RESEARCH ARTICLE

Testing the Transtheoretical Model in Predicting Smoking Relapse among Malaysian Adult Smokers Receiving Assistance in Quitting

Siti Munira Yasin[1]*, Masilamani Retneswari[2], Foong Ming Moy[3], Khairul Mizan Taib[4], Marzuki Isahak[2], David Koh[5]

Abstract

The role of The Transtheoretical Model (TTM) in predicting relapse is limited. We aimed to assess whether this model can be utilised to predict relapse during the action stage. The participants included 120 smokers who had abstained from smoking for at least 24 hours following two Malaysian universities' smoking cessation programme. The smokers who relapsed perceived significantly greater advantages related to smoking and increasing doubt in their ability to quit. In contrast, former smokers with greater self-liberation and determination to abstain were less likely to relapse. The findings suggest that TTM can be used to predict relapse among quitting smokers.

Keywords: Model - smoking - male - cessation - nicotine dependence

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Introduction

Smoking cessation is a complex process, often involving a number of unsuccessful attempts prior to achievement of long-term abstinence. Approximately 75-80% of smokers who attempt to quit relapse within the first six months (USDHHS, 1990). Initiating and maintaining abstinence could be considered two separate components of the quitting process (McEwen et al., 2001; Hyland et al., 2006). Various physiological, biological and cognitive factors determine whether a smoker is able to maintain abstinence (Piasecki, 2006).

The Transtheoretical Model (TTM) is a behavioural change process that has been validated and popularised by Prochaska and colleagues (Prochaska and DiClemente, 1983; Fava et al., 1995; Norman et al., 1998; Velicer et al., 1999). Although it has existed over 20 years ago, it is still famously applied in many smoking cessation behavioural research (Paiva et al., 2012; Campbell et al., 2013; Huang et al., 2013). This model includes five stages of change through which a smoker progresses during the quitting process: pre-contemplation, contemplation, preparation, action and maintenance.

Ten processes of change take place during progression across the stages. These 10 processes are further divided into two categories: experiential (dramatic relief, consciousness raising, social liberation, environmental re-evaluation and self re-evaluation) and behavioural (stimulus control, helping relationships, self-liberation and counter conditioning) processes (Prochaska et al., 1988). Another measure adding explanatory power to the model is decisional balance. Decisional balance consists of two terms that represent a second set of constructs that examines an individual weighing the pros and cons of making a change (Janis and Mann, 1977). This concept originally came from the Janis and Mann model, which included four categories each of pros and cons. Here, in the TTM, the eight categories have been simplified into two: the pros and cons of making a change (Velicer et al., 1985). Prochaska and colleagues (1994) proposed that when a person progresses from precontemplation to contemplation, the pros must increase; to progress from contemplation to action, the cons must decrease.

The last construct in TTM is self-efficacy (Velicer et al., 1990). Self-efficacy conceptualises the perceived capability of an individual to perform a certain task as a mediator of their performance on future tasks. Any change in the level of self-efficacy can lead to a lasting change in behaviour if appropriate incentives and skills are provided. This includes two components: confidence and temptation. Confidence is what an individual needs to survive high-risk situations and to keep from relapsing into their old behaviour. The second component, temptation, covers the intensity of the urges towards a specific behaviour in the middle of a difficult situation (Velicer et al., 1990). It assesses how tempered a person is to engaging in problem

*[1]Population Health and Preventive Medicine, Faculty of Medicine, Universiti Teknologi MARA, Sungai Buloh, [4]Faculty of Information Management, Universiti Teknologi MARA, Puncak Perdana, Selangor, [2]Centre for Occupational and Environmental Health, University of Malaya, [3]Julius Centre University of Malaya, Department of Social and Preventive Medicine, Faculty of Medicine, University of Malaya, Kuala Lumpur, Malaysia, [5]Saw Swee Hock School of Public Health, National University of Singapore, Republic of Singapore *For correspondence: sitimu.yasin@gmail.com, smunira@salam.uitm.edu.my*

Table 1. Effect of Time 1 TTM Measures on Relapse Outcome at Time 2 (6 months), n=120

TTM variables (3 months)		Quit at end of 6 months (N=41)		Relapsed (N=79)		Effects of predictors [a] on relapse outcome
		M	SD	M	SD	OR (95% CI)
Aggregate temptations		2.65	0.75	2.93	0.86	1.44 (0.86-2.44)
	Positive/social temptations	2.85	1.06	3.12	1.16	1.21 (0.80-1.81)
	Habit/addictive temptations	2.28	0.71	2.69	0.84	1.48 (0.89-2.48)
	Negative/affective temptation	2.71	1.08	2.98	0.99	1.67 (1.04-2.68)*
Aggregate behavioural processes		3.39	0.84	3.06	0.61	0.48 (0.25-0.92)*
	Counter conditioning	3.09	1.17	3.04	0.92	0.81 (0.52-1.27)
	Self-liberation	4.22	0.94	3.59	0.89	0.52 (0.31-0.90)*
	Reinforcement management	3.68	1.14	3.42	1.07	0.69 (0.48-1.00)
	Stimulus control	2.68	1.26	2.39	2.50	0.85 (0.56-1.27)
	Helping relationship	3.16	1.53	3.00	1.00	0.75 (0.53-1.07)
Aggregate experiential processes		3.64	0.79	3.49	0.85	0.65 (0.38-1.10)
	Consciousness raising	4.21	0.73	3.93	0.86	0.51 (0.27-0.94)*
	Self re-evaluation	3.06	1.32	3.37	1.00	1.12 (0.75-1.66)
	Environmental re-evaluation	3.65	1.17	3.19	1.21	0.67 (0.47-0.96)*
	Social liberation	3.12	1.33	3.32	1.02	1.14 (0.60- 1.88)
	Dramatic Relief	3.04	1.23	3.35	1.01	1.30 (0.88- 1.94)
Decisional Balance	Pros of smoking	2.21	0.81	2.72	0.87	1.99 (1.20-3.28)**
	Cons of smoking	3.91	1.04	3.75	0.88	0.81 (0.50-1.31)
Others	Self-efficacy to resist temptations	3.53	1.43	3.70	0.67	1.00 (0.69-1.46)
	Self-efficacy to abstain	4.58	0.77	4.11	0.97	0.60 (0.35-1.02)
	Worry about problems associated with quitting	3.06	1.26	3.19	1.15	0.99 (0.69-1.41)
	Resisting urges to smoke	3.90	0.94	3.48	0.98	0.45 (0.28-0.78)**
	Doubting ability to quit	1.94	0.85	3.07	0.99	2.63 (1.63-4.25)**
	Doubting worth of quitting	2.13	1.50	2.56	1.37	1.08 (0.80-1.44)
	Determination to abstain	4.42	0.89	3.74	0.94	0.39 (0.22-0.69)**

*≤0.05, **≤0.01, [a]Using bivariate logistic regression, adjusted for number of cigarettes smoked, NRT adherence and clinic sessions

behaviour in a specific situation. The three temptation situations include: emotional distress or negative affect, positive social temptations and addictive temptations/ cravings. Temptations can be regarded as the opposite of self-efficacy; in fact, the same items can be used to measure both by using a different response format, as they have the same structure (Velicer et al., 1990).

Although relapse is very likely during a quit attempt and is very much associated with behavioural change, limited attention has been paid to the action stage of TTM (quitting for a minimum 24 hours) through the maintenance stage (quitting for at least six months); previous work has focused largely on pre-cessation, rather than the post-cessation stage.

The transition from the action stage to the maintenance stage of TTM remains controversial. It has been cited that the passage from action (the first six months post-cessation) to the start of the maintenance stage (6 months post-cessation) does not result in significant behavioural and cognitive change (Etter and Sutton, 2002). However, the first relapse, normally occurring during an early quit attempt, is related to behavioural aspects, including withdrawal symptoms (Piasecki et al., 2002), negative affect, presence of other smokers, urges and cravings (Shiffma et al., 1996; Piasecki, 2006). Later studies suggest that there is a boundary within the action stage of TTM and question the validity and homogeneity of the TTM-described action stage. A suggested boundary is either the one month (Sega et al., 2006) or the one week mark (Borland and Balmford, 2005). Weistein and associates (1998) postulated that what defines a stage boundary is the discontinuation of prediction or a change in the capacity of a stage's variables to predict an outcome as the stage progresses (Weinstein and Rothman, 1998).

Discontinuity patterns within the stages of TTM have been shown to vary based on time in cessation and relapse. Self-efficacy, for instance, was proven to be an important predictor of the success of an early quit attempt, but gradually lost its predictive power over time (Stuart et al., 1994). Similarly, self-liberation was reported to prevent early relapse but not later relapse (Segan et al., 2002), perhaps because such thoughts may be difficult for former smokers as their cravings weaken. Furthermore, negative and positive affect (and their effects on temptation) may predict initial relapse (Kassel et al., 2003) but not later relapse, as the urge to smoke is reduced (Borland and Balmford, 2005).

Similarly, TTM does not clearly show which factors are pertinent in preventing or predicting relapse once the action stage has been reached. Prochaska and associates (James et al., 1992) predicted that the use of four out of five behavioural change processes (counter conditioning, helping relationships, reinforcement management and stimulus control) acts as a mediator during the progression from action to maintenance. Furthermore, a higher level of self-efficacy has effectively been shown to predict continued abstinence (Ockene et al., 2000). In assessing its importance among smokers for both behavioural and pharmacotherapy, we assessed self-efficacy based on individualised items; these items included confidence in the ability to quit, temptation to smoke and doubt in the ability to quit (Segan et al., 2006).

With regards to the experiential change process and the decisional balance (the pros and cons of smoking),

TTM does not play a clear role in preventing relapse. Nevertheless, it has been shown that self re-evaluation, an experiential change process (feeling upset and disappointed when thinking of the smoking habit), has predicted relapse (Prochaska et al., 1985a). Furthermore, consistent with the finding that stronger beliefs about the benefits of quitting smoking can predict relapse, it is possible that relapse could also be predicted if the pros of smoking outweigh the cons in the decisional balance. To measure this association, this study included an additional item pertaining to worries about the problems caused by quitting ("worrying about quitting problems") such as weight gain (Segan et al., 2006).

The purpose of this study was to provide information on the effects of TTM on smoking relapse among former smokers receiving assistance in quitting. This study is one of the first examining this process among adult smokers, as previous studies were either among "quitline" callers or those not receiving assistance in quitting (Segan et al., 2006). The results in this study may differ to the other studies, as these smokers received external support that may have enhanced their motivation throughout the behavioural and cognitive change processes. Hence, we hypothesised that some of the TTM measures would be able to predict relapse within six months and challenge the homogeneity of the six month-long action stage of TTM. The results may be used as guidelines for health and non-health professionals in targeting specific behaviours of smokers and preventing relapse after quitting.

Materials and Methods

Participants

The data was collected from two universities in Malaysia– between November 2009 and February 2012. Student centres and a student college were used as temporary sites for non-clinically based smoking cessation programmes. Ethical approval was obtained, and full support was given by the management and unions of both universities. We invited participants through staff email, individual letters to all employees, letters to heads of departments and advertisements through the universities' websites. Informed consent was obtained from each participant.

The initial sample comprised 185 participants, with 138 from University A and 47 from University B. Inclusion criteria required that participants be motivated to quit, have smoked at least five cigarettes per day for the last year and be able to read and write in the Bahasa Malaysia language. Participants had to abstain from smoking for at least 24 hours to be recruited for the analysis of this study.

Procedures

All participants received combined medical and cognitive behavioural therapy. To avoid bias, similar programmes were conducted, and all sessions were run by a medical officer and an assistant. Medical treatment consisted of nicotine replacement therapy (NRT) using either gum or a patch (depending on the patient's medical history, degree of nicotine dependence and preference) for a duration of two months. Cognitive behavioural therapy involved three sessions that covered coping strategies, risks and benefits of quitting, relapse prevention, stress reduction and weight control.

The smoking history, socio-demographic and Transtheoretical Model (TTM) questionnaires were administered prior to treatment. Similar TTM questionnaires were administered at the three-month follow-up. The questionnaires were given to participants during the clinic sessions at the beginning of the study and at three months. Smoking assessment by self-report, confirmed with carbon monoxide (CO) ppm was measured at baseline, three months and six months.

Measures

Sociodemographic and smoking history. Sociodemographic information was gathered via questionnaire administration. Data gathered were age group, highest education achievement, occupational status and marital status. Information on smoking history gathered included number of cigarettes/day, age at which the participant began smoking and previous quitting attempts within the past year.

Action Stage of TTM. The fourth, or "action", stage of change in TTM was investigated. This can be defined as the stage in which the person has already taken actions towards changing their behaviour (Prochaska et al., 1983; Fava et al., 1995). An individual in this phase has made specific lifestyle modifications. This stage is where most of the change processes occur; a person typically stays in this stage for six months, and the risk of relapse significantly reduces. The action stage occurs when a daily smoker has achieved at least 24 hours of abstinence, lasting for a period of up to 6 months (of cessation), at which point the maintenance stage begins. In this study, quitting is defined as a minimum of 24 hours of abstinence during the observation period, based on studies of smoking relapse (Shiffman et al., 2006; Abrantes et al., 2008).

TTM Questionnaire. This widely-used questionnaire was validated by Velicer and associates and involves relapse situations (Wayne et al., 1990). The TTM questionnaire consists of four parts: a) smoking decisional balance; b) temptations to smoke; c) impacts of smoking; and d) self efficacy-related beliefs. Responses were on a five-point Likert scale, and results were averaged for each variable.

The decisional balance scale had three-item subscales. Participants were asked their opinions regarding quitting, and their responses were recorded from 1 (not important) to 5 (extremely important). Measurements of situational temptations were based on a three-item subscale indicating temptations to smoke, ranging from 1 (not tempted at all) to 5 (extremely tempted). All items were measured in three separate high-risk circumstances: positive/social, habit/addictive, and negative/affective. Aggregate measures of decisional balance and temptation were the averages of all the subscales within the items.

Impacts of smoking, which affected the change process, consisted of behavioural change processes (counter conditioning, reinforcement management, self-liberation, helping relationships and stimulus control) and experiential change processes (consciousness raising,

environmental re-evaluation and self re-evaluation). Each item was rated on a 5-point Likert scale (1=never to 5=repeatedly). The original questionnaire, assessing the change process "during the past month", was modified to reflect the "current" change process, as administered in previous studies (Borland et al., 2000; Segan et al., 2006).

Additional items measured on a similar scale (1=never to 5=repeatedly) included two negative thoughts associated with self-efficacy (resisting urges to smoke and doubting the ability to quit), three measures of motivation to quit ("doubting worth of quitting", "worry about problems associated with quitting" and "determination to remain abstinent") (Segan et al., 2006) and two self-efficacy related beliefs pertaining exclusively to quitters ("self-efficacy to resist temptations" and "self-efficacy to remain a non-smoker") (Ron Borland and Balmford, 2005).

The original validated English questionnaire was translated by a back-to-back translation and administered to a sample of 40 smokers and former smokers. The internal consistency and reliability scales were Cronbach's alpha (between 0.75-0.89) and a coefficient alpha (between 0.30-0.84) (Yasin et al., 2011).

Outcome Measure. Each smoker was given a Quit Smoking Diary during the initial session, in which they were required to record cigarettes smoked per day; the diaries were presented during the follow-up session. We recorded the date of abstinence, date of relapse and length of abstinence using these diaries. Smoking abstinence was assessed by self-report and confirmed by a CO ppm measurement at three months and six months, using a Mini Smokerlyzer (Bedfont Scientific Ltd, Rochester, England). A CO level of <6 ppm was used as the cut-off point for non-smokers (Jane et al., 2006).

Data analysis

Whether each time period predicted relapse was investigated. The study aimed to answer the following question:

Can TTM be used to predict relapse among smokers engaging in assisted quitting during the first six months of quitting?

Time 0=0 months; Time 1=3 months; Time 2=6 months. a) TTM predictors during time 0 to time 2; b) TTM predictors during time 0 to time 1; c) TTM predictors during time 1 to time 2.

Bivariate logistic regressions involving the assessment of one exposure and one outcome variable were performed on the individual TTM variables and smoking relapse. The variables were adjusted for the number of cigarettes smoked, NRT adherence and number of clinic sessions. Relapse (coded as 1) served as the outcome variable. Three points were examined during follow-ups at 0 months, 3 months and 6 months. Subsequently, a multivariate logistic regression analysis was conducted on all the positive variables identified in the bivariate model, using the ENTER method.

Results

Of the 185 participants initially selected, 65 participants were excluded. Of these 65 participants, 50 failed to abstain for 24 hours, and 15 did not complete all of the necessary assessments and questionnaires. The 120 participants recruited for this study were males, and the age groups represented were 18-29 years (41.7%), 30-40 years (21.7%), 41-50 years (21.7%) and 51 years and above (15%). Most respondents were Malay (94.2%). Forty-three participants (35.8%) were single, 75 (62.5%) were married and 2 were divorced. All participants had completed at least a primary school education, while 67 (55.8 %) reported a secondary school-level of education and 48 (40%) had graduated from college. At the beginning of study, 25.4% of participants smoked 5-10 cigarettes per day, 55.8% smoked 10-19 cigarettes per day and 17.5% smoked 20 or more cigarettes per day. When the two universities were compared, the socio demographic variables and smoking histories were not significantly different (all p>0.05). All former and current smokers completed questionnaires at time 0, time 1 and time 2.

Outcome results

The mean CO ppm measurement obtained during the first visit was 15.5 ppm. Forty per cent of the smokers only attended the initial session, 32% attended two sessions within two weeks, 17% joined three sessions, and the remaining 11% attended four and more sessions. Fifty-nine per cent of smokers adhered to NRT (took NRT gums/patches for at least two weeks), and 41% of smokers were non-adherent. All 120 smokers answered the first and second set of questionnaires at the zero month time point prior to the smoking cessation sessions and at three months.

Of the 120 participants included in the study, 68 smokers continued to abstain from smoking at three months. At six months, when the smokers were contacted

Table 2. Multivariate Logistic Regression for Predictors of Relapse from Time 1 to Time 2

Variables	β	SE	Wald^{x}2	df	Odds Ratio* (95% CI)	p value
Pros of smoking	1.27	0.51	6.13	1	3.56 (1.30-9.75)	0.01
Environmental re-evaluation	-0.18	0.19	0.88	1	1.78 (0.56-1.22)	0.35
Negative/affective temptations	0.16	0.40	0.16	1	1.57 (0.53-2.59)	0.69
Conciousness raising	-0.39	0.34	1.29	1	0.68 (0.35-1.33)	0.26
Self-liberation	1.29	0.59	4.93	1	0.70 (0.40-0.91)	0.03
Doubting ability to quit	1.59	0.42	14.83	1	4.94 (2.19-11.14)	<0.01
Determination to abstain	-2.20	0.67	10.80	1	0.11 (0.03-0.41)	<0.01
Aggregate behavioural	-8.58	0.56	2.35	1	0.42 (0.14-1.27)	0.13
Resisting urges to smoke	-0.53	0.28	3.60	1	0.59 (0.34-1.11)	0.08

*Adjusted for number of cigarettes smoked, NRT adherence and clinic sessions

to determine their smoking status, 41 were abstinent, whereas the majority of the others had relapsed. The individual predictors of relapse from this study have been discussed elsewhere (Yasin et al., 2012).

Predictors of relapse during action stage of TTM

None of the variables predicted relapse from time 0 to time 2 or from time 0 to time 1 (Table not shown). In contrast, as shown in Table 1 (predicting relapse from time 1 to time 2), many significant findings were observed. Smokers who relapsed had significantly greater negative affective temptations compared to smokers who abstained. Aggregate behaviour change processes, especially self-liberation, as well as consciousness raising and environmental re-evaluation, were all protective factors against relapse; consciousness raising and environmental re-evaluation were both higher among the quitters.

In the multivariate analysis, 9 significant variables from bivariate analysis were included; of these, four were found to contribute significantly to relapse after controlling for the number of cigarettes smoked, NRT, clinic sessions and all other variables. Focus on the pros of smoking and doubting the ability to quit are both associated with relapse, while determination to abstain and self-liberation prevent relapse (Table 2).

Discussion

In this study, we hypothesised that smoking-related cognitions obtained from the Transtheoretical Model are able to predict smoking relapse after a serious quitting attempt among adult Malaysian smokers.

We identified predictors of relapse between baselines, three and six months of abstinence. TTM was not found to predict relapse among treatment-facilitated smokers during the first three months or from the initial measure to the six-month outcome. We suspect an explanation to this; the initial three months involved support from counselling sessions, which may have enhanced the motivation of the former smokers. Likewise, the smokers' perceptions and behaviours were assumed to change throughout the process of quitting, especially after receiving appropriate counselling (Yasin et al., 2011). The behaviour therapy received, therefore, explains why initial TTM measures cannot predict the outcome at six months. Alternatively, between three and six months, smokers may have behaved in a natural way. The determination and motivation during that period were self-mediated, without external support from any medical personnel. It is important to mention, however, that the structure of change described by Prochaska (James et al., 1992) encompasses both treatment-facilitated and self-initiated change; we could argue that the effects of TTM on relapse differ between the two.

Our findings on aggregate temptations suggesting an association with relapse had earlier been popularised by Marlatt and Gordon (1985) in the area of alcohol relapse (Larimer et al., 1999). It was postulated that high-risk situations and temptations contribute to relapse in addictive behaviours. It is also consistent with the later findings of Piasecki's model of relapse proneness (Thomas et al., 2002), suggesting that stressors from temptations act as one of the three pertinent features of the relapse process; the other two are cravings and fatigue (Thomas et al., 2002). Nevertheless, in our multivariate predictor analysis, none contributed to relapse in the three different time periods. We suggest that this result is due to the aggressive counselling sessions that taught participants methods to address all three aspects of temptation, to the extent that they no longer are important factors in quitting and relapse.

This study contrasts Segan's (2006) study with regards to aggregate behavioural processes of no significance, except for that of self-liberation. The differences between our results and Segan's could be explained by the fact that self-liberation (e.g., convincing yourself that you can quit if you wish to) acts as a coping strategy, and thus, self-liberation is more evident early on when cravings are still frequent (Segan et al., 2002).

Segan's (2006) study of "quitline" users found a significant difference in self-efficacy. Our findings, however, were not significant. This difference could possibly be related to the nature of this study, where the smokers did not depend entirely upon self-efficacy; they received assistance (NRT and counselling) in quitting. In this study, we suspect that 24 hours to relapse may not be a sufficient period of time to measure changes in self-efficacy. It is best if a continuous measurement of self-efficacy at each point during subsequent relapses is conducted. Furthermore, although self-efficacy will strengthen with time (Cupertino et al., 2012), in the earlier phase of quitting, self-efficacy could be masked by other factors, such as the role of NRT dependence, cravings, urges and external temptations (Piasecki, 2006). Timing to cessation could also be accelerated if smokers have higher self-efficacy and greater control over their withdrawal symptoms and vice versa (Schnoll et al., 2011). Hence, further study is warranted to test the role of self-efficacy in relapse during different time phases and more specific questionnaire might be required (Spek et al., 2012).

We found two experiential processes associated with relapse. Environmental re-evaluation and consciousness raising were found to be protective against relapse but not against self re-evaluation. This finding is similar to the results of a recent study, where smokers who relapsed demonstrated frequent experiential processes, including self re-evaluation (Sun et al., 2007). There is also some similarity with the findings of Prochaska and associates (Prochaska et al., 1985b), suggesting that self re-evaluation may lead to subsequent relapse. Our results may suggest that individuals who relapse have less awareness of the impact of smoking on the surrounding environment. In addition, we can also presume that these individuals may not have sufficient preparation, in terms of knowledge and motivation, prior to their quitting attempt. However, once a quitter relapsed, there was no difference in guilt compared to those who maintained abstinence. This finding could suggest that those relapsing were less serious in their attempts to quit. Nonetheless, no significant behavioural processes were observed in the multivariate analysis, similar to the findings by Segan and associates (Segan et al., 2006).

With regards to decisional balance, only the perceived pros of smoking was found to be of significant importance when predicting relapse from three to six months, although from our previous report it. We presumed that the construct perhaps did not account for the gains associated with quitting. We observed an important point in our follow-up sessions and clinical work; once a former smoker had successfully passed the phase of cravings and urges, he began to recognise the satisfaction of freedom from cigarettes. In addition, we noted that the ex-smokers were more worried about the problems associated with quitting, rather than those related to continued smoking, although not significant in any of our observation points. In contrast, smokers who quit for a short while but relapsed, regardless of the motivation provided, were unable to withstand the cravings and also eliminated the perceived advantages associated with abstinence from smoking.

Negative motivation (doubting ability to quit) was also found to predict relapse. Conversely, positive motivation (determination to abstain) was a protective factor against relapse. Both measures were only significant during the three- to six-month time frame. These differences could indicate that as smokers progressed from three to six months their motivation and desire to quit increased.

There were some limitations in this study. First, three monthly assessments of changes in TTM measures may be inadequate to assess the changes in behaviour throughout the relapse process. Additionally, although previous studies have shown the existence of boundaries at one week and one month (Borland and Balmford, 2005; Segan et al., 2006), in our study, we were unable to locate the exact cut-off point that occurs within six months. The cut-off point cannot be identified because our results were analysed at three different points in time. We have only concluded that there exist some changes in the data collected by TTM measures administered after the smokers underwent appropriate counselling. In the future, studies should consider using electronic diaries, recording the current emotion during each relapse episode (Shiffman et al., 2006a). This may help to measure the exact time of behaviour change, prior to relapse and afterwards. Furthermore, for researchers to determine the points that define the stage boundaries, it may be necessary to follow-up with smokers more frequently. Lastly, smokers participating in this study were possibly less motivated than smokers who quit without assistance; thus, our results could not be generalised to self-initiated quitters.

The data produced from this study led us to question the effectiveness of current practices in relapse prevention. Various interventions being utilised in the area, including nicotine fading (Prochaska et al., 2001), nicotine replacement therapy (Velicer et al., 2006), proactive telephone calls (Prochaska et al., 2001) and increased numbers of clinic sessions (Velicer et al., 1999), have failed to increase the cessation rate from the 25-30% breakthrough rate (Sun et al., 2007). Whether the major strategies applied in relapse prevention have accounted for the behavioural changes of smokers and quitters throughout the action stage remains unanswered. It will therefore be helpful for health professionals to develop strategies and tailor interventions that may allow relapsed smokers and former smokers to successfully progress through the action stage and achieve the maintenance stage of quitting.

In conclusion, our findings support the use of the Transtheoretical Model for predicting early relapse among former smokers attempting to quit using cognitive and medical therapy. Emphasising smoking cessation counselling and tailored interventions, especially with reference to issues of misconceptions regarding smoking benefits (pros of smoking), enhanced motivation to abstain and prioritisation of self-liberation, may assist former smokers in preventing relapse.

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References

Abrantes AM, Strong DR, Lejuez CW, et al (2008). The role of negative affect in risk for early lapse among low distress tolerence smokers. *Addict Behav*, **33**, 1394-401.

Borland R, Balmford J (2005). Perspectives on relapse prevention: an exploratory study. *Psychol Health*, **20**, 661-71.

Borland R, Segan C, Velicer W (2000). Testing the transtheoretical model for smoking change: Victorian data. *Aust J Psychol* **52**, 83-8.

Campbell S, Bohanna I, Swinbourne A, et al (2013). Stages of change, smoking behaviour and readiness to quit in a large sample of indigenous australians living in eight remote North Queensland communities. *Int J Environ Res Public Health,* **10**, 1562-71.

Cupertino AP, Berg C, Gajewski B, et al (2012). Change in self-efficacy, autonomous and controlled motivation predicting smoking. *J Health Psychol*, **17**, 640-52.

Etter JF, Sutton S (2002). Assessing 'stage of change' in current and former smokers. *Addiction*, **97**, 1171-82.

Fava JL, Velicer WF, Prochaska JO (1995). Applying the transtheoretical model to a representative sample of smokers. *Addict Behav*, **20**, 189-203.

Huang CM, Wu HL, Huang SH, et al (2013). Transtheoretical model-based passive smoking prevention programme among pregnant women and mothers of young children. *Eur J Public Health* [Epub ahead of print].

Hyland A, Borland R, Li Q, et al (2006). Individual level predictors of cessation behaviors among participants in the International Tobacco Control (ITC) four country survey. *Tob Control*, **15**, 83-94.

Jane H, Ching-Hua L, Jung-Der W, et al (2006). Exhaled carbon monoxide level as an indicator of cigarette consumption in a workplace cessation program in Taiwan. *J Farmos Med Assoc*, **105**, 210-3.

Janis IL, Mann L (1977). Decision making: a psychological analysis of conflict, choice, and commitment: New York Free Press.

Larimer ME, Palmer RS, Marlatt GA (1999). Relapse prevention: an overview of marlatt's cognitive-behavioural model. *Alcohol Res Health*, **23**, 151-60.

McEwen A, West R, Bolling K, et al (2001). Smoking cessation and smoking patterns in the general population: a 1 year follow-up. *Addiction*, **96**, 891-902.

Norman GJ, Velicer WF, Fava JL, et al (1998). Dynamic typology clustering within the stages of change for smoking cessation. *Addict behav*, **23**, 139-53.

Ockene J, Emmons K, Melmelstein R, et al (2000). Relapse and maintenance issue for smoking cessation. *Health Psychol*, **19**, 17-31.

Paiva AL, Prochaska JO, Yin H-Q, et al (2012). Treated individuals who progress to action or maintenance for one behavior are more likely to make similar progress on another behavior: coaction results of a pooled data analysis of three trials. *Prev Med* [Epub ahead of print].

Piasecki TM (2006). Relapse to smoking. *Clin Psychol Rev*, **26**, 196-215.

Piasecki TM, Fiore MC, McCarthy DE, Baker TB (2002). Have we lost our way? The need for dynamic formulations of smoking relapse proneness. *Addictions*, **97**, 1093-108.

Piasecki TM, Jorenby DE, Smith SS (2002). Smoking withdrawal dynamics: II. Improved tests of withdrawal-relapse relations. *J Abnorm Psychol*, **112**, 14-27.

Prochaska J, DiClemente C (1983). Stages and processes of self-change of smoking: toward an integrative model of change. *J Consult Clin Psychol*, **51**, 390-5.

Prochaska J, Diclemente C, Velicer W, et al (1985a). Predicting change in smoking status for self-changers. *Addict Behav*, **10**, 395-406.

Prochaska J, Velicer W, DiClemente C, et al (1988). Measuring processes of change: applications to the cessation of smoking. *J Consult Clin Psychol*, **56**, 520-8.

Prochaska J, Velicer W, Fava J, et al (2001). Counselor and stimulus control enhancement of a stage-matched expert system intervention for smokers in a managed care setting. *Prev Med*, **32**, 23-32.

Prochaska J, Velicer W, Fava J, et al (2001). Evaluating a population-based recruitment approach and a stage-based expert system intervention for smoking cessation. *Addict Behav*, **26**, 583-602.

Prochaska JO, DiClemente CC, Norcross JC (1992). In search of how people change: applications to addictive behaviors. *Am Psychol*, **47**, 1102-14.

Prochaska JO, Velicer WF, Rossi JS, et al (1994). Stages of change and decisional balance for 12 problem behaviors. *Health Psychol*, **13**, 39-46.

Schnoll RA, Martinez E, Tatum KL, et al (2011). Increased self-efficacy to quit and perceived control over withdrawal symptoms predict smoking cessation following nicotine dependence treatment. *Addict behav*, **36**, 144-7.

Segan C, Borland R, Greenwood K (2002). Do transtheoretical model measures predict the transition from preparation to action in smoking cessation? *Psychol Health*, **17**, 417-35.

Segan C, Borland R, Greenwood KM (2006). Can transtheoretical model measures predict relapse from the action stage of change among ex-smokers who quit after calling a quitline? *Addict Behav*, **31**, 414-28.

Shiffman S, Ferguson SG, Gwaltney CJ (2006). Immediate hedonic response to smoking lapses: relationship to smoking relapse, and effects of nicotine replacement therapy. *Psychopharmacol*, **184**, 608-18.

Shiffman S, Paty J, Gyns M, et al (1996). First lapses to smoking: Within subject analysis of real- time reports. *J Consulting and Clinical Psychology*, **64**, 366-79.

Spek V, Lemmens F, Chatrou M, et al (2012). Development of a Smoking Abstinence Self-efficacy Questionnaire. *Int J Behav Med* [Epub ahead of print].

Stuart K, Borland R, McMurray N (1994). Self-efficacy, health locus of control, and smoking cessation. *Addict Behav,* **15**, 271-83.

Sun X, Prochaska JO, Velicer WF, et al (2007). Transtheoretical principles and processes for quitting smoking: A 24- month comparison of a representative sample of quitters, relapsers, and non-quitters. *Addict Behav*, **32**, 2707-26.

USDHHS (1990). The health benefits of smoking cessation: A report of the Surgeon General: US Department of Health and Human Services, Public Health Service, Centers of Disease Control and Prevention.

Velicer W, DiClemente CC, Prochaska JO, et al (1985). Decisional balance measure for assessing and predicting smoking status. *J Pers Soc Psychol,* **48**, 1279-89.

Velicer W, DiClemente CC, Rossi JS, et al (1990). Relapse situations and self-efficacy: an integrative model. *Addict Behav*, **15**, 271-83.

Velicer W, Norman G, Fava J, et al (1999) .Testing 40 predictions from the transtheoretical model. *Addict Behav*, **24**, 455-69.

Velicer W, Prochaska Fava J, Laforge L, et al (1999) Interactive versus non-interactive interventions and dose-response relationships for stage matched smoking cessation programs in a managed care setting. *Health Psychol,* **18**, 21-8.

Velicer W, Prochaska J, Redding C (2006). Tailored communications for smoking cessation: Past successes and future directions. *Drug Alcohol Rev*, **25**, 47-55.

Weinstein N, Rothman A, Sutton S (1998). Stage theories of health behavior: Conceptual and methodological issues. *Health Psychol*, **17**, 290-9.

Yasin SM, Khairul M, Rafdzah A (2011). Reliability and construct validity of the bahasa malaysia version of Transtheoretical Model (TTM) questionnaire for smoking cessation and relapse among malaysian adult smokers. *Asian Pac J Cancer Prev*, **12**, 1439-43.

Yasin SM, Moy FM, Retneswari M, et al (2012). Timing and risk factors associated with relapse among smokers attempting to quit in Malaysia. *Int J Tuberc Lung Dis*, **16**, 980-5.

Yasin SM, Retneswari M, Moy FM, et al (2011). Smokers can quit regardless of motivation stage in a worksite smoking cessation programme in malaysia. *Asian Pac J Cancer Prev*, **12**, 2193.

Yasin SM, Retneswari M, Moy FM, et al (2011). Does change in perception following counseling result in improved quitting outcome among Malaysian smokers? *Asia Pac J Public Health,* [Epub ahead of print].