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INTRODUCTION

Tobacco smoking is responsible for the greatest disease burden in Australia, providing around 12% of the total burden in males and 7% in females (Mathers, Vos, Stevenson, & Begg, 2001). Despite the prevalence of smoking in the general population having decreased by over 15% in the past 25 years (Australian Institute of Health and Welfare, 2007) some 17.9% of the Australian population aged 14 and over were daily or weekly smokers in 2007 (Australian Institute of Health and Welfare, 2007). The decline in smoking prevalence among youth, however, has plateaued in recent years. This is of concern because persistent smoking behaviour is more likely to occur if it starts during adolescence or young adulthood (Australian Institute of Health and Welfare, 2007). The university years may be a particularly important period in terms of initiation into smoking, or the development of long-term smoking habits. Increased smoking rates among this population have the potential to reverse the overall decline in smoking rates among Australian adults in the past 50 years. It is important to understand why youths and young adults in university smoke, so that prevention programs can be implemented.

The life changes and stress that typically occur during university study may have a substantial negative impact on emotional wellbeing of these young people and could lead to the adoption of unhealthy or maladaptive behaviours. The unsuccessful adjustment to these life changes has been posited to lead to psychological distress. Numerous studies have shown that university students experience high psychological morbidity after the commencement of a university course, and that the problems begin from first year with stress, anxiety, depression, and burnout being common and peaking in the pre-examination period. The prevalence of depression among undergraduates is approximately 11% overall, and up to 14% for male

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students (Grant et al., 2002). In both adults and adolescents, stress has been shown to be positively associated with levels of psychological distress (Wills & Shiffman, 1985). Stress and associated distress or depression is an important factor in the adoption of smoking behaviour (Naquin & Gilbert, 1996).

The model that has been used to explain the impact of stress and its associated distress or depression on health behaviour is the resilience approach, which takes into account the influences of protective factors on youth, at both individual and social level (McLoyd, 1998). Successful adaptation or resilience has been described as the interaction between risk and protective factors, specifically a process that results from an individual that successfully copes with the risk factors, or vulnerabilities, that are present in the environment (Luthar, 2003; Luthar & Cicchetti, 2000). Risk factors, such as stress, have been defined as a hazard relating to the individual, or to the individual's environment, that can increase the likelihood of problem development (Rutter, 1987). Studies on resilience in terms of adaptation and successful coping despite risk often cite protective factors to explain why only the minority of individuals living in adverse conditions manifest problem behaviours and symptoms of psychopathology (Rutter, 1987). Protective factors have been referred to as those factors in the individual, or the environment, that enhance an individual's ability to resist problems and deal with life's stresses. Thus, protective factors exert their effect only when a risk is present (Rutter, 1987). Protective factors have been considered to either compensate the risk, or buffer the effect of risk on health behaviours.

Protective factors that have been consistently found to have a buffering effect on smoking include social support and increased personal anti-smoking beliefs, which denormalize tobacco use (Patterson, Lerman, Kaufmann, Neuner, & Audrain-McGovern, 2004). Research

has incorporated normative influences, such as personal beliefs, in behavioural models and found that this measure correlates with, and strongly predicts, a range of behaviours, including smoking (Eisenberg & Forster, 2003; Hamilton, Biener, & Brennan, 2008). While external protective factors include social support or organizations that promote positive youth development, the term 'external' emphasizes the social environmental influences on youth health behaviour and development and moves away from conceptualization of health behaviour as a static, individual trait.

It has been suggested that factors residing within the individual include a variety of coping resources (i.e., disengagement vs active coping) that contribute directly to smoking behaviour, implying that the increased vulnerability of students with poor coping skills is an important issue. The linkage to the variations in coping is whether the stressors are controllable. When situations are controllable, active coping strategies predominate; when situations seem less controllable, alternative strategies such as disengagement, or using cigarettes to release stress predominate (Scheier, Weintraub, & Carver, 1986). Stress, measured in various ways, is consistently associated with smoking behaviour (Hemmingsson, Kriebel, Tynelius, Rasmussen, & Lundberg, 2008). Smoking has been suggested as a coping tool to deal with stress as nicotine has pharmacological effects that moderate stress (Henningfield, Cohen, & Pickworth, 1995; Marlatt & Cordon, 1985; Shiffman et al., 2007). Furthermore, once smokers adopt smoking as a method for coping, they are less likely to see the need to try to develop healthier and active coping strategies.

If vulnerability to stress and depression is linked to smoking behavior in university students, then it is important to understand the moderators and mediators of this relationship so that health promotion practitioners can develop more effective targeted smoking prevention and

cessation interventions for this population. Social support and coping abilities may be important moderators, given that people who have high level of coping abilities are less likely than those with low level of coping abilities to smoke (Patterson et al., 2004). Prior studies have not adequately addressed this issue, and thus, it is unclear if stress and depressed mood can be moderated by protective factors, which lead to reduced chance to take up smoking.

Given that both high levels of stress and low levels of coping resources have been found to be associated with tobacco use, it might be expected that the two would interact, that is, the availability of coping resources (e.g., disengagement coping style) might be expected to influence tobacco use during times of high stress, but not during times of low stress. On the other hand, protective factors such as social support and personal beliefs might have buffering effects on the relationship between stress and smoking behaviour. If, for example, stress is high and coping skills are also high and personal beliefs level is anti-smoking, the likelihood of smoking will be low. On the other hand, if stress is high but coping is low and personal belief is pro-smoking, smoking will be more likely to occur (Figure 1 below)

Considering the possible relationships between the variables discussed above, we have formulated the following two hypotheses:

Hypothesis 1: Increased stress is associated with self-reported depression, which may serve to increase levels of disengagement coping strategies, which, in turn, is associated with elevated levels of smoking.

Hypothesis 2: Active coping strategies, anti-smoking personal beliefs and protective factors (social support) may serve to buffer the effects of increased levels of stress and depression on smoking behaviour.

Insert FIGURE 1

This research is part of a longitudinal prospective intervention study on the promotion of health and prevention of smoking behaviour among university students. It provided an important opportunity for identifying the mechanisms underlying smoking behaviour among university students.

METHOD

A cross-sectional investigation using survey questionnaires with university students was conducted. Students across three campuses of an urban university in Brisbane, Australia, were invited to participate in an online survey in August 2009. Preliminary reports compared the sample characteristics with the overall university data to ensure sample representativeness. All participants completed an online survey administered via the e-mail system at the University after the invitation was sent out by the Pro-Vice Chancellor. As an incentive to complete the survey participants were invited to participate in a prize draw. The study was approved by the Griffith University Human Research Ethics Committee (Ref number: PBH/24/09/HREC).

Participants

In August 2009, 18000 university students in the Brisbane to Gold Coast area, aged 18 to 60 years were invited to participate in the study. Before students filled in an extensive questionnaire they were informed that the information they provided would be analysed to identify risk factors in terms of smoking. The questionnaires were then administered by an online survey by broadcast email. To ensure that there was a reasonable spread of participants in terms of year of study, age, gender, and residential status, the entire university sample characteristics were also extracted for comparison.

Measures

Standardised instructions were provided in the survey. The questionnaire was a structured self-report instrument and inquired about socio-demographic characteristics, current smoking behaviour, life stressors and mental health status, as well as knowledge and attitudes about smoking. Coping strategies such as social support, disengagement coping, participation in social activities and exercise were also assessed.

Socio-demographic characteristics: Socio-demographic data collected included age, gender, marital status (divorced/married/widowed), ethnicity (Caucasian/Asian/others), monthly income, and level of education based on years of schooling. Participants in the sample were asked to self-rate their medical diagnosis provided by their doctors, where available.

Smoking habits were assessed by asking participants, "Do you currently smoke tobacco?" Answers for this question could be "Yes" or "No", and current smokers were defined as respondents reporting ''Yes'' to this question. Current smokers are those who either regularly or occasionally smoke tobacco, including manufactured cigarettes, roll-your-own cigarettes, cigars and pipes. This indicator was calculated for all persons aged 18 to 60 years.

Life Stressors: The Stress Scale (Clements & Turpin, 1996) was used to measure life stressors. Each stress event was given a score that represents the amount of readjustment a person has to make in life as a result of the change. The Stress Scale has a reasonable level of test-retest reliability with a correlation coefficient level of 0.66, and predictive validity of

anxiety measured by the General Health Questionnaire (Clement & Turpin, 1996) with a correlation coefficient of 0.58.

Depression measure: Depression was assessed via self report and included questions about mental illness including depression, anxiety, eating disorder, schizophrenia, other forms of psychosis, and bi-polar disorder. Answers to those questions could be, "No", "Yes, diagnosed" (without prescription or a medical consultation), or "Yes, treated" (with prescription and/or a medical consultation). All questions were answered in a "yes" (yes with diagnosis/yes with treatment) or "no" fashion.

Personal beliefs on smoking: Smoking beliefs were evaluated in the current study by asking participants, ''Would you say your attitude to smoking is one of…?''. Answers for this question could be ''strongly approve/approve/neither approve nor disapprove/disapprove/strongly disapprove''. Perception of the exposure to environmental smoke was assessed by two questions as follows: "Are you bothered or affected by smoke on campus…?" with answers for this question being either "Yes" or "No". The effect of smoking on health is assessed by asking students, "Do you think the smoke from other people's cigarettes on campus is harmful to you…?". The choice of answers for this question was: "Definitely yes", "Probably yes", "Probably no", "Definitely no".

Coping Strategies: Eight items from the COPE questionnaire (Carver, Scheier, & Weintraub, 1989) were chosen to assess two coping strategies "using emotional social support" and "tobacco use". The four emotional social support questions were as follows: "I discuss my feelings with someone"; "I try to get emotional support from friends or relatives"; "I get sympathy and understanding from someone"; "I talk to someone about how I feel". The four

tobacco use questions from the COPE were as follows: "I smoke cigarettes to make myself feel better"; "I try to lose myself for a while by smoking a cigarette"; "I smoke cigarettes, in order to think about it less"; "I smoke cigarettes to help me get through it". These two dimensions of COPE have a good internal consistency with a Cronbach alpha of 0.76 and 0.61 respectively (Carver et al., 1989). The questions showed a high level of predictive validity of self-esteem and locus of control. To reflect active coping strategies, two questions including "I join recreational activities, such as sports or exercise to get through it", "I participate in social activities such as choir, or church or volunteering organisations" were designed and added into the COPE questionnaire. The alpha level of reliability of the two questions is 0.65 for the current study. The questionnaires used above showed that validity coefficients are not affected by socio-demographic variables and particularly age, thus avoiding an age test bias.

Table 1 below confirms that the validity and reliability of the stress, COPE and attitude and knowledge scales have reached an adequate level for the current study sample. The construct validity for the three scales is 49%, 81%, and 57.6% of variances explained respectively in principal component analysis. The reliability of the Stress Scale, COPE, and attitude and knowledge scale was found to be moderate to high with Cronbach alpha levels of 0.73, 0.94, and 0.59 respectively.

Insert TABLE 1

Statistical analyses

We first determined the overall and by-gender group prevalence of current tobacco use (i.e., number of current tobacco cases divided by the total number of participants and the number of cases by each gender divided by the total number in that gender group).

There were a number of strong and statistically significant correlations within and across sets of significant predictor variables (i.e., there was substantial collinearity among predictors). Therefore, structural equation modelling (SEM) was used to generate a multivariate model. SEM was selected to model associations because the sets of predictor variables can be considered indicator variables for specific latent constructs. The statistically significant correlations among the measures within predictor sets supports the use of this approach, and sufficient sample size are suitable for SEM model. Maximum likelihood estimation results are reported. SEM was chosen to test hypothesis 1 and 2.

Using SEM, the hypothesized model, which tests the relationships among the latent factors (independent, mediating, and dependent variables), was analysed with analysis of moment structures (Joreskog & Sorbom, 2004). SEM permits simultaneous assessment of a range of relations among constructs and rigorously examines and compares similarities as well as differences between two or more groups. LISREL provides full maximum likelihood estimates and presents a means of controlling for the presence of measurement errors (Joreskog & Sorbom, 2004). In the SEM model, the viability of our proposed latent factors was also examined in the structure model. The structure model seeks to determine if the number of latent factors and the loadings of indicator variables on them conform to what is empirically expected. The latent factors comprise all unobserved variables (e.g., coping strategies) which are measured by their respective observed variables (e.g., "I participate in social activities, e.g., choir, church and volunteering work"). Statistical tests to evaluate

model fit were based on the normed fit index (NFI) (Bentler, 1980), comparative fit index (CFI) (Bentler, 1980), and root mean squared error of approximation (RMSEA) (Browne & Cudeck, 1993). Values above 0.90 on the NFI, CFI and GFI, and values less than 0.08 for RMSEA, signify good fit (Browne & Cudeck, 1993). Although Chi-square is reported, it was only used to evaluate the relative differences in fit among competing models because it is very sensitive to sample size (Hoyle, 1995). Further analyses were conducted to examine the structural models that reflect hypothesized relationships among the latent variables (see Figure 1).

RESULTS

Response rate and sample characteristics

A total of 3515 students, including both undergraduate and postgraduate students in both full time and part-time mode, responded to the online survey. In the study sample, women represented 74.2%, Caucasians 81.5% and younger age (18-30) 76.9% of the total sample. Undergraduate students represented 80.8% of the sample. Regarding educational level, 91.6% of the students had at least 12 years of schooling. Half of the students (48.8%) received less than $12,000 in terms of annual income (See Table 2).

Insert TABLE 2

There were no significant differences between the study sample and the total university undergraduate and postgraduate student population in gender and nationality, but there were significant differences between the two groups in terms of age and student study year level. There was a smaller proportion of students aged less than 21 years in the study sample compared with the university student population and there was a higher proportion of year 1 students in the study sample compared with the university student population. Therefore, in

order to manage the potential effect of age and student year level, these two variables were controlled in the structural equation models to ensure the representativeness of the study sample of entire university student population.

Insert FIGURE 2

Figure 2 shows the model testing results for Hypothesis 1. It indicates that the relationship between stress and likelihood of smoking was moderated by the disengagement coping methods when students were depressed. It indicates that a high level of stress is related to increased level of depression, and when the methods of disengagement of coping strategies were chosen, there was an increased chance of adopting smoking behaviour. As predicted, when respondents had high levels of stress and depression and when disengagement coping strategies were adopted, the direct path from stress to smoking behaviour remained significant. Hypothesis 1 is therefore supported.

An evaluation of the model's robustness was judged on the basis of (a) the appropriateness of the direction, strength, and significance of the parameter estimate; (b) the convergence of the maximum likelihood estimates; (c) the statistical tests and fit indices previously noted (NFI, CFI, GFI, and RMSEA); In the measurement model for hypothesis 1, all variables' loadings on the hypothesized latent factors were significant (P<0.01) and the overall fit was good ($\Delta\chi^2$= 22.5, NFI=0.95, CFI=0.95, GFI=0.92, RMSEA=0.08).

Table 3 shows the standardised path coefficients (i.e., standardised regression weights) of the total latent variables and the indirect effect of stress on other latent variables.

Results indicate that the path from stress to smoking indicates that stress was significantly related to smoking behaviour. The path from stress to smoking was significantly related when disengagement coping strategies were taken into account (β=0.80 from disengagement to smoking).

Figure 3 shows the model testing results for Hypothesis 2. It indicates that the effect of stress and depression on smoking behaviour was mediated by active coping strategies and social support. Under high levels of stress and depression respondents were less likely to engage in smoking when social support and coping levels were high. In the measurement model for Hypothesis 2, all variables' loadings on the hypothesized latent factors were significant (P<0.01). Overall fit was good ($\Delta\chi^2$= 9.14, NFI=0.95, CFI=0.96, GFI=0.95, RMSEA=0.05).

Table 4 shows the standardised path coefficients (i.e., standardised regression weights) of the total latent variables and the indirect effect of stress on other latent variables.

Results in Table 4 indicate that the path from stress to smoking is not direct, in that stress is not significantly related to smoking behaviour. The path from stress to smoking is not

significantly related when coping strategies and social support levels were high and these, in turn, were related to decreased levels of depression ($\beta=-0.89$ from active coping to depression). Personal beliefs were independently related to smoking. The effect, for example, of an 'antismoking belief' on smoking is related to a decreased chance of smoking when active coping and social support levels are simultaneously high.

In conclusion, stress did not have a significant **direct** effect on smoking behaviour when the impact of depression, social support and active coping abilities as mediators were included in the model. Thus, when stress was high, coping skills were also high and personal beliefs were oriented towards anti-smoking, the likelihood of smoking was low. Hypothesis 2 was therefore supported.

DISCUSSION

Current tobacco usage rates for both genders (20.0%) and among men (26.0%) and women (18.6%) in this sample indicate that smoking is a relatively common practice among university students in Australia. The prevalence of tobacco use among Australian university students was similar to that found among young people in Australia as a whole (20%) (AIHW, 2006).

Some researchers have suggested that smoking might serve as a coping mechanism through which people deal with life and environmental stress. The current study investigated study and life stressors (Clement & Turpin, 1996) and our results show that these stressors substantially contribute to the explanation of smoking behaviour. The impact of differential exposure to stress on smoking behaviour of university students is in accordance with the majority of other studies on this subject that state that well established stressors contribute to

health behaviour (Dohrenwend, 1973; Thoits, 1982). However, several issues should be considered in judging the extent or context in which these results can be taken as valid. First, stress is associated with smoking when stress affects depression levels, and when protective factors are not available, so that an increased level of depression might heighten stress levels if the life stressors are not controllable. People who reported they typically could do nothing to deal with the life stressors tended to rely more on such strategies as denial and disengagement. Those who were stressed, tended to become preoccupied with 'distressful' emotions, were low in coping strategies, were more likely to disengage from their goals when under stress, and were more likely to use smoking as a method to deal with stress. Second, when the pathway between stress, depression and smoking is moderated by active coping strategies and social support, stress is related to the decreased likelihood of smoking. Given any level of stress, coping and social support may have attenuated the depression level, hence leading to a decreased chance of adopting smoking behaviour.

Personal beliefs did not act as a moderator of the relationship between stress and depression, and smoking. However, a high level of pro-smoking belief was significantly related to smoking behaviour. A pro-smoking belief acted simultaneously together with the effect of social support and active coping strategies on the relationship between stress, depression and smoking behaviour. People who believe that smoking did not have a harmful effect on health, and whose exposure to environment smoking did not bother or affect them had a higher chance of smoking, indicating that for this sample students' beliefs towards smoking may be important.

Our results provide evidence that supports the resilience perspective that personal coping resources, personal beliefs, and protective factors such as social support, are important factors to either lead to people adopting smoking behaviour, or decrease the likelihood of smoking.

LIMITATIONS

There are a number of limitations in this study. First, this was not a random sample, but rather one that self selected according to whether they wished to complete the on-line survey, thus there may have been selection bias. Second, we did not measure the length of time that participants had been stressed and depressed, thus we were not able to determine whether smoking behaviour was due to cumulative effects of stress and depression. Third, other variables such as informal social control, availability of health services were not analysed in this paper. These variables may have provided additional explanation of the effects of the multi-factorial university characteristics on smoking behaviours.

CONCLUSIONS

These findings can provide the basis for designing prevention and cessation programs for young adults. If, in fact, the relationships are causal, interventions designed to modify coping strategies might provide a way of reducing smoking. Such programs may be more effective and easier to implement than interventions designed to address physical and mental health variables. It may, in fact, be easier to have someone adopt active coping strategies (such as exercise, recreational activities, seeking social support) than to reduce their level of stress or anger. Interestingly, it appears that effective interventions may be similar for males and females in these areas.

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Table 1. Validity and reliability of Stress, COPE, and Knowledge and Attitude Scales for the current study sample.

Scale	Scale	No of items	% of Variances explained	Reliability (alpha level)
Stress		31	46.88%	0.73
COPE (81.15% variances explained in total, and reliability alpha level is 0.76)	Social support	4	36.42% in the COPE scale	0.91
	Disengagement coping	4	31.55% in the COPE scale	0.96
	Active coping	2	13.17% in the COPE scale	0.65
Personal belief		3	57.58%	0.59

Table 2. Sample's socio-economic characteristics

Socio-economic variables	Study Sample	University sample demographic characteristics	χ^2	P
	N* (%)	N (%)		
Gender				
Female	2531 (74.2)	21833 (58.8)	0.24	0.62
Male	882 (25.8)	15276 (41.2)		
Age				
<21	664 (26.2)	14274 (38.4)	478	0.001***
21-30	1084 (42.8)	16671 (44.9)		
31-40	353 (13.9)	3586 (9.7)		
41-50	278 (11.0)	1862 (5.0)		
>50	153 (6.0)	743 (2.0)		
Student year level				
First year	1166 (34.1)	9227 (25.90)	202.03	0.001***
Second year	664 (19.4)	7217 (20.26)		
Third year	935 (27.3)	8929 (25.61)		
Postgraduate	655 (19.2)	10255 (28.78)		
Nationality				
Domestic students	2929 (73.9%)	27088 (73.5%)	0.27	0.63
International students	1037 (26.1%)	9780 (26.5%)		
Marital status				
Never Married	2080 (67.1)			
Widowed	11 (0.4)			
Divorced	119 (3.8)			
Separated but not divorced	48 (1.5)			
Married	842 (27.2)			
Qualification				
Illiterate	4 (0.1)			
Year 9 or below	43 (1.4)			
Year 10	117 (3.8)			
Year 11	97 (3.1)			
Year 12	2852 (91.6)			
Income				
More than $60,000	192 (6.2)			
40K-59,999	215 (6.9)			
12,000-39,999	1185 (38.1)			
Less than 12,000	1516 (48.8)			

Each variable shows different size due to missing information

Table 3. Model paths of stress, depression, disengagement coping strategies, and smoking behaviour

Paths	estimate	SE	T ratio	P
Stress-Smoking	0.10	0.02	4.54	P<0.001
Stress-disengagement	0.05	0.02	3.52	P<0.01
Stress-depression	0.40	0.03	15.56	P<0.001
Disengagement-depression	0.21	0.01	14.76	P<0.001
Disengagement-Smoking	0.80	0.02	53.13	P<0.001
Depression-Disengagement	0.10	0.02	4.54	P<0.001
Total effect of stress on smoking	0.99	0.02	45.40	P<0.001
Total effect of stress on disengagement coping	0.22	0.02	9.95	P<0.001
Total effect of stress on depression	0.40	0.03	15.56	P<0.001

Table 4. Model paths of stress, depression, coping strategies, social support and smoking behaviour

| Paths	estimate	SE	T ratio	P
Stress-coping	0.06	0.02	4.00	P<0.001
Stress-Social support	0.09	0.02	4.50	P<0.01
Stress-depression	0.39	0.03	13.00	P<0.001
Beliefs-smoking	0.80	0.01	8.00	P<0.001
Social support-smoking	0.34	0.02	17.00	P<0.001
Social support-coping	2.12	0.02	101.00	P<0.001
Active coping-social support	-5.59	0.02	279.50	P<0.001
Active coping-depression	-0.89	0.02	44.50	P<0.001
Total effect of depression on smoking	-0.013	0.007	-1.884	
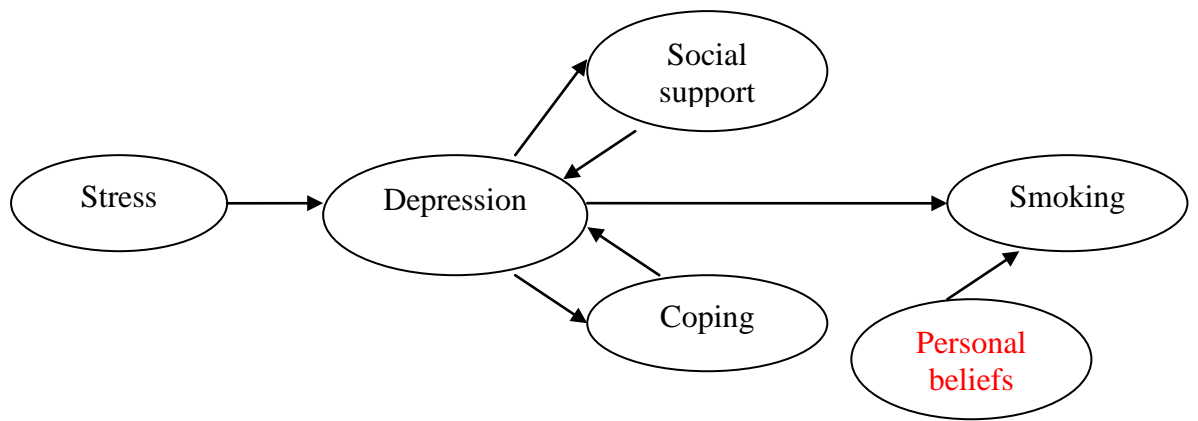
Figure 1: Hypothesized relationships among latent variables (Stress, depression, social support, coping and smoking)
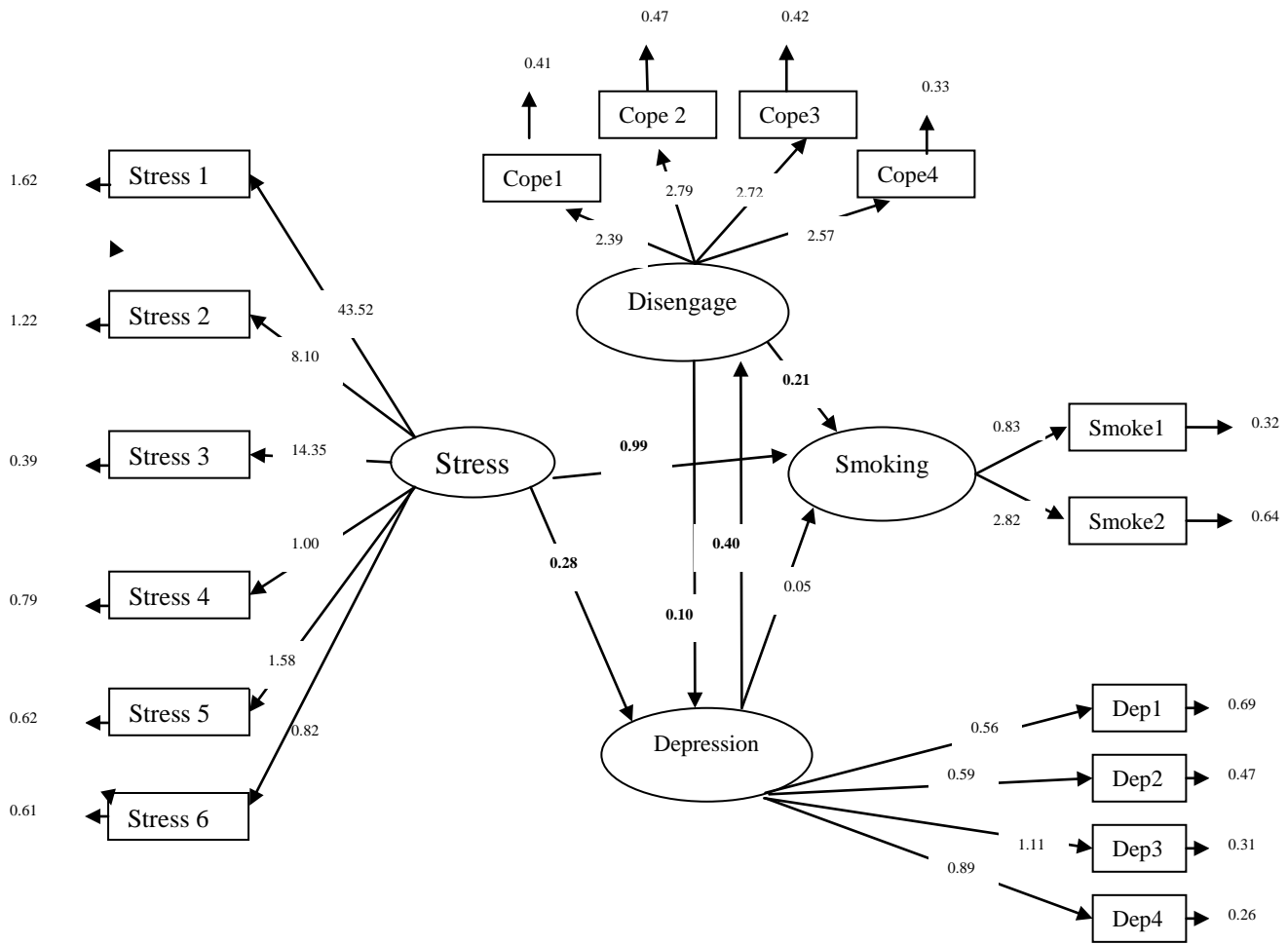
Figure 2: Stress and likelihood of smoking moderated by smoking as disengagement coping methods
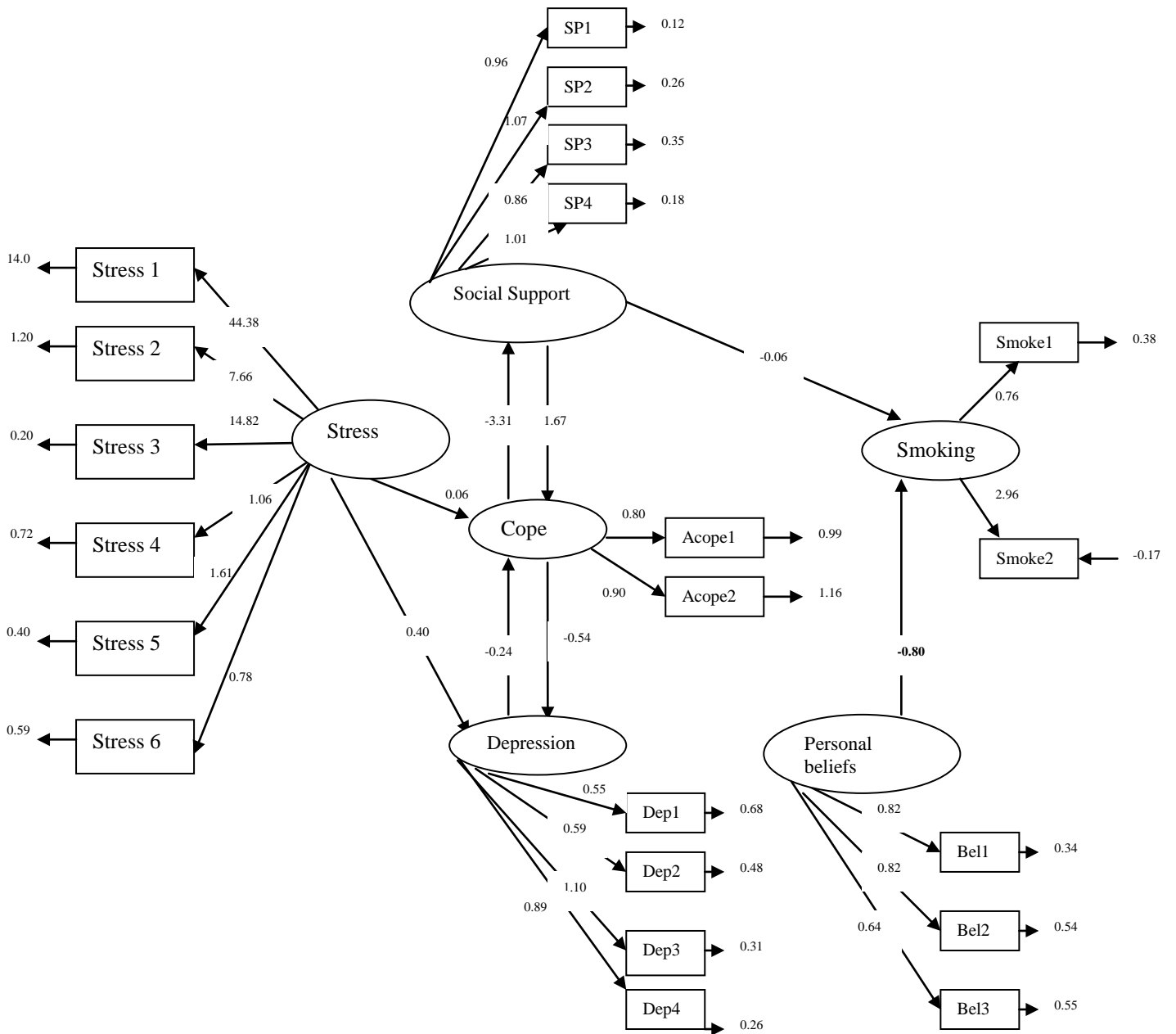
Figure 3. The effect of stress and depression on smoking behaviour mediated by active coping strategies and social support