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The predictive utility of micro indicators of concern about smoking: Findings from the International Tobacco Control 4-country study

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Abstract

This study explored the association between six “micro indicators” of concern about smoking (1. stubbing out cigarettes before finishing; 2. forgoing cigarettes due to packet warning labels; thinking about... 3. the harms to oneself of smoking; 4. the harms to others of one’s smoking; 5. the bad conduct of tobacco companies; and 6. money spent on cigarettes) and cessation outcomes (making quit attempts, and achieving at least six months of sustained abstinence) among adult smokers from Australia, Canada, the United Kingdom, and the United States of America. Participants were 12049 individuals from five survey waves of the International Tobacco Control Four Country Survey (interviewed between 2002 and 2006, and followed-up approximately one

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Conflict of Interest

All authors declare they have no conflicts of interest.

Contributors

T.R.P. conducted literature reviews, statistical analyses, and wrote the first draft of the manuscript. R.B. designed the study, provided interpretations of the data, and contributed substantially to drafting the manuscript. J.F.T. was involved in statistical analysis and contributed to interpreting the data. L.L. was involved in study design, and contributed to drafting the manuscript and interpreting findings. H-H.Y contributed to study design, statistical analysis, interpretation of findings and drafting the manuscript. R.J.O. contributed to drafting the manuscript and interpreting findings. M.S. contributed to the conceptualization and drafting of the manuscript and measurement of variables. All authors contributed to and have approved the final version of the manuscript.

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year later). Generalized estimating equation logistic regression analysis was used, enabling us to control for within-participant correlations due to possible multiple responses by the same individual over different survey waves. The frequency of micro indicators predicted making quit attempts, with premature stubbing out, forgoing, and thinking about the harms to oneself of smoking being particularly strong predictors. An interaction effect with expressed intention to quit was observed, such that stubbing out and thinking about the harms to oneself predicted quit attempts more strongly among smokers with no expressed plans to quit. In contrast, there was a negative association between some micro indicators and sustained abstinence, with more frequent stubbing out, forgoing, and thinking about money spent on cigarettes associated with a reduced likelihood of subsequently achieving sustained abstinence. In countries with long-established tobacco control programs, micro indicators index both high motivation by smokers to do something about their smoking at least partly independent of espoused intention and, especially those indicators not part of a direct pathway to quitting, reduced capacity to quit successfully.

Keywords

tobacco; prospective study; smoking cessation; relapse; maintenance

1 Introduction

Tobacco use is a chronic, relapsing behavior (Fiore, Jaen, Baker et al., 2008), as most smokers want to quit and make a number of attempts to quit over a period of years (CDC, 2011; Borland, Partos, Yong, Cummings, & Hyland, 2012). This suggests sustained negative attitudes to smoking. Expressed motivation and attitudes to smoking predict making quit attempts (Borland, Yong, Balmford, Cooper, Cummings et al., 2010; Hyland, Borland, Li, Yong, McNeill et al., 2006; Zhou, Nonnemaker, Sherrill, Gilseman, Coste et al., 2009). This research is grounded in cognitive theories of behaviour change, whereby intentions predict the “actions” that may ultimately lead to the maintenance of healthy behavior, and the desire to quit translates into intentions, which lead to quit attempts or other activities related to the desired behaviour change (Vangeli, Stapleton, Smit, Borland, & West, 2011). However, negative attitudes only appear to translate into attempts to quit from time to time, with smokers on average making only around two attempts to quit each year, only one of which lasts a day or more (Borland, Partos, Yong, Cummings, & Hyland, 2012).

The challenge of smoking cessation is to persist in a task in the face of ongoing contingencies which create strong impulses to smoke. Understanding this challenge requires a reconceptualization of decisional balance away from a simple balancing of the pros and cons of acting (Janis & Mann, 1977), to one between rational, executive preferences and the operational contingencies of the moment (Borland, 2014). The likelihood of making a quit attempt in any given period is theorised to be related to the frequency with which reasons for quitting are made salient, and the capacity for sustained executive control when the thought of quitting is activated; that is, not too many competing demands (Borland, 2014). Measures of attitude accessibility have been shown to predict behaviour over and above the valence of the attitude (Fazio & Olson, 2003; Fazio, Sanbonmatsu, Powell et al., 1986). Thus someone convinced that they should quit, but who never thought about it may be less likely to try to

quit than someone initially less certain, but who thinks about it a lot. Frequently worrying about the health consequences of smoking can increase a smoker's motivation to quit (Magnan, Koblitz, Zielke, & McCaul, 2009; McCaul, Hockemeyer, Johnson, Zetocho, Quinlan et al., 2006; McCaul, Mullens, Romanek, Erickson, & Gatheridge, 2007; Costello, Logel, Fong, Zanna & McDonald, 2012) or make the idea of quitting more salient, and be associated with increased quit attempts (Borland, Yong, Balmford, Cooper, Cummings et al., 2010).

Smokers also take actions from time to time that fall short of initiating a full attempt to quit such as forgoing cigarettes and premature stubbing out of cigarettes in response to thoughts about the harms (Borland, 1997). Originally, these micro-behaviours were conceptualised as partial initiations of action, in a context where the smoker was unready to transform this into a full-blooded attempt, but which may contribute to them learning strategies that ultimately help them successfully quit (Borland, 1997). We refer to the occurrence of thoughts and behavioural responses collectively as *micro indicators* of concern about smoking, as they are situation-based consequences of underlying beliefs, but are not inevitable consequences of holding the beliefs. Micro indicators can be elicited by either contextual factors or active executive consideration of the issue. A tendency for them to occur concurrent with the act of smoking, or when tempted to smoke, may indicate a greater readiness to resist smoking, and thus to make a quit attempt.

Micro indicators have been shown to increase in frequency following population level anti-smoking interventions such as warning labels on cigarette packets (Borland, 1997; Borland, Wilson, et al., 2009) and advertising campaigns (Borland & Balmford, 2003; Trotter, 1998). The behavioural microindicators forgoing a cigarette and prematurely stubbing one out, have both been shown to predict subsequent quit attempts (Borland, 1997; Borland et al., 2009; 2010). Greater frequency of prematurely stubbing out cigarettes has also been found to be strongly associated with failure among those trying to quit (Borland, Yong, Balmford, Cooper, Cummings et al., 2010). A similar paradoxical relationship has also been observed among smokers with a history of more frequent and/ or more recent quit attempts being more likely to make further attempts, but being less likely to maintain abstinence when they tried (Partos, Borland, Yong, Hyland, & Cummings, 2013). These findings have been theorised to possibly mean that the occurrence of micro indicators, at least after an initial quit attempt, might indicate a high desire to quit, but a lack of ability to sustain the effort; that is, anybody who really wanted to quit and who tries multiple times, is manifestly demonstrating a lack of ability to sustain their intention (Borland et al, 2010). Rather than these activities representing preliminary steps, those microindicators that are not part of a necessary path to making attempts (i.e., other than thinking about the harms), may be more displacement activities taken as a means of doing something in the face of the task of quitting being seen as beyond them. Thus such measures may be able to be used to identify smokers who will find it more difficult to quit and may be in need of extra cessation assistance. The aim of this study is to better understand how micro indicators relate to cessation outcomes and whether the cognitive and behavioural indicators have different relationships. We are also interested in whether the relationships between micro indicators and quitting are independent of an expressed desire to quit, in particular whether they can

predict cessation outcomes among smokers with no immediate plans to quit. This latter group is of considerable interest as they are routinely excluded from many studies of cessation outcomes.

2 Methods

2.1 Participants

Participants were adult smokers from the International Tobacco Control (ITC) 4-country (Australia, Canada, the UK and USA) study, recruited using stratified random sampling and computer-assisted telephone interviewing. The ITC aims to then follow-up participants annually, regardless of whether they have quit or are still smoking, and the numbers lost to attrition are replenished at each follow-up with new smokers from the same sampling frame. Further information on ITC survey methodology, including the derivation of basic demographic variables, has been published elsewhere (Borland, Partos, Yong, Cummings, & Hyland, 2012). The present analyses focus on the first 6 waves of the study (occurring approximately yearly between 2002 and 2007) as questions relating to the micro indicators were not consistently included in later waves.

We investigated the role of micro indicators at one wave (the baseline wave) on participants' cessation outcomes at the subsequent wave (the follow-up wave). Participants were eligible if they were smoking at least monthly at the baseline wave (17862 potential participants), and were retained in the study for at least one follow-up wave (30.6% were excluded for being lost to follow-up), and also provided valid data on all the baseline variables of interest (2.9% were excluded for missing data). This resulted in a final sample of 12049 individuals providing 25978 observations across 5 baseline-to-follow-up wave pairs (44.4% contributed data to only one, 22.0% to two, 14.8% to three, 8.5% to four, and 9.4% to all 5 wave pairs). It should be noted that participants who contributed data to multiple wave pairs were necessarily still smoking at the multiple baseline waves, thus those quit at any follow-up wave were unable to provide data on predictors at that wave, but could again on subsequent waves if they relapsed back to smoking.

2.2 Measures

2.2.1 Micro indicators of concern about smoking (measured at baseline)—We assessed 6 micro indicators relating to concern about smoking. All pertained to the 1 month period preceding each baseline survey. Two of the micro indicators were behaviours, scored on a 4-point scale (*1-never, 2-once, 3-a few times, or 4-lots of times*): 1) have you stubbed/butted out a cigarette before you finished it because you thought about the harm of smoking; and 2) have the pack warning labels stopped you from having a cigarette when you were about to smoke one? Due to low prevalence in some categories, stubbing out was recoded to *never, once/ a few times, and lots of times*, and forgoing was recoded to *never* versus *at least once* for most analyses. The remaining four micro indicators concerned the frequency of thoughts, scored on a 5-point scale (*1-never, 2-rarely, 3-sometimes, 4-often, or 5-very often*): *How often did you think about... 1) the harm your smoking might be doing to you; 2) the harm your smoking might be doing to others; 3) the bad conduct of tobacco companies; and*

4) *the money you spend on smoking*. Exploratory factor analyses showed that the items did not form a single underlying construct, so they are treated individually in all analyses.

2.2.2 Control variables (measured at baseline)—We included one measure of expressed intention to quit (1-not planning to quit, and planning: 2-sometime in the future beyond 6 months, 3-within the next 6 months, 4-within the next month, and 5-*within the next month with a firm date set*).

The Heaviness of Smoking Index (HSI) score was included as an indicator of nicotine addiction, ranging from 0 (least addicted) to 6 (most addicted). It is derived from the number of cigarettes smoked per day and the number of minutes after waking before smoking the first cigarette of the day (Heatherton, Kozlowski, Frecker, Rickert, & Robinson, 1989).

We controlled for participants' country of residence, age group (*18 – 24 years, 25 – 39 years, 40 – 54 years, or 55 years and over*), sex, highest level of education attained (*low, moderate, or high*), annual household income bracket (*low, moderate, high, or not disclosed*); ethnic minority status (*non-minority or minority group*), and marital status (*married, separated, divorced, widowed, commonlaw/ defacto, or single*). Education and income were adjusted according to the norms within each country.

The remaining control variables were participants' time in the ITC sample (number of waves participated in), the length of the interval (in months) between an individual's baseline and follow-up surveys, and dummy variables for year to account for changes over time.

2.2.3 Outcome variables (measured at follow-up)—There were two outcome measures of interest. First, whether participants had made any quit attempts between the baseline and follow-up wave, determined by asking Have you made any attempts to stop smoking since we last talked with you, that is, since [baseline survey date]?. Second, among those who had tried, whether they had achieved sustained abstinence for at least 6 months on any attempt that started between the baseline and corresponding follow-up surveys, determined by asking What is the longest time that you stayed smoke-free since [baseline survey date]? Regardless of whether they had relapsed back to smoking by the corresponding follow-up survey, anyone who reported a period of 6 months or longer met this criterion. For those who were currently quit, but reported being quit for less than 6 months, we used the next wave of data collection to determine their subsequent length of abstinence, where possible. If not, they were excluded from analyses relating to sustained abstinence (3.3% of otherwise eligible individuals were excluded from this analysis for this reason).

2.3 Analyses—For exploring the consistency of the micro indicators over time, we conducted one-way analyses of variance (ANOVAs) of the mean micro indicator score with the baseline survey wave as the factor variable. We followed up any significant results with a test of a linear contrast for survey wave, as a linear trend would be the most likely to indicate a consistent effect of time.¹

Generalized estimating equations (GEE) logistic regressions with unstructured correlation matrices were used for the main analyses. GEE was ideal for our data because we had a combination of participants who were present in multiple consecutive baseline-follow-up wave-pairs, and participants who were present in only one wave-pair or multiple but non-consecutive wave-pairs. Traditional repeated-measures analyses would have restricted our sample to only those participants present in all five wave-pairs, whereas separate analyses at each wave-pair would have reduced the power afforded by a larger sample. GEE enables the estimation of relationships between variables across repeated observations (in this case the multiple baseline-follow-up wave-pairs), while taking into consideration both those who were present at all or only some observation points. GEE thereby maximizes the number of cases to increase power, while controlling for any within-participant correlations where the same individual contributed data at multiple observation points. For both of our outcome measures, we first investigated the relationship between each individual micro indicator and the outcome, and then we entered all the micro indicators concurrently into one model, to determine the best predictors. All analyses were adjusted for the control variables (except expressed intention to quit) reported in section 2.2.2. The concurrent analyses also controlled for expressed intention to quit.

We also explored the interaction between the micro indicators and expressed intention to quit. For ease of interpretation, we recoded all micro indicators to a binary format (*never* versus *at least once* for the behavioural indicators, and *never, rarely or sometimes* versus *often or very often* for the cognitive indicators). Intention to quit was recoded to 3 categories: 1-no proximal plans to quit versus 2-beyond 6 months or within 6 months versus 3-within the next month or firm date set in the next month. First we conducted separate GEE logistic regressions of each micro indicator, intention to quit, and their interaction (unadjusted for any other variables), predicting both making quit attempts and achieving sustained abstinence. Where the interaction effects were significant, we conducted follow-up GEE logistic regressions separately for the group with no proximal plans to quit (1) and the group with plans to quit within the next month (3), fully adjusted for all our control variables. For thoughts about costs of smoking, we also looked for interactions with respondent income, as this might only be a factor for poorer smokers.

3 Results

The prevalence of the micro indicators remained fairly stable from wave to wave, as may be seen in Table 1. There was, however, a small but significant trend for thoughts about the harms to oneself of smoking to increase, and for thoughts about the money spent on cigarettes to decrease over time. Intention to quit also fluctuated with time however this trend was not linear. Around 30% of smokers reported stubbing out cigarettes before finishing. Many smokers also often thought about the harms to themselves (over 50%) and

¹It is a limitation that these analyses do not account for correlations in responses from the same individual over multiple waves, however conducting repeated measures ANOVAs was not appropriate as it would only have included those participants who remained smoking for all five wave-pairs or smoking for all five wave-pair – a highly biased group. Similarly, we did not wish to run generalized estimating equations logistic regression analyses (see below) because of the loss in descriptive power due to the requirement for arbitrary dichotomization of the micro indicators as outcomevariables, and these analyses are included for descriptive purposes. This should be kept in mind when interpreting the results, which will slightly overestimate any consistency in the micro indicators over time.

to others (around 40%) from their smoking. The majority of smokers often thought about the money they spent on cigarettes. The correlations between the different micro indicators and between the micro indicators and expressed intention to quit were moderate (see Table 2).

3.1 Micro indicators and making quit attempts

Around 39% of our sample made at least one quit attempt between the baseline and follow-up waves. The results of the individual analyses showed all six micro indicators were positively associated with making quit attempts (see Table 3), even after controlling for expressed intention to quit and HSI. In the concurrent analysis, stubbing out before finishing, forgoing cigarettes due to warning labels, and thinking about the harms of smoking to oneself remained strong independent predictors of making quit attempts. Thinking about the harms to others and the bad conduct of tobacco companies also remained predictive; however their influence was greatly reduced. Even in the individual analyses, the pattern of odds ratios for thinking about the harms to others was not easily interpretable as a linear dose-response relationship, and no single contrast was statistically significant in the concurrent analysis. Thinking about the money spent on cigarettes was no longer significant overall for predicting making quit attempts in the concurrent analysis, although a trend remained. There was no interaction with income. Finally, it is important to note that more proximal plans to quit significantly increased the odds of making a quit attempt in both individual and concurrent analyses.

3.2 Micro indicators and achieving at least 6 months of sustained abstinence

Among participants who had made at least one quit attempt in the interval between baseline and follow-up, 22% achieved at least 6 months of sustained abstinence. As can be seen in Table 4, stubbing out cigarettes before finishing, forgoing cigarettes due to pack warnings, thinking about the harms to self, and thinking about the money spent on cigarettes often or very often were all associated with a reduced likelihood of achieving sustained abstinence. In the concurrent analysis, the effects of stubbing out and thinking about money remained relatively strong, whereas the effect of forgoing was considerably diminished (although it remained statistically significant) and the effect of thinking about the harms to self was no longer statistically significant, and again there was no interaction with respondent income. While expressed intention to quit was also associated with a reduced likelihood of achieving at least 6 months of sustained abstinence overall, having set a firm date to quit within the next month appeared to mitigate this effect.

The micro indicator most strongly associated with a failure to sustain abstinence was premature stubbing out. We conducted additional analyses to explore whether it was associated with unplanned or more numerous attempts among those who tried to quit during the follow-up period. After adjusting for control variables (see section 2.2.2) and all other micro indicators, there was a marginally non-significant trend suggesting that those who prematurely stubbed out lots of times were less likely to subsequently plan their quit attempts than those who never did: $OR = 0.80$, 95% $C.I. = 0.64 - 1.002$, and a strong association between premature stubbing out and making two or more quit attempts rather than just one: for stubbing out once or a few times, $OR = 1.25$, 95% $C.I. = 1.12 - 1.38$, and stubbing out lots of times, $OR = 1.56$, 95% $C.I. = 1.36 - 1.80$.

3.3 Interactions between micro indicators and plans to quit

Between 26.2% and 29.1% of participants reported no proximal plans to quit from wave to wave. Of these, a considerable minority reported thinking often or very often about the harms to themselves (between 25.7% and 30.8%) and to others (between 24.2% and 26.4%) of their smoking, and between 38.0% and 50.3% reported thinking about the money they spend on smoking often or very often. Frequent stubbing out of cigarettes, forgoing due to warning labels, and thinking about the bad conduct of tobacco companies was less prevalent among this group (under 14%).

Only two of the interaction effects between the micro indicators and intention to quit were statistically significant. The first was between stubbing out and intention to quit predicting making quit attempts (interaction $\chi^2(2) = 7.2, p < .05$). Frequency of stubbing out predicted making quit attempts more strongly among the group with no proximal plans to quit versus those planning to quit within the next month. Results of the fully adjusted GEE logistic regression analyses predicting making quit attempts, separately for the group who reported no proximal plans to quit versus those who intended to quit within the next month are presented in Table 5, where the diminished effects of stubbing out for the latter group may be seen. The second significant interaction effect was between thoughts about the harms to oneself of smoking and intention to quit predicting making quit attempts (interaction $\chi^2(2) = 9.0, p < .05$). As with stubbing out, frequent thoughts about the harms to oneself of smoking was much less predictive among smokers who planned to quit within the next month versus those with no proximal plans to quit; indeed it was no longer significant in the fully adjusted model (see Table 5).

4 Discussion

The experience of micro indicators of concern about smoking was quite prevalent among our sample of smokers, especially thoughts about the harm their smoking is doing to them and others, and the money they spend on cigarettes. There were some small time-based trends in levels of micro-indicators, but these did not appear to have interacted with their predictive relationships with quitting.

As expected there was a positive association between more frequent reporting of micro indicators and expressed desire to quit, however the magnitude of this relationship was modest, suggesting a divide between one's expressed desire to quit and their day-to-day thoughts and actions relating to smoking. This was particularly highlighted by the finding that a considerable minority of smokers who reported no plans to quit still reported frequently stubbing out cigarettes before finishing and thinking about the harms of smoking. Given that many smokers tend to underestimate their risk of developing smoking-related illnesses (Peretti-Wadel, Constance, Guilbert, Gautier, Beck et al., 2007), it is encouraging that concern about their smoking is often on their minds.

Most micro indicators were strongly associated with making subsequent quit attempts, even when we controlled for HSI scores and expressed intention to quit. Premature stubbing out of cigarettes, forgoing cigarettes, and thoughts about harms to self were all strong

independent predictors, and thoughts about the bad conduct of tobacco companies had a persistent weak effect.

We found an interactive relationship between intention to quit and both premature stubbing out and thoughts of harms to self on quit attempts. For the group who planned to quit within the next month, the effect on quitting of thoughts of harms to self was eliminated, whereas the effect of premature stubbing out was reduced to just below significance. To understand this pattern of findings, it is necessary to consider the meanings of the two kinds of measures. That these measures are predicting quit attempts over the following year, and the majority of those attempts remembered are reported as having come from a period more than 6 months after being asked, implies that these measures are indicators of underlying processes as well as being measures of recent activity (micro indicators) or thinking (interest/ intention) at the time. Thus, when considering intention to quit over a longer period of around 1 year, it is more useful to think of it as a measure of overall interest in quitting, rather than as a measure of specific intention to quit within that period. Similarly, taken over an extended period, the micro indicators may be thought of as indicators of likely ongoing concern. Although our analysis is traditionally used for moderation effects, conceptually the temporal relationship between our variables indicates a mediation effect. That is, concern about smoking arguably precedes the formation of an interest in quitting. That thoughts about harm to self has its predictive power mediated through interest in quitting, makes sense. Concern, not yet translated into interest in quitting, is likely to be transformed into action if it persists for long enough, thus it adds predictive power when intentions are not (yet) formed. That interest only partly mediates the effect of prematurely stubbing out could be because those stubbing out are slightly more likely to make spontaneous attempts and thus not form intentions well ahead of trying. Taken together, these interaction effects suggest that micro indicators, particularly cognitive ones, contribute to the formulation of stronger intentions to quit, as would be predicted by expectancy-value models of behaviour (Weinstein, Sandman, Blalock, 2008).

In contrast to their positive relationships with making quit attempts, some micro indicators (premature stubbing out, forgoing due to pack warnings, and thinking about the money spent on cigarettes) had negative relationships with sustained abstinence. For premature stubbing out, this finding is consistent with prior research on a part of this sample (Borland et al., 2010). These findings are consistent with our hypothesis (Borland et al., 2010) that at least some microindicators are signalling high motivation to quit in the face of reduced ability. A hypothetical thought process might be: "I know I should, and want to, so at least I can resist momentarily, even if stopping completely is beyond me at this time". Behavioural indicators may be stronger indicators of this internal conflict as they take thought to preliminary action without the commitment to follow through. We do not know whether the factors underlying increased difficulty maintaining abstinence reflects poor quitting strategies, or greater psychological or physiological addiction, but are attempting to differentiate the two in our current work.

The finding that frequency of worries about the money spent on cigarettes was also an independent predictor of failure may indicate that reasons for quitting play a role in likely success. These effects seem to be independent of income. Money concerns may not have the

capacity to sustain action, as after quitting, money is no longer being spent - the benefit has already been gained. Even if the saving is appreciated, it is not contingently linked to smoking cigarettes, so may have little power to help prevent relapse unless the person invokes it at the times when they are experiencing cravings. We need to better understand the dilemma many smokers are facing in repeatedly trying and failing (Borland, Partos, Yong, Cummings, & Hyland, 2012; Partos et al., 2013). Prematurely stubbing out cigarettes is associated with subsequent multiple failed attempts and less clearly related to unplanned attempts. It may be a useful indicator of increased dependence over and above more conventional measures such as HSI.

It is likely that policy interventions in different countries impact on the levels of micro indicators. While our inclusion of country as a control variable addressed this in a broad sense, we acknowledge we have not fully controlled for the possibility, we think it unlikely that these indicators may have impact differently on quitting, at least in the four countries studied. We do have evidence that the negative associations found for maintenance are not observed in China (Li et al, 2014), which is consistent with our argument that the status of these measures as indicators of the difficulty of maintaining abstinence only emerges once smokers have tried and failed multiple times, something that is not the case for most Chinese smokers (Li et al., 2014).

Limitations of the present study need to be considered. As noted earlier, we think much of the effects we found on quitting are a result of what they indicate about more stable states, rather than what they explicitly measure. Studies are required with both short and longer term outcomes to try to separate out these two aspects of the measures more fully. We think it is likely that we would find even stronger relationships if measuring over shorter intervals. We may thus clarify whether some of the marginally significant effects found, particularly for prediction of maintenance, are real or not. Over half our sample comprised individuals who provided data at more than one survey wave. This is both a strength and weakness. Individuals providing multiple sets of data are those who by definition have failed to quit at earlier waves, so our findings may be tilted towards more highly addicted smokers, but as they are the main problem we face, this is not a major drawback. It does, however, mean that caution should be exercised in applying these findings to smokers quitting for the first time, and a related issue is that the balanced panel of participants was not therefore used, so the ideal conditions for our GEE analyses were not met. Unfortunately this was unavoidable for our intended analyses. Finally, the samples come from four high income countries all with quite active tobacco control movements, and although there are marked differences in policies, smokers are well informed about the harms and there is a lot of encouragement to quit. These findings should not be generalised to different cultures, and in particular to countries where more smokers are quitting for the first time, rather than from a long history of failed attempts.

5 Conclusions

Micro indicators of concern about smoking are prevalent, even among smokers with no expressed desire to quit, and indicate future interest in quitting, partly mediated by intentions, where these are present. Micro indicators, particularly prematurely stubbing out

cigarettes, also seem to be measuring a lack of capacity to quit successfully in the context of high concern about smoking. We need to better understand smokers in this situation and find ways to help them in their apparently desperate attempts to free themselves from their addiction. Smokers who report few micro indicators of concern about smoking and no interest in quitting may be a particularly hard group to reach. This subgroup need to be better understood, as the support and encouragement currently being provided is clearly inadequate. Micro-indicators, particularly behavioural ones, should be assessed more commonly in studies of quitting, both in developed and developing countries.

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Ethics clearance

All waves of the study have received ethical approval from the relevant institutional review board or research ethics committee at The Cancer Council Victoria (Australia), Roswell Park Cancer Institute (USA), University of Waterloo (Canada), and University of Strathclyde (UK).

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Highlights

- Micro indicators of concern about smoking prospectively predict making quit attempts.
- This predictive capacity is only partly mediated by intentions.
- Stubbing out cigarettes prematurely indicates increased difficulty quitting at least among smokers with a history of failed attempts.

Table 1

Percentage prevalence of micro indicators among smokers at each wave, and outcome of analyses of variance (ANOVA) for differences in mean micro indicator scores across waves.

Sample size	Wave 1 6368	Wave 2 5177	Wave 3 5110	Wave 4 4615	Wave 5 4708
Stubbing out $F(4, 25973) = 2.33, p = .053$					
Marginal mean (standard error)	1.67 (0.1)	1.64 (0.1)	1.69 (0.1)	1.71 (0.2)	1.68 (0.2)
Never	70%	71%	69%	69%	69%
Once to a few times	21%	22%	22%	22%	22%
Lots of times	9%	8%	9%	10%	9%
Forgoing $F(4, 25973) = 2.5, p = .085$					
Marginal mean (standard error)	1.23 (0.1)	1.25 (0.1)	1.22 (0.1)	1.21 (0.1)	1.23 (0.1)
Never	88%	87%	88%	89%	88%
At least once	12%	13%	12%	11%	12%
Harm to you $F(4, 25973) = 14.1, p < .0001$; $F_{LIN}(1, 25973) = 24.5, p < .0001$					
Marginal mean (standard error)	3.41 (0.2)	3.32 (0.2)	3.43 (0.2)	3.50 (0.2)	3.45 (0.2)
Never	11%	13%	12%	9%	10%
Rarely	13%	14%	12%	12%	11%
Sometimes	22%	22%	21%	21%	23%
Often	31%	32%	34%	34%	35%
Very Often	23%	20%	22%	23%	21%
Harm to others $F(4, 25973) = 1.65, p = 0.16$					
Marginal mean (standard error)	2.95 (0.2)	2.94 (0.2)	2.96 (0.2)	3.00 (0.2)	2.94 (0.2)
Never	18%	20%	19%	18%	20%
Rarely	20%	20%	20%	20%	20%
Sometimes	22%	21%	21%	21%	21%
Often	22%	23%	25%	26%	25%
Very Often	16%	15%	15%	15%	14%
Tobacco companies $F(4, 25973) = 0.82, p = .51$					
Marginal mean (standard error)	2.07 (0.2)	2.06 (0.2)	2.03 (0.2)	2.07 (0.2)	2.07 (0.2)
Never	45%	44%	46%	43%	43%
Rarely	25%	28%	26%	29%	29%
Sometimes	14%	13%	13%	13%	13%
Often	9%	10%	10%	10%	10%
Very Often	6%	6%	6%	6%	5%
Money spent $F(4, 25973) = 19.7, p < .0001$; $F_{LIN}(1, 25973) = 71.1, p < .0001$					
Marginal mean (standard error)	3.76 (0.2)	3.66 (0.2)	3.65 (0.2)	3.60 (0.2)	3.55 (0.2)
Never	9%	10%	10%	11%	11%
Rarely	9%	10%	10%	10%	10%
Sometimes	15%	16%	16%	17%	18%
Often	31%	33%	33%	32%	33%
Very Often	36%	31%	31%	30%	28%

Sample size	Wave 1 6368	Wave 2 5177	Wave 3 5110	Wave 4 4615	Wave 5 4708
Intention to quit $F(4, 25973) = 5.7, p < .0005$; $F_{LIN}(1, 25973) = 0.22, p = .64$					
Marginal mean (<i>standard error</i>)	2.25 (0.1)	2.16 (0.1)	2.18 (0.1)	2.21 (0.2)	2.22 (0.2)
No proximal plans to quit	26%	28%	29%	29%	29%
Beyond 6 months	38%	40%	38%	37%	36%
Within the next 6 months	25%	22%	23%	24%	24%
Within the next month	7%	6%	6%	6%	6%
Firm date set in next month	4%	3%	4%	5%	5%

Note: WL = cigarette packet warning label; F statistic refers to one-way ANOVA of the mean micro indicator score across waves; F_{LIN} statistic refers to the test of a linear trend over waves (only conducted for micro indicators with significant overall ANOVA results).

Table 2

Correlations among micro indicators of concern about smoking and overt interest in quitting (ranges over the 5 baseline waves).

	1. Stub	2. Forgo	3. Harm self	4. Harm others	5. Industry	6. Money	7. Intent
1.	---						
2.	.47 - .55	---					
3.	.45 - .52	.28 - .39	---				
4.	.28 - .35	.27 - .34	.46 - .52	---			
5.	.30 - .38	.34 - .38	.36 - .43	.32 - .38	---		
6.	.25 - .29	.22 - .27	.40 - .46	.33 - .38	.28 - .34	---	
7.	.37 - .42	.24 - .31	.39 - .46	.21 - .25	.20 - .23	.25 - .29	---

Note: Correlations are based on polychoric correlation coefficients. Samples were restricted to smokers with valid data on all control variables and micro indicators who were present in at least two survey waves (wave 1 $n = 6368$; wave 2 $n = 5177$; wave 3 $n = 5110$; wave 4 $n = 4615$; wave 5 $n = 4708$). Stub = stubbing out a cigarette before finishing; Forgo = forgoing a cigarette due to pack warning labels; Harm self = think about harm to you of smoking; Harm others = think about harm to others of your smoking; Industry = think about bad conduct of tobacco companies; Money = think about the money spent on smoking; Intent = intention to quit.

Table 3

Generalized estimating logistic regression results for micro indicators at the baseline wave predicting making quit attempts at the following wave (approximately 1 year later), 25978 observations from 12049 individuals.

		Percentage making quit attempts within each category	Individual analyses		Concurrent analysis	
			OR	95% CI	OR	95% CI
Stubbing out						
Never	32.8%	Ref	p < .00001	Ref	p < .00001	
Once – a few times	50.2%	1.60	1.50 – 1.70	1.20	1.12 – 1.28	
Lots of times	58.5%	2.06	1.88 – 2.26	1.31	1.18 – 1.45	
Forgoing						
Never	36.6%	Ref	p < .00001	Ref	p < .00001	
At least once	55.5%	1.66	0.53 – 1.80	1.27	1.16 – 1.38	
Harm to you						
Never	24.1%	Ref	p < .00001	Ref	p < .00001	
Rarely	27.4%	1.17	1.06 – 1.30	1.09	0.97 – 1.23	
Sometimes	32.0%	1.36	1.24 – 1.50	1.11	0.996 – 1.25	
Often	43.9%	1.98	1.80 – 2.18	1.28	1.15 – 1.44	
Very often	52.0%	2.60	2.35 – 2.87	1.40	1.24 – 1.58	
Harm to others						
Never	33.1%	Ref	p < .00001	Ref	p < .05	
Rarely	35.9%	1.05	0.97 – 1.14	0.91	0.83 – 1.001	
Sometimes	34.7%	1.08	0.999 – 1.17	0.93	0.85 – 1.02	
Often	42.9%	1.38	1.27 – 1.49	1.00	0.91 – 1.09	
Very often	49.4%	1.70	1.56 – 1.86	1.04	0.94 – 1.16	
Tobacco companies						
Never	34.9%	Ref	p < .00001	Ref	p < .01	
Rarely	37.5%	1.07	1.01 – 1.14	0.95	0.89 – 1.02	
Sometimes	40.5%	1.18	1.09 – 1.27	0.99	0.91 – 1.08	
Often	48.9%	1.52	1.39 – 1.66	1.10	1.002 – 1.22	
Very often	54.3%	1.82	1.63 – 2.03	1.16	1.02 – 1.31	
Money spent						
Never	29.4%	Ref	p < .00001	Ref	p = .17	
Rarely	33.5%	1.12	1.01 – 1.25	1.00	0.89 – 1.14	
Sometimes	33.7%	1.19	1.08 – 1.32	1.05	0.93 – 1.18	
Often	39.2%	1.46	1.32 – 1.60	1.06	0.95 – 1.18	
Very often	45.9%	1.81	1.64 – 2.00	1.12	1.003 – 1.26	
Intention to quit						
No proximal plans	18.5%	Ref	p < .00001	Ref	p < .00001	
Beyond 6 months	34.3%	2.04	1.89 – 2.20	1.83	1.69 – 1.97	
Within 6 months	55.8%	4.26	3.92 – 4.62	3.53	3.24 – 3.85	
Within 1 month	71.2%	7.03	6.21 – 7.95	5.72	5.04 – 6.50	

	Percentage making quit attempts within each category	<u>Individual analyses</u>		<u>Concurrent analysis</u>	
		OR	95% CI	OR	95% CI
Firm date in 1 month	73.0%	8.34	7.22 – 9.65	6.62	5.70 – 7.70

Note: all analyses (including the individual analyses) controlled for country of residence, age, sex, highest level of education attained, annual household income, ethnic minority status, marital status, Heaviness of Smoking Index scores, time in sample, year, and inter-wave interval. The concurrent analyses considered all of the micro indicators and intention to quit in one analysis

Table 4

Generalized estimating logistic regression results for micro indicators at the baseline wave predicting achieving at least 6 months of sustained abstinence on attempts starting before the follow-up wave (approximately 1 year later), 9181 observations from 6065 individuals.

		Percentage achieving sustained abstinence within each category	Individual analyses		Concurrent analysis	
			OR	95% CI	OR	95% CI
Stubbing out						
Never	23.7%	Ref	p < .00001	Ref	p < .0001	
Once – a few times	20.4%	0.77	0.68 – 0.86	0.80	0.71 – 0.91	
Lots of times	17.4%	0.68	0.57 – 0.80	0.72	0.60 – 0.85	
Forgoing						
Never	22.6%	Ref	p < .00005	Ref	p < .05	
At least once	18.5%	0.74	0.64 – 0.85	0.83	0.72 – 0.96	
Harm to you						
Never	24.6%	Ref	p < .05	Ref	p = .63	
Rarely	23.6%	0.88	0.69 – 1.12	0.87	0.67 – 1.13	
Sometimes	24.3%	0.90	0.72 – 1.12	0.99	0.79 – 1.24	
Often	21.4%	0.78	0.63 – 0.95	0.91	0.73 – 1.14	
Very often	20.1%	0.78	0.63 – 0.96	0.97	0.77– 1.23	
Harm to others						
Never	23.8%	Ref	p = .09	Ref	p = .65	
Rarely	24.0%	1.04	0.88 – 1.22	1.09	0.92 – 1.30	
Sometimes	22.3%	0.91	0.77 – 1.08	0.96	0.81 – 1.14	
Often	20.9%	0.87	0.75 – 1.02	1.01	0.85 – 1.20	
Very often	19.5%	0.86	0.72 – 1.02	0.99	0.82 – 1.20	
Tobacco companies						
Never	22.5%	Ref	p = .45	Ref	p = .58	
Rarely	22.3%	0.99	0.88 – 1.12	1.05	0.92 – 1.20	
Sometimes	23.1%	1.02	0.88 – 1.19	1.14	0.97 – 1.33	
Often	20.1%	0.87	0.73 – 1.03	1.03	0.86 – 1.24	
Very often	18.8%	0.91	0.75 – 1.12	1.10	0.88 – 1.36	
Money spent						
Never	31.0%	Ref	p < .00005	Ref	p < .01	
Rarely	30.2%	0.99	0.79 – 1.24	1.02	0.81 – 1.29	
Sometimes	24.6%	0.81	0.66 – 1.01	0.84	0.68 – 1.05	
Often	20.4%	0.72	0.60 – 0.87	0.78	0.64 – 0.95	
Very often	18.6%	0.69	0.57 – 0.84	0.76	0.62 – 0.93	
Intention to quit						
No proximal plans	26.1%	Ref	p < .001	Ref	p < .005	
Beyond 6 months	20.8%	0.80	0.69 – 0.94	0.87	0.74 – 1.02	
Within 6 months	20.8%	0.78	0.66 – 0.91	0.89	0.76 – 1.05	

		Percentage achieving sustained abstinence within each category		<u>Individual analyses</u>		<u>Concurrent analysis</u>	
				OR	95% CI	OR	95% CI
Within 1 month	21.2%			0.79	0.65 – 0.96	0.92	0.75 – 1.13
Firm date in 1 month	25.7%			1.04	0.85 – 1.29	1.23	0.99 – 1.53

Note: all analyses (including the individual analyses) controlled for country of residence, age, sex, highest level of education attained, annual household income, ethnic minority status, marital status, Heaviness of Smoking Index scores, time in sample, year, and inter-wave interval. The concurrent analyses considered all of the micro indicators and intention to quit in one analysis

Table 5

Generalized estimating logistic regression results for stubbing out and thoughts about the harms to you of smoking at the baseline wave predicting making quit attempts at the following wave (approximately 1 year later), separately for those with no proximal plans to quit (7312 observations from 4196 individuals) and those planning to quit in the next month (2684 observations from 2172 individuals).

	<u>No proximal plans to quit</u>		<u>Planning to quit within 1 month</u>	
	OR	95% CI	OR	95% CI
Stubbing out				
Never	Ref	p < .0005	Ref	p < .05
Once – a few times	1.59	1.32 – 1.92	1.25	1.02 – 1.54
Lots of times	1.79	1.31 – 2.46	1.32	1.02 – 1.70
Harm to you				
Never	Ref	p < .001	Ref	p = .77
Rarely	1.18	0.95 – 1.43	1.03	0.61 – 1.75
Sometimes	1.21	1.003 – 1.47	1.01	0.63 – 1.61
Often	1.49	1.21 – 1.83	0.87	0.57 – 1.33
Very often	1.61	1.24 – 2.07	0.97	0.63 – 1.52

Note: all analyses controlled for country of residence, age, sex, highest level of education attained, annual household income, ethnic minority status, marital status, Heaviness of Smoking Index scores, time in sample, year, inter-wave interval, and all other micro indicators.