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Use of Smokeless Tobacco, Cigarette Smoking, and Hypercholesterolemia

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Abstract: The primary purpose of this study was to determine the extent to which regular use of smokeless tobacco is associated with hypercholesterolemia (≥ 6.2 mmol/L) among 2,840 adult males. The confounding effects of age, education, physical fitness, body fatness, and other tobacco use were also examined. After adjustment, smokeless tobacco users were 2.5 times, heavy smokers were 2 times and mild/moderate smokers were 1.5 times more likely to have hypercholesterolemia than non-users of tobacco. Cigarette smokers did not differ significantly from users of smokeless tobacco regarding hypercholesterolemia. Users of smokeless tobacco were younger and less educated compared to non-users of tobacco, while smokers were less educated and less physically fit. (*Am J Public Health* 1989; 79:1048-1050.)

Introduction

National estimates indicate that at least 12 million Americans used some form of smokeless tobacco during 1985 and recent data show that 16 percent of males 12 to 25 years of age have used smokeless tobacco within the past year. An estimated 6 million persons use smokeless tobacco at least weekly and rates seem to be increasing, especially among adolescent and young adult males.¹

The increased appeal and use of smokeless tobacco has generated considerable public health concern because research indicates that snuff and chewing tobacco can be significant health hazards. Most notably, dipping and chewing have been linked to oral cancer,¹⁻⁵ and numerous clinical studies have shown strong associations between smokeless tobacco use and noncancerous and precancerous oral conditions.⁶⁻⁸

Many of the health problems associated with tobacco use are a consequence of nicotine. Since the blood nicotine levels which result from smokeless tobacco use are similar to those from cigarette smoking,⁹⁻¹¹ the nicotine-related health effects of smoking would also be expected to result from using smokeless tobacco. Compared to nonsmokers, smokers tend to have elevated levels of low density and very low density lipoproteins and reduced levels of high density lipoproteins,¹²⁻¹⁷ a lipid profile strongly associated with increased risk of atherosclerosis and coronary heart

disease.¹⁸⁻²² To date, only one unpublished study has been conducted to determine the effects of smokeless tobacco use on lipid metabolism.²³

The present study was conducted to determine the extent to which use of smokeless tobacco contributes to hypercholesterolemia controlling for lifestyle and demographic factors, and to compare the effects of smokeless tobacco and cigarettes on hypercholesterolemia.

Methods

Subjects

A sample of 2,840 adult males with a mean age of 40.7 ($SD = 10.8$) was studied. Subjects were employees of over 25 different companies that participated in the Health Examination Program offered by Health Advancement Services (HAS), Inc. Approximately 70 percent of the men were married, 78 percent were White, and 73 percent had some college education. The median and modal annual gross family income was \$25,000-\$30,000.

All data were collected by registered nurses employed by HAS, Inc. Each subject was examined individually and privately for approximately 60 minutes after participating in an orientation and completing an informed consent form.

Instrumentation and Procedures

A written questionnaire was administered to assess demographic and life-style information, including use of smokeless tobacco and cigarettes. A Harpenden skinfold caliper was employed to assess subcutaneous fat at three body sites and the sum of the skinfold measurements along with age and gender were used to calculate the total body fat percentage of each subject.²⁴ Physical fitness was assessed using a step test, the Kasch 3-minute Pulse Recovery Test.²⁵ Approximately 10cc of blood was drawn from each subject and analyzed using the enzymatic method to determine serum cholesterol levels.²⁶

Data Analysis

Subjects were classified as regular users of smokeless tobacco, mild/moderate smokers (1-20 cigarettes/day), heavy smokers (>20 cigarettes/day) or non-users of tobacco, according to their questionnaire responses. High blood cholesterol or hypercholesterolemia was defined as a total serum cholesterol level of 6.2 mmol/L or greater, consistent with the criteria of the National Cholesterol Education Program New Cholesterol Adult Treatment Guidelines.²⁷ The control variables were categorized as depicted in Table 1.

The associations between smokeless tobacco use, cigarette smoking, and hypercholesterolemia were measured by the odds ratio.²⁸ To control for potential confounders, Man-

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TABLE 1—Smokeless Tobacco Use, Cigarette Smoking, and Hypercholesterolemia According to the Control Variables

Control Variables	col %	Tobacco Use				Hypercholesterolemia
		None	Smokeless	1–20 cig	> 20 cig	6.2 + mmol/L
Total Group	100.0	76.7	3.3	15.1	4.9	18.6
Age (years)						
19–29	15.8	74.6 (6.1)	6.6 (13.8)	16.1 (2.8)	2.7 (16.7)	6.3
30–39	34.8	76.9 (13.5)	3.3 (9.4)	14.4 (21.3)	5.5 (14.8)	14.6
40–49	27.1	77.0 (20.7)	2.5 (31.6)	14.5 (33.6)	6.0 (37.0)	23.7
50+	22.3	77.1 (27.0)	1.9 (33.3)	17.1 (29.0)	3.8 (29.2)	27.9
Body Fat						
lean	13.5	75.3 (3.8)	4.5 (0.0)	14.7 (8.7)	5.5 (11.8)	4.8
moderate	58.4	77.7 (15.7)	3.2 (18.2)	14.6 (24.4)	4.5 (21.3)	17.4
obese	28.1	75.7 (29.2)	3.2 (33.3)	15.1 (34.7)	6.0 (33.3)	30.4
Education						
elem/hs	22.2	60.6 (17.3)	6.5 (18.4)	24.6 (21.0)	8.3 (27.1)	19.3
trade/voc	4.6	62.7 (13.5)	5.9 (14.3)	20.3 (37.5)	11.0 (23.1)	19.0
college	38.1	79.4 (15.1)	3.0 (16.7)	11.7 (25.0)	5.9 (15.5)	16.4
grad/prof	35.1	87.3 (18.9)	.9 (25.0)	9.6 (19.3)	2.2 (45.0)	19.8
Fitness						
good	21.7	87.1 (11.1)	2.9 (17.7)	8.0 (19.4)	2.0 (7.7)	12.0
average	30.2	80.4 (17.5)	3.6 (17.2)	11.4 (24.4)	4.7 (23.1)	18.9
poor	19.3	76.1 (23.9)	4.0 (9.5)	14.2 (28.6)	5.7 (25.0)	24.3
did not take	28.8	75.0 (17.6)	3.2 (29.2)	15.2 (20.7)	6.6 (28.9)	19.5

NOTE: Values in parentheses reflect the percentage of subjects within the subgroup who had hypercholesterolemia. For example, 33.3% of the subjects who were 50 years of age or older who used smokeless tobacco had hypercholesterolemia.

Body fat: lean = 10% or less body fat; moderate = 11–19% body fat; obese = 20% + body fat

Fitness: (age < 27) good = recovery HR ≤ 83 bpm; average = rec HR 84–99 bpm; poor = rec HR 100 + bpm

(age ≥ 27) good = recovery HR ≤ 87 bpm; average = rec HR 88–107 bpm; poor = rec HR 108 + bpm
didn't take = those subjects who chose not to take the step test.

tel-Haenszel summary risk estimates were employed.^{29–31} Analysis of covariance (ANCOVA) for unbalanced data was employed to determine mean cholesterol differences between the groups after adjusting for age, education, fitness, and additional tobacco use.

Results

Of the 2,840 subjects, 93 (3.3 percent) were regular users of smokeless tobacco, 568 (20 percent) were cigarette smokers, and 10 (.35 percent) subjects reported regular use of both products. The serum cholesterol global mean was 5.30 mmol/L

(SD = 1.08). As revealed in Table 1, regular use of smokeless tobacco was reported more often by the younger and the less educated subjects, and cigarette smoking was more prevalent among the less educated and the less fit. Hypercholesterolemia, measured in nearly 20 percent of the subjects, was more common in older, fatter, and less fit subjects.

Table 2 shows the estimated relative risk of hypercholesterolemia by tobacco use, including smokeless tobacco, without adjustment and with adjustment for age, education, physical fitness, and additional tobacco use. Control for differences in body fat had little effect on the results.

TABLE 2—Estimated Risk of Hypercholesterolemia by Use of Tobacco

Use of Tobacco	Variable Controlled	Hypercholesterolemia			
		N	%	RR _{mh}	95% CI
no use (n = 2,179)	none	377	17.3	1.00	—
smokeless tobacco (n = 93)	none	17	18.3	1.08	0.63, 1.85
	age, educ, fitness, & smoking			2.51	1.47, 4.29
cigarettes 1–20 daily (n = 429)	none	100	23.3	1.45	1.13, 1.86
	age, educ, fitness, & smokeless use			1.51	1.14, 2.00
cigarettes > 20 daily (n = 139)	none	34	24.5	1.55	1.04, 2.31
	age, educ, fitness, & smokeless use			1.98	1.29, 3.03

NOTE: Subjects who reported no use of tobacco were used as the reference group.

After adjustment, subjects who used smokeless tobacco regularly displayed 2 1/2 times the prevalence of hypercholesterolemia compared to non-users of tobacco. Heavy smokers had twice the prevalence, and light/moderate smokers had 1 1/2 times the prevalence of elevated cholesterol after controlling for the potential confounders (for the smokers, use of smokeless tobacco was controlled rather than cigarette smoking). There were no differences in risk of hypercholesterolemia between the smokeless tobacco and cigarette smoking groups.

Adjusted serum cholesterol means for the non-users of tobacco, smokeless tobacco users, light/moderate smokers, and heavy smokers were 5.29, 5.36, 5.38 and 5.52 mmol/L, respectively.

Discussion

Why smokeless tobacco users had 2 1/2 times the prevalence of hypercholesterolemia compared to non-users of tobacco is not clear. The substantial proportion of hypercholesterolemia among smokeless tobacco users could be the function of multiple factors and may not reflect cause and effect. Selection bias is possible, although unlikely (i.e., those with high blood cholesterol may choose to use smokeless tobacco more than the norm).

Other potential confounders, notably diet, could account for the smokeless tobacco/hypercholesterolemia relation. Moreover, because subjects in this study had relatively high socioeconomic status and educational levels, generalization to poorer, less educated groups will require additional study. The association between smokeless tobacco use and hypercholesterolemia is biologically sound, however, since smokeless tobacco acts as a vehicle to deliver nicotine to the system and results in blood nicotine levels similar to those attained by cigarette smoking.^{1,11} Hence, it is plausible that increased levels of blood cholesterol result from dipping and chewing.

In conclusion, it is apparent from the present findings that the consequences of using smokeless tobacco may reach beyond the oral cavity. Although cause-and-effect conclusions are premature given the design of this study, carrying "a pinch between the cheek and gum" may lead to hypercholesterolemia and ultimately cardiovascular disease, as well as leukoplakias and oral cancer. Clearly, increased efforts directed toward elucidating the non-oral health effects of using smokeless tobacco are warranted.

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