Key points:

- smoking and unhealthy weight contribute to a substantial percentage of preventable mortality, and to health inequalities
- for many smokers the prospect of putting on weight after giving up is a barrier to making a quit attempt
- most weight gain is trivial compared to the health benefits of not smoking
- smoking is not an effective weight management strategy
- understanding the complex interaction of causal risk factors and inequalities is vital to both improving public health and reducing inequalities.

Despite the best efforts of the tobacco industry the last forty years have seen a decline in smoking rates in the developed world. Over the same period obesity rates have soared, leading to speculation that the two are linked. This briefing examines the effect that smoking has on body mass index (BMI) and the supposed connection between declining smoking prevalence and the ‘obesity epidemic’.

Introduction

In 1925 American Tobacco launched the slogan ‘For a slender figure reach for a Lucky instead of a sweet’ and saw their market share increase by 200%. Transcripts of American Tobacco’s Lucky Strike Radio Hour from the late 1920s show famous figures touting Luckies as ‘a splendid alternative to fattening sweets’ and exhorting listeners to ‘smoke Luckies to keep petite’. This was just the start of creating a public perception that cigarettes could control body weight, especially among young women, which the tobacco industry has ruthlessly exploited ever since. The late 1960s then saw the introduction of ‘light’ cigarettes, followed by ‘super lights’, ‘ultra lights’, and ‘slims’ and ‘superslims’ all with connotations of a ‘diet’ cigarette designed to prevent weight gain. A 1976 ad for Silva Thins ‘I’m a Thinner’ campaign declares ‘I like my figure slim. My men trim. And my cigarette thin’. Appetite-suppressant molecules, such as tartaric acid and 2-acetylpyridine were even added to some American cigarettes, this of course being in addition to modifications that were made to enhance addiction and dependence.
Effect of cigarette smoking on body mass index (BMI)

Numerous studies have confirmed that smokers do have a lower body mass index (BMI) than non-smokers\textsuperscript{9, 10, 11, 12}. In the World Health Organization Monitoring Cardiac Disease surveys, BMI was lower in smokers than in non-smokers in 20 (men) and 30 (women) of the 42 populations, and there was no population in which smokers had a higher BMI than did non-smokers\textsuperscript{13}.

However, there is evidence that cigarettes smoked per day are positively associated with central fat accumulation, particularly in women\textsuperscript{14}. Intra-abdominal accumulation of body fat may confer a higher risk of developing diabetes\textsuperscript{15}, cardiovascular disease\textsuperscript{16} and death\textsuperscript{17}, independently of general obesity. There is also some evidence that heavy smokers have greater bodyweight than light or non-smokers\textsuperscript{18, 19}, perhaps because heavy smokers also make other unhealthy lifestyle choices.

Reasons for lower BMI in some smokers

Nicotine, whether smoked, used orally or as patches is the major appetite-suppressing component of tobacco\textsuperscript{20}. The effect of chronic nicotine administration on appetite suppression, decreased food intake, and leanness has been replicated in animal experiments\textsuperscript{21}, suggesting that post-cessation weight-gain results from a purely physiological response. Research\textsuperscript{22} into the effects of nicotine on the appetite-regulating regions of the hypothalamus\textsuperscript{*} further confirms the contribution it makes to reduced appetite and body weight loss. There is also evidence\textsuperscript{23, 24} that nicotine’s effect on the metabolism lowers the body weight set point (normal body weight) and this may account for the initial weight gain experienced by some people when they give up smoking.

Behavioural factors may play a role in explaining the lower mean BMI of current smokers compared to never and former smokers. There appears to be a strong relationship between smoking habits, lifestyle factors, and BMI and there may also be a relationship between the number of cigarettes smoked per day and BMI, where the BMI of never-smokers and heavy smokers appears similar\textsuperscript{25}. However, the results of a 2009 longitudinal study\textsuperscript{26} from England suggest that when cigarette smokers achieve long-term abstinence, they revert to a mean BMI roughly equivalent to that of never-smokers.

\textsuperscript{*} The main function of the hypothalamus is homeostasis, or maintaining the body’s status quo. Factors such as blood pressure, body temperature, fluid and electrolyte balance, and body weight are held to a precise value called the set-point. Although this set-point can migrate over time, from day to day it is remarkably fixed.
Weight gain after smoking cessation

A 2010 study in Oxfordshire GP practices\textsuperscript{27} found that obese smokers gain most weight on quitting smoking, while obese continuing smokers are likely to remain stable or lose weight. However, a 2010 analysis using figures from the British Household Panel Survey\textsuperscript{28} concluded that smoking cessation may lead to moderate effects on weight increases only for underweight and normal weight subjects but they were not significant for people affected by higher obesity prevalence rates.

The European Prospective Investigation into Cancer and Nutrition-Physical Activity, Nutrition, Alcohol, Cessation of smoking, Eating out of home And obesity (EPIC-PANACEA) project\textsuperscript{29} assessed the association between smoking cessation and prospective weight change in the European population. The study (which involved more than 300,000 healthy volunteers in nine European countries) confirmed that smoking cessation tends to be followed by weight gain; when compared to stable smokers, annual weight gain was higher in men and women who stopped smoking during follow-up. When smokers who stopped smoking at least one year before recruitment were compared to never smokers, no major differences in annual weight gain were observed. The excess weight gain following smoking cessation appears to occur mostly in the first few years following the cessation.

A study\textsuperscript{30} of data from the 2004-2005 and 2009-2010 Behavioral Risk Factor Surveillance Survey found that quitting smoking was associated with a small increase in BMI and that this effect increased over time. Young women gained about 2.3 per cent in BMI within a month after quitting smoking, up to a maximum of 5.2 per cent between 3 and 6 months after quitting. This pattern was similar in young men and older women and men, although the maximum increases took longer in those groups. The largest BMI increase occurred in older women, whose BMI increased by more than 8 per cent, or about 13 pounds, over 10 years after quitting. Essentially, it appears that the amount of weight likely to be gained varies depending on whether a quitter is young or old, male or female, and if they are already overweight. The authors of this study concluded that ‘the price that must be paid, in terms of weight gain, to enjoy the health benefits of smoking cessation is trivial even for the obese population’.

Unsurprisingly, the prospect of weight gain is known to deter prospective quitters\textsuperscript{31}, which suggests that interventions to ameliorate weight gain in those most at risk or who believe themselves most at risk should be offered alongside cessation advice. This message was reinforced by a 2010 study in the Journal of Nutrition\textsuperscript{32} which included an investigation of smoking status and the association between diet quality and weight change. The study concluded that ‘when developing preventive behavioural interventions to promote weight loss and prevent weight gain,
overweight, and obesity, these results underscore the need for targeting physical inactivity, smoking, and poor diet quality, particularly in women who cease smoking, as well as increased exercise, reduced weight fluctuation, and earlier onset of excess weight especially among men.’

A 2009 study in the journal ‘Obesity’\textsuperscript{33} compared the prevalence of obesity among smokers seeking cessation treatment with a general population of never smokers, former smokers, and current smokers. The results of this American study appear to suggest that treatment-seeking smokers may have a different health profile from current smokers in the general population. The authors of this study, as with studies noted above, advise that health care providers should be aware of underlying health issues, particularly obesity, in patients seeking smoking cessation treatment.

A Norwegian study\textsuperscript{34} over an 11 year period found that former daily smokers demonstrated equivalent BMI increases to never smokers which is in line with evidence suggesting that the average body weight of quitters tends to stabilize over time to levels of never smokers.

**Smoking cessation as a contributor to the ‘global obesity epidemic’**

The rise in smoking cessation has been linked to the global rise in obesity. For example, a 2009 study on forecasting the effects of smoking and obesity on life expectancy\textsuperscript{35} reported that ‘the negative effects of increasing BMI overwhelmed the positive effects of declines in smoking in multiple scenarios. In the base case, increases in the remaining life expectancy of a typical 18-year-old are held back by 0.71 years or 0.91 quality-adjusted years between 2005 and 2020. If all U.S. adults became non-smokers of normal weight by 2020, we forecast that the life expectancy of an 18-year-old would increase by 3.76 life-years or 5.16 quality-adjusted years’. This study concluded that ‘if past obesity trends continue unchecked, the negative effects on the health of the U.S. population will increasingly outweigh the positive effects gained from declining smoking rates.’ This view is not without its detractors and the study prompted a sharp response from Professor Richard Peto and colleagues\textsuperscript{36}. Professor Peto writes that ‘Stewart et al overestimate the hazards of obesity and underestimate the hazards of tobacco use. They mainly use data from a study involving only 3000 deaths that were analysed, without epidemiologically appropriate precautions, in 32 separate subgroups, yielding unreliable relative risks.’ Peto concludes that ‘stopping smoking can lead to a gain in life expectancy of about 10 years, far more than a smoker could expect to gain from weight control’.

In July 2011, a 28 year prospective cohort study in Renfrew and Paisley\textsuperscript{37} concluded that women who had never smoked and were not obese had the lowest mortality rates, regardless of their social position. This study also reported that obesity was more prevalent in never smokers than in the current smokers in the full cohort, with higher prevalence among women in lower social positions, who had higher

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associated mortality rates. This was somewhat selectively reported on Scottish Television news as ‘Scottish study finds that declining numbers of female smokers may have led to rising weight problems and associated illnesses’.

A Swedish study published in the 2010 European Journal of Epidemiology set out to estimate the net effect on premature mortality of the rise in obesity and parallel decline in smoking prevalence. It concluded that despite large increases in overweight (pre-obese) and obesity, a continued decline in premature deaths among Swedish males is expected due to reduced smoking during the last four decades.

In 2007 Katherine Flegal (a distinguished American obesity epidemiologist) reported that for the population of America ‘decreases in the prevalence of cigarette smoking probably had only a small effect, often less than one percentage point, on increasing the prevalence of obesity and decreasing the prevalence of healthy weight in the population’. A study of British survey results found that ‘the cost in terms of a loss of health due to the increase in overweight subjects, which must be paid in order to achieve the goal of a reduction in smoking, did not clearly emerge in the UK’. Similarly, a 2009 study from China concluded that ‘while smoking cessation may lead to moderate weight gain among subjects of healthy weight, the effects on obese subjects are modest and should not be expected to lead to a large increase in obesity prevalence rates’.

Conclusion

Even if worsening rates of obesity were an obvious corollary to improving rates of smoking cessation, a June 2011 editorial in the British Medical Journal suggests that ‘exchanging smoking for obesity is a good bargain, but inequalities in mortality will not necessarily become smaller. Inequalities in mortality persist among those who have never smoked, partly because obesity takes over the role of smoking, but they persist at a much lower level, and that is good news for whoever wants to reduce health inequalities.’

Smoking remains a much stronger risk factor for mortality than most other risk factors, including obesity. Although the strong link between cigarette smoking and increased risk of mortality has been well established since 1950, there is still uncertainty within the scientific community on obesity’s effect on mortality at the population level. What is certain is that the mortality risk among obese smokers, even young obese smokers, far exceeds the sum of their individual risks.

A 2009 study published in the British Medical Journal showed a flattening of the decline in mortality from coronary heart disease in the two most deprived fifths of younger adults in Scotland, leading the authors to conclude that ‘unfavourable trends in the major risk factors for coronary heart disease (smoking and poor diet) provide
the most likely explanation for these inequalities’. A better understanding of the complex interaction of causal risk factors and inequalities may prove to be the key to both improving public health and reducing inequalities.

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