RESEARCH PAPER

Are comprehensive environmental changes as effective as health education for smoking cessation?

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Objectives: To compare the effectiveness of health education on smoking cessation for all smokers regardless of their willingness to quit smoking and cumulative environmental changes including designation of smoking places, legislation, and price rise.
Design: Comparison of smoking cessation rates over two time periods: the period of health education on smoking cessation (1997–1999), and the period of cumulative environmental changes (2002–2004).
Setting: An occupational setting in a radiator manufacturing factory in Japan.
Subjects: All habitual male smokers who remained in the worksite through the pertinent time period (n = 202 in the period of health education and n = 170 in the period of environmental changes).
Main outcome measurements: Smoking cessation rates at the end of each time period.
Results: The smoking cessation rates over the periods of health education and environmental changes were 8.9% and 7.1%, respectively. There was no difference between these two proportions in a χ^2 test (p = 0.513). The age adjustment did not significantly alter the cessation rate.
Conclusions: Cumulative environmental changes are fairly effective in promoting smoking cessation, and may yield similar smoking cessation rates as a health education intervention reaching all smokers regardless of their willingness to quit smoking.

Environmental changes such as designation of smoking areas, legislation and price rise, and health education for smokers are important measures for reducing the prevalence of smoking. It is, however, practically impossible to compare concurrently the effectiveness of these two measures, because environmental changes necessarily affect all smokers.

Smokers in Japan have experienced nationally implemented environmental changes since 2002. The Japanese government enacted a new law called Health Promotion Law in August 2002 and began enforcing it in May 2003. This law was enacted to promote public wellness through specifying fundamental actions concerning the comprehensive promotion of public health. One of the articles reads as follows:

> Article 25: Protection from passive smoking.
> Administrators of facilities used by the general public, such as schools, gymnasiums, hospitals, theaters, pavilions, assembly halls, exhibition halls, department stores, offices, public facilities, and eating and drinking places, shall endeavor to take necessary measures to protect users of these facilities from being exposed to passive smoking. (Passive smoking refers to unwillingly inhaling others' tobacco smoke in indoor or equivalent environments.)

After the enforcement of this law, many facilities, including occupational settings, banned indoor smoking or instituted designated smoking areas. In July 2003, the government raised the tobacco tax by approximately 20 Japanese yen (nearly equivalent to 19 US cents) per a pack.

Cumulative environmental changes are likely to affect smokers and lead a considerable portion of them to quit smoking. These comprehensive measures are especially important in East Asian and West Pacific regions including Japan, since smoking prevalence for men in these regions is more than 50%.[1] Public health approaches to tobacco control can affect large numbers of individuals at minimal cost.[2] Smoke-free workplaces and increasing the cost of cigarettes through increased taxation are two cost effective approaches to tobacco control.[2] Evidence from countries of varying economic levels shows that price increases on cigarettes are highly effective in reducing demand.[2] However, the effectiveness of such measures is lower than direct intervention targeting smokers.[3]

Apart from these environmental changes, health education on smoking cessation is also important for tobacco control. A large number of controlled trials using health education interventions have demonstrated effectiveness in smoking cessation. Efforts have been made to specify what kind of interventions are effective, plausible, and practical.[4] While such interventions are more effective than public health approaches, they can usually reach only a small proportion of smokers.[3]

Our study sought an answer to the question: ''Can comprehensive environmental changes be as effective as health education in a setting where smoking prevalence is considerably high?'' As mentioned above, it is hard to compare these two measures, because one affects all smokers and the other can reach a relatively small portion of smokers. We can, however, still compare them if we involve all smokers in health education in a limited setting, although we need to give up parallel comparison and allow different time frames. There has been no report comparing the effectiveness of comprehensive environmental changes and health education on smoking cessation reaching all smokers regardless of their willingness to quit smoking. Therefore, we compared the smoking cessation rates of two time periods: the time period of health education in all smokers regardless of their willingness to quit smoking, and the time period of environmental changes including legislation, price rise, and designation of smoking areas in an occupational setting in Japan.

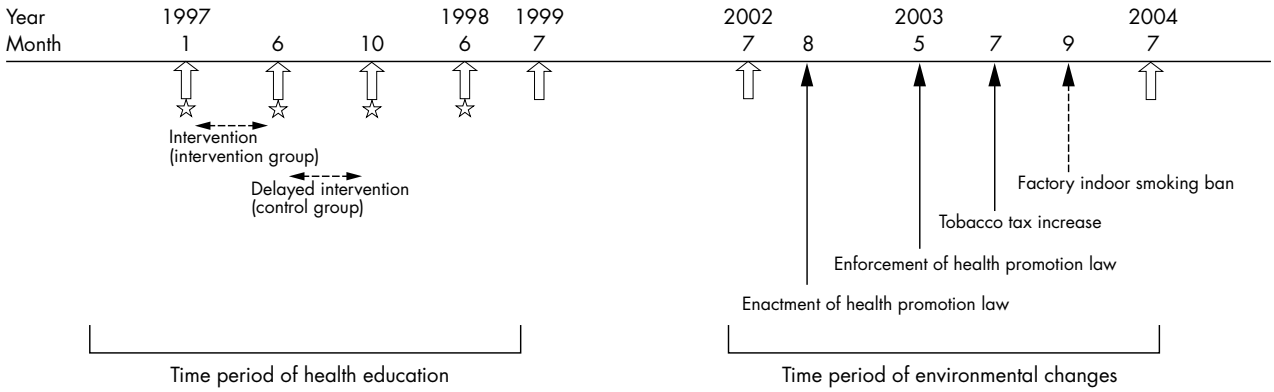

Figure 1 Time frame of events the factory experienced and smoking status survey in 1997–1999 and 2002–2004. Vertical arrows indicate when smoking status survey was done; stars indicate results are previously reported elsewhere.[5]

SUBJECTS AND METHODS

Subjects

Subjects in this study were male workers in a radiator manufacturing factory in Shiga, Japan, who were habitual smokers at the beginning of each study period: the time period of health education (1997–1999) and the time period of environmental changes (2002–2004). There were originally 542 workers (423 men and 119 women) at the beginning of the study in 1997. We limited the study to male smokers, because the smoking rate was considerably higher among men (62.2%) than among women (3.4%) at baseline. Those who left the worksite for some reason unrelated to smoking status during the pertinent time period were excluded from the study. The time frame of this study is displayed in fig 1.

Time period of health education (1997–1999)

We have previously reported the effectiveness of the smoking cessation intervention in all of the male smokers regardless of their willingness to quit smoking in an occupational setting conducted in 1997.[5] All of the male smokers in the factory (n = 263) were randomly allocated to an intervention group (n = 132) or a control group (n = 131). Subjects in the intervention group received individual counselling by a doctor, and those who signed a smoking cessation declaration underwent a five month intervention programme including individual advice, self help materials, and group sessions. Although the primary purpose of this previous study was to evaluate the effectiveness of intervention by comparing the two groups, we afterward conducted a delayed intervention of an equivalent health education intervention among the subjects in the control group. The intervention contents and materials have been published elsewhere.[6] The cessation rate after the original intervention was 12.9% (17/132) and 3.1% (4/131) in the intervention and control groups, respectively (p = 0.003). Among those from both groups who successfully quit smoking after the delayed intervention (n = 35), 62.9% (22/35) maintained cessation in 1998. Overall, the cessation rate was 8.4% (22/263) 17 months later from the initial intervention. In the present study, we re-evaluated the smoking cessation rate in 1999, because smoking relapse is reported to occur even six months after cessation, but the rate may be 4% or less after the second year.[7 8]

Time period of environmental changes (2002–2004)

For the time period of environmental changes, we set the time frame of 2002 to 2004 to include all the cumulative changes in the smoking environment at the worksite (fig 1). As mentioned above, the Japanese government enacted the Health Promotion Law in August 2002, and enforced it in May 2003. The tobacco tax was increased in July 2003. In addition, the health and safety committee of the factory decided to ban indoor smoking as of 1 September 2003, in accordance with Article 25 of the Health Promotion Law. Since then, smokers at the factory were allowed to smoke only at designated smoking areas outside the buildings. We identified smokers through a self administered questionnaire at their annual health check up in July 2002, when no environmental change had yet begun. We reassessed the smoking cessation rate at the annual health check up in July 2004, when the cumulative environmental changes were over. We did not conduct any health education programmes for smokers during the time period of environmental changes.

Confirmation of smoking status

In the beginning of each period, male smokers were self identified in self administered written questionnaires. Successful smoking cessation was ascertained by a urine test of nicotine metabolites.[9] The smoking cessation rate was calculated as the proportion of those who were ascertained to have quit smoking among those baseline smokers who remained employed in the factory through the entire pertinent period.

Statistical procedures

We used χ^2 tests to test the proportional differences in categorical variables. As for the age adjustment, we employed a direct method to adjust for the different age distributions, using the baseline age distributions of health education period as the reference and those of the environmental change period as the comparison group. We tested the difference in the age adjusted smoking cessation rates assuming Poisson distribution in the occurrence of smoking cessation.

Ethical consideration

For the intervention in the health education period, initial advice was given to each of the smokers as a part of the company's health promotion activities encouraged in the Occupational Health and Safety Law. In addition to the initial individual advice, the smoking cessation programme was provided only to those smokers who decided to participate in it. The urine test to ascertain successful smoking cessation was conducted after informed consent was obtained from the subjects. The protocols of these studies were reviewed and approved by the institutional review board of Shiga University of Medical Science, Japan (No. 11-4, No. 16-14).

RESULTS

At the beginning of the time period of health education in January 1997, there were 263 male smokers. By the end of the period in July 1999, 61 of the baseline smokers had left the worksite for some reason unrelated to smoking status,

Table 1 Age distributions and cessation rates in the periods of health education and smoking environmental changes in an occupational setting in Japan

Age group (years)	Health education (reference group)				Environmental changes (comparison group)			
	Baseline smokers (1997)		Quitters (1999)		Baseline smokers (2002)		Quitters (2004)	
	n	(% in population)	n	(% in age group)	n	(% in population)	n	(% in age group)
18–24	32	(15.8)	1	(3.1)	11	(6.5)	0	(0.0)
25–34	102	(50.5)	8	(7.8)	92	(54.1)	8	(8.7)
35–44	49	(24.3)	8	(16.3)	37	(21.8)	4	(10.8)
45–60	19	(9.4)	1	(5.3)	30	(17.6)	0	(0.0)
Total	202	(100.0)	18	(8.9)	170	(100.0)	12	(7.1)
					(Age group adjusted cessation rate: 7.0%)			

and the remaining 202 baseline smokers were included in the analysis of the time period of health education. Among the 202 smokers in the period of health education, 18 (8.9%) quit smoking by the end of the period in 1999.

At the beginning of the time period of environmental changes in July 2002, there were 202 male smokers. Among the 202 smokers, 159 were from the previous period and 43 newly entered the worksite. By the end of the period in July 2004, 32 of the baseline smokers had left the worksite for some reason unrelated to smoking status, and the remaining 170 baseline smokers were included in the analysis of the time period of environmental changes. Among those 170 male smokers, 141 experienced both periods. Among the 170 baseline smokers in the period of environmental changes, 12 (7.1%) quit smoking by the end of the period in 2004.

Table 1 shows the age distribution and the number and proportion of men who quit smoking in each age group. There was no difference in the cessation rate between these two time periods in a χ^2 test ($p = 0.513$). The age distribution in the beginning of the two periods were significantly different ($p = 0.007$). The age adjusted cessation rate of the period of environmental changes, having the health education subjects as the reference group, was 7.0%. There was no significant difference in the cessation rates after age adjustment between health education and environmental change groups ($p = 0.189$).

DISCUSSION

We demonstrated that there was no significant difference between the effect of health education and cumulative environmental changes, including legislation, tax rises, and designation of smoking areas in an occupational setting, on smoking cessation rate. To our knowledge, there has been no report comparing the effectiveness between comprehensive environmental changes and health education on smoking cessation reaching all smokers regardless of their willingness to quit smoking.

Table 2 Smoking rate of Japanese men and estimated cessation rate, 1997–2004

Year	Smoking rate (%)	Estimated cessation rate (%)
1996	57.5	
1997	56.1	2.4
1998	55.2	1.6
1999	54.0	2.2
2000	53.5	0.9
2001	52.0	2.8
2002	49.1	5.6
2003	48.3	1.6
2004	46.9	2.9

Smoking rates are the data reported annually as a news release by Japan Tobacco, Inc. The estimated cessation rate was calculated as 100 × [(smoking rate in the previous year) − (smoking rate in the current year)]/(smoking rate in the previous year) (%).

As a post-hoc analysis for comparison purposes, table 2 shows the smoking rate of Japanese men from a survey conducted annually and reported in a news release by Japan Tobacco, Inc (Japan Health Promotion and Fitness Foundation: http://www.health-net.or.jp/tobacco/product/pd090000.html). The estimated cessation rate was calculated as 100 × [(smoking rate in the previous year) − (smoking rate in the current year)]/(smoking rate in the previous year) (%). The estimated cessation rates of the pertinent two years calculated likewise were 3.7% for 1997–1999 and 4.5% for 2002–2004.

Our results indicate that comprehensive environmental changes can effectively decrease rates of smoking. We believe that the reduction of 7.1% of all smokers can be regarded as fairly effective, although the lack of a significant difference may be due to an insufficient sample size. This reduction is higher than the estimated national cessation rate during the same period (4.5%). Of note, the cost for the indoor smoking ban is very low, since the change is only designating smoking areas outside. More rigid measures such as totally smoke-free workplaces may yield better effects on smoking behaviours, as has been reported in previous studies.[10] However, the new Health Promotion Law only specified the avoidance of passive smoking, not a complete ban of smoking in facilities. Since the law has no penalty for failure to adopt the designation of smoking areas, there are still many facilities and workplaces that have not yet fully implemented improvements to avoid passive smoking. The setting in our present study is a typical workplace that endeavours to observe the law.

There were two strengths in our study: (1) all of the smokers in this setting experienced cumulative comprehensive environmental changes including designation of smoking areas that the company adopted in accordance with the new Health Promotion Law; and (2) we were able to reach all the smokers for health education regardless of their willingness to quit smoking, which made it possible to compare the effectiveness between the two measures.

There were several limitations in our study. First, the sample size was insufficient to deny the possible statistically significant difference between the cessation rates of the two measures. However, the relatively small sample size made it possible to reach all the smokers for health education, as mentioned above. The conclusion that the comprehensive environmental changes successfully reduced smoking prevalence does not change regardless of the statistical difference. Second, we were unable to compare the two situations concurrently. However, as mentioned previously, parallel comparison is virtually impossible, and we must accept that the possible background change such as public attitude toward smoking is a part of environmental change.

What this paper adds

Effectiveness of environmental changes and health education has been established separately. Direct comparison of these measures is regarded to be difficult, because one affects all smokers, making concurrent comparison impossible, and the other reaches a relatively small proportion of smokers.

We evaluated the effectiveness of cumulative environmental changes, including designation of smoking places, and price rises in tobacco that Japan has experienced in recent years, comparing them to health education for all smokers in a limited specific setting. We found that cumulative environmental changes are fairly effective, and may be as effective as health education on smoking cessation rates.

Since there was a three year interval between the two periods, we believe that the influence of the former period did not affect the smokers' smoking behaviour in the latter period. In fact there was no difference in the smoking cessation rate between those who experienced both periods (10/141 = 0.0709) and those who experienced only the latter period (2/29 = 0.0690). Third, there was considerable worker turnover in both of the study periods and many subjects were lost to follow up, which made it difficult to compare smoking prevalence instead of the smoking cessation rate. In the period of health education, Japan experienced a national economic recession, which may have affected the personnel changes. In the period of environmental changes, the company reorganised their production system, which caused major employee fluctuation. Both of these circumstances were out of our control. However, we believe that there was no one who left the worksite because of reasons related to smoking status.

In conclusion, we evaluated the effectiveness of cumulative environmental changes including designation of smoking places, and price rises in tobacco that Japan has experienced in recent years, comparing them to health education in a limited specific setting. We found that cumulative environmental changes are fairly effective, and may have an effect similar to health education on smoking cessation rates.

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