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Chapter 9

Tobacco Amblyopia

Source: 1971 Report, Chapter 7, pages 431 - 438.

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TOBACCO AMBLYOPIA

Tobacco amblyopia (tobacco-alcohol amblyopia) is that syndrome of visual failure occurring in association with the use of tobacco, with or without the concurrent use of alcohol, and with or without concurrent nutritional deficits. The disease has a subacute onset, leading to a loss of visual acuity and color perception (12). It is characterized by centrocecal scotomas which are bilateral but not necessarily symmetrical and which have sloping diffuse edges and by the presence of nuclei of denser visual loss within the large scotomas (22, 23). Such visual impairment is not unique to tobacco amblyopia, as it is also seen in neurodegenerative disorders, such as Leber's hereditary optic atrophy (7, 25).

Clinical information on tobacco amblyopia has appeared in numerous articles throughout the past century. This information has been reviewed by Silvette, et al. (17) and, more recently, by Dunphy (5). Pure tobacco amblyopia (TA), that is amblyopia unassociated with excessive alcohol intake or the exposure to other toxins, is rarely seen in the United States today (12). Walsh, et al. (23) have observed that when TA is found it is usually present in association with nutritional or idiopathic vitamin deficiencies. Victor (22) recently observed that the type of visual defect seen in tobacco amblyopia may be found in clinical circumstances in which tobacco is clearly not a causative factor. He questions whether TA is distinguishable from other forms of amblyopia.

The prevalence of this disorder has been variously estimated in the past at from 0.5 to 1.5 percent of all eye clinic patients (20, 23). However, currently in the United States, it appears to be a rare condition. Silvette, et al. (17) have observed that the incidence of tobacco amblyopia appears to have decreased substantially during the past decades. Other authors (3, 15) have also commented on this trend. Although reference has been made to the increased frequency of certain types of tobacco usage in patients with this disorder, adequate population studies with proper controls have yet to be performed. The association of this disorder with the use of tobacco is strengthened by the frequent clinical observations of improvement following the cessation of smoking although improvement has been noted by some to occur without cessation.

Research into the pathogenesis of tobacco amblyopia has cen-

tered upon the interrelationships of cyanide metabolism, vitamin B₁₂, and other vitamin deficiencies. Three reviews of this material have recently appeared (1, 12, 22). Numerous studies reviewed in these articles suggest that tobacco amblyopia may result from the incomplete detoxification of the cyanide present in tobacco smoke. This failure of detoxification may stem from or be intensified by inadequate dietary intake of necessary nutritional factors. This may be the reason for the association of this disorder with excessive alcohol intake and with its related nutritional deficits (2, 4, 6, 8, 9, 10, 11, 13, 14, 16, 18, 19, 21, 24, 26, 27, 28).

SUMMARY AND CONCLUSIONS

Tobacco amblyopia is presently a rare disorder in the United States. The evidence suggests that this disorder is related to nutritional or idiopathic deficiencies in certain detoxification mechanisms, particularly in handling the cyanide component of tobacco smoke.

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Chapter 10

Pipes and Cigars

Source: 1973 Report, Chapter 6, pages 165 - 236.

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Introduction

This chapter is a review of the epidemiological, pathological, and experimental data on the health consequences of smoking cigars and pipes, alone, together, and in various combinations with cigarettes. Previous reviews on the health consequences of smoking have dealt primarily with cigarette smoking. Although some of the material on pipes and cigars presented in this chapter has been presented in previous reports of the Surgeon General, this is the first attempt to summarize what is known about the health effects of pipe and cigar smoking. Since the use of pipes and cigars is limited almost exclusively to men in the United States, only data on men are included in this review.

The influence of pipe and cigar smoking on health is determined by examining the overall and specific mortality and morbidity experienced by users of these forms of tobacco compared to nonsmokers. Epidemiological evidence suggests that individuals who limit their smoking to only pipes or cigars have overall mortality rates that are slightly higher than nonsmokers. For certain specific causes of death, however, pipe and cigar smokers experience mortality rates that are as great as or exceed those experienced by cigarette smokers. This analysis becomes more complex when combinations of smoking forms are examined. The overall mortality rates of those who smoke pipes, cigars, or both in combination with cigarettes appear to be intermediate between the high mortality rates of cigarette smokers and the lower rates of those who smoke only pipes or cigars. This might seem to suggest that smoking pipes or cigars in combination with cigarettes diminishes the harmful effects of cigarette smoking. However, an analysis of mortality associated with smoking combinations of cigarettes, pipes, and cigars should be standardized for the level of consumption of each of the products smoked in terms of the amount smoked, duration of smoking, and the depth and degree of inhalation. For example, cigar smokers who also smoke a pack of cigarettes a day might be expected to have mortality rates somewhat higher than those who smoke only cigarettes at the level of a pack a day, assuming that both groups smoke their cigarettes in the same way. Mixed smokers who inhale pipe or cigar smoke in a manner similar to the way they smoke cigarettes might be expected to have higher mortality rates than mixed smokers who do not inhale their cigars and pipes and also

resist inhaling their cigarettes. Unfortunately, little of the published material on mixed cigarette, pipe, and cigar smoking contains these types of analyses or controls.

A paradox seems to exist between the mortality rates of ex-smokers of pipes and cigars and ex-smokers of cigarettes. Ex-cigarette smokers experience a relative decline in overall and certain specific causes of mortality following cessation. This decline is important but indirect evidence that cigarette smoking is a major cause of the elevated mortality rates experienced by current cigarette smokers. In contrast to this finding, several prospective epidemiological investigations, Hammond and Horn (40), Best (9), Kahn (50), and Hammond (38), have reported higher death rates for ex-pipe and ex-cigar smokers than for current pipe and cigar smokers. This phenomenon was analyzed by Hammond and Garfinkel (39). The development of ill health often results in a cigarette smoker giving up the habit, reducing his daily tobacco consumption, switching to pipes or cigars, or choosing a cigarette low in tar and nicotine. In many instances, a smoking-related disease is the cause of ill health. Thus, the group of ex-smokers includes some people who are ill from smoking-related diseases, and death rates are high among persons in ill health.

As a result, ex-cigarette smokers initially have higher overall and specific mortality rates than continuing cigarette smokers, but because of the relative decrease in mortality that occurs in those who quit smoking for reasons other than ill health, and because of the dwindling number of ill ex-smokers, a relative decrease in mortality is observed (within a few years) following cessation of cigarette smoking. The beneficial effects of cessation would be obvious sooner were it not for the high mortality rates of those who quit smoking for reasons of illness. A similar principle operates for ex-pipe and ex-cigar smokers, but because of the lower initial risk of smoking these forms and therefore the smaller margin of benefit following cessation, the effect produced by the ill ex-smokers creates a larger and more persistent impact on the mortality rates than is seen in cigarette smoking.

For the above reasons a bias is introduced into the mortality rates of current smokers and ex-smokers of pipes and cigars, so that a more accurate picture of mortality might be obtained by combining the ex-smokers with the current smokers and looking at the resultant mortality experience.

Because of a lack of data that would allow a precise analysis of mortality among ex-pipe and ex-cigar smokers, a detailed analysis of these groups could not be undertaken in this review.

For each specific cause of death, tables have been prepared which summarize the mortality and relative risk ratios reported in the major

prospective and retrospective studies which contained information about pipe and cigar smokers. The smoking categories used include: cigar only, pipe only, total pipe and cigar, cigarette only, and mixed. The total pipe and cigar category includes: those who smoke pipes only, cigars only, and pipes and cigars. The mixed category includes: those who smoke cigarettes and cigars; cigarettes and pipes; and cigarettes, pipes, and cigars. Mortality and relative risk ratios were calculated relative to nonsmokers.

The Prevalence of Pipe, Cigar, and Cigarette Usage

The prevalence of pipe, cigar, and cigarette smoking in the United States was estimated by the National Clearinghouse for Smoking and Health from population surveys conducted in 1964, 1966, and 1970 (98, 99, 100). In each survey, about 2,500 interviews were conducted on a national probability sample stratified by type of population and geographic area. The use of these products among adults aged 21 and older is summarized in tables 1 and 2. The prevalence of pipe, cigar, and cigarette smoking in Great Britain for the years 1965, 1968, and 1971 is presented in table 3.

TABLE 1.—Percent distribution of U.S. male smokers aged 21 and older by type of tobacco used for the years 1964, 1966, and 1970

Forms used	1964 (percent)	1966 (percent)	1970 (percent)
1. Cigar only.....	6.8	5.5	5.6
2. Pipe only.....	1.7	3.0	3.6
3. Pipe and cigar.....	3.9	4.9	4.4
4. Cigarette only.....	28.6	31.2	25.9
5. Cigarette and cigar.....	11.3	9.9	6.6
6. Cigarette and pipe.....	5.3	4.9	5.3
7. Cigarette, pipe, and cigar.....	7.7	6.3	4.6
8. Nonsmoker.....	34.7	34.3	44.0
Total.....	100.0	100.0	100.0
Number of persons in sample.....	2,389	2,679	2,861
Total pipe users (2+3+6+7).....	18.7	19.2	17.9
Total cigar users (1+3+5+7).....	29.9	26.7	21.2
Total cigarette users (4+5+6+7).....	52.9	52.4	42.3

Source: U.S. Department of Health, Education, and Welfare (98, 99, 100).

TABLE 2.—Percent distribution of U.S. male smokers by type of tobacco used and age for 1970

Forms used	Age groups				
	21 to 34	35 to 44	45 to 54	55 to 64	65 to 75 +
1. Cigar only.....	3.7	6.5	4.7	6.7	9.3
2. Pipe only.....	4.3	3.5	3.0	3.2	3.6
3. Pipe and cigar.....	3.8	3.3	5.2	4.4	6.9
4. Cigarette only.....	28.8	29.0	27.1	24.3	13.6
5. Cigarette and cigar.....	6.8	10.4	5.5	5.2	4.2
6. Cigarette and pipe.....	6.6	4.4	5.6	4.0	3.8
7. Cigarette, pipe, and cigar.....	5.8	4.8	5.0	4.0	1.4
8. Nonsmoker.....	40.2	38.1	43.9	48.2	57.2
Total.....	100.0	100.0	100.0	100.0	100.0
Number of persons in sample.....	1,009	528	523	405	388
Total pipe users.....	20.5	16.0	18.8	15.6	15.7
Total cigar users.....	20.1	25.0	20.4	20.3	21.8
Total cigarette users.....	48.1	48.6	43.3	37.5	23.0

Source: U.S. Department of Health, Education, and Welfare (100).

TABLE 3.—Percent distribution of British male smokers aged 25 and older by type of tobacco used for the years 1965, 1968, and 1971

Forms used	1965	1968	1971
1. Cigars only.....	1.9	2.8	3.3
2. Pipe only.....	5.1	5.6	5.9
3. Cigarettes only.....	46.8	45.7	40.8
4. Cigarettes and pipe.....	8.0	7.0	6.1
5. Mixed smokers.....	7.5	9.1	8.4
6. Nonsmokers.....	30.7	29.9	35.4
Total.....	100.0	100.0	100.0
Number of persons in sample.....	3,576	3,566	3,594
Total pipe users.....	13.9	14.3	13.3
Total cigar.....	9.0	11.7	11.3
Total cigarette.....	67.6	67.6	61.6

Source: Todd, G. F. (94).

The Definition and Processing of Cigars, Cigarettes, and Pipe Tobaccos

Cigarettes

The U.S. Government has defined tobacco products for tax purposes. Cigarettes are defined as "(1) Any roll of tobacco wrapped in paper or in any substance not containing tobacco, and (2) any roll of tobacco wrapped in any substance containing tobacco which, because of its appearance, the type of tobacco used in the filler, or its packaging and labeling, is likely to be offered to, or purchased by, consumers as a cigarette described in subparagraph (1)." Cigarettes are further classified by size, but virtually all cigarettes sold in the United States are "small cigarettes" which by definition weigh "not more than 3 pounds per thousand" which is not more than 1.361 grams per cigarette (96).

American brands of cigarettes contain blends of different grades of Virginia, Burley, Maryland, and oriental tobaccos. Several varieties of cigarette tobaccos are flue-cured. In this process, tobacco leaves are cured in closed barns where the temperature is progressively raised over a period of several days. This results in "color setting," fixing, and drying of the leaf. The most conspicuous change is the conversion of starch into simpler sugars and suppression of oxidative reactions. Flue-cured tobaccos produce an acidic smoke of light aroma (35, 112).

Cigars

Cigars have been defined for tax purposes as: "Any roll of tobacco wrapped in leaf tobacco or in any substance containing tobacco (other than any roll of tobacco which is a cigarette within the meaning of subparagraph (2) of the definition for cigarette)" (112). In order to clarify the meaning of "substance containing tobacco" the Treasury department has stated that, "The wrapper must (1) contain a significant proportion of natural tobacco; (2) be within the range of colors normally found in natural leaf tobacco; (3) have some of the other characteristics of the tobaccos from which produced; e.g., nicotine content, pH, taste, and aroma; and (4) not be so changed in the reconstitution process that it loses all the tobacco characteristics" (102). Further, "To be a cigar, the filler must be substantially of tobaccos unlike those in ordinary cigarettes and must not have any added flavoring which would cause the product to have the taste or aroma generally attributed to cigarettes. The fact that a product does

not resemble a cigarette (such as many large cigars do not) and has a distinctive cigar taste and aroma is of considerable significance in making this determination" (102).

Cigars are also classified by size. "Small cigars" weigh not more than 3 pounds per thousand and "large cigars" weigh more than 3 pounds per thousand. "Large cigars" are further divided into seven classes for tax purposes based on the retail price intended by the manufacturer for such cigars (96).

Cigars are made of filler, binder, and wrapper tobaccos. Most cigar tobaccos are air-cured and then fermented. More recently, reconstituted cigar tobaccos have been used as wrapper, binder, or both. Cigars are either hand-rolled or machine made. Some brands of small cigars are manufactured on regular cigarette making machines. The aging and fermentation processes used in cigar tobacco production produce chemical catalytic, enzymatic, or bacterial transformations as evidenced by increased temperature, oxygen utilization, and carbon dioxide generation within fermenting cigar tobaccos. In this complex process, up to 20 percent of the dry weight of the leaf is lost through decreases in the concentration of the most readily fermentable materials such as carbohydrates, proteins, and alkaloids. The flavor and aroma of cigar tobaccos are in large measure the results of precisely controlled treatment during the fermentation process (35, 36, 112).

Pipe Tobaccos

The definition of pipe tobacco used by the U.S. Government was repealed in 1966 and there is no Federal tax on pipe tobaccos. The most popular pipe tobaccos are made of Burley; however, many pipe tobaccos are blends of different types of tobacco. A few contain a significant proportion of midrib parts that are crushed between rollers. "Saucing" material, or casings containing licorice, sweetening agents, sugars, and other flavoring materials are added to improve the flavor, aroma, and smoke taste. These additives modify the characteristics of smoke components (112).

Conclusion

Because of the unique curing and processing methods used in the production of cigar and pipe tobaccos, significant physical and chemical differences exist between pipe and cigar tobaccos and those used in

cigarettes. The extent to which these changes may alter the health consequences of smoking pipes and cigars can best be estimated by an analysis of the potentially harmful chemical constituents found in the smoke of these tobaccos, the tumorigenic activity of smoke condensates in experimental animals, and a review of the epidemiological data which has accumulated on the health effects of pipe and cigar smoking.

Chemical Analysis of Cigar Smoke

Only a few studies have been conducted that compare the chemical constituents of cigar smoke with those found in cigarette smoke. Hoffmann, et al. (43) compared the yields of several chemical components in the smoke from a plain 85 mm. cigarette, two types of cigars, and a pipe. The particulate matter, nicotine, benzo(a)pyrene, and phenols were determined quantitatively in the smoke of these tobacco products. One cigar tested was a 135-mm.-long, 7.8-g., U.S.-made cigar. The other was a handmade Havana cigar 147 mm. long weighing 8.6 g. The relative content of nicotine in the particulate matter produced by the cigars was similar to that of the cigarette tars. The benzo(a)pyrene and phenol concentrations in the cigar condensate was two to three times greater than in cigarette "tar" (table 4). Kuhn (58) compared the alkaloid and phenol content in condensates from an 80-mm. Bright-blend cigarette sold commercially in Austria with that obtained from 103-mm. cigars. These were tested

TABLE 4.—Amounts of several components of 1 g. of particulate material from mainstream smoke of tobacco products

Compound	Tobacco product ¹					
	U.S. cigar A (b)	Havana cigar B (b)	Standard pipe tobacco in pipe (b)	Cigarette tobacco in pipe	85 mm. plain U.S. cigarette (a)	85 mm. plain U.S. cigarette (b)
Nicotine (mg.)	46.2	63.6	56.1	61.0	65.9	77.4
Benzo(a)pyrene (μg.)	3.9	3.6	6.0	3.6	1.2	1.3
Phenol (mg.)	8.2	6.7	15.0	7.3	2.9	4.1
m-Cresol (mg.)	1.6	1.7	1.9	1.4	.6	.8
n+p-Cresol (mg.)	4.8	3.8	5.6	3.4	1.4	1.9
n+p-Ethylphenol (mg.)	1.1	1.5	1.1	1.3	.7	.7

¹ Smoking conditions:

(a) 1 puff per minute, duration 2 sec., puff volume 35 ml.

(b) 2 puffs per minute, duration 2 sec., puff volume 35 ml.

Source: Hoffmann, et al. (43).

with and without the use of a cellulose acetate filter. The concentrations of total alkaloids and phenol in the cigar smoke condensate were essentially the same as in the cigarette condensate, but pyridine values were about 2½ times higher in the cigar condensate.

Campbell and Lindsey (17) measured the polycyclic hydrocarbon levels in the smoke of a small popular-type cigar 8.8 cm. long, weighing 1.9 g. Significant quantities of anthracene, pyrene, fluoranthene, and benzo(a)pyrene were detected in the unsmoked cigar tobacco, in concentrations much greater than those found in Virginia cigarettes but of the same order as those found in some pipe tobaccos. The smoking process contributed considerably to the hydrocarbon content of the smoke. Table 5 compares the concentrations in the mainstream smoke of cigarettes, cigars, and pipes of four hydrocarbons frequently found in condensates. The authors reported that the mainstream smoke from a popular brand of small cigar contained the polycyclic aromatic hydrocarbons; acenaphthylene, phenanthrene, anthracene, pyrene, fluoranthene, and benzo(a)pyrene. The concentrations of these hydrocarbons in the mainstream smoke were greater than those found in Virginia cigarette smoke.

Osman, et al. (69) analyzed the volatile phenol content of cigar smoke collected from a 7-g. American-made cigar with domestic filler. After quantitative analysis of phenol, cresols, xylenols, and meta and para ethyl phenol, the authors concluded that the levels of these compounds were generally similar to those reported for cigarette smoke. Osman and Barson (68) also analyzed cigar smoke for benzene, toluene, ethyl benzene, m-, p-, and o-xylene, m- and p-ethyltoluene, 1,2,4-trimethylbenzene, and dipentene, and generally found levels within the range of those previously reported for cigarette condensates.

In summary, available evidence suggests that cigar smoke contains many of the same chemical constituents, including nicotine and other alkaloids, phenols, and polycyclic aromatic hydrocarbons as are found

TABLE 5.—A comparison of several chemical compounds found in the mainstream smoke of cigars, pipes, and cigarettes

Compound	Micrograms per 100 g. of tobacco consumed		
	Cigars	Pipes †	Cigarettes
Acenaphthylene.....	1.6	29.1	5.0
Anthracene.....	11.9	110.0	10.9
Pyrene.....	17.6	75.5	12.5
3,4-benzopyrene.....	3.4	8.5	.9

† This is a light pipe tobacco.

Source: Campbell, J. M., Lindsey, A. J. (17).

in cigarette smoke. Most of these compounds are found in concentrations which equal or exceed levels found in cigarette "tar." A more complete picture of the carcinogenic potential of cigar "tars" is obtained from experimental data in animals.

Mortality

Overall Mortality

Several large prospective studies have examined the health consequences of various forms of smoking. The results of these investigations have been reviewed in previous reports of the Surgeon General in which the major emphasis has been on cigarette smoking and its effect on overall and specific mortality and morbidity. The following pages present a current review of the health consequences of smoking pipes and cigars. Data from the prospective investigations of Dunn, et al. (31), Buell, et al. (16), Hirayama (42), and Weir and Dunn (105) are not cited, because in these studies a separate category for pipe and cigar smokers was not established.

The smoking habits and mortality experience of 187,783 white men between the ages of 50 and 69 who were followed for 44 months were reported by Hammond and Horn (41). The overall mortality rates of men who smoked pipes or cigars were slightly higher than the rates of men who never smoked. The overall mortality rate of cigar smokers was slightly higher than that of pipe smokers.

In a study of 41,000 British physicians, Doll and Hill (26, 27) reported the overall mortality of pipe and cigar smokers as being only 1 percent greater than that among nonsmokers. Best (9), in a study of 78,000 Canadian veterans, reported overall mortality rates of pipe and cigar smokers slightly above those of nonsmokers. Kahn (50) examined the death rates and smoking habits of more than 293,000 U.S. veterans and Hammond (38) examined the smoking habits of and mortality rates experienced by 440,559 men. In these studies, pipe smokers experienced mortality rates similar to those of men who never smoked regularly, whereas cigar smokers had death rates somewhat higher than men who never smoked regularly. Table 6 summarizes the results of these five studies.

Thus, data from the major prospective epidemiological studies demonstrate that the use of pipes and cigars results in a small but definite increase in overall mortality. Cigar smokers have somewhat higher death rates than pipe smokers, and mixed smokers who use cigarettes in addition to pipes and cigars appear to experience an intermediate level of mortality that approaches the mortality experience of cigarette smokers.

TABLE 6.—Mortality ratios for total deaths by type of smoking (males only)

Author, reference	Smoking type							
	Non-smoker	Cigar only	Pipe only	Cigar and pipe	Cigarette and cigar	Cigarette and pipe	Mixed (cigarette and other)	Cigarette only
Hammond and Horn ¹ (40)	1.00	1.22	1.12	1.10	1.36	1.50	1.43	1.68
Doll and Hill (26)	1.00	-----	-----	1.01	-----	-----	1.11	1.28
Best (9)	1.00	1.06	1.05	.98	1.22	1.26	1.13	1.54
Kahn (50)	1.00	1.10	1.07	1.08	-----	-----	1.51	1.84
Hammond ² (38)	1.00	1.25	1.19	1.01	-----	-----	1.57	1.86

¹ Only mortality ratios for ages 50 to 69 are presented.
² Only mortality ratios for ages 55 to 64 are presented.

Mortality and Dose-Response Relationships

A consistent association exists between overall mortality and the total dose of smoke a cigarette smoker receives. The methods most frequently used to measure dosage of tobacco products are: Amount smoked, degree of inhalation, duration of smoking experience, age at initiation, and the amount of tar in a given tobacco product. For cigarette smokers, the higher the dose as measured by any of these parameters, the greater the mortality. The significance of the small increase in overall mortality that occurs for the entire group of pipe and cigar smokers can be analyzed by examining the mortality of subgroups defined by similar measures of dosage as used in the study of cigarette smokers.

AMOUNT SMOKED

Hammond and Horn (40) reported an increase in the overall mortality of pipe and cigar smokers with an increase in the amount smoked. Individuals who smoked more than four cigars a day or more than 10 pipefuls a day had death rates significantly higher than men who never smoked ($P < 0.05$ for cigar smokers and $P < 0.05$ for pipe smokers) (table 7). Cigar and pipe users who smoked less than this amount experienced an overall mortality similar to men who never