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Health Effects of Light and Intermittent Smoking A Review

Rebecca E. Schane, MD; Pamela M. Ling, MD, MPH; Stanton A. Glantz, PhD

Current public health guidelines on the identification and treatment of smokers and the information on the health risks associated with tobacco are based on studies that focus on adult daily cigarette users.¹ Daily smoking, however, is declining, and light and intermittent smoking are increasing.^{2,3} Light and intermittent smoking are frequently found among young people, educated people, women,^{4,5} and minority populations (Hispanics/Latinos, blacks, American Indians, Alaska Natives, Asian Americans, and Pacific Islanders^{6–9}). Light and intermittent smokers pose a serious challenge to healthcare professionals because they tend not to consider themselves “smokers” and, consequently, are underidentified.^{10–13} This propensity not to label oneself as a smoker reinforces the belief that light and intermittent smoking do not carry significant health risks.

There is no consensus on how to best define “light smoking.”^{7,12,14} Light smokers have been classified as smoking <1 pack per day, <15 cigarettes per day, <10 cigarettes per day, and 1 to 39 cigarettes per week.^{9,14} There are various subgroups of light smokers: low-rate daily smoking (<5 cigarettes per day),¹⁵ very light smoking (<6 cigarettes per day),^{14,16} and “chippers” who consistently smoke ≤5 cigarettes per day on the days when they do smoke.¹⁷ In the past, light smoking has been viewed as a transient practice among former heavier smokers or among tobacco users who are trying to quit.^{4,5,18} New research, however, shows that some light smokers maintain this consumption pattern indefinitely.^{11,12,19}

Like light smoking, intermittent smoking is a broad term that consists of a variety of patterns of tobacco use but is generally defined as smoking on a nondaily basis.^{4–6,8,12,14,20–22} Social smoking is another example of intermittent smoking, which is characterized by limiting smoking to social contexts, such as parties, bars, or nightclubs.^{11,12} (Social smokers, unlike other types of intermittent smokers, may never smoke alone.^{11,23}) As with light smoking, intermittent smoking is common among minority populations.^{4,5,8} Black smokers are nearly twice as likely to smoke intermittently (odds ratio, 1.82; 95% confidence interval [CI], 1.59 to 2.07), and Hispanic/Latino smokers are 3 times more likely to smoke intermittently (odds ratio, 3.2; 95% CI, 2.75 to 3.74) than non-Hispanic whites.⁶ Among young adults, intermittent smoking is frequently

paired with excessive alcohol use, particularly binge drinking, on US college campuses.^{24,25}

The number of young adult smokers (aged 18 to 29 years) who consume <5 cigarettes per day has increased from 4.7% in 1992 to 6.0% in 2002.³ According to the 2002 National Survey on Drug Use and Health, more than one third of all adult smokers report smoking less than daily.²⁶ The 2007 Behavioral Risk Factor Surveillance Survey data indicate that 26% of adult smokers were nondaily smokers.² The prevalence estimates of light and intermittent smoking are likely an underestimate because most surveys rely on self-report measures, and nondaily smokers tend to self-classify as nonsmokers.^{10–13} This important change in the composition of the US smoking population has developed in part because of tobacco control policies, including home and workplace smoking restrictions, coupled with society’s progressive denormalization of smoking.^{3,12,13}

As smoking patterns continue to change, there will be a shift in the US smoking population from daily, addicted tobacco users who smoke for the clear physiological and psychological benefits of nicotine to the low-level or occasional smoker who may not experience the same degree of nicotine dependence.¹² Understanding the health effects of light and intermittent smoking is important for healthcare professionals, who are increasingly likely to encounter this type of tobacco use in practice. Although the available literature is not large, it indicates that light and intermittent smoking pose substantial risks; the adverse health outcomes parallel dangers observed among daily smoking, particularly for cardiovascular disease.

Methods

We used standard methods to systematically identify studies on the health outcomes associated with light and intermittent smoking. From July 2008 to July 2009, we searched PubMed using the terms *light smoking*, *intermittent smoking*, *occasional smoking*, *social smoking*, and *nondaily smoking* to locate studies on the associated health effects. Inclusion criteria were studies of the following: (1) adult humans (age 18 years old or older, without any upper limit of age specified); (2) smokers who were not considered to be in an experimental phase of their smoking; and (3) health outcomes among light or intermittent (nondaily) smokers published in English (10 studies not in English were excluded). Studies of adolescents were excluded (age 18 years old or younger) because their light and intermittent smoking often represent an experimental phase of tobacco use rather than stable chronic low-level

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Table. Health Effects of Light and Intermittent Smoking

Disease	Level of Smoking	Risk for Light Smokers vs Nonsmokers	Study Design
Cardiovascular disease			
Ischemic heart disease ²⁸	1–4 cig/d	RR 2.74 (2.07–3.61) in men; RR 2.94 (1.75–4.95) in women	Prospective cohort
Aortic aneurysm ³⁰	<10 cig/d	RR 2.29	Prospective cohort
Cardiovascular mortality ³¹	Occasional smoking	RR 1.5 in men (1.0–2.3)	Prospective cohort
Malignancy			
Esophageal cancer ³²	1–14 cig/d	RR 4.25	Prospective cohort
Lung cancer ²⁸	1–4 cig/d	RR 2.79 (0.94–8.28) in men; RR 5.03 (1.81 to 13.98) in women	Prospective cohort
Gastric cancer ³³	1–4 cig/d	RR 2.4 (1.3–4.3)	Case control
Pancreatic cancer ³⁴	<10 cig/d	RR 1.8 (1.4–2.5)	Prospective cohort
Respiratory diseases			
Lower respiratory tract infections ³⁵	Light smoking (<1 pack/d)	RR:1.5 in men; RR 1.13 in women	Prospective cohort
Prolonged duration of respiratory symptoms: cough ³⁵	<1 pack/d	Duration of respiratory symptoms (cough) was 7.7 d in the light smoking group vs 6.8 d in never smokers	Prospective cohort
Reproductive health			
Impaired fecundity in women (delayed time to conception) ³⁶	1–4 cig/d	Increasing OR of delayed conception from 1.1 for 6-mo delay to 3.2 at 18-mo delay	Prospective cohort
Spermatozoa function ³⁶	4 cig/d for 5 y	Spermatozoa showed decreased density/motility	Prospective cohort
Placenta previa ³⁷	Light smoking (<1 pack/d)	OR 2.2 (0.87–7.83)	Case control
Ectopic pregnancy ³⁸	<10 cig/day	OR 1.4 (0.8–2.5)	Case control
Other conditions			
Ankle fractures in women ³⁹	1–10 cig/d	OR 3.0 (1.9–4.6)	Retrospective
Cataracts/development of nuclear lens opacities ⁴⁰	Light smoking (<10 cig/d)	OR 1.68 (1.14–2.49)	Prospective cohort
Physical disability after meniscal tear ⁴¹	Light smoking (<1 pack/d)	RH 1.44 (1.07–1.94)	Prospective cohort
All-cause mortality			
Risk of all-cause mortality in men ³¹	Occasional smoking	OR 1.6 (1.3–2.1)	Prospective cohort

Cig indicates cigarettes; RR, relative risk; OR, odds ratio; and RH, relative hazard.

consumption. Studies were not limited to US populations. Health outcomes in light and intermittent smokers were compared with outcomes observed among daily smokers and nonsmokers. All of the light and intermittent smokers were self-identified. In addition to studies identified with PubMed, we examined data on the dose-response relationship between active smoking and disease beginning with studies summarized in the 2004 US Surgeon General's report on the health consequences of smoking²⁷ to identify health effects associated with smoking ≤ 10 cigarettes per day. We reviewed bibliographies of studies located by these procedures to identify additional articles, yielding a total of 805 citations. After the titles were screened, abstracts were reviewed to determine eligibility for full text review. Forty-five studies met criteria for inclusion in this review.

Results

Cardiovascular Disease

Light and intermittent smoking carry nearly the same risk for cardiovascular disease as daily smoking.^{28,29} The dose-response relationship between tobacco exposure and cardiovascular mortality is highly nonlinear.²⁹ An analysis of the dose-response relationship based on combined data of passive smoking, particulate matter from air pollution, and active light and heavy smoking indicates that low levels of tobacco

exposure as seen in light smoking (4 to 7 cigarettes per day) has $\approx 70\%$ of the effect of heavy smoking (≥ 23 cigarettes per day).²⁹ In addition, the risk of ischemic heart disease in light-smoking men and women aged 35 to 39 years who smoke 1 to 4 cigarettes per day is nearly 3 times that of a nonsmoker (Table).^{28,30–41} Adult women who smoke ≈ 3 to 5 cigarettes per day have a relative risk of 2.14 for myocardial infarction compared with nonsmokers.⁴² Adult men who consume 6 to 9 cigarettes per day also have a relative risk of 2.10 for myocardial infarction compared with nonsmokers.⁴² Among men aged 47 to 55 years who smoke 1 to 4 cigarettes per day, the prevalence of a major cardiac event during a 12-year period is 11% compared with 3.7% in nonsmoking men.⁴³ The risk of death from aortic aneurysm is nearly 3 times greater in light smokers than in nonsmoking men and women.²⁷ Overall, occasional smoking among men is associated with an increased risk of cardiovascular mortality (relative risk, 1.5; 95% CI, 1.0 to 2.3) compared with nonsmoking men.³¹

Lung and Other Cancers

In the United States, lung cancer causes 1 of every 3 cancer deaths in men (31%) and ≈ 1 in 4 cancer deaths among women

(27%).⁴⁴ There is a dose-response relationship for cigarette smoking and lung cancer, with no evidence of a threshold.²⁷ For daily smokers (>20 cigarettes per day), the risk of dying of lung cancer is >23 times higher in men and ≈13 times higher in women than in nonsmokers.¹ The risks for light smokers, although lower, are still substantial. Women between the ages of 35 and 49 years who smoke 1 to 4 cigarettes per day have 5 times the risk of developing lung cancer (relative risk, 5.0; 95% CI, 1.8 to 14.0) and men have 3 times the risk (relative risk, 2.8; 95% CI, 0.9 to 8.3) as nonsmokers.²⁸

The risk of low-level smoking is greater among certain ethnic and racial populations. Blacks and Native Hawaiians who smoke ≤10 and between 11 and 20 cigarettes per day are more susceptible to lung cancer than whites, Japanese Americans, and Latinos who smoke the same amount of tobacco.⁴⁵ When adjusted for sex and duration of smoking, the relative risk of developing lung cancer among blacks and Native Hawaiians is nearly twice that of whites despite consuming the same number of cigarettes.⁴⁵ Consistent with these data, the incidence of lung cancer has been found to be substantially higher among blacks, Native Hawaiians, and other Pacific Islanders compared with whites in the United States.⁴⁶

Light smoking also results in an increased risk of gastrointestinal (esophagus, stomach, pancreas) cancers (Table).³²⁻³⁴

Other Diseases

Light smoking is associated with lower respiratory tract infections, including a prolonged duration of respiratory symptoms (particularly cough),³⁵ cataracts,⁴⁰ compromised reproductive health,³⁶ an increased risk for ectopic pregnancy³⁸ as well as placenta previa,³⁷ and poor bone mineral density, leading to frequent ankle fractures in older women³⁹ (Table).

Light smokers report lower health-related quality of life than nonsmokers on all 8 dimensions of the SF-36 health status questionnaire (physical functioning, physical roles, bodily pain, general health, vitality, social functioning, emotional roles, and mental health).⁴⁷ Specifically, standardized scores for light smokers on the SF-36 ranged from the 43rd to the 50th percentile when general health, physical functioning, social functioning, and vitality were assessed, whereas standardized scores for the same variables among never smokers were consistently above the 50th percentile.⁴⁷

Light smoking has also been associated with the development of physical disability after a musculoskeletal injury or disorder.⁴¹ In particular, young adult light smokers (<1 pack per day) are at great risk for physical disability after a meniscal injury compared with nonsmokers (relative hazard, 1.44; 95% CI, 1.07 to 1.94); these results paralleled the risks observed among heavy smokers (relative hazard, 1.49; 95% CI, 1.06 to 2.11).⁴¹ Menisci are especially vulnerable because they have a limited blood supply that may be easily compromised by the physiological effects of smoking: arterial vasoconstriction, cellular hypoxia, delayed revascularization, demineralization of bone, and immune suppression, which are factors that can impair healing after trauma.⁴¹

Light smoking has an impact on frailty and survival in older adults. Among adults aged ≥65 years, light smoking leads to poorer outcomes in the elderly population as mea-

sured by a frailty index, a variable that was created to assess 40 self-reported health deficits (excluding symptoms that could be directly related to smoking). Overall, light smokers between the ages of 66 and 75 years had a frailty index that was halfway between that of heavier smokers and never smokers. Higher frailty indices correlated with higher mortality rates that persisted into older age among all smokers.⁴⁸

All-Cause Mortality

The risk of all-cause mortality in intermittent male smokers is significantly increased (odds ratio, 1.6; 95% CI 1.3 to 2.1) compared with nonsmoking men.³¹ Among women, light smoking resulted in a 4- to 6-year median loss of life compared with nonsmoking women.⁴⁹ Consistent with these results, a recent study of low-rate daily smokers (1 to 4 cigarettes per day) found a relative risk for all-cause mortality of 1.6 (95% CI, 1.3 to 1.9) in men and a relative risk of 1.5 (95% CI, 1.2 to 1.8) in women.

Discussion

The available literature primarily consists of prospective studies (Table), which are the strongest form of evidence to support a causal association between disease and exposure. The data from these studies indicate that there are substantial risks associated with these patterns of tobacco use that warrant immediate clinical attention. To improve our understanding of the risks associated with light and intermittent smoking, more large-scale cohort studies explicitly comparing heavy smokers, light smokers, intermittent smokers, and nonsmokers are needed to better identify outcomes among these patterns of tobacco use. The published cohort studies lack a specific focus on intermittent smoking and tend to underrepresent minority populations, in which this type of tobacco use is most prevalent. The long-term risks of light and intermittent tobacco use for important medical conditions such as obstructive lung disease, cerebrovascular disease, peripheral vascular disease, and breast cancer have not been discussed in this review because of the lack of available evidence. In addition to specific disease outcomes, research is needed to examine whether chronic low-level or occasional tobacco use causes a poorer quality of life or leads to a greater frequency of health-related symptoms.

The risks associated with passive smoking^{50,51} also support the conclusion that clinically important risks are associated with light and intermittent smoking. Although there are differences in the composition of secondhand and mainstream cigarette smoke,^{50,51} with doses that passive smokers receive being much lower than those of active smokers, the health risks associated with secondhand smoke are substantial and well documented. Passive smoking has effects on many biological mediators of cardiovascular disease that are nearly as large as those associated with active smoking, including changes in platelet activation and endothelial cell dysfunction, factors that are recognized as key mediators of cardiovascular disease.⁵² Passive smoking causes cardiovascular disease, lung cancer, head and neck cancers, obstructive lung disease (chronic obstructive pulmonary disease, asthma), vascular disease, lower respiratory tract infections,^{50,51} and breast cancer in younger women.⁵¹

Few studies have examined the role of nicotine dependence among light and intermittent smokers. Although some data indicate that these groups can abstain from tobacco use for days and even weeks without exhibiting signs of withdrawal,⁵³ other studies suggest that intermittent tobacco users, despite their low level of exposure, may experience sudden urges to smoke and difficulties with achieving cessation as a result of a physiological addiction.⁵⁴ For example, a study of very light (1 to 3 cigarettes per day) adolescent smokers found no active signs of nicotine withdrawal, as measured by changes in heart rate and neuropsychological testing, after 24 hours of abstinence.⁵³ The authors of another study examining the effect of intermittent, low-dose exposure to nicotine on the brain suggest that this type of tobacco use may trigger upregulation of nicotinic acetylcholine receptors, resulting in a heightened physiological response to an occasional cigarette.⁵⁴ The authors argue that intermittent smokers are just as vulnerable to nicotine dependence as daily smokers. Additional research is needed to address whether nicotine addiction occurs among light and intermittent smokers.

Part of the responsibility in helping patients to become tobacco free rests in having established therapies to assist patients in quitting. Currently, public health guidelines¹ do not provide formal recommendations for the treatment of light and intermittent smoking, other than informing clinicians that they should advise their patients to stop. It is unclear whether pharmacotherapy has a role in the treatment of light and intermittent smoking because these tobacco users are not typically enrolled in clinical trials, and questions remain regarding their level of nicotine addiction. Clinicians need to understand better what treatment options are effective to help these patients to quit.

Limitations

The available literature on the health effects of light and intermittent smoking is limited; for example, the risks of developing obstructive lung disease, asthma, and cerebrovascular disease have not been studied in this population. There are no published data on the health effects of intermittent smoking in pregnant women. In addition, there are no standard definitions of light smoking, which has led to variability in the level of smoking considered “light” in different studies (Table).

Conclusions

There is a widespread belief, based in part on truth (ie, the dose-response relationship between smoking intensity and some diseases, including cancer) and in part on successful tobacco industry marketing to “health-conscious smokers,”^{11,55,56} that light and intermittent smoking are safer than heavier smoking. The fact remains, however, that even stable light smoking carries substantial health risks. Although a reduction in cigarette consumption can be an intermediate stage before a total stop and may increase the motivation of daily, heavier smokers without intention to quit to achieve eventual cessation,^{57,58} chronic light and intermittent smoking should not be presented to patients as a healthy long-term choice. Complete cessation is 1 of the most cost-effective interventions and provides a benefit nearly as large as, if not

greater than, other widely used forms of treatment for the secondary prevention of cardiovascular disease.⁵⁹ Cessation is the only known primary therapy that can significantly reduce the risk of cancer⁶⁰ and obstructive lung disease.⁶¹

Light and intermittent smokers often go undetected because many of them do not view themselves as smokers and will deny their habit when asked by family, friends, and healthcare providers.^{11,12} Clinical screening for light and intermittent smoking should be improved. Specifically, questions that rely on self-labeling such as “Are you a smoker?” should be abandoned in favor of questions that focus on smoking behavior such as “Do you use any tobacco products on a daily, weekly, or social basis?”

Although this question has not been the subject of a formal clinical trial, it is more specific and recognizes behavioral triggers that are not normally assessed with the existing screening tools. Consequently, healthcare providers may capture many tobacco users who otherwise may not consider themselves smokers. Relying only on the current healthcare screening question of “Are you a smoker?” runs the risk of missing light and intermittent consumers who do not consider themselves tobacco users. Furthermore, biochemical markers, such as cotinine, may also serve as screening tools to supplement a patient’s smoking history and to help healthcare providers to identify not only light smokers but also heavier smokers and passive smokers. Once identified, clinicians should work aggressively to encourage these patients to quit smoking completely.

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