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Predictive validity of the Motivation To Stop Scale (MTSS): A single-item measure of motivation to stop smoking☆

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ABSTRACT

Background: Many different measures of motivation to stop smoking exist but it would be desirable to have a brief version that is standard for use in population surveys and for evaluations of interventions to promote cessation. The aim of this study was to assess the predictive validity and accuracy of the single-item Motivation To Stop Scale (MTSS).
Methods: This study is part of the "Smoking Toolkit Study;" a monthly survey of representative samples of the English population. We used data from 2483 respondents to the surveys from November 2008 to January 2011, who were smokers, used the MTSS, and were followed up 6 months later to provide information on quit attempts since baseline. The MTSS consists of one item with seven response categories ranging from 1 (lowest) to level 7 (highest level of motivation to stop smoking).
Results: A total of 692 smokers (27.9% (95% CI = 26.1–29.6)) made an attempt to quit smoking between baseline and 6-month follow-up. The odds of quit attempts increased linearly with increasing level of motivation at baseline ($p < 0.001$) and were 6.8 (95% CI = 4.7–9.9) times higher for the highest level of motivation compared with the lowest. The accuracy of the MTSS for discriminating between smokers who did and did not attempt to quit was $ROC_{AUC} = 0.67$ (95% CI = 0.65–0.70).
Conclusions: The MTSS provides strong and accurate prediction of quit attempts and is a candidate for a standard single-item measure of motivation to stop smoking. Further research should assess the external validity of this measure in different smoking populations.

1. Introduction

Measuring motivation to stop smoking is useful in population surveys as a means of assessing the impact of interventions such as mass media campaigns, and tracking trends over time, or making comparisons between different populations or subpopulations. Different studies use different ad-hoc measures (for example: Ashraf et al., 2009; Boardman et al., 2005; George et al., 2002; Kotz et al., 2009; Tønnesen et al., 2006). It would be useful to have a standard measure that is as brief as possible and has proven validity. This paper reports on the validation of such a measure using a large population sample.

Three published studies have examined associations between measures of motivation to quit and quit attempts prospectively in population samples in the absence of interventions (Borland et al., 2010; West et al., 2001; Zhou et al., 2009). Many other studies have examined the predictive validity of measures of motivation to stop in clinical samples or in the context of interventions studies (for example: Biener and Abrams, 1991; Boardman et al., 2005; Crittenden et al., 1994; Hughes et al., 2005; Ong et al., 2005; Sciamanna et al., 2000). Others have examined the predictive value of measures of "stage of change" which incorporates past quitting behavior and so conflates motivation and previous action (Cancer Prevention Research Center, 2012; DiClemente et al., 1991). It also represents a very broad classification in pre-quit stages and has been found to have low temporal stability (Hughes et al., 2005). For the purposes of evaluating a standard scale for population samples, reports of associations in clinical and intervention studies cannot be used. The three relevant prospective studies found moderate associations between measured motivation and subsequent quit attempts but no attempt was made to define a function relating scores on the measures and the behavioral outcome (Borland et al., 2010; West et al., 2001; Zhou et al., 2009).

☆ Supplementary material can be found by accessing the online version of this paper. Please see Appendix A for more information.

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Key elements of motivation include beliefs about what one should do, and both desire and intention to act in a particular way (West, 2005). In relation to motivation to stop smoking, it has been found that intention and desire to stop are predictive of quit attempts while belief alone that one should stop is not (Smit et al., 2011). A simple rating scale has been constructed that incorporates all of these components: the Motivation To Stop Scale (MTSS). This scale was developed for use in large scale tracking surveys by RW in collaboration with the English Department of Health and Central Office of Information. It should provide an ordinal measure of motivation to stop smoking which would allow assessment of all the relevant aspects of motivation. It is important to note that this rating specifically includes intention, desire and belief into a single item with the expectation that this will provide the most cost-efficient possible measure. Splitting the constructs into two or three items would double the cost and for large surveys this could represent a substantial decrease in cost-efficiency.

This study assessed the predictive validity of the MTSS by examining associations between scores on the scale and incidence of attempts to stop smoking in the subsequent 6 months. Additionally, we assessed both the diagnostic accuracy of the scale by calculating the area und the receiver operating characteristic (ROC_{AUC}) curve and the divergent validity of the motivation measure by calculating and comparing the ROC_{AUCs} for two measures of cigarette dependence.

2. Methods

This study is part of the "Smoking Toolkit Study," which is an ongoing research program designed to provide information about smoking prevalence and behavior (The Smoking Toolkit Study, 2011). Each month a new sample of approximately 1700 adults aged 16 and over completes a face-to-face computer-assisted survey, of whom approximately 500 will be smokers. The methods have been described in full elsewhere and have been shown to result in a sample that is nationally representative in its socio-demographic composition (Fidler et al., 2011a).

2.1. Study population

We used data from respondents to the survey in the period from November 2008 (the wave in which the measure of motivation was added to the survey) to January 2011, who smoked cigarettes (including hand-rolled) or any other tobacco product (e.g., pipe or cigar) daily or occasionally at the time of the survey.

All respondents were asked if they were happy to be re-contacted. A follow-up questionnaire was sent to consenting respondents 6 months after baseline. Participants were given £5 ($8) remuneration and one reminder letter was sent. Of the 11,673 smokers at baseline, 2483 (21%) were followed-up 6 months later. This sample of respondents with baseline and follow-up data was used for the analyses in our current study.

2.2. Measurement of motivation to quit at baseline

The MTSS consist of one item and was measured at baseline. Smokers were asked: "Which of the following describes you?". The response categories (and codings) were: (1) "I don't want to stop smoking"; (2) "I think I should stop smoking but don't really want to"; (3) "I want to stop smoking but haven't thought about when"; (4) "I REALLY want to stop smoking but I don't know when I will"; (5) "I want to stop smoking and hope to soon"; (6) "I REALLY want to stop smoking and intend to in the next 3 months"; (7) "I REALLY want to stop smoking and intend to in the next month". The ordering reflects: 1, absence of any belief, desire or intention; 2, belief only; 3, moderate desire but no intention; 4, strong desire but no intention; 5, moderate desire and intention; 6, strong desire and medium-term intention; and 7, strong desire and short-term intention. The MTSS also has "Don't know" as a response category, but this was used by only 0.5% of smokers at baseline and these participants were counted as missing from the analysis.

2.3. Measurement of quit attempts between baseline and 6-month follow-up

Respondents to the 6-month follow-up were asked: "Have you made a serious attempt to stop smoking in the past 12 months? By serious attempt I mean you decided that you would try to make sure you never smoked another cigarette? Please include any attempt that you are currently making." Participants who responded "yes" were then asked how long ago the three most recent quit attempts started. If a participant reported to have made at least one quit attempt in the previous week or up to 6 months ago, the primary outcome variable was coded 1, and otherwise 0.

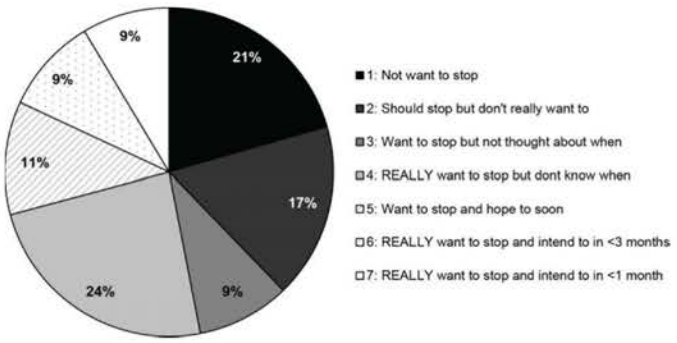

Fig. 1. Distribution of scores on the MTSS at baseline ($N = 2483$).

2.4. Other measurements

Respondents provided data at baseline on age, sex, and social grade (AB = managerial and professional occupations, C1 = intermediate occupations, C2 = small employers and own account workers, D = lower supervisory and technical occupations, and E = semi-routine and routine occupations, never workers, and long-term unemployed).

We used two measures of cigarette dependence. The commonly used Heaviness of Smoking Index (HSI) combines two items, time to first cigarette of the day and cigarettes per day, into a sum score ranging from 0 (lowest) to 6 (highest level of dependence; Kozlowski et al., 1994). Strengths of urges to smoke was measured by asking "In general, how strong have the urges to smoke been?" slight (1), moderate (2), strong (3), very strong (4), extremely strong (5). This question was coded "0" for smokers who responded "not at all" to a previous question asking "How much of the time have you felt the urge to smoke in the past 24 h?". Strengths of urges to smoke has been shown to be a stronger predictor of successful quitting than HSI (Fidler et al., 2011b).

2.5. Data analyses

We compared those followed up with those not-followed up on key baseline variables to establish representativeness of the follow-up sample using t-tests and Chi-squared tests as appropriate.

We assessed the predictive validity of the motivation measure in two main ways. First, we assessed the association between levels of motivation and quit attempts with a χ^2-test for a linear-by-linear association. Then, we regressed quit attempts between baseline and 6-month follow-up (outcome) on to baseline motivation to quit (predictor) using simple logistic regression and in multiple logistic regression after adjusting for the following covariates measured at baseline: age, sex, social grade, HSI, cigarettes smoked per day, and wave of the survey.

Furthermore, we calculated the measure's receiver operating characteristic (ROC) curve, which is a standard way of assessing the accuracy of a diagnostic test (Mandrekar, 2010). The ROC curve is a graphical presentation of the accuracy of a measure in which the sensitivity of the measure (i.e., the true positive rate) is plotted against the 1-specificity (i.e., the false positive rate). The area under the ROC curve (ROC_{AUC}) has a value from 0.5 (chance level only) to 1 (perfect discrimination).

We also assessed the divergent validity of the motivation measure by calculating and comparing the ROC_{AUCs} for the two measures of cigarette dependence. The divergent validity can be used to investigate the construct validity in the absence of a different measure of the same underlying construct (i.e., motivation to quit smoking). Our a priori hypothesis was that, in contrast to motivation to quit, HSI and strength of urges to smoke are not accurate in discriminating whether or not smokers make an attempt to quit in the future, but rather predict success of quit attempts (Fidler and West, 2011).

Finally, we performed a sensitivity analysis of data from respondents who provided data at 3 months after baseline in order to assess whether recall bias might have influenced the predictive validity of the MTSS. The sample size for this analysis was lower because the 3-month follow-up was only included for some waves of the study.

3. Results

The sample followed up 6 months after baseline ($N = 2483$) differed only slightly from those not followed up ($N = 9180$) in being more likely to be female and older, to have slightly higher strengths of urges to smoke, HSI score and daily cigarette consumption, and being less motivated to stop (Table 1). Although small, all the differences were statistically significant.

Table 1
Baseline characteristics of participants who were followed up compared to those not followed up.

	Followed up (N = 2483)	Not followed up (N = 9180)	P
Female sex	55.8 (1385)	48.4 (4440)	<0.001
Age, mean (SD)	47.4 (15.6)	41.0 (16.7)	<0.001
Social grade:			
AB	11.6 (288)	10.5 (968)	0.104
C1	21.3 (528)	22.6 (2078)	
C2	22.1 (549)	21.5 (1976)	
D	17.1 (425)	18.6 (1706)	
E	27.9 (693)	26.6 (2452)	
Heaviness of Smoking Index, mean (SD)	2.3 (1.6)	2.1 (1.6)	<0.001
Strengths of urges to smoke, mean (SD)	2.1 (1.1)	2.0 (1.1)	<0.001
Cigarettes smoked per day, mean (SD)	14.3 (8.9)	13.0 (8.6)	<0.001
Level of motivation:			
1: "I don't want to stop smoking"	20.7 (513)	19.9 (1813)	<0.001
2: "I think I should stop smoking but don't really want to"	17.1 (424)	12.6 (1154)	
3: "I want to stop smoking but haven't thought about when"	9.2 (228)	9.9 (908)	
4: "I REALLY want to stop smoking but I don't know when I will"	23.8 (591)	23.4 (2134)	
5: "I want to stop smoking and hope soon"	11.3 (280)	12.6 (1149)	
6: "I REALLY want to stop smoking and intend to in the next 3 months"	9.3 (232)	11.2 (1021)	
7: "I REALLY want to stop smoking and intend to in the next month"	8.7 (215)	10.4 (950)	

Data are presented as percentage (number), unless otherwise stated.

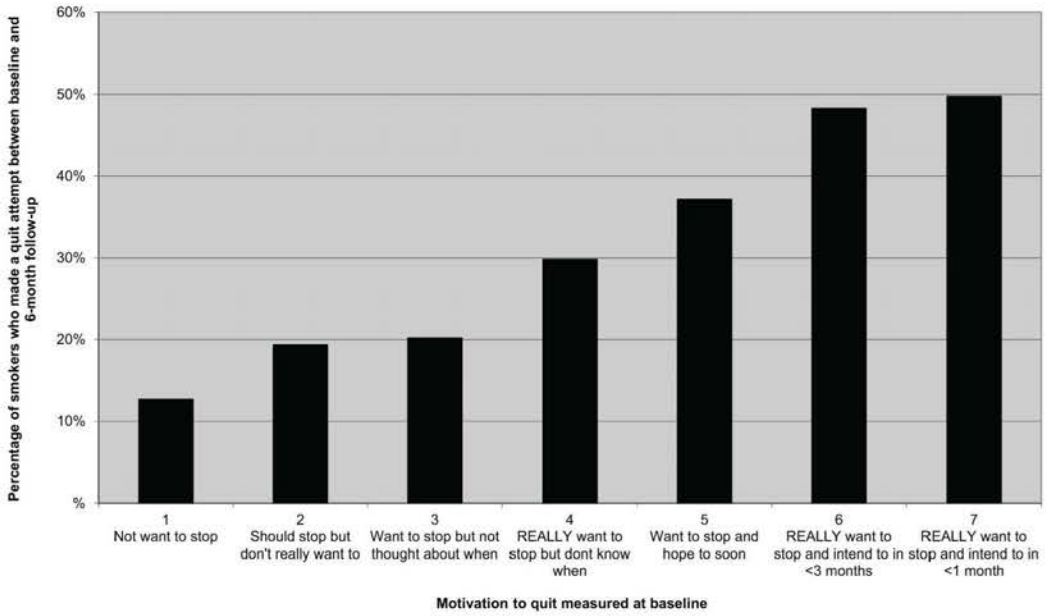

Fig. 2. Percentage of smokers who made a quit attempt between baseline and 6-month follow-up, stratified by their baseline MTSS score (N = 2483).

Fig. 1 shows the distribution of scores on the MTSS at baseline in the follow-up sample (N = 2483). The two most frequently stated levels of motivation were level 1: "I don't want to stop smoking" (20.7%) and level 4: "I REALLY want to stop smoking but I don't know when I will" (23.8%). Eighteen percent of smokers (N = 447) scored the two highest levels of motivation: "I REALLY want to stop smoking and intend to in the next 3 months" or "...in the next month" (95% CI = 16.5–19.5%).

A total of 692 smokers (27.9% (95% CI = 26.1–29.6)) made an attempt to quit smoking between baseline and 6-month follow-up. Fig. 2 presents the percentage of smokers attempting to quit stratified by their baseline MTSS score. The figure shows a linear increase in the percentage making quit attempts with increasing level of motivation (χ^2 = 193.408, df = 6, p < 0.001 for a linear-by-linear association). Of the 447 smokers who scored the two highest levels of motivation, 219 made an attempt to quit (positive predictive value = 49%).

The odds of making a quit attempt between baseline and 6-month follow-up according to the MTSS score are presented in Table 2. Smokers with the highest score had 6.8 times the odds of making a quit attempt (95% CI = 4.7–9.9) than smokers with the lowest score. The odds ratios were similar after adjusting for age, sex, social grade, strengths of urges to smoke, HSI, cigarettes smoked per day at baseline, and wave of the survey (Table 2).

Fig. 3 shows the ROC curve for our measure of motivation. The ROC_{AUC} was 0.67 (95% CI = 0.65–0.70). The ROC_{AUCs} of the two variables used to assess the divergent validity were 0.47 (95% CI = 0.45–0.50) for HSI and 0.53 (95% CI = 0.50–0.55) for strengths of urges to smoke (Supplementary Fig. E1).[1]

A total of 1842 respondents were included in the sensitivity analysis, of which 388 (21.3%, 95% CI = 19.4–23.3) made an attempt to quit smoking between baseline and 3-month follow-up. The odds of making a quit attempt over that period according to the MTSS score differed from the odds over the period between

[1] Supplementary material can be found by accessing the online version of this paper. Please see Appendix A for more information.

Table 2
Odds ratio (OR) and adjusted odds ratio (aOR[a]) of making a quit attempt between baseline and 6-month follow-up (any versus none) for the various levels of motivation at baseline.

Levels of motivation at baseline	Quit attempt (*N*)		OR	95% CI for OR		aOR[a]	95% CI for aOR	
	No	Yes		Lower	Upper		Lower	Upper
1: "I don't want to stop smoking" (reference)	448	65	1.0			1.0		
2: "I think I should stop smoking but don't really want to"	342	82	1.65	1.16	2.36	1.70	1.19	2.44
3: "I want to stop smoking but haven't thought about when"	182	46	1.74	1.15	2.63	1.75	1.14	2.69
4: "I REALLY want to stop smoking but I don't know when I will"	415	176	2.92	2.14	4.00	2.96	2.14	4.09
5: "I want to stop smoking and hope soon"	176	104	4.07	2.85	5.81	4.20	2.90	6.08
6: "I REALLY want to stop smoking and intend to in the next 3 months"	120	112	6.43	4.46	9.28	6.30	4.31	9.22
7: "I REALLY want to stop smoking and intend to in the next month"	108	107	6.83	4.70	9.92	7.16	4.87	10.53

N = 2483 for the OR and *N* = 2465 for the aOR.
[a] OR adjusted for age, sex, social grade, strengths of urges to smoke, HSI, cigarettes smoked per day at baseline, and wave of the survey.

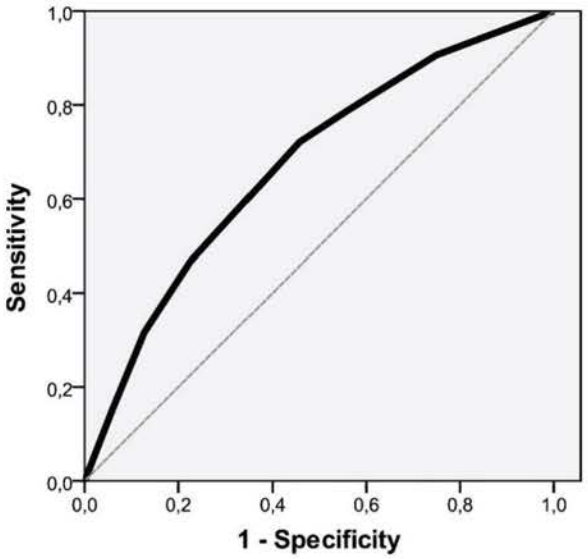

Fig. 3. Receiver operating characteristic (ROC) curve showing the accuracy of the MTSS in predicting quit attempts between baseline and 6-month follow-up (*N* = 2483). Area under the ROC curve = 0.67 (95% CI = 0.65–0.70).

baseline and 6-month follow-up, particularly for the highest MTSS score (Supplementary Table E1)[1]. Smokers with the highest score had 9.2 times the odds of making a quit attempt within the next 3 months (95% CI = 5.62–15.08). The accuracy of the MTSS in predicting quit attempts between baseline and 3-month follow-up was only slightly higher than in the main analysis of the 6-month follow-up: ROC_{AUC} = 0.69 (95% CI = 0.66–0.72; Supplementary Fig. E2).[2]

4. Discussion

We used data from a large English household survey to assess the validity of a single-item rating of motivation to quit smoking: the Motivation To Stop Smoking (MTSS) scale. The scale effectively combines both current desire and intention to stop smoking – two key components of motivation (Smit et al., 2011) – into one single response scale, ranging from 1 (lowest) to 7 (highest level of motivation to stop smoking). Scores on the MTSS predicted quit attempts in the following 6 months in a linear fashion. The degree of association was good, with those at the top of the scale having 6.8 times the odds of trying to stop than those at the bottom, as was the degree of accuracy.

The accuracy of our measure of motivation in discriminating between smokers who quit and who did not quit during follow up was 0.67, which is considered to be broadly acceptable (Hosmer and Lemeshow, 2000). In the tobacco research literature, the reporting of psychometric indicators (sensitivity, specificity, ROC_{AUCs}) for predictors of behavioral change from prospective research is scarce. A study conducted in the 1990s compared the validity of the Stage of Change Model with a prediction equation that combined *four* smoking- and quitting-related variables in predicting long-term cessation and reported ROC_{AUCs} of 0.55 and 0.69, respectively (Farkas et al., 1996). An internet survey conducted in the 2000s assessed the validity of two measures of dependence in predicting short-term cessation and reported ROC_{AUCs} that were either not significant or very marginal (0.55; Etter, 2005). In a similar but more recent study, the same research group reported ROC_{AUCs} between 0.67 and 0.76 for the same two measures of dependence in predicting abstinence at 8-day follow-up but again marginal ROC_{AUCs} for the 31-day follow-up (0.51–0.58; Courvoisier and Etter, 2010). We could not find literature on ROC_{AUCs} for predictors of quit attempts.

It should be noted that we conducted our analysis on all respondents who were smokers at the time of our survey, but that these respondents comprise a heterogeneous group in terms of personal and smoking characteristics. For example, it has been shown that low level smokers are more motivated to quit than moderate-to-heavy smokers (Kotz et al., 2012). Other factors have been shown to be associated with motivation to quit as well, including age, nicotine dependence and previous quit attempts (Marques-Vidal et al., 2011). However, our aim was to evaluate the predictive validity of the MTSS across all subgroups of smokers to maximize generalizability and usability of the scale.

An additional point of interest is the significant minority of smokers who made a quit attempt soon after reporting no intention, desire or belief that one should stop smoking (i.e., smokers with the lowest score on the MTSS). At the 3-month follow-up 8% of these "unmotivated" smokers had made an attempt to quit, while at the 6-month follow-up the percentage had risen to 13%. These magnitudes are not trivial and provide yet more evidence that behavior is relatively unstable and likely to result from the interplay between multiple motivational influences on a moment-to-moment basis (West, 2009). Similarly, it suggests that clinicians should not stop offering support to smokers even if they have recently reported that they do not want to quit (Aveyard et al., 2012).

The main limitation of this study was the low response rate to the follow-up measurement; only 21% of smokers at baseline responded to the 6-month questionnaire. However, the sample was one of the largest general adult population samples with long-term follow-up data, and we have found that those followed up showed only small differences in key variables relating to smoking and smoking cessation (Fidler et al., 2011a). Respondents to the follow-up survey reported at baseline slightly lower motivation to quit, smoked more cigarettes per day, and had higher levels of nicotine

[2] Supplementary material can be found by accessing the online version of this paper. Please see Appendix A for more information.

addiction. Therefore, the strength of the association between motivation and quit attempts may have been slightly underestimated, although the bias is likely to be small. A second limitation is reliance on retrospective self-report of quit attempts up to six months ago and the fact that failed quit attempts tend to be forgotten (Berg et al., 2010). Again this would lead to an underestimation of the association with motivation. Such recall bias appeared to have only a small influence because the ROC_{AUC} was only marginally higher for the 3-month than for the 6-month follow-up period. Thirdly, we were not able to assess the convergent validity of the MTSS because the survey did not include other measures of motivation to stop. Instead, we assessed the divergent validity by comparing the MTSS with two measures of cigarette dependence. In contrast to the MTSS, those measures were inaccurate in predicting attempts to quit.

Having a single-item measure of motivation to stop smoking that combines key motivational constructs and shows a strong ordinal association with subsequent quitting provides a valuable, cost-efficient, quantitative tool for population surveys and studies assessing the impact of interventions aimed at increasing motivation to stop smoking. Further research should first of all assess the external validity of this measure in different smoking populations and examine whether other measures of motivation to quit may improve it.

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Contributors

Robert West designed the Smoking Toolkit Study. Daniel Kotz analysed the data for this manuscript. Daniel Kotz wrote the first draft of the manuscript and all authors contributed to the writing of subsequent versions and approved the final version.

Conflict of interest

Robert West undertakes research and consultancy for, and has received travel expenses and hospitality from, companies that develop and market smoking cessation medications. He has a share on a patent for a novel nicotine delivery device. Daniel Kotz and Jamie Brown have no conflict of interest to declare.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.drugalcdep.2012.07.012.

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