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ORIGINAL ARTICLE

Workplace smoking restrictions: smoking behavior and the intention to change among continuing smokers

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Abstract
Objectives In this study, the association between three levels of workplace smoking restrictions and smoking behavior and variables related to the intention to quit among continuing smokers was examined.
Methods Adult smokers were recruited from consecutive patients attending a random sample of 34 general medical practices from a pre-defined, north-eastern German region. Self-reported data were gathered in the waiting room by questionnaire. Cross-sectional data of 1,012 employees were analyzed using ordered logistic regression analyses.
Results Among the sample, 12% reported a smoke-free workplace, 51% had partial, and 37% no smoking restrictions. Daily cigarette consumption was lower when there were higher levels of restriction. No association was found between smoking restrictions and previous attempts to quit, nicotine dependence, or indicators of adjusted inhalation to compensate for the lower number of cigarettes (e.g. puffs per cigarette, darker coloring of filter). Smoking restrictions were positively associated with single psychological measures related to the intention to quit.
Conclusion Employees who continue to smoke may benefit from workplace smoking restrictions in terms of reduced, active smoke exposure and psychological effects increasing their readiness to quit.

Keywords Workplace smoking ban · Tobacco control · Smoking habits · Inhalation behavior · Transtheoretical model

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Beschränkungen des Tabakrauchens am Arbeitsplatz: Rauchverhalten und die Intention zur Verhaltensänderung bei fortgesetztem Rauchen

Zusammenfassung
Zielstellung In der vorliegenden Studie wird der Zusammenhang zwischen drei Ausprägungsgraden von Rauchbeschränkungen am Arbeitsplatz und dem Rauchverhalten, sowie der Intention zur Beendigung des Tabakrauchens untersucht.
Methode Erwachsene Raucher wurden aus einer Stichprobe von konsekutive Patienten in 34 zufällig ausgewählten hausärztlichen Praxen einer nordostdeutschen Region rekrutiert. Die Datenerhebung erfolgte per Fragebogen im Wartezimmer. Mittels ordinaler logistischer Regression wurden Daten von 1012 Berufstätigen analysiert.
Ergebnisse In der vorliegenden Stichprobe gaben 12% an, an einem rauchfreien Arbeitsplatz beschäftigt zu sein. Keine oder partielle Rauchbeschränkungen am Arbeitsplatz berichteten 37% bzw. 51%. Ein höherer Grad der Rauchbeschränkung ging mit niedrigerem täglichem Zigarettenkonsum einher. Zwischen Rauchbeschränkungen und früheren Abstinenzversuchen, Nikotinabhängigkeit

oder Indikatoren für ein kompensatorisches Inhalationsverhalten bei reduziertem Zigarettenkonsum (z.B. Züge pro Zigarette, dunklere Verfärbung des Zigarettenfilters) fand sich kein statistisch bedeutsamer Zusammenhang. Für einzelne psychologische Variablen, die nach Vorbefunden mit der Bereitschaft zur Aufgabe des Rauchens in Zusammenhang stehen, fanden sich positive Zusammenhänge mit dem Grad der Rauchbeschränkungen am Arbeitsplatz.

Schlussfolgerungen Auch weiterhin rauchende Arbeitnehmer profitieren von Rauchbeschränkungen am Arbeitsplatz durch eine verminderte aktive Tabakrauchexposition und psychologische Effekte, welche die Bereitschaft zu Aufgabe des Rauchens erhöhen.

Introduction

Smoking restrictions in workplaces have been initiated in several countries to protect non-smokers from environmental tobacco smoke (US Department of Health and Human Services 1986). In addition to producing an environment with cleaner air, workplace smoking restrictions also might augment the intention to cease smoking, as well as reduce the number of cigarettes smoked per day by continuing smokers (Bauer et al. 2005; Fichtenberg and Glantz 2002; Heloma and Jaakkola 2003; Hopkins et al. 2001; Levy and Friend 2003). However, the effect of workplace smoking restrictions in these regards might be countered by increased smoking off the job or by compensatory smoking, during which smokers adjust inhalation habits to extract more nicotine and other substances from each cigarette compared to when they had unrestricted smoking conditions (Hughes 2000). Such adjustments of inhalation habits may include an increased number of puffs, deeper inhalation, longer duration of inhalation, or compression of the ventilation holes in the cigarette filter.

Smokers employed at workplaces with a higher level of smoking restrictions have been shown to smoke fewer cigarettes during workdays but not during their days off from work, while no such differences in smoking habits between workdays and non-workdays were found for smokers who had no smoking bans at their workplace (Wakefield et al. 1992). Other longitudinal data revealed that cigarette consumption on non-workdays remained unchanged after the implementation of smoking restrictions, and some smokers even decreased consumption after longer periods (Biener et al. 1989; Borland et al. 1991). One study, focusing on inhalation habits, found that employees who had to leave their office building to smoke generally smoked 19% "harder" in terms of puffs per cigarette, compared to smokers observed in purely social situations (Chapman et al. 1997). Finally, a survey with assessments of motivational effects revealed that the level of workplace smoking restriction, measured by four different categories, was positively correlated to the intention to quit smoking among employees (Woodruff et al. 1993).

Smoking restrictions may trigger different psychological mechanisms related to the intention to quit smoking. Restrictions support new experiences and perceptions such as nicotine withdrawal symptoms and an increased awareness and acceptance of non-smoking norms. Such aspects may stimulate critical reflection upon an individual's own smoking behavior and, in turn, lead to an increased intention to quit. On the other hand, workplace smoking restrictions may be experienced as a limitation to the freedom of choice. In the context of interpersonal counseling, this has been known to increase the psychological state referred to as resistance (Miller and Rollnick 2002; Moyers and Rollnick 2002). In the field of alcohol treatment, the level of resistance was found to be a long-term predictor of less favorable outcomes (Miller et al. 1993). Thus, individual decisions to maintain smoking might be strengthened by imposing smoking restrictions on current smokers.

A model that is often used to understand the process of change in regards to well-established habits is the transtheoretical model of intentional behavior change (Velicer et al. 2000). However, it has hardly been applied to smoking behavior change as it relates with workplace smoking restrictions, although intentional processes may be affected when such restrictions are introduced. This model postulates a temporal dimension that is described by five stages of change, all of which must be undergone to achieve and maintain long-term behavior change. According to the individual intention to quit, current smokers were differentiated into the following first three stages: precontemplation, contemplation and preparation. Smokers allocated to the precontemplation stage typically by definition did not intend to quit within the foreseeable future, while smokers in the contemplation stage have considered a behavior change but are currently ambivalent to the costs and benefits of enacting such a change. In the preparation stage smokers are intending to take action in the immediate future and have a plan of action. As intermediate measures indicating progress within the stages of change, the decisional balance and self-efficacy construct were further integrated into the model. The decisional balance construct refers to the smoker's relative weighing of the pros and cons of quitting, and the self-efficacy construct covers his or her confidence to resist smoking in situations of high temptation. The fourth core construct is represented by the process of change, including different self-change strategies which must be activated to progress through subsequent stages of change.

Taken together, the evidence is not sufficiently conclusive as to whether workplace restrictions on smoking lead more to compensatory smoking or to increased intention to abstain from smoking. The aim of the present study was to examine associations between degrees of workplace smoking restrictions and the number of cigarettes smoked per day, degree of nicotine dependence, single indicators of inhalation habits that may reflect behavioral adjustments to compensate for a reduced number of cigarettes, and variables in the framework of the transtheoretical model.

Methods

For the present analyses, baseline data was used from the ProGP study ("Proactive interventions for smoking cessation in General medical Practices"; Meyer et al. 2008), a quasi-randomized, controlled trail, which was conducted to test the efficacy of different brief interventions for smoking cessation among an unselected sample of consecutive patients in general medical practices. The study was approved by the ethics committee of the Association of Physicians Mecklenburg-Vorpommern at the University of Greifswald.

Sample

In Germany, primary medical care is provided by general practitioners in private practices on a fee-for-service basis. In terms of the provision of public health measures, general practices open access to the general population due to the proportion among the general population who are in contact with a physician regularly. According to a general population survey in Germany, 90% of the adults see their doctor at least once a year (Bergmann and Kamtsiuris 1999). Furthermore, employees on sick leave are obligated to visit a practitioner. Thus, primary medical care is an opportune setting in which to investigate employees from various workplaces with respect to smoking. In this study, a two-stage sampling procedure was used. In the first step, a random sample of 44 out of 149 general practitioners in a demographically defined, northeastern German region was drawn. Five practices were excluded because they did not provide primary medical care during the study period. Among the remaining practices, 87.2% (34/39) took part in our study. In a second step, all consecutive patients who attended the practice were screened for age and smoking status within a period of 3 weeks in each practice. We registered 11 560 consultations of 9 896 patients between April 2002 and August 2003. Eligibility for the study was determined by whether the patients reported current smoking, were in the age range of 18–70 years, and were able to respond to a questionnaire. From this group, there were 2,016 eligible patients. Among them, 1,653 (82.0%) gave informed consent to take part in the randomized, controlled trial. For a detailed description of the recruitment of patients see Fig. 1.

Participants answered a paper and pencil questionnaire in the waiting room. The questionnaire was divided into two parts. If the waiting time of a patient in the practice was too short, the patient was allowed to take the second part of the questionnaire home and mail it back. In total, 1,610 participants (97.4%) completed the first part of the questionnaire. After at most two written reminders, 1,431 participants (86.6%) filled in the second part of the questionnaire.

Assessments

Workplace smoking restrictions

Three levels of workplace smoking restrictions were assessed, according to the answers to the following question: Is smoking allowed at your workplace? The first category of "no restriction" was assumed if the individuals answered, "Yes, smoking is generally allowed." Second, workplaces with partial restrictions were assumed if the answer to the question was, "Yes, but smoking is only allowed at certain places or rather at certain times." The third category included smoke-free workplaces based on the answer, "No, smoking is not allowed at all." Individuals also had the option to indicate that they were currently unemployed if that was the case.

Smoking behavior

Active exposure to cigarette smoke was assessed via self-report with the following items (Etter and Perneger 2001): (a) number of cigarettes smoked per day, (b) puffs per cigarette, (c) dark color of the cigarette filter after smoking, rated on a scale between zero, or "not colored at all (white)", and ten, referring to "extremely dark (dark brown)," (d) intensity of smoking, rated on a scale with zero referring to "not intense" to 100 referring to "extremely intense", and (e) type of cigarette smoked with the response options of ultra-light, light, medium or mild, or normal. Due to small numbers, the categories of ultra-light and light were combined for data analysis. Evidence revealed that the combination of items relating to how one smoked his or her cigarette substantially increased the explained proportion of variance in saliva cotinine compared to the number of cigarettes smoked per day alone (Etter and Perneger 2001). Cotinine, a major metabolite of nicotine, is a biochemical marker of cigarette smoke exposure. A serious attempt to quit was defined as abstinence lasting at least 24 h in the past year. The Fagerström

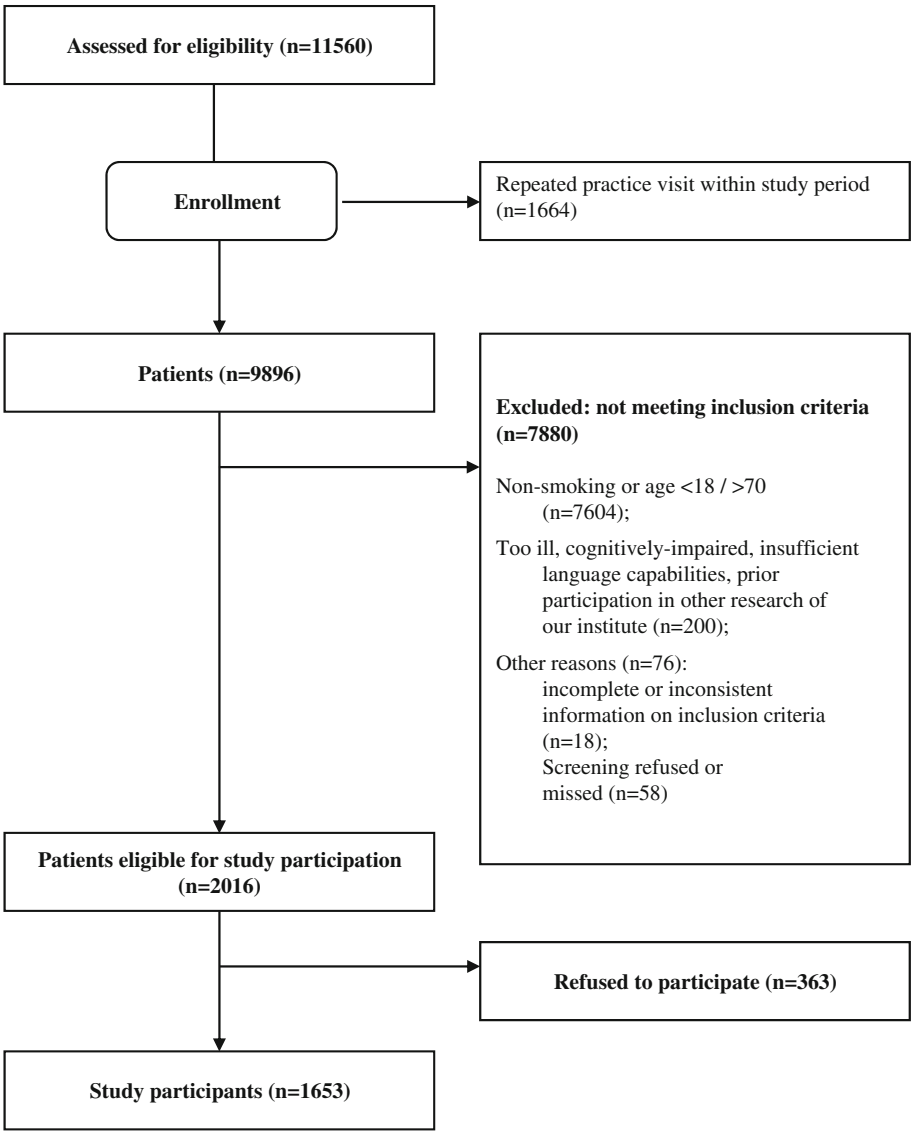

Fig. 1 Recruitment of patients from 34 general medical practices

test for *Nicotine Dependence* (FTND), which consists of six items (Heatherton et al. 1991), was also used. Because the number of cigarettes smoked per day is part of the FTND, this item was excluded in the calculation of the sum score to avoid multicollinearity in the multivariate analyses. Thus, the FTND used in the present study ranged from zero (lowest degree of dependence) to seven (highest degree of dependence).

Variables related to the intention to quit

S*tages of change* were assessed by the following question (DiClemente et al. 1991): Which of the following statements applies best to you? The answer choices were as follows: (1) I am not intending to quit smoking, (2) I am seriously thinking about quitting smoking within the next 6 months, or (3) I am planning to quit smoking within the next 4 weeks. Category 1 refers to the precontemplation stage and category 2 to the contemplation stages. Participants endorsing category 3 were allocated to the preparation stage if they additionally reported an attempt to quit within the last 12 months and otherwise to the contemplation stage. Decisional balance was assessed by a German-language version of two five-item scales for the *pros* and *cons of non-smoking* (Cronbach's alpha 0.83 and 0.85; Jäkle et al. 1999). Participants rated the importance of each statement on a five-point Likert-type scale. Self-efficacy in resisting the temptation to smoke was assessed according to the following three scales (Cronbach's alpha 0.95; Jäkle et al. 1999): confidence to resist smoking in *positive-social situations*, confidence to resist smoking in *negative-affect situations*, and confidence to resist smoking in *habitual or craving situations*. Each of these scales included three items with a five-point Likert-type response

format ranging from "not confident at all" to "very confident". The processes of change were assessed by a 19-item scale (Etter et al. 2000), which included the subscales of *risk assessment*, *commitment to change*, *helping relationships*, *taking control*, and *coping with temptations* (Cronbach's alpha 0.65–0.87; Tönjes et al. 2007). Means were calculated for each scale, ranging from one to five.

Demographic variables

Age, gender, and educational level (categorized by <10, 10, or more than 10 years of school education) were assessed as potential confounders.

Data analysis

Data was included from a total of 1,012 smokers, who provided information about smoking restrictions at their workplace. Individuals who reported being unemployed ($n = 393$) or those with missing data ($n = 26$) on the respective question were excluded from the analysis. Data were analyzed using STATA 9.2. To consider design effects that might result from our two-stage sampling procedure, sample survey methods, as implemented in STATA (Localio et al. 2001), were applied to adjust standard errors for cluster correlations within practices.

To compare participants' characteristics across different levels of smoking restrictions, ordered logistic regression analyses were performed by fitting a proportional odds model, as implemented in the STATA procedure "ologit" (Long and Freese 2006). This model provides a useful extension of the binary logistic model to situations where the response variable, in our case smoking restriction, takes on ordered categorical values. The categories can be ranked from low to high, but the distances between adjacent categories are unknown. The proportional odds model is the most appropriate method when the response variable is a grouped, continuous variable that refers to the situation from which categories from an underlying continuum have been measured (Lall et al. 2002). As a prerequisite, the proportional odds assumption must be satisfied by each covariate (Long and Freese 2006). To verify this, the Brant test (Brant 1990) was used. In case of violation of the parallel regression assumption, generalized, ordered logistic regression analysis, as implemented in the STATA procedure "gologit2", was used to fit partial proportional odds models (Williams 2006). Thus, for covariates that did not meet the proportional odds assumption, two different regression coefficients were estimated. One contrasted the category of "no restrictions" with the combined categories of "partial restrictions" and "smoke-free", while the other contrasted the combined categories of "no restrictions" and of "partial restrictions" with the category "smoke-free". Regression coefficients, b, were transformed to $\exp(b)$, which can be interpreted as a factor change in odds, i.e. odds ratios. Odds ratios greater than one indicate that higher values on the covariate were associated with a higher level of smoking restriction.

In a first step, each demographic, smoking behavior, and intention-related variable was separately entered into a univariate regression model to test for an association with smoking restrictions. In a second step, two multivariate models were performed, including those variables, which were found to be significant ($P \leq 0.05$) in the univariate analyses for variables of smoking behavior and for variables related to the intention to quit. In addition, both multivariate models included all demographic variables that were found to be significant in the univariate analyses.

Results

Table 1 presents a description of the sample with respect to demographics, smoking behavior, and intention-related variables. Among the 1,012 currently employed smokers (age range of 18–62 years), 37.1% reported a workplace without smoking restrictions, 51.3% reported a workplace with partial smoking restrictions, and 11.6% reported at a smoke-free workplace.

Demographic variables

The univariate, ordered logistic regression analyses revealed that, compared to men, women had increased odds of working at places with higher levels of smoking restrictions ($P < 0.001$). Employees with ten or more years of school education were more likely to work at workplaces with partial smoking restrictions and at smoke-free workplaces than at workplaces with no restrictions ($P < 0.001$). No significant association emerged for age. Hence, gender and educational level were included in the multivariate models described below.

Smoking behavior

The univariate analyses described in Table 2 revealed that the odds of working at a place with higher levels of smoking restrictions significantly decreased with an increasing number of cigarettes smoked per day, darker color of the cigarette filter, and higher intensity of smoking. Further, the odds of being at a workplace with no smoking restrictions were lower for smokers preferring to smoke medium or regular cigarettes compared to the remaining categories. No significant differences emerged for puffs per

Table 1 Descriptive statistics for demographics, smoking behavior and intention-related variables for the total sample and different levels of workplace smoking restrictions

	Total sample	No smoking restrictions	Partial smoking restrictions	Smoke-free
All subjects, *n* (%)	1,012	376 (37.1)	519 (51.3)	117 (11.6)
Gender (%)				
Female	49.1	31.1	59.0	63.2
Age, mean (SD)	31.38 (11.3)	32.0 (11.7)	30.8 (11.0)	32.0 (11.5)
Educational level (%)				
<10 years	27.4	36.4	24.8	20.2
=10 years	53.9	51.8	58.1	61.4
>10 years	14.7	11.8	17.2	18.4
Cigarettes smoked per day, mean (SD)	16.3 (7.6)	17.9 (8.0)	15.5 (7.0)	14.3 (7.7)
Puffs per cigarette, mean (SD)	14.3 (12.6)	14.6 (5.6)	14.5 (10.6)	13.8 (6.7)
Dark coloring of cigarette filter, mean (SD)	5.1 (2.2)	5.4 (1.8)	5.2 (1.8)	4.8 (1.7)
Intensity of smoking, mean (SD)	57.5 (28.4)	61.2 (23.7)	58.2 (22.1)	54.4 (23.9)
Type of cigarette (%)				
Light	34.6	24.4	41.9	36.4
Medium	5.6	5.9	5.0	7.1
Regular	59.8	69.7	53.1	56.5
24-h Quit attempt in the past year (%)				
At least one attempt	32.2	34.8	30.6	31.6
Fagerstöm test for nicotine dependence, mean (SD)	2.3 (1.7)	2.4 (1.7)	2.2 (1.6)	2.0 (1.6)
Stages of change (%)				
Precontemplation	64.3	67.6	63.1	69.3
Contemplation	30.3	28.9	32.9	28.1
Preparation	3.6	3.5	3.9	2.6
Decisional balance, mean (SD)				
Cons of non-smoking	2.5 (1.1)	2.7 (0.9)	2.6 (0.8)	2.3 (0.8)
Pros of non-smoking	3.0 (1.5)	2.8 (1.1)	3.0 (1.2)	3.0 (1.2)
Self-efficacy to resist smoking in, mean (SD)				
Positive-social situations	2.5 (1.3)	2.4 (1.0)	2.4 (1.0)	2.6 (1.1)
Negative-affect situations	2.6 (1.3)	2.5 (1.1)	2.6 (1.1)	2.6 (1.1)
Habitual or craving situations	3.2 (1.3)	2.9 (1.1)	3.2 (1.0)	3.1 (1.2)
Processes of change, mean (SD)				
Risk assessment	2.9 (1.3)	2.7 (1.0)	2.8 (1.0)	2.9 (1.0)
Taking control	2.4 (1.0)	2.1 (0.8)	2.3 (0.8)	2.5 (0.8)
Commitment to change	3.0 (1.2)	2.9 (1.0)	3.0 (0.9)	3.0 (1.0)
Coping with temptation	2.3 (1.0)	2.1 (0.7)	2.2 (0.8)	2.4 (0.8)
Helping relationships	1.9 (1.1)	1.9 (0.9)	1.9 (0.9)	1.9 (0.9)

cigarette, attempts at quitting, or nicotine dependence as measured by the FTND.

The multivariate regression model, including the number of cigarettes smoked per day, dark coloring of cigarette filter, intensity of smoking, type of cigarette, gender, and educational level was significant ($P < 0.001$). The number smoked per day and preferred type of cigarettes (see Table 2), as well as gender, remained significant in the multivariate model.

Variables related to the intention to quit

According to the univariate analyses, smokers with higher scores for the pros of non-smoking, lower scores for the cons of non-smoking, and higher scores on the scale of self-efficacy in resisting the urge to smoke in habitual or craving situations were significantly more likely to work at workplaces with a higher level of smoking restrictions (see Table 3). Further, more frequent use of the process,

Table 2 Ordered logistic regression analyses of levels of workplace smoking restrictions and smoking behavior variables

	Univariate analyses		Multivariate analysis	
	OR	*P*	OR	*P*
Cigarettes smoked per day	0.95	<0.001	0.96	0.030
Puffs per cigarette	0.99	0.543	–	–
Dark coloring of cigarette filter	0.91	0.022	0.97	0.539
Intensity of smoking	0.99	0.030	1.00	0.668
Preferred type of cigarette smoked[a]		0.005		0.077
Light	Reference		Reference	
Medium	0.54[b]/1.25[c]	0.005[b]/0.581[c]	1.05	0.884
Regular	0.46[b]/0.89[c]	<0.001[b]/0.574[c]	0.66[b]/1.18[c]	0.027[b]/0.461[c]
Quit attempt in the past year				
No quit attempt	Reference		–	–
At least one quit attempt	0.86	0.200	–	–
Fagerström test for nicotine dependence	0.91	0.065	–	–

The response variable was coded "0" for *no smoking restrictions*, "1" for *partial smoking restrictions*, and "2" for smoke-free workplaces. The multivariate analysis included gender and educational level as additional covariates. All analyses were adjusted for cluster correlation within practices

[a] Generalized, ordered logistic regression was performed due to violation of the parallel regression assumption for *type of cigarette*

[b] Odds ratio for the comparison of smokers at workplaces with no restrictions versus partial restrictions or smoke-free workplaces

[c] Odds ratio for the comparison of smokers at workplaces with no restrictions or partial restrictions versus smokers at smoke-free workplaces

Table 3 Ordered logistic regression analyses of levels of workplace smoking restrictions and intention-related variables

	Univariate analyses		Multivariate analysis	
	OR	*P*	OR	*P*
Stages of change		0.896		
Precontemplation	Reference		–	–
Contemplation	1.08	0.643	–	–
Preparation	0.99	0.968	–	–
Decisional balance				
Cons of non-smoking	0.76	0.005	0.87	0.165
Pros of non-smoking	1.17	0.004	1.16	0.046
Self-efficacy to resist smoking in				
Positive-social situations	1.04	0.534	–	–
Negative-affect situations	0.97	0.702	–	–
Habitual or craving situations	1.21	0.017	1.09	0.187
Processes of change				
Risk assessment	1.03	0.697	–	–
Taking control	1.62	<0.001	1.54	<0.001
Commitment to change	1.17	0.244	–	–
Coping with temptation	1.12	0.353	–	–
Helping relationships	0.69	0.003	0.74	0.002

The response variable was coded "0" for *no smoking restrictions*, "1" for *partial smoking restrictions*, and "2" for smoke-free workplaces. All analyses were adjusted for cluster correlation within practices. The multivariate analysis included gender and educational level as additional covariates

"taking control," was significantly associated with higher levels of workplace smoking restrictions. On the contrary, smokers more frequently using the process "helping relationships" were less likely to be employed at workplaces with higher levels of smoking restrictions. No association emerged for the stages of change, self-efficacy in positive-social or negative-affect situations, or the remaining processes of change (see Table 3).

The multivariate model, including the pros and cons of non-smoking, self-efficacy in habitual or craving situations, the processes "taking control" and "helping relationships", gender, and educational level was significant ($P < 0.001$). Several of the covariates, such as pros of non-smoking, the processes "taking control" and "helping relationships" (see Table 3), as well as gender, also remained significant in the multivariate model.

Discussion

The main finding of this study was that the level of smoking restriction at the workplace is associated with a lower number of cigarettes smoked per day and that, at the same time, there is no significant compensation by adjustment of inhalation habits, according to the data. Second, single variables that are relevant in the intention to stop smoking were shown to be associated with levels of workplace smoking restrictions. By using a population-based sampling strategy, a vast range of smoking restrictions and working conditions were covered. A further strength of the study is that it included a comprehensive assessment of smoking behavior and psychological variables that were related to the process of smoking cessation.

This study revealed that employees working at smoke-free workplaces and employees with partial smoking restrictions smoked 3.6 and 2.4 cigarettes per day less, respectively, than employees at workplaces without any smoking restrictions. These results are similar to meta-analysis of 26 studies showing that totally smoke-free work places are associated with a mean reduction of 3.1 cigarettes per day by continuing smokers (Fichtenberg and Glantz 2002). Furthermore, no evidence was found for compensatory smoking with respect to other indicators of active smoke exposure. On the contrary, at workplaces with higher levels of restrictions, measures of inhalation habits even tended to indicate less exposure and a lower level of nicotine dependence. This is in contrast to the findings of Chapman et al. (1997), which were based on unobtrusive observations of puffs per cigarette. Although our measures covered a wider range of aspects related to the puff topography and were validated by previous research using biochemical indicators as a reference, a social desirability bias might be possible due to higher awareness of non-smoking norms in workplaces with smoking restrictions. On the other hand, the rating of one's own smoking behavior across different smoking situations might yield a more adequate representation of reality than choosing specific situations and locations where smokers were more or less pressed for time.

According to our multivariate analysis, it was found that smoking light cigarettes was more often reported by employees with partial or complete workplace smoking restrictions. Previous research revealed that the smoking of medium or regular, compared to light, cigarette types was associated with higher levels of smoke exposure (Etter and Perneger 2001). Survey studies show that, in particular, male smokers choosing light brands were more likely to intend to quit (Kelbsch et al. 2005), and those light smokers who believed that light cigarettes are relatively safe reported a deeper inhalation of smoke (Lee et al. 2008). Thus, the choice of light cigarettes might be driven by different mechanisms, reflecting one's intention to reduce health risks and lower nicotine needs.

Furthermore, the highest proportion of smokers in the contemplation stage of change was found at workplaces with partial restrictions, and lower rates were found in smoke-free and unrestricted workplaces. Thus, no significant ordinal relationship was observed. On the other hand, it was observed that the pros of non-smoking were rated to be more important, the confidence to resist smoking in habitual smoking or craving situations was higher, and the process "taking control" was more often used by smokers with a higher level of smoking restrictions. This is limited evidence for the assumption that smoking restrictions might support progression through the stages of change. It might be argued that partial, compared to complete, smoking bans trigger different processes in the intention to stop smoking and to maintain a smoke-free position. Smokers confronted with a partial smoking ban might be more prone to remain in the contemplation stage, a phenomenon that has been previously described as chronic contemplation or behavioral procrastination (Velicer et al. 2000). The experience of nicotine withdrawal and the need to develop strategies to cope with craving can be avoided by taking a cigarette break. The use of self-change strategies as measured by the scale "helping relationships" was negatively related to the level of smoking restrictions. This may indicate that smokers working in a smoke-free environment become more isolated and less likely to benefit from social support regarding smoking cessation. This finding highlights that smoking restrictions must be supplemented with individual support measures and acknowledgement of the multiple factors that hinder individuals in the cessation of smoking. Accordingly, recent evidence shows that worksite measures for smoking prevention predominantly consist of restrictions alone, while supporting measures like smoking cessation courses or counseling are rarely used (Friedrich et al. 2009).

Finally, several limitations of our analysis should be considered. First, no causal inference can be drawn from our results, which are based on cross-sectional analysis only. Furthermore, no direction of the causal mechanism can be derived. The differences in characteristics of smokers working under different levels of restrictions might be attributed to both individual behavior change, resulting from the implementation of a stricter smoking

policy, and self-selection of smokers into the respective work environment. Second, workplace smoking restrictions were assessed only according to the self-reports of the study participants and not according to workplace data. Third, only a rough quantification of restrictions was used, and there were no single measures of these restrictions. Fourth, the time elapsed since an individual smoker was confronted with the currently prevailing smoking restrictions was not considered. Fifth, in regards to the intention to stop smoking, variables were used that had been revealed to be important based on the transtheoretical model of behavior change. The validity of this model has been debated (Herzog and Blagg 2007; Hughes et al. 2005; Littell and Girvin 2002; West 2005). Thus, other potentially important factors mediating smoking cessation might have been overlooked. Sixth, when generalizing these results to other countries, it must be considered that our data were collected in a country with a history of less restrictive tobacco control policies (Thyrian and John 2006). In fact, a recent survey comparing data from 14 countries showed that the prevalence of employees and employers reporting that it is acceptable to smoke at the workplace is highest in Germany (Halpern and Taylor 2009). Thus, different mechanisms might be in play if workplace smoking restrictions were embedded within a more comprehensive set of tobacco control measures.

Therefore, it can be concluded that employees who continue to smoke may benefit from workplace smoking restrictions, in terms of reduced active smoke exposure and psychological effects to increase the readiness to quit. Consequently, the health of both smokers and non-smokers can be improved by workplace smoking restrictions.

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