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Adolescents’ movement towards cessation of smoking: Role and relative value of the processes of change and nicotine dependence

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Adolescents’ movement towards cessation of smoking: Role and relative value of the processes of change and nicotine dependence

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Abstract
The present study addresses the applicability of the Transtheoretical Model’s processes of change in explaining adolescents’ readiness to quit smoking. Furthermore, the association between nicotine dependence and readiness to quit was assessed both directly, as well as indirectly through the processes of change. A cross-sectional survey was conducted, identifying 1547 weekly smokers aged 14–18 years. Structural equation modelling showed that the processes of change were only marginally associated with readiness to quit. Adding nicotine dependence to the model showed a direct association between nicotine dependence and readiness to quit. Only one process of change, self-liberation (i.e. choice/commitment to change and belief in the ability to change), was found to mediate this association. Nicotine dependence appeared to be highly important in adolescents’ readiness to quit.

Keywords: Nicotine dependence, processes of change, stages of change, smoking cessation, adolescents

Introduction
Worldwide, about one in every five adolescents aged 13–15 years is a smoker (World Health Organisation, 2002). Previous studies, however, indicated that a...
considerable number of adolescent smokers wants to quit smoking, and that many of them have tried to do so (Balch, 1998; Sussman, Dent, Severson, Burton, & Flay, 1998). Unfortunately, relapse rates are high and maintenance of smoking cessation is poor. Moreover, Johnston, Bachmann, and O’Malley (1992) found that 75% of adolescent daily smokers would continue to smoke as adults. Because of the addictive and harmful nature of smoking, it is important to motivate adolescent smoking cessation. Nevertheless, different from the adult population, there has been little research on smoking cessation among adolescents (Hoeppner et al., 2006). Moreover, a sound theoretical basis for developing interventions aiming at smoking cessation among this group is still lacking. Because greater insight into the process of quitting smoking among adolescents is required, the aim of the present study is to contribute to a better understanding of the determinants of smoking cessation among adolescents.

A construct previously found to be related to the process of smoking cessation is addiction to nicotine or nicotine dependence (Farkas et al., 1996; United States Department of Health and Human Services, 1988). In adults, nicotine dependence was found to be related both to a high number of previous quit attempts and to a low intention to quit (John, Meyer, Rumpf, & Hapke, 2004; Velicer, Rossi, Diclemente, & Prochaska, 1996). It has been suggested that nicotine dependence is an important factor in the process of smoking cessation, not only in adults who have smoked for many years, but also in teenagers (Engels, Knibbe, De Vries, & Drop, 1998). Research among adolescents indeed indicated that nicotine dependence was associated with readiness and ability to quit smoking (Horn, Fernandes, Dino, Massey, & Kalsekar, 2003; Prokhorov et al., 2001). Few studies, however, addressed the means by which nicotine dependence affects processes of smoking cessation. To design optimal ways of increasing readiness to quit and actual smoking cessation in adolescents, it is useful to determine the specific role and relative value of nicotine dependence, as well as the mechanisms by which nicotine dependence may influence the process of smoking cessation.

A construct widely used as an indication of the process of smoking cessation is the stages of change concept (Prochaska, DiClemente, & Norcross, 1992a; Prochaska, Norcross, Fowler, Follick, & Abrams, 1992b). The stages of change construct is part of the Transtheoretical Model (TTM) (Prochaska et al., 1992a), and describes a temporal dimension containing five levels of readiness to change: pre-contemplation, contemplation, preparation, action and maintenance. Readiness to quit, as measured by the stages of change, has been found to be associated with smoking cessation (DiClemente et al., 1991). According to the TTM, movement through the different stages of change is expected to be facilitated by certain strategies known as the processes of change (Prochaska, Velicer, DiClemente, & Fava, 1988; Prochaska et al., 1992a, 1992b). Ten processes of change have been suggested that can be used in changing one’s smoking behaviour, with five processes reflecting experiential (cognitive/affective) strategies and five processes reflecting behavioural strategies. Moreover, these strategies are thought to contribute differentially to transition through the
different stages of behaviour change. The experiential processes, including 
environmental re-evaluation, self-re-evaluation, consciousness raising, social 
liberation and dramatic relief, are expected to be most frequently engaged in 
during the pre-contemplation and contemplation stages of change, and also, but 
to a lesser extent, in the preparation stage. The behavioural processes, including 
reinforcement management, counter conditioning, stimulus control, self-libera-
tion and helping relationship are supposed to be most frequently engaged in 
during the preparation, action and maintenance stages of change (Prochaska 
et al., 1992a; Rosen, 2000) (Table I).

In adults, however, results regarding the effectiveness of the TTM in explaining 
smoking cessation have been contradictory. On the one hand, there have been 
studies supporting the efficacy of Transtheoretical constructs (such as the 
processes of change) in the process of smoking cessation (Prochaska et al., 
1992a), and in addition, the effectiveness of smoking cessation interventions 
based on the constructs of the TTM (Dijkstra, Conijn, & De Vries, 2006; 
Prochaska, Velicer, Fava, Rossi, & Tsoh, 2001). On the other hand, some 
prospective studies among adult smokers failed to support the relevance of the 
TTM’s processes of change in smoking cessation (Herzog, Abrams, Emmons, 
Linnan, & Shadel, 1999; Segan, Borland, & Greenwood, 2002; Segan, Borland, 
& Greenwood, 2004).1 Partly because of the failure to find consistent evidence 
for the effectiveness of the TTM in explaining smoking cessation, the 
model has received some critical reviews (Bridle et al., 2005; Sutton, 2001; 
West, 2005).

Despite this growing controversy, the TTM remains widely applied. Moreover, 
several studies have been conducted to test whether the TTM, or parts of the 
model, could be applied among adolescent smokers as well. Psychometric 
properties of the processes of change among adolescents have already been

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**Table I.** Description of the processes of change.

<table>
<thead>
<tr>
<th>Description</th>
<th>Description</th>
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<tr>
<td><strong>Experiential processes</strong></td>
<td><strong>Consciousness raising</strong> Increasing knowledge and information about one’s smoking</td>
</tr>
<tr>
<td></td>
<td><strong>Social liberation</strong> Awareness, availability and acceptance of alternative, problem-free lifestyles in society</td>
</tr>
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<td></td>
<td><strong>Dramatic relief</strong> Experiencing and expressing feelings about one’s smoking</td>
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<tr>
<td></td>
<td><strong>Self-re-evaluation</strong> Considering feelings and thoughts about the self in relation to one’s smoking</td>
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<td></td>
<td><strong>Environmental re-evaluation</strong> Considering how smoking affects one’s environment</td>
</tr>
<tr>
<td><strong>Behavioural processes</strong></td>
<td><strong>Helping relationship</strong> Trust others and being open about one’s smoking</td>
</tr>
<tr>
<td></td>
<td><strong>Self-liberation</strong> Choosing and commitment to act or belief in ability to change</td>
</tr>
<tr>
<td></td>
<td><strong>Counter conditioning</strong> Replacing smoking with alternatives</td>
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<tr>
<td></td>
<td><strong>Stimulus control</strong> Avoidance or dealing with stimuli that bring out smoking</td>
</tr>
<tr>
<td></td>
<td><strong>Reinforcement management</strong> Rewarding oneself or being rewarded by others for changing smoking behaviour</td>
</tr>
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</table>
reported, as well as adolescents’ level of engagement in the processes of change within the different stages of the stages of change construct (Hoeppner et al., 2006; Pallonen, 1998). However, the impact of the processes of change on adolescents’ readiness to quit, as measured by the stages of change construct, has hardly been studied. Therefore, in order to establish whether cognitions and behaviours as measured by the processes of change are useful concepts to address in interventions to promote smoking cessation among adolescents, the first goal of the present study is to examine the associations between the processes of change and stages of change in a large nationwide sample of adolescent smokers in the Netherlands.

Because of their anticipated role as catalysts of behaviour change, it is likely that an increased engagement in the processes of change is associated with a higher readiness to quit. Furthermore, since experiential processes are thought to be more important in the earlier motivational stages of change, i.e. pre-contemplation, contemplation and to some extent in preparation, and behavioural processes are thought to be more important in the later action-oriented stages of change, i.e. preparation, action and maintenance, it is expected that associations between experiential processes of change and readiness to quit are more apparent as compared to associations between behavioural processes of change and readiness to quit.

The second goal is to increase insight into the impact of nicotine dependence on the process of cessation and the mechanisms by which nicotine dependence may influence this process. Velicer et al. (1996) previously described the pattern of change for dependency across four stages of change, i.e. pre-contemplation, contemplation, action and maintenance in adults. They found that pre-contemplators had high levels of dependency and were more likely to continue smoking despite environmental influences. Environment was hereby conceptualised to include personal (emotions and mood), historic or external environment. Dependency in the contemplation and action stage was found to be open to environmental manipulation and smoking status in these stages was increasingly determined by the environment. Persons in the maintenance stage had low levels of dependency and were likely to be non-smokers despite their environment. First of all, in line with these and other previous findings, it is expected that among adolescents, nicotine dependence will be negatively related to readiness to quit as measured by the stages of change. Second, because of the relations found between dependency and environmental influences, it is expected that higher levels of nicotine dependence will be associated with fewer efforts to engage in strategies to influence or control the environment, such as the avoidance of stimuli that initiate smoking or increasing one’s knowledge about smoking and its consequences. Therefore, it is expected that nicotine dependence will be negatively related to engagement in the cognitive and behavioural strategies known as the processes of change.

To conclude, it will be examined to what extent nicotine dependence will operate through the processes of change in explaining readiness to quit. Here, based on the above, it is expected that higher levels of nicotine dependence will be
associated with less engagement in the different processes of change, which in turn will be associated with less readiness to quit.

Methods
Procedure and sample
Thirty-three secondary schools in four regions of the Netherlands participated in the present study. Through these schools a total of 10,264 respondents were reached. Respondents were predominantly aged 14–16 years and completed paper- and-pencil questionnaires that were administered during classes in grades 9 and 10. The questionnaire consisted of two sections: one for respondents who indicated that they had smoked at least once in the past month, and one for respondents who had not smoked during the past month. The respondents who had smoked during the past month ($N = 2182$) had to answer questions on smoking demographics, smoking history, smoking behaviour, etc. Because previous findings indicate that irregular smokers respond differently to smoking interventions as compared to regular smokers, and in addition are more likely to have fluctuating smoking patterns (Hollis et al., 2005), only those respondents who reported to smoke at least weekly were selected ($N = 1547$).

Sample characteristics
Of the 1547 smokers included in the study, 51% were female. Of the respondents, 51.4% was receiving lower vocational training, 23.1% intermediate vocational training, 17.8% high school education and 5.6% pre-university education. The mean age was 15.2 (range 12–18) years.

Measures
Processes of change. The measure of the processes of change is conform the original measure as developed by Prochaska et al. (1988), and consisted of 40 items assessing the respondents’ use of the processes of consciousness raising, self-liberation, dramatic relief, counter conditioning, stimulus control, helping relationship, environmental reevaluation, social liberation, self-re-evaluation and reinforcement management (see Table I for a description of the processes). All items were translated into Dutch by three independent translators. After solving minor differences, consensus was reached on the final translation of the items. Each item could be scored on a five-point scale ranging from (1) never to (5) often, and followed the question: ‘How often did the following occur in the last four weeks?’ The reliabilities of the scales were found to be good to excellent (Table II).

Nicotine dependence. Nicotine dependence was measured by a recently developed multidimensional scale based on both the modified Fagerstrom Tolerance Questionnaire (mFTQ) (Prokhorov, Pallonen, Fava, Ding, & Niaura, 1996)
and the Hooked on Nicotine Checklist (HONC) (DiFranza et al., 2000; O’Loughlin et al., 2002). This 11-item scale has been validated in a study by Kleinjan et al. (2007). In this study it was shown that combining items of the mFTQ and the HONC resulted in three distinct dimensions: behavioural aspects of nicotine dependence, craving and nervousness during abstinence. Items selected for preservation were required to have a minimal loading of 0.45 (van Dyke, Prybutok, & Kappelman, 1999). Selection of items was further based on conceptual interpretation, scores on descriptive statistics and on inter-item and item-total correlations. The multidimensional model was subsequently tested in a second sample using confirmatory factor analysis. The new measure fitted the data satisfactorily and showed good psychometric properties. In addition, to test convergent validity, it was found that the three components of the combined scale are uniquely related to readiness to quit and number of previous quit attempts.

**Readiness to quit.** Readiness to quit was assessed according to respondents’ plans to stop smoking. A nine-point ordinal scale was used that ranged from (i) ‘I am planning to quit within the next 10 days’, through (ii) ‘planning to quit within 1 month’, (iii) ‘planning to quit within 6 months’, (iv) ‘planning to quit within 1 year’, (v) ‘planning to quit within 5 years’, (vi) ‘planning to quit within 10 years’, (vii) ‘planning to quit somewhere in the future but not within the next 10 years’, (viii) ‘planning to never quit but planning to cut down’ and (ix) ‘planning to never quit and not planning to cut down’ (Dijkstra, Tromp, & Conijn, 2003). Respondents were categorised into the different stages of change consistent with the approach as described by Prochaska et al. (1988, 1992a), i.e. those respondents who agreed to plan to quit within the next 10 days or the next month were labelled preparers, whereas those who agreed to plan to quit within the next 6 months, but not in the next 10 days or next month, were categorised as contemplators. The label pre-contemplators was used for all respondents who were planning to quit within the next year or the next 5 years, but not in the next
6 months, those who agreed to quit somewhere in the future but not within 5 years, and those who had no plans to quit at all.

Statistical analyses

In order to examine to what extent adolescents adhere to the processes of change, we assessed the usage of these processes within the different stages of change. Analysis of variance (ANOVA) with Scheffé post hoc tests were used to stratify the average scores for the processes of change by the stages of pre-contemplation, contemplation and preparation.

To assess the association between the processes of change and the stages of change, we used Structural Equation Modeling in Mplus version 4.0 (Muthén & Muthén, 1998). Mplus was used because of its ability to accommodate non-normality without reliance on large samples or unrealistically small models (Kaplan, 2000; Muthén, du Toit, & Spisic, 1997). The processes of change were measured as latent variables with the 40 items providing four manifest variables for each of the processes of change. Within the models we accounted for the correlations between the separate processes of change. To assess the associations between nicotine dependence and both the processes of change and readiness to quit, we added the concept to the initial model. Because the nicotine dependence measure used has been previously validated with regard to its psychometric properties and convergent construct validity (Kleinjan et al., 2007), we chose to enter nicotine dependence into the model as a manifest variable. For all analyses $p < 0.05$ are considered significant.

Results

Smoking characteristics

On average, respondents smoked 50 cigarettes a week (SD = 44.5). Subjects reported having smoked their first cigarette or having taken their first puff at an average age of 11.5 years (SD = 4.2). Of the respondents, 15.0% were in the preparation stage, 6.3% in the contemplation stage, and 78.7% in the pre-contemplation stage. Quit attempts in the last 12 months were reported by 30.1% (Mean = 2.8, SD = 5.4).

Processes of change. Smokers in the three stages of behavioural change differed in the extent to which they engaged in 8 of the 10 processes of change (Table III). Pre-contemplators showed less engagement in the processes of change compared to contemplators, which in turn showed less engagement in these processes compared to preparers. Helping relationship and social liberation were the only processes that did not differ between pre-contemplators, contemplators and preparers.

Findings of structural equation modelling showed that three processes of change were significantly associated with readiness to quit as measured by
the stages of change construct (Figure 1). The more smokers engaged in self-liberation and counter conditioning, the higher the reported readiness to quit. More engagement in social liberation was associated with a lower readiness to quit. The total variance explained by the processes of change in readiness to quit was 10%. The model as shown in Figure 1 had a good fit ($\chi^2/df = 3713.49, df = 725, p < 0.001, \text{RMSEA} = 0.05, \text{CFI} = 0.92$ and $\text{TLI} = 0.91$).

Nicotine dependence. Adding nicotine dependence to the model resulted in a good model fit with $\chi^2 = 3827.99, df = 755, p < 0.001, \text{RMSEA} = 0.05, \text{CFI} = 0.92$ and $\text{TLI} = 0.91$ (Figure 2). Nicotine dependence was directly negatively associated with readiness to quit. In addition, higher scores on nicotine dependence were associated with more engagement in the processes of stimulus control and social liberation, and with less engagement in self-liberation and counter conditioning.

The model showed one indirect association between nicotine dependence and the readiness to quit, i.e. through the process of self-liberation. The explained variance in readiness to quit increased to 12% when nicotine dependence was added to the model.

### Discussion

The findings of the present study show that among adolescents, self-reported nicotine dependence is a strong correlate of readiness to quit, while the association between the processes of change and readiness to quit is limited. After the association of the processes of change with readiness to quit had been accounted for, nicotine dependence remained negatively associated with readiness to quit.

The findings indicate that adolescents’ perceived engagement in the processes of change within the different stages of the stages of change construct was similar to that found among adults, with pre-contemplators engaging less in the different
processes of change than contemplators, and contemplators engaging less in the different processes as compared to preparers (Herzog et al., 1999; Kleinjan, van den Eijnden, Dijkstra, Brug, & Engels, 2006). In addition, adolescents’ mean scores on the processes of change were similar to those among adults (Herzog et al., 1999), indicating that adolescents’ perceived degree of engagement in processes of change is comparable to that of adults. Despite these processes of change than contemplators, and contemplators engaging less in the different processes as compared to preparers (Herzog et al., 1999; Kleinjan, van den Eijnden, Dijkstra, Brug, & Engels, 2006). In addition, adolescents’ mean scores on the processes of change were similar to those among adults (Herzog et al., 1999), indicating that adolescents’ perceived degree of engagement in processes of change is comparable to that of adults. Despite these
findings, the present study shows that, in adolescents, the processes of change are only marginally associated with readiness to quit.

Within our sample, 3 out of the 10 processes, i.e. self-liberation, counter conditioning and social liberation, were associated with readiness to quit. The processes of self-liberation (i.e. adolescents’ choice and commitment
to change and the belief in their ability to change) and counter conditioning (i.e. adolescents’ efforts to replace smoking with alternatives) were positively and most strongly associated with stage of change. Contrary to what was expected, social liberation (i.e. adolescents’ realisation that the social norms are changing in the direction of supporting non-smoking) was found to be negatively associated with stage of change. A possible explanation for this negative association might lie in cognitive dissonance. Cognitive dissonance is experienced when two or more cognitions are inharmonious in relation to one another, which results in motivational tension (Festinger, 1957; Wicklund & Brehm, 1976). Adolescents might experience cognitive dissonance because they continue to smoke cigarettes despite their knowledge of the negative health effects and the changing social norm regarding smoking. The more adolescents realise that societal norms are changing in favour of non-smoking, the more they may feel inclined to justify their smoking behaviour. Dissonance reduction mechanisms may therefore affect potential readiness to change in a negative manner.

There are several possible explanations for the limited associations between the processes of change and readiness to quit. One explanation could lie in the measurement of readiness to quit by the stages of change construct. In their paper on adult smokers, Herzog et al. (1999) reasoned that the absence of associations between the processes of change and the different stages of change could be explained by the notion that the stages of change algorithm might not adequately measure readiness to quit. It should be noted that the stages of change model has recently been criticised for its use of arbitrary cut-off points to differentiate between the stages (Sutton, 2001; West, 2005). Especially among adolescents, the criteria of intending to quit within 1 month (preparation) or within 6 months (contemplation) may not adequately capture adolescents’ eventual and perhaps vague intentions of quitting sometime in the future. Within our sample, 74.7% of the adolescent smokers were classified as pre-contemplators, and within the daily smokers subgroup 81.2% were in the pre-contemplation stage, meaning they did not intend to quit within 6 months. Several studies among adult smokers found distributions of 40% of the smokers in pre-contemplation, 40% in contemplation and 20% in preparation (Pallonen, 1998; Velicer et al., 1995). Thus, readiness to quit among adolescents seems to be remarkably lower compared to that among adults.

Adolescent smokers on average have relatively short smoking careers and concrete plans to quit may not yet have been established. In his study on exploring perceptions of smoking cessation among adolescents, Balch (1998) found that many participants considered it important to quit eventually, but did not consider it serious or urgent. The stages of change construct might be more useful within adolescent populations, when it distinguishes different levels of pre-contemplation to enable more variance within the construct of readiness to quit. Several studies among adults have already suggested that within the large group of pre-contemplators, several subtypes exist (Anatchkova, Velicer, & Prochaska, 2006; Crittenden, Manfredi, Warnecke, Cho, & Parsons, 1998; Dijkstra, De Vries, & Roijackers, 1999; Dijkstra & De Vries, 2000; Norman, Velicer,
Fava, & Prochaska, 2000; Velicer et al., 1995). These subtypes are described based on the degree in which they vary in their perceived pros and cons of smoking, and their temptations to smoke. Further research is necessary to establish whether subtypes exist within the pre-contemplation stage of smoking cessation among adolescents and, in addition, whether the use of these subtypes increases the ability of the stages of change construct to differentiate between the differences in adolescent smokers’ readiness to quit.

Another explanation for the limited association between the processes of change and readiness to quit may lie in previous findings indicating a difference between adults and adolescents in their use of the processes of change across the stages of change (Pallonen, 1998). Adults tend to emphasise the experiential processes at the early stages, and to depend on the behavioural processes at the later stages, whereas adolescents appear to rely more on the behavioural processes, even at the early stages of change. These findings, however, cannot account for the lack of associations between the behavioural processes and readiness to quit, indicating that the processes of change in their present form might not be entirely appropriate as indicators of adolescents’ readiness to quit.

Considering that within the TTM, the processes of change can be seen as proximal indicators of behaviour change (Prochaska et al., 1992a), the finding of a negative association between nicotine dependence and readiness to quit, while controlling for the processes of change, underlines previous conclusions on nicotine dependence as being an important factor in the process of smoking cessation among adolescents (Horn et al., 2003; Prokhorov et al., 2001).

Remarkably, and contrary to what was expected, not all of the associations found between nicotine dependence and the processes of change were negative. The higher the self-reported nicotine dependence, the more respondents reported to make use of the processes of social liberation and stimulus control. In case of social liberation, this positive association could be explained by frequency of smoking. Daily smoking adolescents are thought to be more at risk of developing, or having developed, a tobacco dependency (Colby, Tiffany, Shiffman, & Niaura, 2000), and in addition, a daily smoker might be more often confronted with the changing social norms supportive of non-smoking. In case of stimulus control it was expected that higher nicotine dependence would result in fewer efforts to engage in avoidance of stimuli that bring out smoking. A possible explanation for the found positive association might be that smokers who have a higher perceived engagement in stimulus control are more convinced of their dependence on nicotine. Self-liberation was the only process found to play a mediating role between dependency and readiness to quit. Less dependence on nicotine was associated with a higher perceived commitment to act or belief in the ability to change smoking behaviour, which in turn was associated with a higher readiness to quit. This implies that in order to increase adolescents’ readiness to quit smoking, it is important to decrease nicotine dependence, because lower levels of nicotine dependence show a relationship with making a commitment to change smoking behaviour.
This study is one of the first to provide insight into the impact of the processes of change on the process of smoking cessation and into the specific role, relative value and the mechanisms by which nicotine dependence may influence this process in adolescents, using a large nation-based sample. In interpreting the findings of the present study, however, one should bear an important limitation in mind. The cross-sectional design makes it impossible to draw conclusions concerning the causality of the associations between the different variables. Research with longitudinal designs will therefore be needed to gain more insight into the direction of the associations found in this study.

In conclusion, the findings of the present cross-sectional study showed that, although adolescent smokers do engage in the processes of change as defined by the TTM, there is only a limited association between these processes and readiness to quit. In addition, this study identified that nicotine dependence has a significant impact on the process of smoking cessation, over and above the processes of change. The findings of this study emphasise previous conclusions on the occurrence of nicotine dependence in adolescents (DiFranza et al., 2000), and indicate that nicotine dependence among adolescents plays a profound role in the process towards smoking cessation. To increase successful smoking cessation, it is advised that adolescents’ nicotine dependence be targeted.

Acknowledgements

This study was financed by the Dutch Asthma Foundation and STIVORO for a smoke free future.

Note

[1] It should be stated that within the studies by Herzog et al. (1999) and Segan et al. (2002, 2004) the short-form measure of the processes of change was used, and in addition, that the first two studies mentioned did not assess all of the 10 processes of change.

References


