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Do perceptions of vulnerability and worry mediate the effects of a smoking cessation intervention for women attending for a routine cervical smear test? An experimental study

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Abstract

Objective

There have been numerous correlational studies examining whether perceptions of vulnerability or worry are better predictors of health-related behaviour. The aim of this experimental study was to explore some of the potential causal relationships involved: are the effects of a brief smoking cessation intervention for women attending for cervical smear tests on intentions to stop smoking mediated by perceived vulnerability or worry about cervical cancer?

Design

A mediation analysis of an experimental study.

Main outcome measures

Perceived vulnerability to and worry about cervical cancer, and intentions to stop smoking in the next month.

Results

Questionnaires were completed by 172 (71%) women at 2-week follow-up. Compared to women in the control group, those in the intervention group had higher perceptions of vulnerability, worry and intentions to stop smoking. Personal ($p < 0.01$) and comparative ($p < 0.05$) vulnerability were significant mediators of the relationship between study group and intentions to stop smoking. Worry about cervical cancer was not related to intentions.

Conclusion

This study suggests that worry may be a less important construct in relation to disease prevention behaviours such as smoking cessation. More experimental studies, comparing

different behaviours, are needed to determine the causal relationship between worry and outcomes.

Keywords: smoking cessation, vulnerability, worry, primary prevention, uterine cervical neoplasms

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Introduction

As well as increasing the risks of coronary heart disease, lung cancer, and other serious illnesses, smoking doubles the chance of developing cervical cancer (Szarewski & Cuzick, 1998). Many women are unaware of this (Marteau, Rana, Kubba, 2002). Giving information about female smokers' increased risk of cervical cancer as part of nurse-delivered brief smoking cessation advice during routine cervical screening has been shown to increase women's motivation to stop smoking (Hall et al., 2007). However, the psychological mechanisms of this effect have not been explored. Two potential psychological mediators, which have received much attention in the literature, are perceived vulnerability to health threats and worry about health threats.

Health threat messages usually aim to increase perceptions of vulnerability. Risk or vulnerability perceptions are included in many theories of health behaviour such as the Health Belief Model (Janz & Becker, 1984), Protection Motivation Theory (Rogers & Prentice-Dunn, 1997) and the Extended Parallel Process Model (Witte, 1992). Meta-analyses of the association between perceptions of vulnerability and outcomes usually find a small positive association, with mean estimated effect sizes varying from $r = 0.12$ to $r = 0.20$ (Milne, Sheeran & Orbell, 2000; Harrison, Mullen & Green, 1992; Floyd, Prentice-Dunn & Rogers, 2000). With the exception of Leventhal's Parallel Process Model (Leventhal, 1970) and Witte's Extended Parallel Processing Model (Witte, 1992) most models of health behaviour do not include affect.

Perceptions of vulnerability are assumed to involve cognitive processes. In contrast, worry is closely related to anxiety and emotionally driven, although it is also

considered to involve cognitive activity. There has been considerable recent interest in the role of worry in health behaviours (e.g. Cameron, 1997; Hay et al., 2006; Robb et al., 2006; Peters et al., 2006; Moser et al., 2007). Although worry can be maladaptive when it is a feature of a generalised anxiety disorder (Borkovec et al., 2004), it has also been suggested that worry can be adaptive when it facilitates analytic thinking and motivates healthy behaviour (Davey et al., 1996). Adaptive worrying may reflect problem-focussed coping and promote information seeking and monitoring of coping strategies (Davey et al., 1992). It has also been suggested that brief periods of worry and negative feelings help motivate behaviour change by serving as continual cues to action (McCaul et al., 1998). There is some evidence to suggest that worry can be adaptive in relation to disease detection behaviours. A meta-analysis of 12 prospective studies found a small ($r = 0.12$) but reliable association between worry about breast cancer and breast cancer screening behaviours (Hay et al., 2006).

Although perceived vulnerability and worry tend to be related (Cameron & Leventhal, 1995), studies exploring the associations between both perceived vulnerability and worry with health-related behaviours have produced mixed findings. For example, perceived vulnerability but not worry has been shown to be an independent predictor of interest in genetic testing (Croyle & Lerman, 1993; Lerman et al., 1994). In contrast, worry but not perceptions of vulnerability predicted interest in genetic screening for breast cancer (Cameron & Diefenbach, 2001) and subsequent uptake of mammography screening (Diefenbach et al., 1999; McCaul et al., 1996). A recent cross-sectional study showed that both perceptions of vulnerability and worry were independently associated with past regular uptake of mammography, sigmoidoscopy and colonoscopy, but neither was associated with having a fecal occult blood test or prostate screening (Moser et al., 2007).

Studies exploring the relationship between perceived vulnerability, worry and health behaviours have focussed largely on disease detection behaviours. These present people with the threatening prospect of detecting the presence of disease. Although engaging in disease detection behaviours has the potential to reduce the severity of the disease detected, and thereby survival rates, they do not reduce the risk of getting the disease. In contrast, disease prevention behaviours such as smoking cessation can directly reduce risk. It has been suggested that disease detection behaviours are more likely than disease prevention behaviours to be influenced by emotional factors such as worry (Millar & Millar, 1993).

Nevertheless, several studies have indicated that worry might be an important predictor of disease prevention behaviours (McCaul & Mullens, 2003). Mermelstein and colleagues (1999) found that worry about skin cancer was a significant predictor of whether or not sunbathers took a voucher for sunscreen. Cuite and colleagues (2000) found that worry about Lyme disease was a strong predictor of intentions to be vaccinated against the disease even after perceived vulnerability had been controlled in the analysis. A prospective study, Dijkstra and Brosschot (2003) found that worry about the health consequences of their smoking was positively associated with smokers' subsequent quitting activity. These findings prompted the authors to speculate that one function of worry is to keep the potential threat more available in mind and suggested that interventions to increase worry might prove useful in promoting smoking cessation.

All these studies of worry and disease prevention behaviours employed correlational designs. They are thereby limited in their capacity to demonstrate a causal role for worry in disease prevention behaviours (Weinstein, 2007). Equally, studies exploring the relationship between vulnerability perceptions, worry and outcomes are usually cross-sectional, with a small number of prospective studies, and few if any being

experimental. Even in prospective studies, the associations between perceived vulnerability and behaviour are not necessarily causal, as the observed association could be due to a third variable, such as symptoms experienced, which causes both perceptions and behaviour. In contrast, an experimental test with mediation provides strong evidence of causation.

A recent experimental study McCaul and colleagues (2007) manipulated student smokers' worry about cancer by asking them to read at random intervals cards with brief statements about the effects of smoking. This intervention increased worry, motivation to stop smoking and plans to quit. This study also showed that worry was associated with motivation to stop smoking, which suggests that worry may have mediated the impact of the intervention on motivation. However, this analysis was not reported.

The aim of the present study is to explore some of the potential causal mechanisms of the effects of an intervention to promote intentions to stop smoking, a disease prevention behaviour. An experimental design and mediation analysis are used to examine the respective causal roles of perceived vulnerability and worry. The hypothesis is that the both perceived risk and worry are independent mediators of the impact of the smoking cessation intervention.

Methods

Participants

The study population consisted of smokers attending for cervical screening at one of eight general practices (offering primary care in the community) located in the south east of England. The practices were part of the Medical Research Council General Practice Research Framework. In the UK, cervical screening is universal and free of charge at the point of use. One practice nurse currently conducting cervical smear tests in each of the practices participated in the study. Women were eligible to participate if they

smoked at least one cigarette a day and understood spoken English. Women were excluded from the study if they were participating in any other intervention study or general practitioners (primary care physicians) requested that they were not approached.

We planned to recruit 280 smokers. This gives 80% power at the 5% level of significance to detect a medium sized difference (Cohen's $d = 0.42$) in mean intention to stop smoking between the intervention and control groups (two-tailed test). This is the effect size found in our leaflet evaluation (Hall, Weinman & Marteau, 2004). The sample size calculation allowed for 30% loss to follow-up and incorporated an increase of 10% to allow for a possible variance inflation factor resulting from the randomisation of clinic weeks rather than individual participants.

Design

A cluster randomised design was used, with clinic weeks as the units of randomisation. Clinic weeks were randomly allocated by the study statistician to the trial arms, using computer generated random numbers. In intervention weeks, nurses delivered brief smoking cessation advice as part of the smear test visit to all smokers consenting to take part in the study. In control weeks they did not give smoking cessation advice.

Although some nurses already gave smoking cessation advice during smear test consultations, all nurses were asked not to give smoking cessation advice to women in the control group.

Procedure

The intervention was given just once to each woman in the intervention group at the end of her cervical smear test appointment, and it took on average five minutes to deliver. It was based on the "5 A's" approach designed for health professionals assisting patients in stopping smoking (Ask, Advice, Assess, Assist and Arrange) (West, McNeill & Raw, 2000). Women were informed of their increased risk of cervical cancer, that

stopping smoking could reduce this risk, an explanation of how smoking adversely affects the cervix, and, for those interested in stopping smoking, information on the widely available services to help them do so. In addition to verbal smoking cessation advice, nurses gave all women in the intervention group an information pack including a leaflet we developed for the study (Hall et al., 2003).

When practice nurses received the results of current smear tests, they forwarded them to the study team. Outcomes were assessed for both groups by postal questionnaire at two weeks follow-up. One reminder questionnaire was sent to participants who did not respond to the initial mailing.

Measures

Intention was assessed by taking the mean of two scales were used (“do you intend to stop smoking in the next month” and “how likely is it that you will stop smoking in the next month”), each with seven-point response scales (Cronbach’s Alpha = 0.81). Worry (how worried are you about getting cervical cancer?) and perceived personal vulnerability (how likely do you think you are to develop cervical cancer?) were assessed using single seven-point scales. Comparative vulnerability (vulnerability compared to non-smokers) was assessed using a five point response scale. Baseline readiness to stop smoking (contemplators: planning to stop within the next six months; pre-contemplators: not planning to do so) and demographic measures were collected by nurses before the intervention was delivered.

Analysis

To assess potentially mediating effects in explaining the impact of the intervention upon intention to stop smoking, the methods of Preacher and Hayes (2004) to assess single mediation effects and Preacher and Hayes (unpublished) to assess multiple mediation effects were used. A comparison of 14 methods of assessing mediation

concluded in favour of the Sobel test or its variants, instead of the more popular Baron and Kenny (1986) method, mainly due to it employing a single test of the statistical significance of the mediating pathway (MacKinnon, Lockwood, Hoffman, West & Sheets, 2002). The method of Preacher and Hayes (2004) is a development of the Sobel test that uses bootstrapping to provide an appropriate sampling distribution, rather than relying on the questionable assumption that it is appropriate to use the normal distribution. The method we employed is that of Preacher and Hayes (unpublished), which is an extension of the Preacher and Hayes method (2004), which allows comparisons of the unique contributions of multiple mediators. Since scores did not cluster around clinic weeks, the variance inflation factor was not included in the analyses.

Ethical approval

The study was approved by the Metropolitan Multi-centre Research Ethics Committee (03/11/067) and all relevant local research ethics committees.

Results

The sample

The final sample comprised 242 of the 353 women eligible for the study (69%). There were 121 women in each group. The desired sample size was not achieved because recruitment was slower than expected. Questionnaires were completed by 172 (71%) women at 2-week follow-up. Non-responders at follow-up were younger than responders, however, age was not associated with intention to stop smoking. Since the two groups did not differ in age, ethnicity, education, having an abnormal result on a previous cervical smear test, current smear test result or baseline readiness to stop smoking, these were not entered as control variables in the analyses.

Insert Table

As can be seen in the Table, the intervention had an impact on intentions to stop smoking in the next month and the proposed mediators. Compared to women in the control group, those in the intervention group had higher intentions to stop smoking, worry about cervical cancer and higher perceived personal and comparative vulnerability to cervical cancer. Both personal and comparative vulnerability to cervical cancer were associated with intentions to stop smoking (adjusted $R^2 = 0.056$, $\beta = 0.247$, $p = 0.001$; adjusted $R^2 = 0.025$, $\beta = 0.177$, $p = 0.025$ respectively). Worry about cervical cancer was not significantly associated with intentions to stop smoking (adjusted $R^2 = 0.008$, $\beta = 0.117$, $p = 0.136$). Personal and comparative vulnerability to cervical cancer were moderately correlated ($r = 0.39$) and both were moderately correlated with worry about cervical cancer ($r = 0.38$ and $r = 0.34$ respectively).

Preacher and Hayes (2004) tests for single mediation showed that perceived personal and comparative vulnerability to cervical cancer were both significant mediators of the relationship between group and intentions (mean indirect effects = -0.2144 (95% CI = -0.4498 to -0.0461 ; $p < 0.01$) and -0.1119 (95% CI = -0.2956 to -0.0007 respectively; $p < 0.05$), whereas worry was not (mean indirect effects = -0.0547 (95% CI = -0.2009 to 0.0420). Tests for multiple mediation showed that no mediator uniquely mediated the effects of the intervention: none of the three hypothesised mediators accounted for a significant amount of mediation variance, once mediation variance attributable to the other two variables was partialled out.

Discussion

This experimental study has shown that intentions to stop smoking are increased in response to brief smoking cessation advice for women attending for routine cervical smear tests. This causal relationship is mediated by perceived vulnerability, but not by

worry about cervical cancer. Although the intervention increased worry about cervical cancer, the effect was weaker than that on perceptions of vulnerability to cervical cancer, and worry was not associated with women's intentions to stop smoking. Our findings also provide some support for the hypothesis that worry may be less important in motivating behaviour change in disease prevention behaviours, which can directly reduce risk (Millar & Millar, 1993).

Since worry has a cognitive component, fear and worry are not equivalent. Other measures of emotion such feelings about risk (Weinstein et al., 2007), disgust or fear, might be better predictors of behaviour change than perceived risk or worry. However, whether these feelings could or should be increased during cervical smear test appointments is unresolved. Increasing negative feelings might result in harm if women are deterred from returning for future cervical smear tests. The nurses who delivered the intervention were trained to be empathetic, to avoid arguments, and to affirm and support self-confidence in smoking cessation rather than instil negative emotions in participants, an approach that was appreciated by participants. Furthermore, the intervention did not deter women from attending for future cervical smear tests (Hall et al., 2007).

Personal and comparative risk perceptions have been assessed in many studies, however, there is no consensus as to which is the best predictor of motivation to change behaviour (Weinstein, 1999). It has been suggested that comparative risk perceptions primarily trigger social comparison processes and are not prime determinants of preventive health behaviours (van der Pligt, 1998). This study has shown that individually, both personal and comparative risk perceptions explained the impact of the intervention. However, these measures were moderately related to each other and to worry and neither was an independent mediator of intentions.

The main strength of this study is the design employed, which allows a valid test of a causal model. There are some limitations to this study: potential priming effects of assessing readiness to stop smoking at baseline; measuring outcomes and mediators simultaneously; the use of single item measures to assess perceived vulnerability; the use of an unconditional vulnerability measure; and the use of a proximal indicator of behaviour.

Firstly, readiness to stop smoking was assessed at baseline (prior to the intervention in the intervention group). This may have had a priming effect on one or both groups. Self-reported assessments can influence risk perceptions and intentions to change behaviour (Kalichman, Kelly & Stevenson, 1997). Second, since outcomes and mediators were assessed simultaneously (worry, followed by intentions, followed by risk perceptions), reverse causality cannot be ruled out. It is possible that reporting intentions to stop smoking influenced risk perceptions. The most likely impact of this would be a reduction risk perceptions because respondents with stronger intentions to stop smoking soon could believe that they will stop smoking therefore their risk of cervical cancer is reduced. This would reduce the strength of the association between risk perceptions and intentions to stop smoking. Third, both perceived vulnerability and worry were assessed using single items which are generally thought to be less reliable than multiple item measures. However, the error introduced by this may be relatively small. Weinstein and colleagues (2007), for example, found that single risk items had similar measurement errors to multi-item scales. Fourth our measures of perceived vulnerability were not contingent on continuing to smoke. Women may have taken several factors into account when answering this question. For example, they may have rated themselves as less vulnerable to cervical cancer, because they planned to stop smoking in the future. Conditional vulnerability might have been more strongly related to intentions to stop

smoking and therefore a stronger mediator of the impact of the intervention. Finally, since the evaluation of the intervention was aimed at providing a “proof of principle”, our study was not powered to detect differences in smoking cessation. Nevertheless, intentions are a reliable predictor of health-related behaviour, including smoking cessation (Armitage and Connor, 2001). Further, a recent meta-analysis of 47 experimental tests of intention-behavior relations showed that a medium to large change in intention led to a small to medium change in behavior (Webb & Sheeran, 2006). The effect size for intentions to stop smoking in our study was small to medium (Cohen’s $d = 0.32$), and is thus likely to lead to a relatively small change in smoking cessation. However, brief smoking cessation interventions are expected only to achieve small increases in smoking cessation (i.e. 2.3% to 3.8%) (Wetter et al, 1998; Silagy & Ketteridge, 2000; US Department of Health and Human Services, 2000).

To the best of our knowledge, this is the first published experimental study which has explored the role of both perceptions of vulnerability and worry in relation to disease protection behaviour. This study has shown that women’s intentions to stop smoking in response to brief smoking cessation advice may be explained by increases in perceived vulnerability rather than worry. More generally, there is little need for more correlational studies examining whether perceptions of vulnerability or worry are more important in relation to disease prevention and disease detection behaviours, more experimental tests are needed, as they provide the strongest evidence for causal relationships and hence theory testing.

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Table Impact of smoking cessation advice on worry, perceived vulnerability and intentions to stop smoking

	Intervention N=90	Control N=82	adjusted R ²	Beta ¹	p value
Intention to stop smoking	3.00 (1.92)	2.40 (1.84)	0.019	-0.158	0.040
Worry about cervical cancer	5.16 (1.59)	4.63 (1.73)	0.019	-0.159	0.042
Personal vulnerability cervical cancer	4.39 (1.17)	3.72 (1.29)	0.064	-0.264	0.001
Comparative vulnerability to cervical cancer	4.22 (0.66)	3.95 (0.73)	0.035	-0.202	0.009

All measures scored 1-7 except comparative vulnerability, which was scored 1-5

¹Standardised