.83, $P < 0.001$]. Thereafter, each rater rated a unique set of 300 abstracts, with a final test of inter-rater reliability to assess potential rater drift during the rating process (ICC = 0.79, $P < 0.001$) [15]. To assess inter-rater reliability for the second period (2009–2013), four raters (three were the same and one different) were trained on inclusion criteria and then rated the same set of 20 abstracts (ICC = 1.0). Thereafter, each rater rated unique sets of abstracts. Last, inter-rater reliability was assessed using a single set of 20 abstracts, to assess potential rater drift (ICC = 1.0).

Reviewing papers for exclusion

A total of 239 papers met abstract inclusion criteria. Each of these papers was read by one of two reviewers, with attention to four exclusion criteria: (a) a review paper (not primary data); (b) smoking prevalence not reported for addiction treatment sample; (c) participant selection was based on smoking status; and (d) participants were adolescents. Of the 61 papers remaining eligible, one was excluded due to a small sample size (defined for this review as less than 25 participants) [18], and one multi-national paper was excluded because it did not report smoking prevalence of the sample by country where data were collected

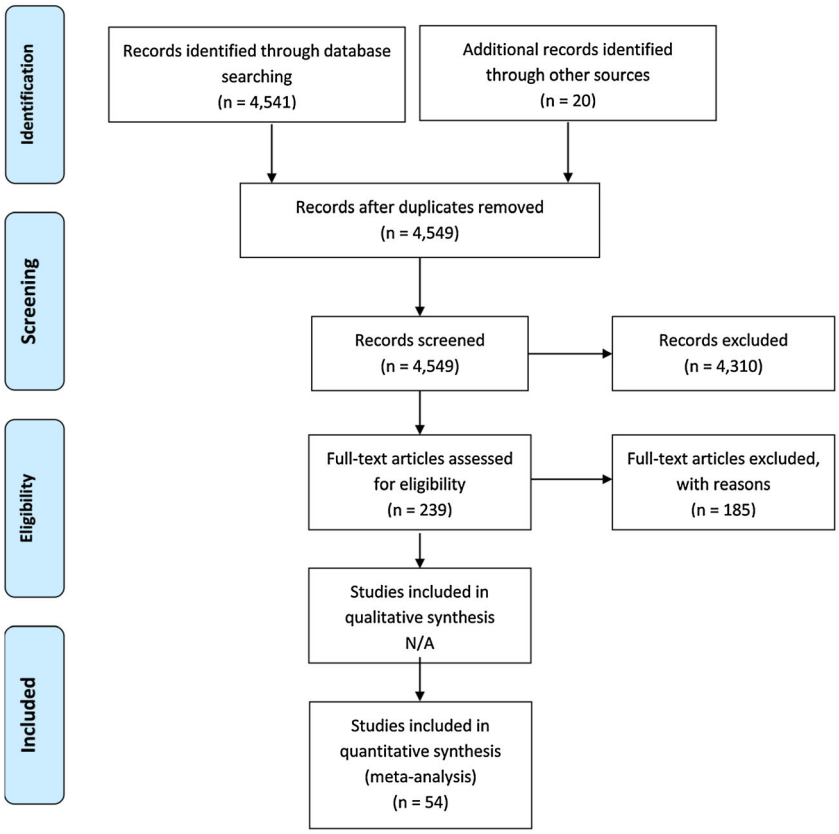

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram summarizing article identification and selection

[19]. Five papers were excluded due to an overlapping sample with another paper included in the review [20–24]. A total of 54 papers from 20 countries are included in the review. Search terms and the checklists used for rating abstracts and reviewing papers are available from the first author.

National smoking prevalence data

Each study in the review provides smoking prevalence for a sample of people enrolled in addiction treatment, in one country and in one year. We compared smoking prevalence in each study sample to national smoking prevalence for the same country and in the same year. Smoking prevalence differs widely by gender in many countries. When the addiction treatment sample included > 70% women we used national prevalence estimates for women (five studies), and when the sample included > 70% men we used the national prevalence estimate for men (35 studies). When the sample included 31–69% of either women or men (10 studies) [25–34], or when the gender breakdown was unknown (four studies) [35–38], we used a national prevalence estimate for men and women combined.

To obtain national smoking prevalence rates we first consulted the World Health Organization (WHO) Global Health Observatory Data Repository (http://apps.who.int/gho/data/view.main). Within the Repository we referred to the Tobacco Control section and to the Prevalence—adult age-standardized by country data set, which reports current smoking for male, female and both sexes. However, these data refer to only 2006, 2009 and 2011. For national smoking prevalence from additional years we consulted the 2011 Country Profiles from the WHO Report on Global Tobacco Epidemic (http://www.who.int/tobacco/global_report/2011/en/). Where national prevalence rates were not available through these WHO sources, we consulted the web edition of the International Smoking Statistics (ISS) (http://www.pnlee.co.uk/ISS.htm). If rates were not available through the WHO or ISS sources, we consulted official country websites. Finally, rates reported in published papers were used if rates could not be found through other sources. Smoking prevalence estimates were not available for all countries in all years. For 30 papers we found national smoking prevalence in the year the study was published. For 21 papers we found prevalence estimates within 1 year, and for three papers we found prevalence estimates within 2 years of the publication year.

To calculate confidence intervals (CIs) for national smoking prevalence, we found the report where each

estimate originated. We used either the total *N* from the original survey or the *n* for men or women, according to the gender-matched prevalence for each study. For 13 papers where the original source was not found, was found behind a paywall or was found in a language we could not translate using Google Translate, we used $n = 4000$ to calculate CIs. This is the lower bound of the *n*s that were found, and so represents a conservative approach to estimating the population CIs. When the sample size for the national survey was not reported by gender, we estimated the *n* for each gender by halving the total.

Data analysis

Country, year of publication, author, sample size, proportion of women and smoking prevalence were extracted for each paper. For papers reporting intervention studies, or for papers reporting repeated measures over time, we used prevalence from the baseline data. Treatment modality (in-patient, out-patient, opiate replacement therapy) and primary drug treated (alcohol, alcohol and other drugs, opiates) were also extracted. Opiate replacement therapy (ORT) is an out-patient modality distinguished by its focus on replacing illicit opiates with either methadone or buprenorphine. Where papers drew clients from two modalities, they were coded to whichever category represented more than half of the patients involved in the paper [39,40]. Two papers reporting cocaine as the primary drug treated were grouped in the 'alcohol and other drug' category [41,42].

We extracted the smoking prevalence and calculated the 95% CI for each estimate. Using a forest plot, we plotted the smoking prevalence and CI for each paper alongside the year and gender-matched national smoking prevalence for the country where the paper was reported. Using these estimates and CIs, we calculated the random-effect pooled estimates for smoking across addiction treatment samples, across national prevalence estimates and the difference between the two (study–national).

Research in the United States has shown that opiate use compared to alcohol use, and enrollment in opiate replacement therapy (ORT) compared to non-opiate out-patient programs, were associated with higher smoking prevalence [16,43]. To assess whether these associations may also be observed internationally, we calculated smoking rates by treatment modality and primary drug treated combined across all papers. Treatment modality and primary drug treated were intercorrelated ($r = 0.55$, $P < 0.0001$), so each variable was evaluated in a separate model before both were included in the same model. Random-effect logistic regression models were used to assess univariate relationships between each predictor (treatment modality, primary drug, year of study) and smoking prevalence, and then to assess multivariate relationships of treatment modality and primary drug with smoking prevalence, controlling for year. In these analyses a random intercept model was used, with country as a random factor. Two papers were removed from analyses because they reported on patient samples that were aggregated over 20 years, confounding any relationship between time in those samples [39,44]. One paper from 1989 was removed [45] so that the analysis period would be 20 years in length (1994–2013) and most years would be represented by at least one study. We conducted these analyses with nesting by country.

RESULTS

Prevalence of smoking in addiction treatment

Papers in the review are summarized in Table 1, listed alphabetically by country and, within country, by year published. Among the studies were six from Germany, five each from Australia and Italy and four each from Brazil, France, Switzerland and the United Kingdom. The remaining 22 papers were from 13 different countries. Programs were identified in the reports as in-patient (41%), methadone or other opiate treatment (30%) or out-patient programs (26%). Type of program could not be determined for two studies [46,47]. Programs identified the primary drug treated as alcohol (48%), heroin or other opiates (35%), or alcohol and other (non-specified) drugs (17%). The final column shows the year and age-matched national smoking prevalence for the country in which each study was reported. Smoking prevalence across all studies ranged from 41.1% [39] to 100% [46,48].

Figure 2 compares smoking prevalence visually in each sample to the corresponding national prevalence. National prevalence rates are shown on the left, while study prevalence rates and 95% CIs are on the right. For each study, the white space between the two estimates represents how much higher smoking is in the addiction treatment sample compared to the general population. Scanning this white space from top to bottom shows that smoking rates are consistently higher in addiction treatment. The random-effect pooled estimate of smoking across people in addiction treatment was 84% (CI = 79%, 88%), not shown in the figure. The pooled estimate of smoking prevalence across the year and gender-matched population samples was 31% (CI = 29%, 33%), and the difference in pooled estimates was 52% (CI = 48%, 57%, $P < 0.0001$).

Association of smoking with treatment modality and primary drug

Smoking rates were 85% in ORT, 80.9% in in-patient and 74.5% in out-patient programs. By primary drug, smoking rates were 85.1% for opiates, 80.9% for alcohol and other drugs and 75.2% for alcohol. Regression results are

Table 1 International addiction treatment studies by country, comparing sample smoking prevalence to national rates. (n = 54 studies, 37 364 participants).

Country	*Source (year)*	*Source (author)*	*n*	*% Female*	*Modality*	*Primary drug treated*	*Smoking prevalence (95% CI)*	*National smoking prevalence*[a]
Australia	2007	Burns *et al.* [66]	1519	100%	ORT[b]	Opiate	70.8% (0.685, 0.731)	18%
Australia	2004	Teichtahl *et al.* [32]	50	50%	ORT	Opiate	92% (0.808, 0.978)	23%
Australia	2002	Shakeshaft *et al.* [67][c]	1212	29.6%	Out-patient	AOD[d]	74.1% (0.715, 0.765)	27%
Australia	1996	Zador *et al.* [68]	86	100%	ORT	Opiate	95% (0.885, 0.987)	20.3%
Australia	1994	Darke *et al.* [25]	222	40.1%	ORT	Opiate	93.7% (0.897, 0.965)	24%
Austria	2012	Hoflich *et al.* [69][e]	37	100%	ORT	Opiate	97%[v] (0.858, 0.999)	34.7%
Austria	2009	Malik *et al.* [28]	57	35.1%	In-patient	Alcohol	88% (0.763, 0.949)	47%
Austria	2009	Winklbaur *et al.* [70]	139	100%	ORT	Opiate	95.7% (0.908, 0.984)	45%
Brazil	2013	Diehl *et al.* [41][f]	105	100%	In-patient	AOD	92.4%[v] (0.855, 0.967)	13%
Brazil	2009	Baltieri *et al.* [71]	155	0%	Out-patient	Alcohol	66.5% (0.584, 0.738)	22%
Brazil	2009	de Meneses-Gaya *et al.* [72][g]	40	10%	Out-patient	AOD	75% (0.588, 0.873)	22%
Brazil	1999	Dunn & Laranjeira [40][h]	294	10%	Out-patient	AOD	81%[v] (0.756, 0.85)	35.4%
Canada	1999	Ellingstad *et al.* [35]	185	Unknown	Out-patient	Alcohol	54.1%[v] (0.466, 0.614)	25.2%
Canada	1995	Toneatto *et al.* [38]	155	Unknown	Out-patient	Alcohol	58% (0.499, 0.659)	31%
Canada	1989	Kozlowski *et al.* [45]	289	27%	Out-patient	AOD	86% (0.816, 0.899)	33%
China	2011	Liao *et al.* [27]	139	32.4%	ORT	Opiate	80.6% (0.73, 0.868)	28.1%
Croatia	2011	Nenadic-Sviglin *et al.* [73]	505	21.4%	In-patient	Alcohol	59% (0.55, 0.637)	36%
France	2009	Lahmek *et al.* [26]	414	47.1%	In-patient	Alcohol	82% (0.776, 0.853)	31%
France	1999	Aubin *et al.* [74][i]	222	26%	In-patient	Alcohol	79% (0.729, 0.84)	31%
France	1995	Batel *et al.* [75]	325	25.2%	Out-patient	Alcohol	88% (0.84, 0.913)	40%
France	1995	Levy *et al.* [76]	50	0%	In-patient	Alcohol	92% (0.808, 0.978)	40%
Germany	2009	Donath *et al.* [77]	1403	25%	In-patient	AOD	84% (0.819, 0.859)	33%
Germany	2008	Hillemacher *et al.* [78]	168	19%	In-patient	Alcohol	80% (0.735, 0.861)	28.3%
Germany	2007	Hintz & Mann [79]	125	20%	In-patient	Alcohol	63.2% (0.541, 0.717)	28.3%
Germany	2007	Ohlmeier *et al.* [29][j]	89	36%	In-patient	Alcohol	67.4%[v] (0.567, 0.77)	23.3%
Germany	2001	Schmidt & Smolka [37]	63	Unknown	Out-patient	Alcohol	76.2%[v] (0.638, 0.86)	34.5%
Germany	1999	Hüttner *et al.* [80]	31	16.1%	Out-patient	Alcohol	90.3% (0.743, 0.98)	36%
India	2012	Basu *et al.* [39][k]	6608	0.1%	Out-patient	Alcohol	41.1%[v] (0.399, 0.423)	24.3%
India	2011	Mattoo *et al.* [81]	110	0%	In-patient	AOD	52% (0.421, 0.615)	24.3%
India	2009	Rooban *et al.* [82][l]	500	0.2%	Out-patient	Alcohol	72.2% (0.681, 0.761)	26%
Israel	2003	Amit *et al.* [83]	72	5.6%	In-patient	Alcohol	91.6% (0.827, 0.969)	23%
Italy	2012	Pajusco *et al.* [84]	305	17.7%	ORT	Opiate	97.2% (0.953, 0.991)	29.5%
Italy	2011	Barbadoro *et al.* [85]	58	27.6%	In-patient	Alcohol	91.4% (0.81, 0.971)	29.5%
Italy	2011	Pajusco *et al.* [44][m]	10 181	19.4%	In-patient	Opiate	99.2% (0.99, 0.993)	29.5%
Italy	2008	Barbadoro *et al.* [86]	76	23.7%	In-patient	Alcohol	81.6% (0.71, 0.896)	33%
Italy	2001	Pastorelli *et al.* [47][n]	60	25%	Unknown	Alcohol	81.7% (0.696, 0.905)	32.4%
Japan	2010	Matsui *et al.* [87]	138	0%	Out-patient	Alcohol	82% (0.744, 0.879)	42%
Japan	2005	Nishiyori *et al.* [88]	153	0%	In-patient	Alcohol	81% (0.739, 0.869)	39.3%
Japan	2003	Nakamura *et al.* [89][o]	132	0%	In-patient	Alcohol	91.7%[v] (0.856, 0.958)	52.8%
Netherlands	2002	Buster *et al.* [90]	100	16%	ORT	Opiate	97%[v] (0.915, 0.994)	32.2%
Nigeria	1998	Lawal *et al.* [91]	80	9%	In-patient	Opiate	97.5% (0.913, 0.997)	15.4%
Poland	2002	Bogucka-Bonikowska *et al.* [92]	28	0%	ORT	Opiate	93% (0.765, 0.991)	43%
Russia	2001	Kampov-Polevoy *et al.* [48]	32	0%	In-patient	Alcohol	100% (0.891, 1)	63.2%
Spain	2011	Pérez de Los Cobos *et al.* [42][p]	125	19.5%	Out-patient	AOD	84%[v] (0.773, 0.906)	35.4%
Spain	2002	Boto de los Bueis *et al.* [46][q]	62	9.7%	Unknown	Opiate	100% (0.942, 1)	42.1%
Switzerland	2010	Walter *et al.* [33][r]	38	36.8%	ORT	Opiate	89.5% (0.752, 0.971)	26%

(*Continues*)

Table 1. (Continued)

Country	*Source (year)*	*Source (author)*	*n*	*% Female*	*Modality*	*Primary drug treated*	*Smoking prevalence (95% CI)*	*National smoking prevalence*[a]
Switzerland	2008	Wapf *et al.* [93]	103	25%	ORT	Opiate	93% (0.865, 0.972)	31%
Switzerland	2000	Zullino *et al.* [34]	88	35.2%	In-patient	Alcohol	80.7% (0.709, 0.883)	33.5%
Switzerland	1998	Perneger *et al.* [31]	48	43.8%	ORT	Opiate	96%[v] (0.858, 0.995)	34.3%
Turkey	2003	Ercan *et al.* [36][s]	60	Unknown	In-patient	Alcohol	88.3%[v] (0.774, 0.952)	33.8%
UK	2012	Palmer *et al.* [30][t]	9285	36%	ORT	Opiate	85.9% (0.852, 0.866)	21%
UK	2004	Harris *et al.* [94][u]	693	22.5%	In-patient	AOD	89.5% (0.869, 0.917)	26%
UK	2001	Tacke *et al.* [95]	50	26%	ORT	Opiate	98% (0.894, 1)	27%
UK	1998	Best *et al.* [96]	100	27%	ORT	Opiate	93% (0.861, 0.971)	30%

[a]National smoking prevalence is adjusted to the gender of the sample (if ≥ 70% of sample was either gender, national smoking rate is reported for that gender only. If gender of sample was not reported, the combined national rate was used.) [b]Opiate replacement therapy. [c]Shakeshaft *et al.* 1998 sample overlap, not included in review [21]. [d]Alcohol and other drugs. [e](Holfich *et al.* 2012) Smoking prevalence collected based on number of deliveries [40] versus number of women [37], so three women are double-counted to determine this calculation. Also, to determine the rate, we totaled smokers of both vaginal and cesarean deliveries and divided that number by the total number of deliveries. [f](Diehl *et al.* 2013) Smoking prevalence based on scale measuring nicotine dependence from 'very low' to 'elevated'. [g](de Meneses-Gaya *et al.* 2009) Setting is psychosocial care center for alcohol or drug users; 40 clients invited to participate; of the 40, 30 self-reported as smokers. [h](Dunn & Laranjeira 1999) Mixed modalities: out-patient 133, in-patient 94, police 40, hospice 26 (from Table 1). [i]Aubin *et al.* 1995 was not included in review [24]. [j](Ohlmeier *et al.* 2007) Paper reports 52.7% were average to heavy smokers in paper, but smoking prevalence was calculated from Table 3 (minimal, average, heavy). [k]Basu *et al.* 2009 uses subset ($n = 312$) of this sample and was not included in review [20]; for modality, facility also has '20 in-patient beds' and clients who utilized beds over a 30-year period were included in the study. [l](Rooban *et al.* 2009) Overlapping sample with Thavarajah *et al.* 2006 [22]. [m](Pajusco *et al.* 2011). The data collected from patients entering a single program over a period of 27 years (1980–2007). [n](Pastorelli *et al.* 2001) Unable to determine modality. [o](Nakamura *et al.* 2003) Calculated by reviewers (11 non-smokers). [p](Pérez de Los Cobos *et al.* 2011) Includes 205 cocaine users, reported smoking rate for subsample ($n = 125$). [q](Boto de los Bueis *et al.* 2002) Unable to determine modality. [r](Walter *et al.* 2010) Sample evenly split between MMT and diacetylmorphine. [s](Ercan *et al.* 2003) n is 15 [childhood attention deficit huperactivity disorder (ADHD) + 45 (no childhood ADHD)]. [t](Palmer *et al.* 2012) Does not separate current and ex-smoker. [u](Harris *et al.* 2004) Does not specify proportions of inpatient, out-patient and detox. [v]Calculated by reviewers.

reported in Table 2. The unadjusted odds ratios (ORs) in the first column show that treatment modality was not associated with differences in smoking rates. However, compared to programs treating alcohol, smoking rates were higher in programs treating both alcohol and other drug use (OR = 1.75, CI = 1.45, 2.11) and in programs treating primarily opiate use (OR = 1.84, CI = 1.49, 2.28). In model 1, adjusting for year of study, odds of smoking were higher in ORT compared to out-patient programs (OR = 1.42, CI = 1.19, 1.68). In model 2, compared to programs treating alcohol, smoking rates were higher in programs treating alcohol and other drug use (OR = 1.83, CI = 1.52, 2.21) and in programs treating opiate use (OR = 2.52, CI = 2.00, 3.17). In model 3, only people in programs treating alcohol and other drug use showed a higher rate of smoking, compared to those in programs treating alcohol use. Neither ORT modality nor opiate as primary drug was associated with smoking, and we believe this is because the two variables are confounded. In all adjusted models, year of study was associated inversely with smoking prevalence, such that the odds of smoking decreased by 6% per year in addiction treatment samples (OR = 0.94, CI = 0.93, 0.96). We discount this result because the 51 papers are spread across 20 years and across countries with wide variation in population smoking rates. A large study reported in one year can affect the estimate of addiction treatment smoking prevalence for that year, influencing an estimate of linear change over time.

DISCUSSION

In every study reviewed, smoking prevalence among people enrolled in addiction treatment was two to four times higher than that in the general population. This is consistent with results from the United States, where NSDUH estimates of smoking among people receiving addiction treatment (1987–2009) ranged across years from 66.9 to 75% [43]. Considering both the prior US review and the current international review, 96 papers reporting from 21 countries show that smoking prevalence is higher in addiction treatment compared to the general population. World-wide, smoking among people in addiction treatment programs contributes prominently to the tobacco epidemic, and to associated economic costs and morbidity and mortality.

Further, among people enrolled in addiction treatment programs internationally, the highest rates of smoking are associated with opiate use and with participation in ORT programs. These findings are also consistent with prior research [16,43], including findings that nicotine appears to potentiate the effect of methadone on opiate withdrawal [49], and that peak smoking rates are observed during methadone administration [50].

There are many potential reasons why smoking prevalence is higher in addiction treatment populations than in general populations. Like many drugs of abuse, smoking increases dopamine levels in reward regions of the brain, and dopamine receptor genes mediate smoking as well as other

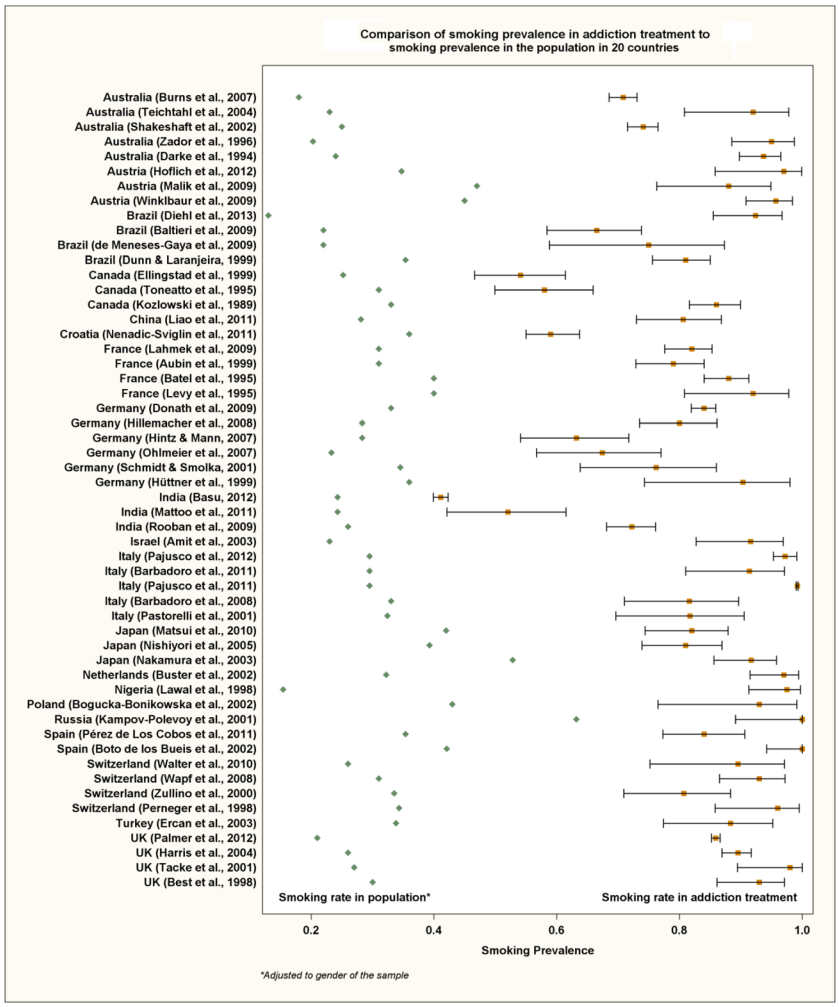

Figure 2 Comparison of smoking prevalence in addiction treatment to smoking prevalence in the population of 20 countries

Table 2 Treatment modality, primary drug and year as predictors of smoking prevalence in international addiction treatment studies.[a]

	Unadjusted OR (95% CI)[b]	*Adjusted OR (95% CI)*[c]		
Predictor	*Univariate*	*Multivariate: model 1 (modality and year)*	*Multivariate: model 2 (primary drug and year)*	*(Modality, primary drug and year)*
Modality				
Out-patient	Reference	Reference		Reference
In-patient	0.95 (0.80, 1.21)	1.07 (0.89, 1.27)		0.97 (0.81, 1.16)
ORT	1.03 (0.88, 1.19)	1.42 (1.19, 1.68)		0.38 (0.04, 3.54)
Primary drug				
Alcohol	Reference		Reference	Reference
Alcohol or drug	1.75 (1.45, 2.11)		1.83 (1.52, 2.21)	1.79 (1.48, 2.17)
Opiate	1.84 (1.49, 2.28)		2.52 (2.00, 3.17)	6.21 (0.67, 57.72)
Year	0.96 (0.95, 0.97)	0.94 (0.93, 0.96)	0.94 (0.93, 0.96)	0.94 (0.93, 0.96)

[a]Analyses are based studies shown in Table 1, excluding Kozolowski *et al.* 1989 [45], Pajusco *et al.* 2011 [44] and Basu *et al.* 2012 [39] (n = 51 studies).
[b]Unadjusted analyses based on the same random-effects model as adjusted models, which includes a random country accounts for nesting by country. [c]There are three adjusted models. One for the relationship of modality to smoking prevalence, and one for the relationship of primary drug to smoking prevalence. One for the relationship of modality and primary drug to smoking prevalence. Three models include a random country and account for nesting by country.
CI = confidence interval; OR = odds ratio.

addiction-related behaviors [51]. Smokers who also use other drugs are more heavily addicted to nicotine than smokers who do not [52,53]; and smokers who are more dependent on other drugs, and thus more likely to enter addiction treatment, are less successful in quitting smoking [53,54]. Importantly, Prochaska *et al.* also found that receipt of smoking cessation services was associated with improved outcomes for other addictions [55].

For patients in addiction treatment, other factors may support continued smoking or interfere with efforts to quit. These include elevated smoking prevalence among patients [43] and staff [56], and limited access to smoking cessation treatment [57–59]. In a meta-analysis of smoking cessation trials among people who received addiction treatment, Prochaska *et al.* found quit rates lower than those achieved in general population samples receiving similar treatments [55]. Staff attitudes and beliefs about smoking may contribute to lower successful quit rates among people in addiction treatment. Staff who smoke are less likely to address smoking with patients [60] and less likely to support smoking cessation in the context of addiction treatment [61]. Both staff and directors sometimes express attitudes that quitting smoking hinders recovery from other addictions, that smoking cessation is a low priority and that patients are not interested in quitting smoking [56]. Importantly, many of the same attitudinal barriers to addressing smoking in addiction treatment programs are also reported in mental health programs [62,63]. Whether difficulty in quitting in addiction treatment populations is due to biological factors, features of the addiction treatment culture or provider misconceptions, interventions tailored especially to this population may be needed to improve both motivation to quit smoking and successful quit rates.

Much of this research comes from the United States and some findings, particularly concerning the culture and beliefs within addiction treatment systems, may not apply internationally. At the same time, the consistent finding of elevated smoking prevalence in addiction treatment internationally suggests that at least some of the contributing factors identified in the US literature may apply in addiction treatment systems in other countries.

Limitations of the current study include reliance on English language publications, as this excludes an unknown number of reports in other languages which may meet inclusion criteria. Search procedures may have missed an unknown number of relevant papers, particularly if tobacco was not mentioned in the abstract but smoking prevalence was later reported in the paper itself. All smoking prevalence rates were provided in the papers or calculated from information provided in the papers. In one instance the prevalence estimate included former as well as current smokers [30]. In another, smoking prevalence was inferred from a tobacco dependence scale [41]. When developing national prevalence rates for comparison, a simple algorithm determined use of male, female or combined national smoking prevalence. This may result in a national prevalence estimate that is either higher or lower than a national prevalence estimate based on the gender proportion in the sample. National smoking estimates do not consider differences in socio-economic status (SES) between the general population and addiction treatment samples. If matched to SES of each treatment sample by year and by country, national estimates may be higher due to an association between lower SES and smoking in most countries [64]. In that case, the gap between smoking in addiction treatment and smoking in national samples may be smaller. Each paper reported on a unique sample and, while we gathered all possible papers, we do not assert that any single sample or collection of papers represents smoking prevalence among all persons in addiction treatment in a single country.

Findings may inform tobacco control strategies in different countries. Addiction treatment programs offer a strategic point for tobacco intervention due to their high smoking prevalence and the potential to reach a large number of smokers. To understand smoking prevalence more clearly in these populations, the WHO may wish to include a question in the GATS similar to that included in the NSDUH, which asks whether the respondent has received any addiction treatment in the past year [65]. When combined with current smoking status, this permits estimation of smoking prevalence in addiction treatment populations at the national level [43]. The WHO, or individual FCTC signatories, may also consider adapting the MPOWER strategies, particularly smoke-free environments and cessation programs, for use in addiction treatment systems.

Even tobacco control efforts that are effective for the general public may have less success when applied to subpopulations such as addiction treatment clients. There is scant information, however, about strategies and success rates for addressing smoking in this population internationally. This paper is a first step toward encouraging dialogue among countries regarding ways to improve the efficacy of tobacco control for addiction treatment populations.

Declaration of interests

None.

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References

1. World Health Organization (WHO). *WHO Global Report: Mortality Attributable to Tobacco*. Geneva: WHO; 2012.
2. World Health Organization (WHO). *WHO report on the Global Tobacco Epidemic*. Geneva: WHO; 2013.
3. Giovino G. A., Mirza S. A., Samet J. M., Gupta P. C., Jarvis M. J., Bhala N. *et al.* Tobacco use in 3 billion individuals from 16 countries: an analysis of nationally representative cross-sectional household surveys. *Lancet* 2012; **380**: 668–79.
4. Joossens L., Raw M. The Tobacco Control Scale: a new scale to measure country activity. *Tob Control* 2006; **15**: 247–53.
5. Martínez C., Martínez-Sánchez J. M., Robinson G., Bethke C., Fernández E. Protection from secondhand smoke in countries belonging to the WHO European Region: an assessment of legislation. *Tob Control* 2014; **23**: 403–11.
6. Ferketich A. K., Lugo A., La Vecchia C., Fernandez E., Boffetta P., Clancy L. *et al.* Relation between national-level tobacco control policies and individual-level voluntary home smoking bans in Europe. *Tob Control* 2014; doi: 10.1136/tobaccocontrol-2014-051819.
7. Martinez-Sanchez J. M., Blanch C., Fu M., Gallus S., La Vecchia C., Fernandez E. Do smoke-free policies in work and public places increase smoking in private venues? *Tob Control* 2014; **23**: 204–7.
8. Szatkowski L., McNeill A. The delivery of smoking cessation interventions to primary care patients with mental health problems. *Addiction* 2013; **8**: 1487–1494.
9. Kalman D., Morissette S. B., George T. P. Co-morbidity of smoking in patients with psychiatric and substance use disorders. *Am J Addict* 2005; **14**: 106–23.
10. Compton W. M., Thomas Y. F., Stinson F. S., Grant B. F. Prevalence, correlates, disability, and comorbidity of DSM-IV drug abuse and dependence in the united states: results from the national epidemiologic survey on alcohol and related conditions. *Arch Gen Psychiatry* 2007; **64**: 566–76.
11. Substance Abuse and Mental Health Services Administration Results from the 2008 National Survey on Drug Use and Health: National Findings. In: *NSDUH Series H-36, HHS Publication no. SMA 09-4434*. Rockville, MD: Office of Applied Studies; 2009.
12. Hser Y. I., McCarthy W. J., Anglin M. D. Tobacco use as a distal predictor of mortality among long-term narcotics addicts. *Prev Med* 1994; **23**: 61–9.
13. Hurt R. D., Offord K. P., Croghan I. T., Gomez-Dahl L., Kottke T. E., Morse R. M. *et al.* Mortality following inpatient addictions treatment. Role of tobacco use in a community-based cohort. *JAMA* 1996; **275**: 1097–103.
14. Tsoh J. Y., Chi F. W., Mertens J. R., Weisner C. M. Stopping smoking during first year of substance use treatment predicted 9-year alcohol and drug treatment outcomes. *Drug Alcohol Depend* 2011; **114**: 110–8.
15. Guydish J., Passalacqua E., Tajima B., Chan M., Chun J., Bostrom A. Smoking prevalence in addiction treatment: a review. *Nicotine Tob Res* 2011; **13**: 401–11.
16. Guydish J., Yu J., Le T., Pagano A., Delucchi K. Predictors of tobacco use among New York State addiction treatment patients. *Am J Public Health* 2015; **105**: e57–64.
17. Moher D., Liberati A., Tetzlaff J., Altman D. G., the PRISMA Group Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLOS Med* 2009; **6**e1000097: .
18. Teichtahl H., Prodromidis A., Miller B., Cherry G., Kronborg I. Sleep-disordered breathing in stable methadone programme patients: a pilot study. *Addiction* 2001; **96**: 395–403.
19. Gossop M., Neto D., Radovanovic M., Batra A., Toteva S., Musalek M. *et al.* Physical health problems among patients seeking treatment for alcohol use disorders: a study in six European cities. *Addict Biol* 2007; **12**: 190–6.
20. Basu D., Banerjee A., Harish T., Mattoo S. K. Disproportionately high rate of epileptic seizure in patients abusing dextropropoxyphene. *Am J Addict* 2009; **18**: 417–21.
21. Shakeshaft A. P., Bowman J. A., Sanson-Fisher R. W. Computers in community-based drug and alcohol clinical settings: are they acceptable to respondents? *Drug Alcohol Depend* 1998; **50**: 177–80.
22. Thavarajah R., Rao A., Raman U., Rajasekaran S. T., Joshua E., Hemalatha R. *et al.* Oral lesions of 500 habitual psychoactive substance users in Chennai, India. *Arch Oral Biol* 2006; **51**: 512–9.
23. Zullino D. F., Besson J., Favrat B., Krenz S., Zimmermann G., Schnyder C. *et al.* Acceptance of an intended smoking ban in an alcohol dependence clinic. *Eur Psychiatry* 2003; **18**: 255–7.
24. Aubin H., Tilikete S., Laureaux C., Nguyen Hac H., Roullet-Volmi M., Troupel S. *et al.* Smoking and coffee intake following alcohol withdrawal in alcoholic inpatients. *Eur Psychiatry* 1995; **10**: 383–5.
25. Darke S., Swift W., Hall W., Ross M. Predictors of injecting and injecting risk-taking behaviour among methadone maintenance clients. *Addiction* 1994; **89**: 311–6.
26. Lahmek P., Berlin I., Michel L., Berghout C., Meunier N., Aubin H. J. Determinants of improvement in quality of life of alcohol-dependent patients during an inpatient withdrawal programme. *Int J Med Sci* 2009; **6**: 160–7.
27. Liao Y., Tang J., Liu T., Chen X., Luo T., Hao W. Sleeping problems among Chinese heroin-dependent individuals. *Am J Drug Alcohol Abuse* 2011; **37**: 179–83.
28. Malik P., Gasser R. W., Kemmler G., Moncayo R., Finkenstedt G., Kurz M. *et al.* Low bone mineral density and impaired bone metabolism in young alcoholic patients without liver cirrhosis: a cross-sectional study. *Alcohol Clin Exp Res* 2009; **33**: 375–81.
29. Ohlmeier M. D., Peters K., Kordon A., Seifert J., Wildt B. T., Wiese B. *et al.* Nicotine and alcohol dependence in patients with comorbid attention-deficit/hyperactivity disorder (ADHD). *Alcohol Alcohol* 2007; **42**: 539–43.
30. Palmer F., Jaffray M., Moffat M. A., Matheson C., McLernon D. J., Coutts A. *et al.* Prevalence of common chronic respiratory diseases in drug misusers: a cohort study. *Prim Care Respir J* 2012; **21**: 377–83.
31. Perneger T. V., Giner F., del Rio M., Mino A. Randomised trial of heroin maintenance programme for addicts who fail in conventional drug treatments. *BMJ* 1998; **317**: 13–8.
32. Teichtahl H., Wang D., Cunnington D., Kronborg I., Goodman C., Prodromidis A. *et al.* Cardiorespiratory function in stable methadone maintenance treatment (MMT) patients. *Addict Biol* 2004; **9**: 247–53.
33. Walter M., Wiesbeck G. A., Degen B., Albrich J., Oppel M., Schulz A. *et al.* Heroin reduces startle and cortisol response in opioid-maintained heroin-dependent patients. *Addict Biol* 2010; **16**: 145–51.
34. Zullino D., Besson J., Schnyder C. Stage of change of cigarette smoking in alcohol-dependent patients. *Eur Addict Res* 2000; **6**: 84–90.
35. Ellingstad T. P., Sobell L. C., Sobell M. B., Cleland P. A., Agrawal S. Alcohol abusers who want to quit smoking: implications for clinical treatment. *Drug Alcohol Depend* 1999; **54**: 259–65.

36. Ercan E. S., Coskunol H., Varan A., Toksoz K. Childhood attention deficit/hyperactivity disorder and alcohol dependence: a 1-year follow-up. *Alcohol Alcohol* 2003; **38**: 352–6.
37. Schmidt L. G., Smolka M. Relapse prevention in alcoholics by cigarette smoking? Involvement of nicotinic-dopaminergic mechanisms. *Alcohol* 2001; **24**: 111–5.
38. Toneatto A., Sobell L. C., Sobell M. B., Kozlowski L. T. Effect of cigarette smoking on alcohol treatment outcome. *J Subst Abuse* 1995; **7**: 245–52.
39. Basu D., Aggarwal M., Das P. P., Mattoo S. K., Kulhara P., Varma V. K. Changing pattern of substance abuse in patients attending a de-addiction centre in north India (1978–2008). *Ind J Med Res* 2012; **135**: 830–6.
40. Dunn J., Laranjeira R. Cocaine—profiles, drug histories, and patterns of use of patients from Brazil. *Subst Use Misuse* 1999; **34**: 1527–48.
41. Diehl A., Silva R. L., Laranjeira R. Female sexual dysfunction in patients with substance-related disorders. *Clinics* 2013; **68**: 205–12.
42. de Los P., Cobos J., Sinol N., Puerta C., Cantillano V., Lopez Zurita C. *et al.* Features and prevalence of patients with probable adult attention deficit hyperactivity disorder who request treatment for cocaine use disorders. *Psychiatry Res* 2011; **185**: 205–10.
43. Guydish J., Passalacqua E., Tajima B., Chan M., Chun J., Bostrom A. Smoking prevalence in addiction treatment: a review. *Nicotine Tob Res* 2011; **13**: 401–11.
44. Pajusco B., Boschini A., Chiamulera C., Benigni M., Smacchia C., Lugoboni F. Tobacco smoking prevalence in a large sample of heroin users accessing rehabilitation. *Heroin Addict Relat Clin Probl* 2011; **3**: 5–10.
45. Kozlowski L. T., Skinner W., Kent C., Pope M. A. Prospects for smoking treatment in individuals seeking treatment for alcohol and other drug problems. *Addict Behav* 1989; **14**: 273–8.
46. de los Boto B. A., Pereira Vega A., Sanchez Ramos J. L., Maldonado Perez J. A., Ayerbe Garcia R., Garcia Jimenez D. *et al.* Bronchial hyperreactivity in patients who inhale heroin mixed with cocaine vaporized on aluminum foil. *Chest* 2002; **121**: 1223–30.
47. Pastorelli R., Bardazzi G., Saieva C., Cerri A., Gestri D., Allamani A. *et al.* Genetic determinants of alcohol addiction and metabolism: a survey in Italy. *Alcohol Clin Exp Res* 2001; **25**: 221–7.
48. Kampov-Polevoy A. B., Tsoi M. V., Zvartau E. E., Neznanov N. G., Khalitov E. Sweet liking and family history of alcoholism in hospitalized alcoholic and non-alcoholic patients. *Alcohol Alcohol* 2001; **36**: 165–70.
49. Elkader A. K., Brands B., Selby P., Sproule B. A. Methadone–nicotine interactions in methadone maintenance treatment patients. *J Clin Psychopharmacol* 2009; **29**: 231–8.
50. Richter K. P., Hamilton A. K., Hall S., Catley D., Cox L. S., Grobe J. Patterns of smoking and methadone dose in drug treatment patients. *Exp Clin Psychopharmacol* 2007; **15**: 144–53.
51. Vandenbergh D. J., O'Connor R. J., Grant M. D., Jefferson A. L., Vogler G. P., Strasser A. A. *et al.* Dopamine receptor genes (DRD2, DRD3 and DRD4) and gene–gene interactions associated with smoking-related behaviors. *Addict Biol* 2007; **12**: 106–16.
52. Hughes J. Do smokers with current or past alcoholism need different or more intensive treatment? *Alcohol Clin Exp Res* 2002; **26**: 1934–5.
53. Sobell L. C., Sobell M. B., Agrawal S. Self-change and dual recoveries among individuals with alcohol and tobacco problems: current knowledge and future directions. *Alcohol Clin Exp Res* 2002; **26**: 1936–8.
54. Drobes D. J. Cue reactivity in alcohol and tobacco dependence. *Alcohol Clin Exp Res* 2002; **26**: 1928–9.
55. Prochaska J. J., Delucchi K., Hall S. M. A meta-analysis of smoking cessation interventions with individuals in substance abuse treatment or recovery. *J Consult Clin Psychol* 2004; **72**: 1144–56.
56. Guydish J., Passalacqua E., Tajima B., Manser S. T. Staff smoking and other barriers to nicotine dependence intervention in addiction treatment settings: a review. *J Psychoact Drugs* 2007; **39**: 423–33.
57. Richter K. P., Choi W. S., McCool R. M., Harris K. J., Ahluwalia J. S. Smoking cessation services in U.S. methadone maintenance facilities. *Psychiatr Serv* 2004; **55**: 1258–64.
58. Fuller B. E., Guydish J., Tsoh J., Reid M. S., Resnick M., Zammarelli L. *et al.* Attitudes toward the integration of smoking cessation treatment into drug abuse clinics. *J Subst Abuse Treat* 2007; **32**: 53–60.
59. Friedmann P. D., Jiang L., Richter K. P. Cigarette smoking cessation services in outpatient substance abuse treatment programs in the United States. *J Subst Abuse Treat* 2008; **34**: 165–72.
60. Bobo J. K., Gilchrist L. D. Urging the alcoholic client to quit smoking cigarettes. *Addict Behav* 1983; **8**: 297–305.
61. Gill B. S., Bennett D. L. Addiction professionals' attitudes regarding treatment of nicotine dependence. *J Subst Abuse Treat* 2000; **19**: 317–8.
62. Prochaska J. J., Fletcher L., Hall S. E., Hall S. M. Return to smoking following a smoke-free psychiatric hospitalization. *Am J Addict* 2006; **15**: 15–22.
63. Prochaska J. J., Reyes R. S., Schroeder S. A., Daniels A. S., Doederlein A., Bergeson B. An online survey of tobacco use, intentions to quit, and cessation strategies among people living with bipolar disorder. *Bipolar Disord* 2011; **13**: 466–73.
64. World Health Organization (WHO) *Systematic Review of the Link Between Tobacco and Poverty.* Geneva: WHO; 2011.
65. US Department of Health and Human Services, Substance Abuse and Mental Health Services Administration. National Survey on Drug Use and Health 2014. Available at: https://nsduhweb.rti.org/respweb/homepage.cfm (accessed 7 November 2014).
66. Burns L., Mattick R. P., Lim K., Wallace C. Methadone in pregnancy: treatment retention and neonatal outcomes. *Addiction* 2007; **102**: 264–70.
67. Shakeshaft A. P., Bowman J. A., Sanson-Fisher R. W. Community-based drug and alcohol counselling: who attends and why? *Drug Alcohol Rev* 2002; **21**: 153–62.
68. Zador D., Lyons Wall P. M., Webster I. High sugar intake in a group of women on methadone maintenance in south western Sydney, Australia. *Addiction* 1996; **91**: 1053–61.
69. Hoflich A. S., Langer M., Jagsch R., Bawert A., Winklbaur B., Fischer G. *et al.* Peripartum pain management in opioid dependent women. *Eur J Pain* 2012; **16**: 574–84.
70. Winklbaur B., Baewert A., Jagsch R., Rohrmeister K., Metz V., Aeschbach Jachmann C. *et al.* Association between prenatal tobacco exposure and outcome of neonates born to opioid-maintained mothers. Implications for treatment. *Eur Addict Res* 2009; **15**: 150–6.
71. Baltieri D. A., Daro F. R., Ribeiro P. L., Andrade A. G. Effects of topiramate or naltrexone on tobacco use among male alcohol-dependent outpatients. *Drug Alcohol Depend* 2009; **105**: 33–41.

72. de Meneses-Gaya C., Zuardi A. W., de Azevedo Marques J. M., Souza R. M., Loureiro S. R., Crippa J. A. Psychometric qualities of the Brazilian versions of the Fagerstrom Test for Nicotine Dependence and the Heaviness of Smoking Index. *Nicotine Tob Res* 2009; **11**: 1160–5.
73. Nenadic-Sviglin K., Nedic G., Nikolac M., Kozaric-Kovacic D., Stipcevic T., Muck Seler D. *et al.* Suicide attempt, smoking, comorbid depression, and platelet serotonin in alcohol dependence. *Alcohol* 2011; **45**: 209–16.
74. Aubin H. J., Laureaux C., Tilikete S., Barrucand D. Changes in cigarette smoking and coffee drinking after alcohol detoxification in alcoholics. *Addiction* 1999; **94**: 411–6.
75. Batel P., Pessione F., Maitre C., Rueff B. Relationship between alcohol and tobacco dependencies among alcoholics who smoke. *Addiction* 1995; **90**: 977–80.
76. Levy P., Mathurin P., Roqueplo A., Rueff B., Bernades P. A multidimensional case–control study of dietary, alcohol, and tobacco habits in alcoholic men with chronic pancreatitis. *Pancreas* 1995; **10**: 231–8.
77. Donath C., Metz K., Chmitorz A., Gradl S., Piontek D., Floter S. *et al.* Prediction of alcohol addicted patients' smoking status through hospital tobacco control policy: a multi-level-analysis. *Drugs Educ Prev Policy* 2009; **16**: 53–70.
78. Hillemacher T., Weinland C., Heberlein A., Wilhelm J., Bayerlein K., Kornhuber J. *et al.* Treatment with clomethiazole is associated with lower rates of premature discharge during alcohol withdrawal. *Pharmacopsychiatry* 2008; **41**: 134–7.
79. Hintz T., Mann K. Long-term behavior in treated alcoholism: Evidence for beneficial carry-over effects of abstinence from smoking on alcohol use and vice versa. *Addict Behav* 2007; **32**: 3093–100.
80. Huttner E., Matthies U., Nikolova T., Ehrenreich H. A follow-up study on chromosomal aberrations in lymphocytes of alcoholics during early, medium, and long-term abstinence. *Alcohol Clin Exp Res* 1999; **23**: 344–8.
81. Mattoo S. K., Chakraborty K., Basu D., Ghosh A., Vijaya Kumar K. G., Kulhara P. Prevalence and correlates of metabolic syndrome in alcohol and opioid dependent inpatients. *Ind J Med Res* 2011; **134**: 341–8.
82. Rooban T., Rao A., Joshua E., Ranganathan K. The prevalence of oral mucosal lesions in alcohol misusers in Chennai, south India. *Ind J Dent Res* 2009; **20**: 41–6.
83. Amit Z., Weiss S., Smith B. R., Markevitch S. The affinity for sweet substances and cigarette smoking in chronic alcoholism. *Isr J Psychiatry Relat Sci* 2003; **40**: 96–102.
84. Pajusco B., Chiamulera C., Quaglio G., Moro L., Casari R., Amen G. *et al.* Tobacco addiction and smoking status in heroin addicts under methadone vs. buprenorphine therapy. *Int J Environ Res Public Health* 2012; **9**: 932–42.
85. Barbadoro P., Ponzio E., Pertosa M. E., Aliotta F., D'Errico M. M., Prospero E. *et al.* The effects of educational intervention on nutritional behaviour in alcohol-dependent patients. *Alcohol Alcohol* 2011; **46**: 77–9.
86. Barbadoro P., Lucrezi D., Prospero E., Annino I. Improvement of knowledge, attitude, and behavior about oral health in a population of alcohol addicted persons. *Alcohol Alcohol* 2008; **43**: 347–50.
87. Matsui T., Yokoyama A., Matsushita S., Ogawa R., Mori S., Hayashi E. *et al.* Effect of a comprehensive lifestyle modification program on the bone density of male heavy drinkers. *Alcohol Clin Exp Res* 2010; **34**: 869–75.
88. Nishiyori A., Shibata A., Ogimoto I., Uchimura N., Egami H., Nakamura J. *et al.* Alcohol drinking frequency is more directly associated with alcohol use disorder than alcohol metabolizing enzymes among male Japanese. *Psychiatry Clin Neurosci* 2005; **59**: 38–44.
89. Nakamura Y., Ishikawa A., Sekiguchi S., Kuroda M., Imazeki H., Higuchi S. Spirits and gastrectomy increase risk for chronic pancreatitis in Japanese male alcoholics. *Pancreas* 2003; **26**: e27–31.
90. Buster M., Rook L., van Brussel G. H., van Ree J., van den Brink W. Chasing the dragon, related to the impaired lung function among heroin users. *Drug Alcohol Depend* 2002; **68**: 221–8.
91. Lawal R. A., Adelekan M. L., Ohaeri J. U., Orija O. B. Rehabilitation of heroin and cocaine abusers managed in a Nigerian psychiatric hospital. *East Afr Med J* 1998; **75**: 107–12.
92. Bogucka-Bonikowska A., Baran-Furga H., Chmielewska K., Habrat B., Scinska A., Kukwa A. *et al.* Taste function in methadone-maintained opioid-dependent men. *Drug Alcohol Depend* 2002; **68**: 113–7.
93. Wapf V., Schaub M., Klaeusler B., Boesch L., Stohler R., Eich D. The barriers to smoking cessation in Swiss methadone and buprenorphine-maintained patients. *Harm Reduct J* 2008; **18**: 5–10.
94. Harris C. K., Warnakulasuriya K. A. A. S., Cooper D. J., Peters T. J., Gelbier S. Prevalence of oral mucosal lesions in alcohol misusers in south London. *J Oral Pathol Med* 2004; **33**: 253–9.
95. Tacke U., Wolff K., Finch E., Strang J. The effect of tobacco smoking on subjective symptoms of inadequacy ('not holding') of methadone dose among opiate addicts in methadone maintenance treatment. *Addict Biol* 2001; **6**: 137–45.
96. Best D., Lehmann P., Gossop M., Harris J., Noble A., Strang J. Eating too little, smoking and drinking too much: wider lifestyle problems among methadone maintenance patients. *Addict Res Theory* 1998; **6**: 489–98.