

Does perceived safety of light cigarettes encourage smokers to smoke more or to inhale more deeply?

Jie-Min Lee¹, Sheng-Hung Chen², Chi-Jung Hsieh³

¹ Department of Logistics Management, National Kaohsiung Marine University, Kaohsiung, Taiwan

² Department of Finance, Nan Hua University, Chiayi, Taiwan

³ Department of Finance and Banking, Kun Shan University, Tainan, Taiwan

Submitted: 22 August 2007; Revised: 04 June 2008; Accepted: 05 June 2008

Published Online First: 29 September 2008

Summary

Objectives: This study investigated the effect of smoking light cigarettes and believing that light cigarettes are less of a health threat on the decision to smoke more light cigarettes or inhale more deeply in Taiwan.

Methods: Demographic and smoking characteristic data for 1,182 smokers who believe that smoking light cigarettes is relatively safe was obtained from the 2002 Survey of the Health Promotion Knowledge, Attitudes, and Behavior of Taiwan Citizens; this data was used to establish Logit models for the decision to smoke more light cigarettes or inhale more deeply.

Results: Respectively 5.64% and 4.76% of the light cigarette smokers were motivated to smoke more light cigarettes or inhale more deeply by their belief that light cigarettes are relatively safe. Light cigarette smokers, who believe that light cigarettes are relatively safe and who wish to quit smoking, and light smokers, are both likely to smoke more light cigarettes or inhale light cigarettes more deeply in comparison to ordinary cigarette smokers.

Conclusions: Government should attempt to reverse the tendency for light smokers to smoke more under the misconception that light cigarettes are relatively safe, and correct the erroneous belief among smokers who wish to quit that smoking light cigarettes is an intermediate stage on the path to quitting.

Keywords: Light cigarettes – Perceived safety – Smoking and inhaling – Tobacco control – Survey data.

Survey data published by the World Health Organization (WHO) indicates that smoking causes more than five million deaths each year worldwide, and that an estimated ten million people will die every year of smoking-related causes by the year 2020 if there is no progress in reducing smoking.¹ Smoking is one of the biggest health risk factors facing people today. The government of Taiwan has consistently regarded the management of tobacco products and the control of smoking as important tasks since Taiwan's accession to the World Trade Organization (WTO) on January 1, 2002. The relatively low price of cigarettes in Taiwan has led to a steady increase in the smoking population. According to statistics issued by the National Health Research Institute's health care policy research section, there are more than five million smokers in Taiwan, which is equivalent to one smoker for every five persons.²

According to the Taiwan Tobacco Control 2007 Annual Report,³ considerable achievements in Taiwan through many years promotion have been made in curtailing the smoking rates of adult, in enhance the anti-smoking consciousness for the public, and in setting non-smoking supporting environment. However, the prevalence of smoking remained around 55–64% for males, and 3–4% for females from 1968 to 1996. Noticeably after the implementation of the Tobacco Hazards Control Act in 1997 and the imposition of a health tax on tobacco in 2002, respectively, however the smoking rates dramatically decreased in males (down to 39.9% in 2005), while slightly increasing in females (4.8% in 2005).

The rate of cancer deaths has soared in Taiwan since 1982, putting cancer at the top of Taiwan's ten leading causes of death. In addition, lung cancer – which is closely linked with smoking^{4–17} – is the second most common cause of cancer death in Taiwan. Chen *et al.*¹⁸ employed a large-scale co-

hort study to research the death rate in Taiwan attributable to smoking, and found that 20% of men's deaths and 4% of women's deaths were attributable to smoking. The most recent statistics issued by the Bureau of Health Promotion indicate that approximately 17,500 persons in Taiwan die of smoking-related causes annually (Bureau of Health Promotion, 2004). Apart from injuring health and taking lives, smoking accounts for more than NT\$16.5 billion in medical expenses and over NT\$50 billion in total economic and medical losses.¹⁹

A 2002 survey conducted by the Bureau of Health Promotion discovered that, among adults age 18 and over, 50.0% of men and 5.8% of women are daily or occasional smokers.¹⁹ In comparison with developed countries, the male smoking rate is quite high in Taiwan. The Bureau of Health Promotion's 2004 and 2005 "Telephone Survey of Adult Smoking Behavior" found that, among adults age 18 and over, 42.78% of men and 4.54% of women were daily or occasional smokers in 2004 and 39.88% of men and 4.78% of women were daily or occasional smokers in 2005. This reveals that the male smoking rate has a significant falling trend, and although the female smoking rate is increasing, this rise is not statistically significant. This suggests the conclusion that Taiwan's anti-smoking efforts are gradually effective.²⁰ Light cigarette smokers account for more than 50% of Taiwan's five million smokers.²¹

Under the influence of the tobacco companies' promotional efforts, more and more smokers wrongly assume that light cigarettes are relatively harmless, and as a result light cigarettes have gradually become a mainstream cigarette type in recent years. Light cigarettes invariably boast lower tar and nicotine content, which makes them an attractive alternative for smokers who want to quit or hope for health benefits. In Taiwan, Lin (2004)²² indicates that there is near to 30% of light cigarette smokers who not intend to quit smoking now, compared with that of 13.8% for regular smokers. However, the ratio of heavy smokers who intend to quit smoking now is 34.5%, that more than 13.8% of light cigarette smokers. Moreover, Lee et al. (2007)²³ exhibits that 43.1% of the enrolled light cigarette smokers regarded "light cigarettes" as less harmful to their health in comparison with regular cigarettes. Among those with the perception of less harmful to health, 4.63% and 81.22% responders tend to inhale deeper and draw the smoke into their lungs, respectively.

Even through many smokers aren't ready to give up smoking, they still want to avoid the health hazards of cigarettes. These smokers therefore prefer to use cigarettes that are less hazardous or less irritating to the throat.²⁴ In addition, smokers who prefer to low tar/nicotine cigarettes actually received about the same amount of tar and nicotine compared with smokers

who consume regular brands.^{25–27} Benowitz *et al.*²⁸ found that smokers of light cigarettes inhale the same amounts of tar/nicotine as smokers of regular cigarettes. Subsequent research has shown that, in order to take in the same amount of tar/nicotine, persons who smoke light cigarettes may inhale more deeply every puff, take more puffs per cigarette, smoke more cigarettes, hold the smoke in their lungs longer, or use their lips or finger to block the holes of the filter and render the filter ineffective.^{29–31}

Most past research on the smoking of light cigarettes consisted of case-control or cohort studies. In addition, some other studies have used cross-sectional survey data or time series data from longitudinal surveys to analyze light cigarette smoking behavior.^{32–33} Kelbsch *et al.*³² have shown that, despite their false impression of being safer, light cigarettes encourage smokers to draw deeper and inhale the smoke into their lungs. This study also discovered that light cigarettes tend to give smokers an erroneous impression of less health risk, and that women are especially susceptible to this misconception. This mistaken belief may also influence whether smokers are able to quit successfully. A survey of the smoking behavior of 8,582 California smokers performed by Gilpin *et al.*³³ in 1996 verified that it gives smokers an excuse to delay quitting when they consider cigarettes sold as light and ultra-light cigarettes to be healthier. This study found that 60% of smokers felt that cigarettes marked light and ultra-light implied low tar/nicotine cigarettes, and otherwise felt that this implied health claims. Those smokers of regular cigarettes who cannot quit successfully may weigh the relative benefits of not smoking and smoking relatively safe cigarettes; among these smokers, the greater their level of addiction, the more likely they are to consider switching to light cigarettes. This shows that certain smokers perceive smoking low tar/nicotine cigarettes as a short-term strategy for reducing health risk. It also implies that marking cigarettes as light or ultra-light misleads smokers, and that administrative agencies should regulate this type of marking.

Tindle (2006)³⁴ found in a study of low tar and low nicotine or "light" cigarettes that smokers who smoke light cigarettes are more than 50% less likely to quit smoking than are smokers who smoke ordinary cigarettes, which suggests that light cigarettes may make it even harder for smokers to kick the habit. This effect seems to become stronger with age: Smokers of light cigarettes over 65 years of age are 76% less likely to quit smoking than are smokers of ordinary cigarettes. Tindle's results indicate that the more than 30 million light cigarettes smokers in the US who have the mistaken belief that smoking light cigarettes can reduce health risk are in fact increasing their health risk by continuing to smoke and not quitting. Consequently, giving smokers of light cigarettes the message

that smoking these cigarettes may reduce health risk is harmful information, and informing them that smoking light cigarettes may influence subsequent quitting, will help reduce the harm done by light cigarettes.

The main goal of this study is to verify that the belief that light cigarettes are relatively safe influences smokers' decision to smoke more light cigarettes or inhale light cigarettes more deeply. Specifically as to previous related studies, this study attends to investigate whether the demographic factors and smoking characteristics affect the light cigarette smokers' decision to smoke more or inhale more deeply. Hence, we collect the data for 1,182 smokers who believed that smoking light cigarettes is relatively safe obtained from the 2002 Survey of the Health Promotion Knowledge, Attitudes, and Behavior of Taiwan Citizens; this data was used to establish Logit models for the decision to smoke more light cigarettes or inhale more deeply, which were used to assess whether those persons who smoke light cigarettes while believing that light cigarettes are safer than ordinary cigarettes smoke more cigarettes or inhale more deeply. The findings of this study can facilitate the drafting of cigarette control policies by the competent health authority.

Methods

In order to achieve the foregoing research goals, this study collected demographic and smoking characteristic data for smokers who previously or currently smoke light cigarettes and believe that light cigarettes are relatively safe. The data source and variables are explained below:

Data source

This study collected the data from the "Survey of the Health Promotion Knowledge, Attitudes, and Behavior of Taiwan Citizens", which is conducted in 2002 by the Bureau of Health Promotion, Department of Health, Executive Yuan in Taiwan. This survey took persons who are 15 years of age and older (born no later than June 30, 1987) in all of Taiwan's counties and cities as its sample. The study focused on demographic factors, smoking status and habits, intention to quit smoking, and health status for 2,037 light cigarette smokers (including 1,182 light cigarette smokers who believed that smoking light cigarettes is relatively safe).

Variables

Respondents were asked to "Add up all the cigarettes you have smoked in your lifetime. Have you smoked at least 100 cigarettes (or five packs of 20 cigarettes)?" The possible responses were "Yes," "No," and "I don't know." Those persons

Does perceived safety of light cigarettes encourage smokers to smoke more or to inhale more deeply?

responding "Yes" were defined as smokers. Smokers were asked, "What kind of cigarette do you usually smoke?" Possible responses were "Light cigarettes with low tar," "Sometimes smoke light cigarettes, sometimes smoke ordinary cigarettes," "Formerly smoked light cigarettes, now smoke ordinary cigarettes," "Formerly smoked ordinary cigarettes, now smoke light cigarettes," "Ordinary cigarettes (original taste)," and "I don't know." Those smokers who responded that they smoke "Light cigarettes with low tar" and "Formerly smoked ordinary cigarettes, now smoke light cigarettes" were defined as light cigarettes smokers. Respondents were asked, "What is your reason for smoking light cigarettes? (Multiple answers are allowed)," where responses consisted of "Smoking light cigarettes is relatively safe," "They taste better," "The brand and packaging are attractive; the advertisements are eye-catching, brand image, etc.," "To get ready to quit," and "Other." Respondents who selected "Smoking light cigarettes is relatively safe" were defined as believing that light cigarettes are relatively safe.

Demographic and economic factors: Demographic factors included light cigarettes smokers' sex, age, level of education, and income level. Age was generally calculated from the smokers' year of birth. Level of education was based on the smokers' highest educational level: "illiterate," "literate," and from "1st year of elementary school" to "6th year of elementary school" were defined as "elementary school or below"; from "1st year of junior high school (vocational school)" to "3rd year of junior high school (vocational school)" were defined as "junior high school"; from "1st year of high school (vocational high school)" to "3rd year of high school (vocational high school)" were defined as "high school"; from "1st year of college or university" to "4th year of college or university" and "graduate school and above" were defined as "college or above". Income level was calculated on the basis of individual monthly income, and included salary, rental income, investment income, children's gifts, and retirement pensions.

Smoking status and habits: Light cigarettes smokers were asked, "Do you inhale more deeply and longer because you smoke light cigarettes?" Possible responses included "Yes," "No," and "Not necessarily." A response of "Yes" indicated that the light cigarette smokers did inhale more deeply. Light cigarettes smokers were also asked "Do you smoke more cigarettes because you smoke light cigarettes?" Possible responses included "Yes," "No," and "Not necessarily." A response of "Yes" indicated that the light cigarette smokers did smoke more cigarettes. Degree of addiction was determined on the basis of number of packs smoked per day. This was determined by asking respondents "On average, how much do you spend each week on cigarettes?" The response to this question was divided by the response to "What is the price of the

Table 1. Definitions and explanations of variables.

Variable	Variable definition	Explanation
Dependent variables		
Smoking more cigarettes	Do you smoke more cigarettes because you smoke light cigarettes?	If smoker smokes more cigarettes, dummy = 1, otherwise dummy = 0
Inhaling more deeply	Do you inhale more deeply and longer because you smoke light cigarettes?	If smoker inhales more deeply and longer, dummy = 1, otherwise dummy = 0
Independent variables		
Demographic and economic factors		
Sex		
Female	Female smoker	If smoker is female, Dummy = 1, otherwise dummy = 0
Age	Smoker's age	Continuous value
Educational level		
College or above	The smoker has attended college or above	If smoker attended university or above, dummy = 1, otherwise dummy = 0
High school	The smoker has attended high school	If smoker attended high school, dummy = 1, otherwise dummy = 0
Junior high school	The smoker has attended junior high school	If smoker attended junior high school, dummy = 1, otherwise dummy = 0
Personal monthly income levels		
≥ NT\$40k	Smoker's monthly income level is equal and greater than NT\$40,000	If smoker's monthly income is ≥ NT\$40,000, dummy = 1, otherwise dummy = 0
NT\$20k–40k	Smoker's monthly income level is between NT\$20,000 to NT\$39,999	If smoker's monthly income is NT\$20,000–39,999, dummy = 1, otherwise dummy = 0
NT\$10k–20k	Smoker's monthly income is between NT\$10,000 to NT\$19,999	If smoker's monthly income is NT\$10,000–19,999, dummy = 1, otherwise dummy = 0
Health status		
Good health	Smoker generally feels his or her health status is very good, good, or adequate	If smoker feels his or her health status is very good, good, or adequate, dummy = 1, otherwise dummy = 0
Smoking characteristics		
Degree of addiction		
Heavy smoker	The smoker smokes more than two packs per day	If smoker smokes more than two packs per day, dummy = 1, otherwise dummy = 0
Moderate smoker	The smoker smokes 1-2 packs per day	If smoker smokes 1-2 packs per day, dummy = 1, otherwise dummy = 0
Brand		
Imported cigarettes	The smoker smokes an imported cigarette brand	If smoker smokes an imported cigarette brand, dummy = 1, otherwise dummy = 0
Intention to quit smoking		
Yes	The smoker intends to quit smoking	If smoker who intend to quit smoking dummy = 1, otherwise dummy = 0

brand of cigarettes that you most often smoke?" to calculate the number of packs purchased per week, which was divided by the seven days in a week to obtain the number of packs smoked per day. Smokers who smoked less than one pack per day were classified as light smokers, those who smoked more than one pack but less than two packs were classified as moderate smokers, and those who smoked two packs or more per day were classified as heavy smokers.

Intention to quit smoking and health status: Light cigarettes smokers were asked, "Do you want to quit smoking?" Possible responses consisted of "Yes" and "No." A response of "Yes" indicated that the light cigarette smoker intended to quit smoking. Light cigarettes smokers were also asked, "Generally speaking, what do you feel your current state of health is?" Possible responses consisted of "very good," "good," "adequate," "not very good," and "very poor." Those smokers

Table 2. General respondent characteristics.

Respondent characteristics	Perception that light cigarettes are relatively safe		Change in light cigarette smoking behavior			
	All light cigarette smokers (n = 2037)		Smoking more cigarettes %	p-value for χ^2	Inhaling more deeply %	p-value for χ^2
	%	N				
Overall	58.02 %	1182	5.64 %		4.76 %	
Demographic factors						
Sex						
Female	4.95 %	101	4.92 %	0.838	6.93 %	0.214
Male	53.06 %	1081	4.75 %		4.62 %	
Age						
18–45	37.26 %	759	5.14 %	0.466	3.82 %	0.14
≥ 46	20.76 %	423	6.15 %		5.67 %	
Education						
Elementary school or below	12.02 %	245	5.87 %	0.527	6.53 %	0.087
Junior high school	12.22 %	249	4.55 %		4.42 %	
High school	22.92 %	467	3.9 %		2.78 %	
College or above	10.84 %	221	5.56 %		5.88 %	
Monthly Income						
< NT\$10k	14.53 %	296	5.94 %	0.184	5.41 %	0.069
NT\$10k–20k	7.56 %	154	3.77 %		1.30 %	
NT\$20k–40k	18.06 %	368	3.83 %		3.53 %	
≥ NT\$40k	17.86 %	364	5.19 %		6.04 %	
Health status						
Good health	51.69 %	1053	5.32 %	0.435	4.08 %	0.057
Poor health	6.33 %	129	6.98 %		7.75 %	
Smoking characteristics						
Brand						
Domestic or others	29.50 %	601	4.99 %	0.436	4.16 %	0.583
Imported	28.52 %	581	6.02 %		4.82 %	
Degree of addiction						
Heavy smoker	4.71 %	96	1.04 %	0.0006	2.08 %	0.002
Moderate smoker	21.79 %	444	3.15 %		2.25 %	
Light smoker	31.51 %	642	7.79 %		6.39 %	
Intention to quit smoking						
Yes	29.31 %	597	5.93 %	0.037	5.86 %	0.02
No	28.71 %	585	3.64 %		3.08 %	

who indicated that their health was very good, good, or adequate were defined as having good health. This study used Logit models for smoking more light cigarettes or inhaling more deeply, and Limdep 8.0 was used to perform estimates. Dependent variables and independent variables are defined and explained in Table 1.

Results

It can be seen from the light cigarette smoker characteristics in Table 2 that 1,182 (58.02%) out of 2,037 light cigarette smokers felt that smoking light cigarettes is relatively safe. Smokers in the 18–45 age group who believed that smoking light cigarettes is relatively safe accounted for 37.26% of all respondents. By educational level, smokers with a high

Table 3. Logit model estimation results for smoking more light cigarettes and inhaling more deeply.

Characteristics	Change of smoking more cigarettes in response to perceived safety of light cigarettes				Change of inhaling more deeply in response to perceived safety of light cigarettes			
	Multi-Logit regression		Multi-Logit regression		Multi-Logit regression		Multi-Logit regression	
	All smoker (N = 1,900)	Light smoker	Intention to quit	All smoker (N = 1,900)	Monthly Income ≥ NT\$40,000	Education Level of High School or Above	Light smoker	Intention to quit
Demographic factors								
Female	-0.00033	0.00917	.01990	.01589	.00635	-.00457	.01918	.02770
Ref: Male								
Age	0.00006	0.00008	-.00026	.00008	.00023	-.00050	.00045	.00002
Education								
Junior high school	0.00635	0.00547	.02596	-.00599	-.04856**	-	.00203	-.00160
High school	-0.00488	-0.00548	-.0097	-.01990	-.04244	-	-.02328	-.00982
College or above	0.01323	0.01019	.02218	.00179	-.01829	-	-.00038	.01489
Ref: Elementary school or below								
Monthly Income								
NT\$10k–20k	-0.03104	-0.05482*	-.02704	-.03024*	-	-.02475	-.05365*	-.03586
NT\$20k–40k	-0.01652	-0.03336	-.03479*	-.01507	-	-.00971	-.01484	-.04345**
≥ NT\$40k	-0.00322	-0.01678	-.01772	-.00113	-	.00294	-.00799	-.00738
Ref: < NT\$10k								
Health status								
Good health	-0.01068	-0.01034	-.04421	-.01732	-.00206	.01065	-.03165	-.01032
Ref: Poor health								
Smoking characteristics								
Degree of addiction								
Heavy smoker	-0.04522**	-	-.05327*	-.02436*	-.00544	-.01867	-	-.04013
Moderate smoker	-0.03661**	-	-.04846**	-.02999**	-.03188	-.01960*	-	-.04100**
Ref: Light smoker								
Brand								
Imported	0.01059	-0.00089	.03723	.01267	-.03613	-.01486	.01522	.00266
Ref: Domestic or others								
Intention to quit smoking								
Yes	0.02345**	0.03710*	-	.02147**	.03808*	.03348**	.03479**	-
Ref: No								

Note: ** and * indicate that the estimated parameter values respectively achieve 5% and 10% levels of statistical significance.

school education who believed that smoking light cigarettes is relatively safe accounted for a relatively high 22.92% of all respondents. In term of health and smoking status, smokers who considered their health to be good and who felt that smoking light cigarettes is relatively safe accounted for a 51.69% majority of all respondents. Light smokers who felt that smoking light cigarettes is relatively safe accounted for 31.51% of all respondents. These figures indicate that relatively high percentages of light cigarette smokers who are 18–45 years of age, have a high school education, consider their health to be good, and are light smokers believe that smoking light cigarettes is relatively safe.

Descriptive statistics concerning whether smokers smoked more cigarettes or inhaled more deeply due to the belief that smoking light cigarettes is relatively safe indicated that 5.64% and 4.76% of respondents smoked more cigarettes or inhaled more deeply respectively due to a perception that smoking light cigarettes is relatively safe. This shows that, in Taiwan, the perception that smoking light cigarettes is relatively safe does not tend to encourage light cigarette smokers to increase their cigarette consumption or inhale more deeply. The percentage of light smokers who smoked more cigarettes due to a belief that light cigarettes are relatively safe was 7.79, however, which significantly for both the moderate and heavy smokers. Among smokers who believed that light cigarettes are relatively safe, 6.39% of light smokers and 5.86% of those who intended to quit inhaled more deeply because of their belief that light cigarettes are relatively safe; higher percentages of smokers in these categories inhaled more deeply than did moderate and heavy smokers and smokers who did not intend to quit.

The Logit model estimation results shown in Table 3 concerning whether the perception that light cigarettes are relatively safe causes smokers to smoke more cigarettes or inhale more deeply show that, when the threshold of significance is set as 5%, the variables of smoking addiction and intention to quit smoking achieve statistical significance. Being a heavy or moderate smoker had a negative correlation with smoking more light cigarettes or inhaling more deeply, which suggests that light smokers who believe that light cigarettes are relatively safe are more likely to smoke more cigarettes or inhale more deeply. Intention to quit smoking had a positive correlation with decision to inhale more deeply, which indicates that smokers who believe that light cigarettes are relatively safe and who intend to quit are more likely to smoke more light cigarettes or inhale more deeply. As for the marginal effect of belief that smoking light cigarettes is relatively safe on probability of smoking more cigarettes, heavy smokers had a 4.522% lower probability of smoking more light cigarettes than did light smokers, and moderate smokers had a 3.661% lower probability than did light smokers. Smokers who intend-

Does perceived safety of light cigarettes encourage smokers to smoke more or to inhale more deeply?

ed to quit had a 2.345% higher probability of smoking more light cigarettes than did smokers who did not intend to quit. As for the marginal effect of belief that smoking light cigarettes is relatively safe on probability of inhaling more deeply, heavy smokers had a 2.436% lower probability of inhaling more deeply than did light smokers, and moderate smokers had a 2.999% lower probability than did light smokers. Smokers who intended to quit had a 2.147% higher probability of inhaling more deeply than did those who did not intend to quit.

Among light smokers who believe that smoking light cigarettes is relatively safe, increasing intention to quit has a positive marginal effect on both smoking more light cigarettes and inhaling more deeply. This shows that light smokers who believe that smoking light cigarettes is relatively safe are more likely to smoke more cigarettes or inhale more deeply as their intention to quit increases. Among smokers who believe that light cigarettes are relatively safe and intend to quit smoking, increasing degree of addiction has a negative marginal effect on both smoking more light cigarettes and inhaling more deeply. This shows that smokers who believe that smoking light cigarettes is relatively safe and who intend to quit are more likely to smoke more cigarettes or inhale more deeply as their degree of addiction decreases. Among smokers who believe that light cigarettes are relatively safe and have a monthly income greater than NT\$40,000 or an educational level of high school or above, increasing intention to quit smoking has a positive marginal effect on inhaling more deeply. This indicates that smokers who believe that smoking light cigarettes is relatively safe and have relatively high income or educational levels are more likely to inhale more deeply as their intention to quit increases.

Finally, this study indicates that 58.02% of light cigarette smokers believed that smoking light cigarettes is less injurious than smoking ordinary cigarettes. However, only 5.64% and 4.76% of respondents smoked more cigarettes or inhaled more deeply respectively due to their belief that smoking light cigarettes is relatively safe. This indicates that domestic light cigarette smokers who believe that light cigarettes are relatively safe certainly do not smoke significantly more cigarettes or inhale significantly more deeply due to smoking light cigarettes. However, among light cigarette smokers who believe that light cigarettes are relatively safe, light smokers and smokers who intend to quit do have a greater probability of smoking more cigarettes or inhaling more deeply.

Discussion

Government health agencies should therefore seek to correctly educate light cigarette smokers who are light smokers

or who intend to quit smoking concerning the health risks of light cigarettes, provide evidences that light cigarettes are not relatively safe, and correct the erroneous perception among smokers who would like to quit that smoking light cigarettes is an intermediate stage on the path to quitting. Because they may mislead consumers, the European Union has prohibited the words “light,” “ultra,” and “mild” in the markings on tobacco product packaging. The June 2007 revision of Taiwan’s Tobacco Control Law prohibited any tobacco product markings, brand name, or text or markings on tobacco containers from using the words “low tar,” “light (cigarette),” “mild,” or any other text or markings that might cause persons to mistakenly believe that smoking is harmless or only a mild health risk. However, the regulations of the revised Tobacco Control Law do not apply retroactively to the names of tobacco products prior to the revision, so the text and markings used by existing light cigarettes cannot be regulated. The government should therefore continue to implement measures prohibiting tobacco companies from using the words “light,” “low-tar,” or other text or markings that might cause persons to mistakenly believe that smoking is harmless or only a mild health risk. Doing so will prevent persons who wish to quit smoking from believing that smoking light cigarettes is a short-term strategy for reducing harm from smoking.

Perceiving smoking light cigarettes is relatively safe and being a light smoker, defined smoking less than one pack per day, are major factors influencing smokers to smoke more light cigarettes or inhale more deeply. This shows that light smokers tend to increase their cigarette consumption or the length of time they hold the smoke in their lungs in order to take in the same amount of tar/nicotine as they would when smoking ordinary cigarettes. Changing method of inhalation in order to take in an equivalent amount of tar from a low-tar cigarette can expose the smoker’s lungs to carcinogens in smoke and possibly cause carcinogens to settle in the lung airways in relatively large quantities. It has been found in the US and other countries that inhaling cigarette smoke more deeply can significantly increase risk of adenocarcinoma. Light smokers who smoke light cigarettes may mistakenly believe that light cigarettes are not harmful since they contain less tar, which may lead them to smoke more and more deeply, with the re-

sult that they become even more addicted to light cigarettes. Because tobacco companies have been using various media channels to create the erroneous impression that smoking light cigarettes is relatively harmless, and because smoking more increases risk of lung cancer, there is an urgent need to draft an education and awareness intervention program and strengthen anti-smoking work aimed at light smokers who smoke light cigarettes.

If one-year cross-sectional survey data is used to determine whether smokers smoke more cigarettes or inhale more deeply, the results may indicate fewer persons responding that they smoke more cigarettes or inhale more deeply than the actual number. This effect possibly occurs because persons who smoke light cigarettes have a different perception of “smoking more” or “inhaling more deeply” than other smokers (light cigarette smokers may have a relatively poor understanding of the meaning of smoking more cigarettes or inhaling more deeply). Future cross-sectional survey data should therefore be analyzed in conjunction with longitudinal time series data in order to shed more light on smoking more cigarettes or inhaling more deeply when smokers switch to smoking light cigarettes.

This study is still restricted and has room to be improved for future study. The advantages of adopting section investigation materials are more representative samples and the disadvantages may be that the investigation data may materially fluctuate (net variance) at each time point. If error factors could be eradicated, there are still many restrictions for a space to explain occurrence or existence of phenomenon. Future study may establish a longitudinal investigation in the act of light cigarette smokers. The data will be helpful to actually assess the dynamic difference with demographical factors and smoking characteristics.

Acknowledgements

The data used in this study was derived from the 2002 Survey of the Health Promotion Knowledge, Attitudes, and Behavior of Taiwan Citizens performed by the Bureau of Health Promotion, Department of Health, Executive Yuan. Any interpretations or conclusions made by this study absolutely do not indicate the position of the Bureau of Health Promotion.

References

1. WHO, Global cancer rates could increase by 50% to 15 million by 2020 (<http://www.who.int/mediacentre/releases/2003/pr27/en/>) (accessed Oct 13, 2004).
2. Wen CP, Levy DT: Smoking policy at the crossroads: opportunities and challenges. In *Collection of Research Papers on Tobacco or Health in Taiwan 2002*. Edited by: Wen Chi-Pang. Taiwan: Division of Health Policy Research, National Health Research Institutes; 2002:4–49.
3. Bureau of Health Promotion, Department of Health: Taiwan Tobacco Control 2007 Annual Report. Taipei, Taiwan.
4. Ockene JK, Kuller LH, Svendsen KH, Meilahn E. The relationship of smoking cessation to coronary heart disease and lung cancer in the multiple risk factor intervention trial (MRFIT). *Am J Public Health*. 1990;80:954–8.
5. Kuller LH, Ockene JK, Meilahn E, Wentworth DN, Svendsen KH, Neaton JD. Cigarette smoking and mortality. MRFIT research group. *Prev Med*. 1991;20:638–54.
6. Tang JL, Morris JK, Wald NJ, Hole D, Shipley M, Tunstall-Pedoe H. Mortality in relation to tar yield of cigarettes: a prospective study of four cohorts. *BMJ* 1995;311:1530–3.
7. Vutuc C, Kunze M. Lung cancer risk in women in relation to tar yields of cigarettes. *Prev Med*. 1982;11:713–6.
8. Vutuc C, Kunze M. Tar yields of cigarettes and male lung cancer risk. *J Natl Cancer Inst*. 1983;71:435–7.
9. Hammond EC, Garfinkel L, Seidman H, Lew EA. “Tar” and nicotine content of cigarette smoke in relation to death rates. *Environ Res*. 1976;12:263–74.
10. Higenbottam T, Shipley MJ, Rose G. Cigarettes, lung cancer, and coronary heart disease: the effects of inhalation and tar yield. *J Epidemiol Community Health*. 1982;36:113–7.
11. Borland C, Chamberlain A, Higenbottam T, Shipley M, Rose G. Carbon monoxide yield of cigarettes and its relation to cardiorespiratory disease. *BMJ* 1983;287:1583–6.
12. Lubin JH, Blot WJ, Berrino F, Flamant R, Gillis CR, Kunze M, et al. Patterns of lung cancer risk according to type of cigarette smoked. *Int J Cancer*. 1984;33:569–76.
13. Petitti DB, Friedman GD. Cardiovascular and other diseases in smokers of low yield cigarettes. *J Chronic Dis*. 1985;38:581–8.
14. Gillis CR, Hole DJ, Boyle P. Cigarette smoking and male lung cancer in an area of very high incidence. I. Report of a case-control study in the West of Scotland. *J Epidemiol Community Health*. 1988;42:38–43.
15. Thun MJ, Lally CA, Flannery JT, Calle EE, Flanders WD, Heath CW Jr. Cigarette smoking and changes in the histopathology of lung cancer. *J Natl Cancer Inst*. 1997;89:1580–6.
16. Burns DR, Major JM, Shanks TG, Thun MJ, Samet JM. Smoking lower yield cigarettes and disease risks. In: Shopland DR, Burns DM, Benowitz NI, Amacher RH, eds. Risks associated with smoking cigarettes with low machine-measured yields of tar and nicotine. Bethesda, MD: US National Institutes of Health, National Cancer Institute. 2001:65–158. (NCI Smoking and Tobacco Control Monograph No 13.)
17. Thun MJ, Lally CA, Flannery JT, Calle EE, Flanders WD, Heath CW Jr. Cigarette smoking and changes in the histopathology of lung cancer. *J Natl Cancer Inst*. 1997;89:1580–6.
18. Chen CJ, Wen CP, Tsai SP, Liaw KM, Cheng TY, Tsai MC. Smoking attributable mortality in Taiwan 1990–2020. *Collection of Research Papers on Tobacco or Health in Taiwan*. 2002;379–99.
19. Lin HS, Wen CP, Hou CC, Hou CC, Chu ST, Chung WS: Research on tobacco litigation in Taiwan. In *Collection of Research Papers on Tobacco or Health in Taiwan 2002*. Edited by Wen Chi-Pang et al. Taiwan: Division of Health Policy Research, National Health Research Institutes; 2002:68–90.
20. Bureau of Health Promotion, Department of Health: Survey of the Health Promotion Knowledge, Attitudes, and Behavior of Taiwan Citizens. Taipei, Taiwan. 2003.
21. Bureau of Health Promotion, Department of Health: Taiwan Tobacco Control Annual Report. Taipei, Taiwan. 2006.
22. Lin H.M. Comparison with urinary cotinine levels and respiratory health effects between light and heavy smokers. Department of Public Health, Taipei Medical University, Master Thesis, 2004.
23. Lee J.M., Ma J.S., Yu T.C., Chen S.H. Does perceived safety of light cigarette make smokers inhale deeper and draw smoke into their lungs? *Taiwan J Public Health*, 2007;27:409–418.
24. Shiffman S, Pillitteri JL, Burton SL, Rohay JM, Gitchell JG. Smokers’ beliefs about “Light” and “Ultra Light” cigarettes. *Tob Control* 2001;10 (Suppl 1):17–23.
25. Cohen JB. Smokers’ knowledge and understanding of advertised tar numbers: health policy implications. *Am J Public Health*. 1996;86:18–24.
26. Gori G.B. Consumer perception of cigarette yields: is the message relevant? *Regul Toxicol Pharmacol*. 1990;12:64–8.
27. Benowitz NL, Hall SM, Herning RI, Jacob P, Jones RT, Osman AL. Smokers of low-yield cigarettes do not consume less nicotine. *N Engl J Med* 1983;309:139–42.
28. Djordjevic MV, Stellman SD, Zang E. Doses of nicotine and lung carcinogens delivered to cigarette smokers. *J Natl Cancer Inst*. 2000;92:106–11.
29. Scherer G.. Smoking behavior and compensation: a review of the literature. *Psychopharmacology*. 1999;145:1–20.
30. Jarvis M, Bates C. Why Low Tar Cigarettes Don’t Work and How the Tobacco Industry Has Fooled the Smoking Public. *Action on Smoking and Health UK Online Bulletin* 1999: www.ash.org.uk/html/regulation/html/big-one.html (accessed 28 November, 2003).
31. Harris JE, Thun MJ, Mondul AM, Calle EE. Cigarette tar yields in relation to mortality from lung cancer in the cancer prevention study II prospective cohort *BMJ*. 2004;328:1982–8.
32. Kelbsch J, Meyer C, Rumpf HJ, John U Hapke U. Stages of change and other factors in ‘light’ cigarette smokers. *Eur J Public Health*. 2005;15(2):146–51.
33. Gilpin EA, Emery S, White MM, Pierce JP. Does tobacco industry marketing of ‘light’ cigarette give smokers a rationale for postponing quitting? *Nicotine Tob Res*. 2002;S147–S155.
34. Tindle H. Light cigarettes harder to quit. *American Journal of Public Health*, online edition, 96. News release, University of Pittsburgh School of Medicine. 2006.

Address for correspondence

Jie-Min Lee, PhD
Department of Logistic Management
National Kaohsiung Marine University,
Kaohsiung, Taiwan
Tel: +886 7 3617141 ext 3459
Fax: +886 7 3617141 ext 3451
E-mail: jmllee866@yahoo.com.tw