TABLE 6.—Continued

Reference	Population	Hip and/or forearm fractures		
		Comparison	Estimated relative risk	Comments
Paganini-Hill et al. (1981)	Cases: 91 postmenopausal women aged >80 with hip fractures Controls: 182 age, race-matched postmenopausal women	1–10 cig/day vs. none ≥11 cig/day vs. none	1.05 1.96	Adjusted for age, age at menopause, Quetelet's Index, physical activity, alcohol consumption, and exogenous estrogen use
Kreiger et al. (1982); Kreiger and Hilditch (1986)	Cases: 98 postmenopausal women aged 45–74 yr hospitalized with hip fracture Trauma Controls: 83 postmenopausal women hospitalized for trauma Nontrauma Controls: 884 postmenopausal women hospitalized for medical illness	Ever vs. never smokers Trauma controls Nontrauma controls	 1.27 1.29	Adjusted for age, Quetelet's Index, months breast feeding, ovariectomy, and estrogen use
Williams et al. (1982); Alderman et al. (1986)	Cases: 344 (355) white women aged 50–74 with hip or forearm fracture Controls: 567 (562) white women from a household survey	Among estrogen nonusers Hip fractures Average weight ever smoker vs. obese never smoker Thin ever smoker vs. obese never smoker Forearm fracture Thin ever smoker vs. obese never smoker ≤1 ppd vs. never >1 ppd vs. never	 6.5[b] 13.5[b] 5.4[b] 1.0 1.2	Smokers and nonsmokers were not directly compared; the comparison group for all analyses was obese nonsmokers who had used estrogen for ≥1 yr; controlled for sex and race only

TABLE 6.—Continued

Reference	Population	Hip and/or forearm fractures		
		Comparison	Estimated relative risk	Comments
Cooper, Barker, Wickham (1988)	Cases: 300 men and women aged ≥50 hospitalized for hip fracture in England Controls: 600 community volunteers matched for age and sex	Smokers vs. nonsmokers	1.7[b]	Controlled for age and sex only
Lau et al. (1988)	Cases: 400 men and women hospitalized for hip fracture in Hong Kong Controls: 400 hospitalized and 400 community volunteers matched for age and sex	Smokers vs. nonsmokers	1.3	Controlled for age and sex only

NOTE: ppd=packs/day.
[a]Calculated from data in paper cited.
[b]$p<0.05$.

large samples from the Framingham Heart Study, the Nurses Health Study, and the first National Health and Nutrition Examination Survey. In the largest study by Hemenway and colleagues (1988), 96,508 nurses reported 975 hip or forearm fractures during an average 4 years of observation. The relative risk of fracture was 1.0 in each smoking category (former smokers, smokers of 1–14 cigarettes/day, 15–25 cigarettes/day, and >25 cigarettes/day) compared with never smokers.

Smoking Cessation and Osteoporosis and Fracture

No studies have evaluated the effect of smoking cessation on osteoporosis and fracture, nor are there studies of the risk of osteoporosis or fracture in former smokers compared with continuing smokers.

Summary

There is insufficient evidence to conclude that smoking decreases bone mineral content and the risk of osteoporotic fractures. Some studies have found lower bone mineral content in smokers compared with nonsmokers, but others have not. Some, but not all, case–control studies have found a higher risk of osteoporotic fracture among smokers. Most negative studies were limited by small sample size, and most positive studies were not designed to control for potentially strong confounding variables. Analysis of data in five cohort studies has found no association of smoking with increased risk of fracture.

Skin Wrinkling

Introduction

Although wrinkling of the facial skin is nearly universal among elderly persons, it is rarely mentioned in textbooks of dermatology or medicine, and little research has been published concerning its etiology or risk factors. Skin wrinkling is associated with sun exposure (Kligman 1969; Allen, Johnson, Diamond 1973; Daniell 1971; Knox, Cockerell, Freeman 1962; Rook, Wilkinson, Ebling 1979). Wrinkling occurs with increasing age (Daniell 1971; Knox, Cockerell, Freeman 1962; Rook, Wilkinson, Ebling 1979), but even among the elderly, wrinkling usually is confined to sun-exposed areas (Kligman 1969; Allen, Johnson, Diamond 1973; Knox, Cockerell, Freeman 1962). There is limited evidence that dramatic weight loss is associated with skin wrinkling (Daniell 1971).

Pathophysiologic Framework

It is not clear how cigarette smoking may promote skin wrinkling. Some investigators have concluded that a localized finding such as wrinkling of the face and hands could not be caused by a systemic factor such as the absorbed components of cigarette smoke.

TABLE 7.—Summary of cohort studies of smoking and fractures

Reference	Population/outcome	Comparison	Relative risk	Comments
Jensen (1986)	Population-based study of 70-year-old women in Copenhagen, Denmark: 77 smoked daily for ≥20 yr; 103 never smoked. Outcome: all fractures	% smokers with fracture vs. % nonsmokers with fracture:		All subjects were 70-yr-old women; no control for other confounders
		All postmenopausal fractures	0.9[a]	
		Osteoporotic fractures[b]	0.7[a]	
Hemenway et al. (1988)	96,508 nurses aged 35–59 at baseline (1980) followed for 4 yr. Outcome: self-report of 975 fractures of hip or forearm	Age-adjusted fracture rate compared to: never smokers		A very large cohort study producing narrow CIs (upper limit 1.25), but most women were middle-aged or younger; controlled for age only
		Ex-smokers	1.0	
		Smokers		
		1–14 cig/day	1.0	
		15–24 cig/day	1.0	
		≥25 cig/day	1.0	
Felson et al. (1988)	5,209 men and women in the Framingham Heart Study followed retrospectively for about 30 yr. Outcome: 217 documented hip fractures	Based on cig/day	No increase	No data given, but reported no association in any analysis
Holbrook, Barrett-Connor, Wingard (1988)	975 men and women aged 50–79 at baseline followed for 14 yr. Outcome: 33 documented hip fractures	Smokers vs. nonsmokers	1.1	Cox regression model, adjusted for age, sex, body mass index, dietary calcium, and alcohol consumption
Farmer et al. (1989)	3,595 white women in NHANES-I aged 40–77 at baseline (1971–75) followed for an average of 10 yr. Outcome: 84 documented hip fractures	Based on number of yr smoked at baseline exam	No increase	No data given, but reported no significant association; analysis adjusted for age, body mass index, menopausal status, calcium consumption, and activity

NOTE: CI=confidence interval; NHANES-I=National Health and Nutrition Examination Survey I.
[a] Calculated from data in reference.
[b] Femoral neck, proximal humerus, lower forearm, vertebral crush.

However, facial skin, and to a lesser extent, the skin of the hands contain an intradermal elastic tissue mesh that is denser and more complex than in other areas (Shelley and Wood 1974). Thus, the toxic effect of both sunlight and smoking may be most damaging in these more susceptible areas. Alternatively, damage from sunlight and smoking may simply be additive, and the threshold for clinically apparent changes from smoking may not be reached in sun-protected areas of the skin. Histopathologic examination of sun-exposed skin commonly shows abnormalities of collagen in the dermis that decrease the elastic properties of the skin, a condition known as elastosis (Marks 1976; Shelley and Wood 1974). However, the mechanism by which sunlight might cause these changes is uncertain, and there is no evidence that smoking is associated with elastosis. Cigarette smoking has been shown to decrease capillary and arteriolar blood flow in the skin acutely (Klemp, Staberg, Thomsen 1982; Reus et al. 1984; Richardson 1987), and hence, may cause tissue hypoxia. However, there is no evidence that this causes changes in skin transparency and turgor or produces wrinkles.

Smoking and Skin Wrinkling

Several studies have reported that smoking is associated with prominent skin wrinkling, particularly in the periorbital or "crow's foot" area of the face.

Ippen and Ippen (1965) defined "cigarette skin" as appearing pale, grayish, and wrinkled, especially on the cheeks, with thick skin between the wrinkles. In an examination of women aged 35 to 84, 66 of the 84 smokers had cigarette skin compared with 27 of the 140 nonsmokers (relative risk=4.1, $p<0.01$). This study did not adjust for differences in age or sun exposure between the smokers and nonsmokers (Ippen and Ippen 1965).

Daniell (1971) examined facial wrinkles and smoking status among 1,104 subjects, most of whom were patients or visitors to his medical practice in Redding, CA. Skin wrinkling was assessed in the crow's foot area and the adjacent areas of the forehead and cheeks and graded as one of six categories of severity. Potential confounders such as age, race (98 percent of the subjects were white), sex, sun exposure, and body weight were also measured. Smokers were more often prominently wrinkled (wrinkle score 4–6) than nonsmokers. Prominent skin wrinkling was also more common in relation to increasing age and sun exposure. The association between smoking and prominent wrinkling was found in each age, sex, and sun exposure subgroup and was statistically significant in most of the subgroups. The most heavily wrinkled class in each age–sex group was composed entirely of smokers. Wrinkling increased with duration of smoking and number of cigarettes smoked daily. Prominent skin wrinkling was more common among smokers aged 40 to 49 than among nonsmokers aged 60 to 69 years. This study provided strong evidence that smoking is associated with skin wrinkling (Daniell 1971). However, the measurements of wrinkling are not very precise, and although an attempt was made to blind the wrinkle assessment, the subjects were patients and friends of the investigator, who may have known their smoking status.

Allen, Johnson, and Diamond (1973), reported on a study that they claimed refuted the above findings, but the data presented actually supported an association between smoking and skin wrinkling in whites (Boston 1973; Daniell 1973; Weiss 1973). Using

Daniell's 6 categories of wrinkling severity. Allen, Johnson, and Diamond (1973) examined 650 persons and obtained information on age, race, sex, smoking status, and sun exposure. Biopsies of the crow's foot area also were performed on some subjects. As evidence that there is no association between smoking and skin wrinkling, the researchers reported that among 137 black subjects, only 2 had prominent wrinkling, regardless of sun exposure or smoking status. Although only fragmentary data are presented, wrinkle scores among white smokers who were exposed to the sun less than 2 hours daily were significantly higher than wrinkle scores for white nonsmokers with limited sun exposure.

In a survey of 122 new patients attending a general medical practice in England, all but 1 of whom was white, wrinkling and other skin changes were found to be much more common among smokers than nonsmokers (Model 1985). "Smoker's face" was defined as exhibiting one or more of the following: lines or wrinkles on the face, typically radiating from the corners of the lips or eyes; gaunt facial features; grayish skin; and a plethoric complexion. Smoker's face was found among 46 percent of smokers, and none of the nonsmokers were classified as having smoker's face. The association of smoking and smoker's face was statistically significant ($p<0.001$) and remained so after controlling for age, social class, sun exposure, and recent weight change. Although this study shows a striking difference between smokers and nonsmokers, it is not clear that prominent skin wrinkling is the major or most common criterion for the diagnosis of smoker's face. Thus, the association reported may not be specific for wrinkling.

Smoking Cessation and Skin Wrinkling

No studies have assessed the effect of smoking cessation on skin wrinkling. Daniell (1971) noted that prominent wrinkling was common in former smokers, but supporting data were not presented. Model (1985) reported that 8 percent of former smokers had smoker's face compared with 46 percent of smokers.

Summary

There is limited but consistent evidence that smoking is associated with prominent facial skin wrinkling among whites (Allen, Johnson, Diamond 1973; Daniell 1971; Ippen and Ippen 1965; Model 1985) but not among blacks (Allen, Johnson, Diamond 1973). It is not clear whether former smokers are less wrinkled than smokers (Daniell 1971; Model 1985).

CONCLUSIONS

1. Smokers have an increased risk of development of both duodenal and gastric ulcer, and this increased risk is reduced by smoking cessation.

2. Ulcer disease is more severe among smokers than among nonsmokers. Smokers are less likely to experience healing of duodenal ulcers and are more likely to have

recurrences of both duodenal and gastric ulcers within specified timeframes. Most ulcer medications fail to alter these tendencies.

3. Smokers with gastric or duodenal ulcers who stop smoking improve their clinical course relative to smokers who continue to smoke.

4. The evidence that smoking increases the risk of osteoporotic fractures or decreases bone mass is inconclusive, with many conflicting findings. Data on smoking cessation are extremely limited at present.

5. There is evidence that smoking is associated with prominent facial skin wrinkling in whites, particularly in the periorbital ("crow's foot") and perioral areas of the face. The effect of cessation on skin wrinkling is unstudied.

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CHAPTER 10
SMOKING CESSATION AND BODY WEIGHT CHANGE

CONTENTS

INTRODUCTION

Cigarette smoking is associated with decreased body weight, and many smokers report that a major reason they smoke is to reduce body weight (Grunberg 1986; Klesges et al. 1989; US DHHS 1988a). However, as documented in this Chapter, the weight gain associated with smoking cessation is generally small and poses a minimal health risk.

This Chapter is organized into six sections. Drawing from prospective investigations meeting specific criteria, the first section of this Chapter determines average weight gain following smoking cessation compared with continued smoking, assesses the percentage of continuing smokers and quitters gaining weight, and calculates the risk of gaining weight after smoking cessation versus continued smoking. The next section of this Chapter discusses the mechanisms responsible for weight gain after smoking cessation. The available literature is reviewed on dietary, activity, and metabolic changes after smoking cessation . The third section reviews the relationship between body weight and adverse medical and psychosocial outcomes. The fourth section examines whether weight-related health effects accompany weight gain in ex-smokers. The fifth section presents potential treatments for reducing postcessation weight gain, including pharmacologic (e.g., nicotine polacrilex gum, phenylpropanolamine, and d-fenfluramine) and nonpharmacologic approaches. The sixth section presents conclusions regarding smoking cessation and body weight change.

AMOUNT OF WEIGHT GAIN AFTER SMOKING CESSATION AND LIKELIHOOD OF GAINING WEIGHT

To evaluate postcessation weight gain and to determine the likelihood or relative risk of gaining weight after smoking cessation, longitudinal investigations after 1970 of postcessation weight gain were examined. Only studies that included a control group of continuing smokers were evaluated. Requirements for studies in this review included a minimum followup period of 1 month and at least 10 smokers who quit. Studies were excluded if a weight loss component or severe caloric restriction was part of the intervention or if an agent known to affect body weight (e.g., nicotine polacrilex gum) was used; however, placebo conditions within drug trials were considered. A few studies were excluded for methodologic or interpretive reasons, such as relapsed subjects included in data analysis along with quit subjects or whenever a weight change could not be calculated. Table 1 summarizes the 15 studies that fulfilled these inclusionary and exclusionary criteria.

The following information is included for each study listed in Table 1: the study reference, the followup or period of abstinence, the mean weight gain among individuals who quit smoking, the mean weight gain of subjects who did not quit smoking, the percentage of subjects quitting smoking who gained weight from baseline to the followup period, the percentage of nonabstinent subjects who gained weight during the same period, and the relative risk of gaining any weight after smoking cessation versus continued smoking. Adjusted averages of weight gain are provided to summarize across all studies. These adjusted averages control for differing sample sizes and assign

TABLE 1.—Summary of prospective studies on smoking and body weight

Reference	Sample size	Number of quitters	Quit period	Mean weight gain (lb)		% quitters who gain weight	% continuing smokers who gain weight	Relative risk of gaining weight
				Quitters	Continuing smokers			
Bossé, Garvey, Costa (1980)	705	237	5 yr	6.35	2.01	—	—	—
Cambien et al. (1981)	475	41	2 yr	7.5	2.2	—	—	—
Coates and Li (1983)	335	13	1 yr	5.15	0.04	76.9	46.3	1.66
Comstock and Stone (1972)	290	46	5 yr	11.2	2.4	87.0	60.7	1.43
Friedman and Siegelaub (1980)	9,539	2,738	18 mo (median)	3.18	0.9	—	—	—
Gritz, Carr, Marcus (1988)	554	61	1 yr	6.1	0.3	—	—	—
Hickey and Mulcahy (1973)	88	60	2 yr	1.6	0.9	—	—	—
Kramer (1982)	134	59	1 yr	—	—	78.0	56.0	1.39
Lund-Larsen and Tretli (1982)	6,580	1,047	3 yr	6.94	0.44	—	—	—
Noppa and Bengtsson (1980)	526	72	6 yr	7.7	2.4	80.6	61.7	1.31

TABLE 1.—Continued

Reference	Sample size	Number of quitters	Quit period	Mean weight gain (lb)		% quitters who gain weight	% continuing smokers who gain weight	Relative risk of gaining weight
				Quitters	Continuing smokers			
Puddey et al. (1985)	28	14	1.5 mo	3.97	0.44	—	—	—
Rabkin (1984b)	107	35	3 mo	4.4	0.7	—	—	—
Rodin (1987)	42	24	1.5 mo	3.18	0.30	58.3	33.3	1.75
Seltzer (1974)	318	104	5 yr	7.9	3.5	—	—	—
Tuomilehto et al. (1986)	496	155	5 yr	6.02	1.57	—	—	—
Total sample size=20,217 Average sample size=1,348 Number of studies reported=15			Median followup period=2 yr	Average weight gain among quitters=4.6; N=4,647	Average weight gain among continuing smokers=0.8; N=15,046	Average % of quitters who gain weight=79%; Number of studies reporting=5; N=214	Average % of continuing smokers who gain weight=56%; Number of studies reporting=5; N=1,113	Average relative risk of gaining weight=1.45; Number of studies reporting=5; N=1,327

NOTE: Averages are weighted for differing sample sizes.