

**PROSIDING**  
**INTERNATIONAL SEMINAR**

**THE IMPACTS OF REGULATIONS  
ON TOBACCO CONTROL**  
**(Review Of Health, Economic, Social  
and Cultural Aspects)**

**NOVEMBER 2012**

**FACULTY OF PUBLIC HEALTH**  
**JEMBER UNIVERSITY**

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**PROSIDING INTERNATIONAL SEMINAR**  
**THE IMPACTS OF REGULATIONS ON TOBACCO CONTROL**  
(Review of Health, Economic, Social and Cultural Aspects)

Jember, 7 – 8 November 2012 – Gedung Mas Soerachman Universitas Jember

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## PREFACE

Until now, the tobacco consumption in Indonesia is not controlled optimally which can set impacts on poverty. This is because in the individuals and families, there are more poor smokers, about 10% of household funds for smokers, the number of patients with diseases caused by tobacco consumption increases the cost of treatment of diseases, worsens malnutrition, reduces access to education; meanwhile, to the state, the cost burden of illnesses and mortality, environmental degradation, fire hazards, in addition to the individual and the state, the risks can happen to tobacco farmers; so far, Indonesia is the only country in Asia Pacific that has not signed the Framework Convention Tobacco Control (FCTC), an international treaty in which there are control attempts of the danger of tobacco. The Government Regulation Draft related with tobacco also is still unclear. Some parties, especially the Ministry of Health, Republic of Indonesia, welcome the regulation concerning the restrictions on tobacco production, while some ministries such as the Ministry of Industry and the Ministry of Manpower and Transmigration want the government to consider even delay the enactment of the regulation draft. This is due to the fact that the production of tobacco and cigarettes become the pedestal to millions of workers and the economic activities, so that the welfare of farmers and agricultural workers could be saved. This review can give us a clear description that cigarette is not only the discussion of health, but it is a complex problem that can affect the economic, social, and cultural aspects. Thus, it is important to promptly conduct an in-depth review on this matter and to involve several parties associated with tobacco and cigarettes.

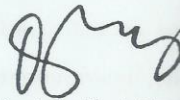
Faculty of Public Health, University of JEMBER, is one of the health institutions responsible on tobacco control efforts supported by Jember University with its World Class University vision as well as the full commitment of the entire academic community members. Therefore, it is time for Faculty of Public Health, University of Jember to hold an international event that discusses the impacts of regulatory restrictions on tobacco products in the view of health, economic, social and cultural aspects.

This event is attended by speakers from several countries, 50 invitees from various government and non-government agencies in University of Jember and in Jember Regency and its vicinity, 100 public participants, 30 oral and poster presenters from various

disciplines and countries. We sincerely hope that this event will provide significances to our lives in the future. We apologize for any inconvenience. Thank you

Jember, 08 November 2012

Chief of Committe,



Novia Luthviatin, S.KM., M.Kes.

NIP. 19801217 200501 2 002

**WELCOME SPEECH BY DEAN OF FACULTY OF PUBLIC HEALTH,  
JEMBER UNIVERSITY**

The honorable

- Rector of Jember University
- Vice Rectors of Jember University
- Deans of Fakultas at Jember University
- Vice Minister of Health of the Republic of Indonesia
- The Regent of Jember Regency or Representative
- All Speakers of the International Seminar
- Committee members of the International Seminar
- Distinguished guests, ladies and gentlemen

At this precious moment let us express our gratitude to the Merciful God who has granted us with His blessings and grace that enable us gather in this international seminar here.

On behalf of our institution, especially the Faculty of Public Health and Jember University in general, we would like to thank for your presence in this seminar, especially for :

1. Prof. Dr. dr. Ali Ghufron Mukti (Vice Minister of Health of the Republic of Indonesia)
2. Mr. Tara Singh Bam, Ph.D., M.PH. (WHO)
3. Dr. M. Haniki Nik Mohamed from International Islamic University Malaysia (IIUM)
4. Drs. Nawiyanto, M.A., Ph.D. (Jember University)
5. Dr. Imam S. Mochny, MD., M.PH. (Airlangga University Surabaya)
6. Chingchai Methapat (Public Health Burapha University)

The purpose of this seminar is to find a meeting point of all public interests on the impacts of deregulation of tobacco products. Until now, the regulation on tobacco product limitation still raises Pro and Contra because;

On one side, the policy can worryingly kill tobacco industry which highly contributes foreign exchange to the State. The member of Comission IX **Poempida Hidayatullah Djatiutomo** (Jakarta – Micom) said that in year 2011 the contribution of cigarette industry to the State through cigarette excise was 77 trillion. This did not include taxes given to the State by the industry. In addition, there are 30 million people who are dependent on cigarette industry. Therefore, the welfare of cigarette farmer and labor must be saved.

On the other side, smoking may cause high cost of health. Dr. **Bahtiar Husain**, Secretary General of Indonesian Pulmonary Doctor Association (PDPI) said that the cigarette excise received by the State is not in balance with health cost that the State and public must pay due to smoking. Bahtiar explained that Government received the custom and excise of tobacco products such as cigarette around 40 trillion per year. However, the revenue of the

State budget is very low compared to the fund that must be paid for the treatment of illnesses caused by smoking.

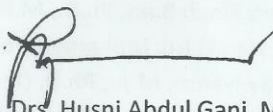
The health cost that must be borne by the public is predictably 120 trillion; this is obviously imbalance.

Bahtiar said that if in the future all treatments are funded by public health insurance (JAMKESMAS), it should bear the remaining 80 trillion of the treatment. This is an irony; public has been sick, and the State experiences a deficit because of smoking. More ironically, smoking habit has been a culture in the society, especially the poor community. This irony will be more and more increasingly felt in 2004 since the Law on Social Insurance Management Body will have been passed, so all public health insurance will be borne by the State.

In this seminar, let us think of the best solution of the danger of cigarette smoke to non-smoking people, and on the other side, we have to be wise to accommodate the argumentation of those who feel the importance of cigarette to survive. Thank you.

Jember, 08 November 2012

Dean,



Drs. Husni Abdul Gani, M.S.

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EFFECT OF SMOKING ON SPERM QUALITY

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ABSTRACT

**Background :** Epidemiological studies indicate an increase in the number of smokers in the world, including Indonesia where the majority of active smokers are male. This causes health problems, one of which is associated with male fertility problems. Smoking affects active and passive smokers. There are substances in tobacco that are harmful to the body.

**Objectives:** This review summarises the effects of harmful chemicals in cigarette smoke towards male fertility by comparing the smokers with nonsmokers' male sperm quality, and evaluates the adverse effects of cigarettes on active and passive smokers. The amount of cigarettes per day affecting sperm quality is also analyzed among the active smokers.

**Methods:** Data were obtained by searching databases using a standard search string, excluding the effects of smoking outside male infertility. Key words used to assess exposure, outcome, and estimates for the concerned associations were: smoking, semen, male infertility, sperm, humans, and fertility. Study strengths, limitations and differences were noted. Article and case reports were also evaluated by two authors, according to other specified criteria.

**Results:** There are a few papers that report no difference in semen analysis between smokers and nonsmokers. Some studies have reported that smoking can decrease sperm quality demonstrated through a number of parameters such as sperm motility, sperm shape abnormality, and sperm fertilising capacity through increased seminal oxidative stress and DNA damage. A significant decrease in sperm quality occurs in heavy smokers, while the decrease percentage in sperm quality on mild smokers was the smallest. As for passive smokers, they showed a negative effect similar to active smokers. This is because a large amount of harmful substances in the tobacco smoke is released and dispersed into the environment.

**Conclusions:** Smoking can cause a decrease in sperm quality which can directly impact male fertility. The percentage decrease in sperm quality is strongly correlated with the number of cigarettes smoked per day. The extent of the environmental tobacco smoke related risk in passive smokers is also estimated to be as high as experienced by active smokers.

*Keywords : Smoking, cigarette, tobacco, sperm, fertility, male infertility.*

## INTRODUCTION

Despite worldwide anti-smoking campaigns, cigarette smoking is very common. Epidemiological studies indicate an increase in the number of smokers in the world, including Indonesia where the majority of active smokers are male. About a third of the world's population aged  $\geq 15$  years smokes cigarettes daily.<sup>1</sup> The highest prevalence of smoking is observed in young adult males during their reproductive period (46% smokers between 20 and 39 years).<sup>2</sup> Some studies in man of reproductive age have shown that cigarette smoking has been associated with subfertility in men, with some reports of decreased sperm concentration, lower sperm motility, and a reduced percentage of morphologically normal sperm. Cigarette smoking has also been correlated with poor sperm function in sperm-penetration assays. However, some studies found no correlation between cigarette smoking and semen quality, sperm function or sperm nuclear DNA damage.<sup>1</sup>

Cigarette contains several compounds are known as chemical carcinogens and mutagenic in humans. Studies have revealed the presence of upwards of 4000 chemicals in cigarettes.<sup>3</sup> The major constituents that affect health are: nicotine, tar in the particulate phase, and carbon monoxide in the gaseous phase.<sup>4</sup> Many people are exposed daily to a form of air pollution that causes twice as many deaths as all other types of air pollution put together. This is known as Environmental Tobacco Smoke (ETS), which is actually the smoke from other people's cigarettes. Also referred to as second-hand smoke, about 85% to 90% of the smoke from every cigarette ends up in the air as ETS.<sup>5</sup>

ETS consists of around 85% sidestream smoke and 15% mainstream smoke. Mainstream smoke emerges into the environment after it is drawn through the cigarette, filtered by the smoker's own lungs and then exhaled. The active smoker inhales far more mainstream smoke than the people around him (passive smoker). At the same time, sidestream smoke arises from the burning end of the cigarette and enters directly into the environment, and the passive smokers inhales both mainstream and sidestream tobacco smoke present in the air breathed.<sup>4,5</sup> So that, many studies were conducted to investigate the smoke effect on both passive and active smokers' health, especially to the male fertility which one of type examination is by sperm analysis.

The exact pathophysiology underlying cigarette smoking and sperm deteriorating is unclear. Available data do not conclusively demonstrate that smoking decreases male

fertility. However, with much debate for its impact on various semen parameters, it is regarded as an infertility risk factor.<sup>4</sup> Therefore, this review was done to summarise the effects of harmful chemicals in cigarette smoke towards male fertility by comparing the smokers with nonsmokers' male sperm quality, comparing the effect of smoking on sperm quality among smokers related to smoking index, and comparing the adverse effects of cigarettes on active and passive smokers.

#### **METHODS AND MATERIALS**

Systematic literature review was conducted by means of a Medline literature search. Data were obtained by searching databases using a standard search string, excluding the effects of smoking outside male infertility. To evaluate the impact of smoking on sperm quality, we searched the Medline site up to September 2012. Key words used to assess exposure, outcome, and estimates for the concerned associations were: smoking, semen, male infertility, sperm, humans, and fertility. The reference lists of relevant articles were reviewed for further reports. Only English-language article were selected. Review articles were included. Study strengths, limitations and differences were noted. Article and case reports were also evaluated by two authors, according to other specified criteria. Meeting abstracts were not included in this study. Because the majority of the studies were case series and reviews, methods of aggregation and analysis were limited to summarization and comparison.

#### **RESULTS AND DISCUSSION**

##### **RESULTS**

##### **Comparison between smokers and non smokers**

The following results (Table 1) were conducted through an experiment by Nadeem et al. The experiment included a total of 130 infertile male patients from the outpatient department of Gynecology and Obstetrics at Liaquat University. The subjects were infertile male, married for more than one year, and were selected randomly.<sup>6</sup>

Table 1. Relationship between effect of smoking on sperm motility and morphology

Parameters	Smokers (%)	Non Smokers (%)
Sperm Motility		
>50% Motility	45,1	54,9
20-40% Motility	75	25
5-19% Motility	60,9	39,1
<5% Motility	66,7	33,3
Sperm Morphology		
>30% Normal sperm	71	29
20-30% Normal sperm	44,8	55,2
10-19% Normal sperm	43,5	56,5
3-9% Normal sperm	60	40
<3% Normal sperm	74,1	25,9

Source : Nadeem, F. et al., 2010

**Comparison between light, moderate and heavy smokers**

The study conducted by Gaur et al. included samples of 100 cigarette smokers and 100 strictly non-smokers. Furthermore, the smokers were categorized as light, moderate and heavy smokers (Table 2).<sup>7</sup>

Table 2. Semen variables among different groups of smokers in comparison to non-smokers.

Diagnosis	Smokers				Non Smokers	p-value*
	Light N (%)	Moderate N (%)	Heavy N (%)	Total		
N	2 (4)	1 (3.5)	0	3	39	1.009x10 <sup>-10</sup>
A	20(41)	7(25)	0	27	9	0.0015
A+O	4(8)	3(11)	4(17)	11	7	0.2297
A+T	11(22)	6(21.5)	6(26)	23	10	0.0106
A+O+T	5(11)	7(25)	9(39)	21	12	0.1266
O	3(6)	2(7)	2(9)	7	8	1.0000
O+T	2(4)	1(3.5)	0	3	8	0.2134
T	2(4)	1(3.5)	2(9)	4	7	0.7673
Total	49 (100)	28(100)	23(100)	100	100	

N: Normozoospermia; A: Asthenozoospermia; O: Oligozoospermia; T: Teratozoospermia; \*p-value by Fisher's exact tests  
Source: Gaur et al. 2007.<sup>7</sup>

In order to determine the contribution of each of the three main semen variables, viz. Asthenozoospermia (A), Oligozoospermia (O) and Teratozoospermia (T), light, moderate and heavy smokers as well as non-smokers were distributed according to the presence of individual semen variables or their various combination observed during semen analysis. Among non-smokers, isolated A was seen only nine times. 41% of samples from light smokers showed isolated A, compared with 25% from moderate smokers, and none from

heavy smokers. In contrast, heavy smokers (39%) and moderate smokers (25%) had more samples with A+O+T than light smokers. Statistical analysis showed that the incidence of both isolated A and A+T among smokers was statistically significant, in comparison to non-smokers. The p-values for other sub-groups were not statistically significant, mainly due to their small sample size.<sup>7</sup>

#### Comparison between passive smokers and active smokers

Polyzos et al. conducted a research on mice exposed in inhalation chambers (8.4 L chamber, 4 mice/chamber, 6 chambers/exposure) to tobacco smoke generated by a smoking machine. The exposure was adjusted so that the smoke generated by the machine were in accordance to the definition of mainstream smoke-MS (as in active smokers) and sidestream smoke-SS (as in passive smokers).<sup>8</sup> The results seen in Table 3. All kinematic measures were significantly reduced with respect to controls. Importantly, at the low dose of SS smoke there was a significant reduction in the percentages of both motile (54% vs. 63% in controls,  $P < 0.05$ ) and progressive sperm (38 % vs. 48% in controls,  $P < 0.005$ ).

Table 3. Sperm motility characteristics after male exposure to mainstream (MS) or sidestream (SS) tobacco smoke measured by the Computer Assisted Sperm Assay (CASA).

Exposure <sup>a</sup>	Mice (N)	% MOT <sup>b</sup>	% PROG <sup>b</sup>
Controls	20	63 ± 3 (64.63)	48 ± 2 (49.46)
3 MS	12	63 ± 5 (60.67)	46 ± 4 (47.45)
16 MS	12	59 ± 3 (58.60)	43 ± 3 (46.40)
3 SS	12	54 ± 3* (51.57)	38 ± 2* (39.36)
16 SS	12	61 ± 2 (58.65)	45 ± 2 (44.46)

<sup>a</sup> The experimental groups are identified by the type of smoke (MS or SS) and the number of daily cigarettes (3 or 16) utilized for the exposures.

<sup>b</sup> Mean ± SE for the total number of mice analyzed. In parentheses are the averages from each of the two separate experiments with 6 mice per treatment group conducted 9 months apart. Velocity parameters are given in  $\mu\text{m}/\text{sec}$ .

\*  $P < 0.05$  vs. controls (ANOVA, 95% CI).

Source: Polyzos et al. 2009.<sup>8</sup>

## DISCUSSION

Due to the fact that cigarette smoke contains a number of harmful substances, there has been concern that smoking could have adverse effects on male reproduction. One of the parameters that may be used to analyze this is by using sperm analysis. From Table 1, it can be seen that the amount of normal sperm motility (>50%) in smokers and non smokers show difference. The percentages are 45.1% in smokers and 54.9% in non smokers. Furthermore, 33.3% of non-smokers showed below 5% sperm motility while 66.7% of smokers showed below 5% sperm motility. This finding underscores the fact that smoking certainly has an adverse influence on the semen quality. Another fact result is that 29% of non-smokers and 71% of all the smokers' sperm morphology had over 30% sperm with normal morphology while only 25.9% from nonsmokers and 74.1% from the smokers showed below 3% normal sperm morphology. This again shows that smoking contributes to the deterioration of the semen quality of smokers when compared with non-smokers, a fact supported by Zinaman et al. in his study done in (2000).<sup>9</sup> So Nadeem et al. concludes that smoking can decrease male fertility by decreasing the sperm motility and percentage of normal sperm cells.<sup>6</sup> Other studies that support this are listed in the Table 4. below.<sup>4</sup>

Table 4. Relevant studies concerning smoking effect on sperm count.

Reference	Conclusion(s)	Study Type
Close et al. <sup>10</sup>	Smokers had lower sperm count vs. non smokers	Comparative
Ochedalski et al. <sup>11</sup>	Sperm count was lower in smokers vs. non smokers	Comparative
Chia et al. <sup>12</sup>	Smoking affects sperm density	Comparative
Vine et al. <sup>13</sup>	Smokers' sperm density was 13-17% lower than non smokers	Meta-analysis
Kunzle et al. <sup>14</sup>	Smoking led to decreased sperm count	
Ramlau Hansen et al. <sup>15</sup>	Smokers had an inverse dose response relation and sperm count.	Cross analysis
Reina Bouvet et al. <sup>16</sup>	Smoking alters sperm concentration	Clinical study

Source: Taymour, 2010.<sup>4</sup>

Different articles have demonstrated a negative impact of smoking on human semen parameters. Most papers have indicated that smokers demonstrate lower semen volume, sperm count, sperm motility and viability compared with non-smokers.<sup>4</sup> A number of papers related to smoking have suggested that severe DNA damage, which might prevent oocyte fertilization or the development of the embryo, could be a cause of infertility. The active transfer of cigarette components through the blood-testis barrier has been shown to

possibly induce oxidative stress-induced DNA damage, one of the causes of sperm quality alteration.<sup>17</sup>

Even so, there are a few papers that report no difference in semen analysis between smokers and nonsmokers.<sup>1</sup> Evaluated the semen quality and hormonal levels of 889 fertile men, divided into non-smokers, mild smokers, moderate smokers and heavy smokers. There were non-significant differences among these groups in sperm concentration, motility, levels of serum FSH, LH, total T or sperm motion characteristics.<sup>1</sup> And lately, Rybar et al. failed to confirm a relationship between smoking and sperm quality in men from any of the investigated groups.<sup>18</sup> The inconsistencies might reflect the small sample size of most studies, differences in the populations (healthy volunteers or patients with suspected infertility), or the confounding association between smoking and alcohol consumption.<sup>1</sup>

Smoking index is a parameter used to quantify cumulative smoking exposure. In this, smokers can be classified as either heavy smokers (>30 pack-years) or light smokers (<8 pack-years), where pack-year is the number of packs smoked/day x number of smoking years.<sup>19</sup> SI is defined as the product of number of cigarettes/day x years of smoking; mild <200 SI, moderate 200–600 SI and heavy >600 SI.<sup>4</sup>

However in Gaur's study, based on their detailed smoking history, the smokers (n = 100) were divided into categories according to the number of cigarettes smoked daily. Those who smoked 20 or less cigarettes per day were categorized as light smokers (n = 49); those who smoked 21–40 cigarettes per day were moderate smokers (n = 28); and those who smoked 41 or more cigarettes per day were heavy smokers (n = 23). The most common anomaly of semen is asthenozoosperm, whether present individually or in combination with teratozoospermia and/or oligozoospermia. The presence of asthenozoospermia can be a very subtle "early indicator" of reduction in the semen quality of an individual, which frequently gets ignored, if the semen sample shows adequate sperm count and normal morphology.<sup>7</sup>

Smoking does affect semen quality, in this case shown with the result in sperm analysis diagnosis. According to Gaur, deterioration in semen quality appears in direct proportion to the number of cigarettes smoked. Gaur also states that there is no "safe" quantity of cigarette smoking as reflected by predominance of asthenozoospermia in light smokers. Heavy and moderate smoking reduce semen quality further by also producing



## Effect Of Smoking On Sperm Quality

teratozoospermia.<sup>7</sup> In a similar study, Nadeem et al. also observes the effects of smoking on sperm quality between the different groups of smokers. The results can be seen in the Table 5 below.<sup>6</sup>

Table 5. Relationship between effect of smoking on sperm motility and morphology in different groups of smokers.

Parameters	Light Smokers (%)	Moderate Smokers (%)	Heavy Smokers (%)
<b>Sperm Motility</b>			
>50% Motility	47.8	39.1	13
20-40% Motility	33.3	62.5	4.2
5-19% Motility	35.7	50	14.3
<5% Motility	18.8	31.2	50
<b>Sperm Morphology</b>			
>30% Normal sperm	54.5	40.9	4.6
20-30% Normal sperm	30.8	53.8	15.4
10-19% Normal sperm	40	60	0
3-9% Normal sperm	16.7	58.3	25
<3% Normal sperm	25	35	40

Source: Nadeem et al.<sup>6</sup>

Among the three groups of smokers, below 5% sperm motility was present in 18.8% of light smokers, 31.2% of moderate and 50% of heavy smokers. Regarding morphology of sperms, below 3% of normal sperm cells were present in 25% of light, 35% in moderate and 40% in heavy smokers. These findings also indicate a strong dose dependent relationship between the smokers and decrease in semen quality. In this study, more cases of abnormal sperm motility and morphology are present in moderate and heavy smokers as compared to light smokers which confirm that smoking and the number of the cigarette smoked per day significantly reduces the sperm motility and number of normal sperm.<sup>6</sup>

The effect of smoking and passive smoke on various semen parameter have been evaluated. Reduction in sperm density, motility, antioxidant activity, and possible adverse effect on morphology have been demonstrated. The decrease in sperm concentration averaged 22% and was dose-dependent.<sup>20</sup> Yokus et al. states that during both passive and active smoking, oxidative stress was clearly exacerbated and the dynamic balance between oxidation and anti-oxidation was seriously disrupted, which was closely related to many disorders or diseases in active and passive smokers. It can be suggested that exposure to passive cigarette smoke especially in indoor environment may cause a similar oxidative stress as in active smoking. Any imbalance between the toxic radicals and antioxidant

enzymes may cause passive smokers to have tendency to pathologic formations as much as active smokers due to structural and functional damages caused by vitamin deficiency.<sup>21</sup>

In the study by Polyzos et al., they used CASA (Computer Assisted Sperm Analysis) to analyze the motility of sperm. As seen in Table 3, there was a differential effect on sperm motility between MS and SS smoke. Exposures to MS smoke did not change the percentages of motile sperm as compared to controls. On the contrary, both doses of SS smoke significantly reduced sperm movement. The lower dose of SS created the greatest decline in the percentages of motile and progressively motile sperm. The difference in this latter parameter was statistically significant (3 SS vs. 16 SS;  $P = 0.02$ ). These results indicate that SS smoke in passive smokers is more damaging to sperm motility than MS smoke in active smokers. The finding that the low dose of SS smoke produced the strongest effect on sperm motility was unexpected. The results show that even very short exposures (~20 min/day) to second-hand smoke can affect sperm motility.<sup>8</sup> Although sperm concentrations, motility, and/or morphology often are reduced compared with results observed in nonsmokers, they often remain within the normal range.<sup>20</sup>

### CONCLUSIONS AND RECOMMENDATION

#### Conclusions

There are a few papers that report no difference in semen analysis between smokers and nonsmokers. But most studies reported that smoking can decrease sperm quality demonstrated through a number of parameters such as sperm motility, sperm shape abnormality, and sperm fertilizing capacity through increased seminal oxidative stress and DNA damage. The decrease in sperm quality can directly impact male fertility.

A significant decrease in sperm quality occurs in heavy smokers, while the decrease percentage in sperm quality on mild smokers was the smallest. The percentage decrease in sperm quality is strongly correlated with the number of cigarettes smoked per day.

The extent of the environmental tobacco smoke related risk in passive smokers is also estimated to be as high as experienced by active smokers. Passive smokers showed a negative effect similar to active smokers. This is because a large amount of harmful substances in the tobacco smoke is released and dispersed into the environment.

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