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

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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 all smokers.3 They can affect large numbers of individuals at minimal cost.2 However, the effectiveness of such measures is lower than direct intervention targeting smokers.1 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.4

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.
The cessation rate after the original control group. The intervention contents and materials have afterward conducted a delayed intervention of an equivalent effectiveness of intervention by comparing the two groups, we the primary purpose of this previous study was to evaluate the dual advice, self help materials, and group sessions. Although went a five month intervention programme including indivi-
dual advice, self help materials, and group sessions. Although 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. 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.7 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

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 \( \chi^2 \) 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,
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
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 χ² test (p = 0.513). The age
distribution in the beginning of the two periods were
significantly different (p = 0.007). The age adjusted cessa-
tion 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 environ-
mental 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.

As a post-hoc analysis for comparison purposes, table 2
shows the smoking rate of Japanese men from a survey
carried out 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/
p090000.html). The estimated cessation rate was calculated
as 100 × [(smoking rate in the current 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

Our results indicate that comprehensive environmental
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. 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 compre-
sensive environmental changes including designation of smok-
ing 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 will-
ingness 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 pre-
valence 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.

<table>
<thead>
<tr>
<th>Year</th>
<th>Smoking rate (%)</th>
<th>Estimated cessation rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>57.5</td>
<td>2.4</td>
</tr>
<tr>
<td>1997</td>
<td>56.1</td>
<td>2.4</td>
</tr>
<tr>
<td>1998</td>
<td>55.2</td>
<td>1.6</td>
</tr>
<tr>
<td>1999</td>
<td>54.0</td>
<td>2.2</td>
</tr>
<tr>
<td>2000</td>
<td>53.5</td>
<td>0.9</td>
</tr>
<tr>
<td>2001</td>
<td>52.0</td>
<td>2.8</td>
</tr>
<tr>
<td>2002</td>
<td>49.1</td>
<td>5.6</td>
</tr>
<tr>
<td>2003</td>
<td>48.3</td>
<td>1.6</td>
</tr>
<tr>
<td>2004</td>
<td>46.9</td>
<td>2.9</td>
</tr>
</tbody>
</table>

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 current year)
− (smoking rate in the current year)/smoking rate in the previous year) (%).
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 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 be as effective as health education on smoking cessation rates.

REFERENCES