

Tobacco use and impact of tobacco-free policy on university employees in an environment of high tobacco use and production

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Abstract

Objective To assess occupational tobacco use and the impact of a tobacco-free policy in the Central Appalachia, an environment characterized by high tobacco use and production.

Methods This study was an Internet-based survey conducted on 2,318 university employees. Descriptive, chi-square, and logistic regression statistics were performed. Unadjusted and adjusted odds ratios (AOR) with respective 95 % confidence intervals (CI) were reported.

Results The survey response rate was 50.8 %; of the respondents, 9.0 % were current smokers. Smoking prevalence among faculty, administrators/professionals, and clerical/support staff was 6.1, 8.1, and 13.1 %, respectively. While those respondents aged 30–39 years showed a significantly increased likelihood of being a current

smoker (AOR 5.64, 95 % CI 1.31–9.26), knowledge that secondhand smoke is harmful (AOR 0.22, 95 % CI 0.07–0.70) and support for tobacco-free policy (AOR 0.11, 95 % CI 0.04–0.27) decreased the likelihood.

Conclusion Low tobacco use among faculty and administrators confirmed the relationship between tobacco use and socio-economic status, even in a tobacco-producing environment. Disaggregation of tobacco use data assists the public health community in the efficient allocation of efforts and resources for cessation programs to reduce tobacco use in such environments.

Keywords Tobacco use prevalence · Tobacco-producing state · Socio-economic status · Tobacco-free campus policy · University personnel or employees

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Introduction

Adult smoking rates across the four states in Central Appalachia [24.8 % for Kentucky (KY), 20.1 % for Tennessee (TN) and 26.8 % for West Virginia (WV)] are above the national average (19.3 % in 2010), except for Virginia (VA; 18.5 %) [1]. The Central Appalachia region encompasses 186 counties—54 in KY, 52 in TN, 25 in VA, and 55 in WV along with eight independent cities in VA. Tobacco use continues to be a leading cause of preventable morbidity and mortality in the US [2, 3] and elsewhere [3], and the states and counties in this region are not only characterized by high incidence of cancer, cardiovascular and respiratory diseases, but they also perform poorly on many health indicators, making the prevention and control of tobacco use of utmost importance. The health burden of tobacco in this region is exacerbated by tobacco production, which also causes diseases, such as the green tobacco

disease [4]. Additionally, the decline in tobacco use over the past decades in the USA has slowed [1], partly due to the prevalence of high tobacco use in places such as the Central Appalachia. This means that to attain the *Healthy People 2020* goal of a 12 % national adult smoking rate [5]—from the current smoking prevalence rate of 19.3 % [1]—a drastic decline in tobacco use in the Central Appalachia will be required. However, the existing data are mostly based on aggregates, limiting insight into tobacco use among population segments in this region and how the high usage rate can be curbed.

Previous studies involving data on tobacco use in states and counties in the Central Appalachia have shown that determinants of tobacco use are complex as the behavior is linked to individual, social, and environmental factors, and usually examined through socio-ecological theoretical models [6]. Despite this complexity, estimates on tobacco use prevalence [1] and analyses of tobacco use behaviors [7–10] in the USA and other developed countries suggest a strong link between tobacco use and socio-economic status (SES) of individuals. In this respect, indicators of SES, such as education, income, occupation, and material wealth, have been found to be negatively associated with tobacco use [11], which is why it is increasingly concentrated among people with lower SES [11, 12]. Because research on tobacco use among population subgroups is generally sparse [13], little information is available on tobacco use among university personnel (people in the same occupational setting) in the Central Appalachia. Hence, we wished to disentangle tobacco use among this population segment in TN.

Although TN is located in a region of the USA with high tobacco use prevalence [1], it is possible that patterns of tobacco use among population segments—and not general population estimates—could better reflect evidence in the extant literature that associates tobacco use with SES [7–9, 14]. In other words, the prevalence of tobacco use among segments of the population will approximate the generalized average in accordance with SES—and not the state or county prevalence rate. For this reason, we investigated tobacco use among the personnel of East Tennessee State University (ETSU), which is located in northeast TN in the Central Appalachia region where the smoking prevalence is not only above the national average (28.9 vs. 20.6 %, respectively, in 2009) but also the state average (28.9 vs. 22 % in 2009).

ETSU is the only 4-year comprehensive university in the northeastern part of Tennessee, and the only university among the 46 institutions under the administration of the Tennessee Board of Regents, the sixth largest public higher education system in the USA, with a tobacco-free campus policy as of November 2011 [15]. Additionally, while all colleges and universities in the Central Appalachia region

have some form of smoke-free policy, ETSU is one of eight colleges and universities having tobacco-free policies (the others include Bellarmine University, Transylvania University, and University of Kentucky in KY; Milligan College in TN; Jefferson College of Health Sciences in VA and Regent University in VA; West Virginia School of Osteopathic Medicine in WV [16]). The aim of our study was to delineate key determinants of tobacco use among the university personnel and tease out the impact of the college's tobacco-free policy on the volume of cigarettes smoked and the personnel's perceptions about tobacco use prevalence. In this case, unlike previous studies involving colleges and universities in the Central Appalachia that mostly focused on policies (and tobacco use among students) [17–19], our study focused not only in gaining an understanding of tobacco use but also on determining the impact of a college-based tobacco-free policy on tobacco use and perceptions about tobacco use. The working hypothesis was that since tobacco use is related to SES, the prevalence among the university personnel would be lower than that among the general county or state population, but the differences in educational attainment would create gradients in tobacco use even among personnel in the same occupational setting. While the generally low prevalence is determined by the nature of the occupation of the study population, differences in an individual's educational attainment provides the main explanation for tobacco use behaviors. The results of our study suggest the need for occupational intervention in tobacco use cessation based on educational attainment, even in occupational settings generally associated with high SES.

Materials and methods

Data collection

In April 2010, based on a standard procedure [20], we administered an Internet-based survey to all the 2,318 personnel of ETSU. Employee lists were obtained from the Human Resources Department of ETSU. The research protocol was approved by the Institutional Review Board at ETSU, and the study was conducted in accordance with the ethical standards of the Institutional Review Board at ETSU and with the Helsinki Declaration.

An email with a link to the survey was sent to all employees of the university from the Office of the Vice President of Health Affairs and Chief Operating Officer. Additionally, flyers with a link to the survey were posted throughout the campus, and cards were placed in each employee's campus mailbox. The initial email contained the informed consent form, which informed the survey participants about the objectives and items in the survey

and invited them to participate on a voluntary basis. If they opted not to participate, then the survey ended. The first item on the survey was a question requiring respondents to confirm that they were older than 18 years of age. At the end of the survey, participants were asked to voluntarily participate in a drawing to win \$50 (a total of 20 such prizes were given). A participant's entry into the drawing was distinct from the survey. A reminder email was sent to all the employees after 10 days. The survey remained active for a period of 26 days to give the employees enough time to participate in the study.

Measures

The dependent variable, tobacco use status, was based on a standard measure of tobacco use prevalence developed by the Global Tobacco Surveillance System Collaborative Group, comprising the World Health Organization (WHO), US Centers for Disease Control and Prevention (CDC), and the Canadian Public Health Association [21–23]. This measure asked respondents to identify themselves as “ever-smoker,” “current smoker,” and “user of other tobacco products.” The independent variables were based on questions pertaining to demographics (age, gender, race, and ethnicity), employment status (administrative/professional, clerical/support staff, and faculty), professional affiliations (colleges and schools in the university), attitude towards college tobacco-free policy (favor or oppose), and belief of whether secondhand smoke (SHS) was harmful to health (yes or no). Because of the small sample size, the race was dichotomized as Caucasian/Whites and non-Caucasian/non-Whites for the regression analysis. The proportions of age, gender, employment status, and professional affiliation characteristics of the respondents in the sample are similar to that of the employee population in the university, which implies that the survey sample is a true representation of the university employee population.

To assess the impact of the college-based tobacco-free policy on tobacco use behavior in the absence of baseline data, respondents were asked to report whether they smoked cigarettes before August 2008, when ETSU implemented the tobacco-free campus policy, and the volume of cigarettes smoked at that time, as well as smoking behavior at the time the survey was conducted in April/May 2010. Additionally, a Likert Scale was used to assess the perceptions of the personnel on the impact of the college-based tobacco-free policy. The rationale for this approach was that given the data limitation, the employees' responses could be taken as valid evidence of the effect of the college-based tobacco-free policy on tobacco use behavior because employees constitute the most stable segment of a university's population.

Data analysis

Descriptive statistics (frequencies, percentages, and proportions) were performed to determine tobacco use prevalence among the university personnel and the impact of the college-based tobacco-free policy on tobacco use. Additionally, multiple variable logistic regression analyses were performed to identify the key determinants of tobacco use among the personnel. We reported 95 % confidence intervals (CIs) along with unadjusted odds ratios (ORs) and adjusted ORs (AORs). The analyses were conducted using Statistical Analysis Software ver. 9.2 (SAS Institute, Cary, NC).

Results

Sample characteristics

All university personnel (2,318) were invited to participate in the study, and 1,414 (61 %) employees ultimately responded. Incomplete survey responses were deleted to yield a total of 1,177 (50.8 %) respondents, who formed the analytical sample for this study.

The percentage of ever-smokers, current smokers, and users of other tobacco products was 44.6, 9.0, and 11.4 %, respectively (Table 1). The age distribution of the respondents was left-skewed as the number of respondents increased with age, peaking at the 50- to 59-year age category (33.7 %) and dropping thereafter. Approximately two-thirds of the respondents were female (67.0 %), and an overwhelming majority were Caucasians/Whites (89.5 %), with percentages similar to that of the university employee population. The largest employment category was faculty (33.3 %), and the largest professional affiliation was the College of Medicine (17.8 %), with similar percentages as in the total population. An overwhelming majority of respondents were aware that SHS was harmful for health (88.2 %) and favored the college tobacco-free policy (79.2 %). Therefore, the sample characteristics signify that the analytical sample (1,177) is a true representation of the employee population in the university.

Distribution and determinants of tobacco use

Table 2 illustrates that out of the total sample in each category, the largest proportion of ever-smokers was between 30 and 39 years old (51.2 %), male (47.4 %), and Hispanic (66.7 %), worked as clerical/support staff (51.3 %) and were affiliated with the College of Clinical and Rehabilitative Health Sciences (48.4 %), reported that SHS was not harmful for health (86.4 %), and opposed the college-based tobacco-free policy (76.1 %). With respect to respondents

Table 1 Distribution of characteristics of survey respondents (*n* = 1, 177)

Characteristics	Number of respondents (<i>n</i>)	Percentage of respondents (%)
Status of tobacco use		
Ever-smoker		
Yes	525	44.6
No	623	52.9
Missing data	29	2.5
Current smoker		
Yes	106	9.0
No	422	35.9
Missing data	649	55.1
User of other tobacco products		
Yes	134	11.4
No	389	33.0
Missing data	654	55.6
Age (years)		
19	5	0.4
20–29	106	9.0
30–39	211	17.9
40–49	271	23.0
50–59	397	33.7
≥60	154	13.1
Missing data	33	2.8
Gender		
Female	789	67.0
Male	367	31.2
Missing data	21	1.8
Race		
American Indian or Alaska Native	5	0.4
Asian	27	2.3
Black or African American	44	3.7
Caucasian/White	1053	89.5
Hispanic	12	1.0
Missing data	36	3.1
Employment status		
Administrator/professional	333	28.3
Clerical/support staff	374	31.8
Faculty	392	33.3
Others	43	3.6
Missing data	35	3.0
Professional affiliation		
College of Medicine	209	17.8
College of Arts and Sciences	194	16.5
College of Education	101	8.6
College of Business and Technology	75	6.4
College of Nursing	71	6.0
College of Public Health	32	2.7

Table 1 continued

Characteristics	Number of respondents (<i>n</i>)	Percentage of respondents (%)
College of Clinical and Rehabilitative Health Sciences	31	2.6
School of Continuing Studies and Academic Outreach	30	2.6
College of Pharmacy	24	2.0
Others	259	22.0
Missing data	151	12.8
Knowledge that secondhand smoke (SHS) is harmful		
Yes	1038	88.2
No	44	3.7
Unsure	55	4.7
Missing data	40	3.4
Attitudes toward tobacco-free policy		
Favor	932	79.2
Oppose	134	11.4
Unsure	70	5.9
Missing data	41	3.5

who reported to be current smokers, the largest proportion was between 30 and 39 years old (17.1 %), male (9.8 %), and American Indian/Native Alaskan (40 %), worked as clerical/support staff (13.1 %) and personnel in the School of Continuing Studies and Academic Outreach (13.3 %), did not know the SHS was harmful to health (45.5 %), and opposed the college-based tobacco-free policy (38.1 %). The proportion of users of other tobacco products was the largest among respondents aged 20–29 years (17.9 %) and male (28.9 %), worked as faculty members (14.3 %) and were affiliated with the College of Public Health (15.6 %), indicated that SHS was not harmful to health (43.2 %), and opposed the college-based tobacco-free policy (29.1 %). In this respect, the descriptive statistics showed that tobacco use was generally high among males and those who opposed the college-based tobacco-free policy and those who lacked knowledge that SHS is harmful to health. It is, however, important to note that while respondents aged between 30 and 39 years constituted the largest proportion of current smokers, those between age 20 and 29 years were the largest users of other tobacco products. Additionally, while clerical/support staff constituted the largest proportion of current smokers, faculty members constituted the largest proportion of users of other tobacco products.

Table 3 shows the results of the regression analysis with unadjusted ORs, AORs, and 95 % CIs and associated *P* values. With respect to ever-smokers, being a faculty member, knowing that SHS is harmful to health, and favoring the college-based tobacco-free policy were the

only significant variables inversely associated with the likelihood of being an ever-smoker. For example, compared with those who reported that SHS is not harmful to health, knowing that SHS is harmful to health reduced the likelihood of being an ever-smoker by 87 % when unadjusted (OR 0.13, 95 % CI 0.05–0.32) and by 75 % when adjusted for the other variables, including age, gender, race, employment status, professional affiliation, and attitudes towards tobacco-free campus policy (AOR 0.25, 95 % CI 0.09–0.68). In the case of current smokers, while being between 30 and 39 years of age increased the likelihood of being a current smoker, favoring the college tobacco-free policy and knowing that SHS is harmful to health decreased this likelihood. In this respect, compared to employees aged between 20 and 29 years, those aged between 30 and 39 years were about fourfold more likely to be current smokers when unadjusted (OR 4.11, 95 % CI 1.13–8.96) and about sixfold more likely when adjusted (AOR 5.64, 95 % CI 1.31–9.26). In contrast, favoring the college tobacco-free policy, for example, was significantly associated with the decreased likelihood of being a current smoker—by 92 % when unadjusted (OR 0.08, 95 % CI 0.04–0.15) and by 89 % when adjusted (AOR 0.11, 95 % CI 0.04–0.27). The clear-cut evidence pertaining to the use of other tobacco products among the personnel was that being between 30 and 39 years of age and female and knowing that SHS is harmful to health significantly reduced the likelihood of usage. In particular, compared to being male, being female was significantly associated with the decreased likelihood of using other tobacco products—by 94 % when unadjusted (OR 0.06, 95 % CI 0.04–0.11) and by 95 % when adjusted (AOR 0.05, 95 % CI 0.03–0.10). In essence, age, gender, employment status, knowledge about the harmful effects of SHS, and attitude toward the college-based tobacco-free policy were the key determinants of tobacco use among these personnel in the same occupational setting.

Impact of the college-based tobacco-free policy on employees' tobacco use status

Tables 4 and 5 present the results of our analysis on the impact of the college-based tobacco-free policy among the personnel and the respondents' perceptions of the impact of the policy. Both tables show a decline in tobacco use among personnel. Thus, Table 4 shows that while the proportion of those who reported smoking one to two packs of cigarettes per day before the policy was implemented declined by 22.5 % (i.e., $9/40 \times 100$), the proportion of those smoking less than one pack a day increased by 12.5 % (i.e., $8/64 \times 100$). These results suggest an overall decrease in the volume of tobacco use since the college-based tobacco-free policy was implemented.

With respect to perceptions, the majority of employees across all dimensions indicated that the college-based tobacco-free policy has not only reduced smoking (72.0 %), exposure to SHS (76.6 %), and the number of cigarette butts on campus (66.7 %) but also improved the health of employees (60.8 %) and made the campus cleaner (69.8 %). Additionally, the results show that many respondents perceived that the college-based tobacco-free policy has promoted the culture of non-smoking both on (45.3 %) and off-campus (39.7 %). In effect, there were generally good perceptions about the first college-based tobacco-free policy in the Tennessee Board of Regents' system [19]. These changes in perceptions suggest the social norming effects of such policies.

Discussion

Although the rate of adult smoking in the country has declined by more than half since the 1960s, recently it has more stalled or leveled off [24], demanding the need to discover avenues to accelerate the decline. In spite of this decline, around 46 million people in the country continue to smoke, and over 4,000 [25] youth begin to smoke every day. Given the health [2, 3] and economic [26, 27] consequences of tobacco in the USA and worldwide, reducing tobacco use is a topmost public health priority for the 21st century [28]. Thus, the identification of tobacco use prevalence among the various population segments for both targeted health promotion and education activities and tobacco use cessation programs is a relevant step towards attainment of the *Healthy People 2020's* objective of a 12 % national adult smoking rate [5]. As such, this study specifically focused on providing insight into tobacco use among university personnel in the Central Appalachia, a tobacco-producing region with a high prevalence of tobacco use.

The study results indicate that 44.6 % of the respondents were ever-smokers, 9.0 % were current smokers, and 11.4 % were users of other tobacco products. The prevalence rate of current smokers (9.0 %) was significantly below the average for the entire country (20.6 % in 2009), the state (22 %), northeast TN and Central Appalachia (28.9 %), and the Southeast USA (range 19–26 %) [1] and is more consistent with prevalence rates reported in studies linking SES with smoking [11, 13, 29] and other health behaviors [30–33]. The demographic characteristics (age, gender, and race/ethnicity) of tobacco users in this study, which was confirmed with the proportion of the total sample, appeared to be consistent with those of the general population. The relatively low rate of smoking among the university personnel in a high prevalence area suggests that public health officials and the community should be more

Table 2 Tobacco use among university personnel (*n* = 1,177)

Characteristics	<i>N</i>	Ever-smoker ^a (<i>n</i> = 525)		Current smoker ^a (<i>n</i> = 106)		User of other tobacco products ^a (<i>n</i> = 134)	
		<i>n</i> (%)	Proportion of <i>N</i>	<i>n</i> (%)	Proportion of <i>N</i>	<i>n</i> (%)	Proportion of <i>N</i>
Age (years)							
19	5	1 (0.2)	20.0	0 (0.0)	0.0	0 (0.0)	0.0
20–29	106	52 (9.9)	49.1	8 (7.5)	7.5	19 (14.2)	17.9
30–39	211	108 (20.6)	51.2	36 (34.0)	17.1	27 (20.1)	12.8
40–49	271	111 (21.1)	41.0	25 (23.6)	9.2	27 (20.1)	10.0
50–59	397	172 (32.8)	43.3	24 (22.6)	6.0	39 (29.1)	9.8
≥60	154	75 (14.3)	48.7	10 (9.4)	6.5	21 (15.7)	13.6
Missing data	33	6 (1.1)	18.2	3 (2.8)	9.1	1 (0.7)	3.0
Gender							
Female	789	347 (66.1)	44.0	68 (64.2)	8.6	27 (20.1)	3.4
Male	367	174 (33.1)	47.4	36 (34.0)	9.8	106 (79.1)	28.9
Missing data	21	4 (0.8)	19.0	2 (1.9)	9.5	1 (0.7)	4.8
Race							
American Indian or Alaska Native	5	2 (0.4)	40.0	2 (1.9)	40.0	1 (0.7)	20.0
Asian	27	10 (1.9)	37.0	1 (0.9)	3.7	2 (1.5)	7.4
Black or African American	44	20 (3.8)	45.5	3 (2.8)	6.8	6 (4.5)	13.6
Caucasian/White	1053	479 (91.2)	45.5	97 (91.5)	9.2	123 (91.8)	11.7
Hispanic	12	8 (1.5)	66.7	0 (0.0)	0.0	0 (0.0)	0.0
Missing data	36	6 (1.1)	16.7	3 (2.8)	8.3	2 (1.5)	5.6
Employment status							
Administrator/professional	333	154 (29.3)	46.2	27 (25.5)	8.1	39 (29.1)	11.7
Clerical/support staff	374	192 (36.6)	51.3	49 (46.2)	13.1	32 (23.9)	8.6
Faculty	392	152 (29.0)	38.8	24 (22.6)	6.1	56 (41.8)	14.3
Others	43	17 (3.2)	39.5	4 (3.8)	9.3	6 (4.5)	14.0
Missing data	35	10 (1.9)	28.6	2 (1.9)	5.7	1 (0.7)	2.9
Professional affiliation							
College of Medicine	209	91 (17.3)	43.5	17 (16.0)	8.1	20 (14.9)	9.6
College of Arts and Sciences	194	85 (16.2)	43.8	25 (23.6)	12.9	27 (20.1)	13.9
College of Education	101	41 (7.8)	40.6	3 (2.8)	3.0	10 (7.5)	9.9
College of Business and Technology	75	34 (6.5)	45.3	5 (4.7)	6.7	10 (7.5)	13.3
College of Nursing	71	27 (5.1)	38.0	3 (2.8)	4.2	1 (0.7)	1.4
College of Public Health	32	13 (2.5)	40.6	0 (0.0)	0.0	5 (3.7)	15.6
College of Clinical and Rehabilitative Health Sciences	31	15 (2.9)	48.4	2 (1.9)	6.5	3 (2.2)	9.7
School of Continuing Studies and Academic Outreach	30	13 (2.5)	43.3	4 (3.8)	13.3	2 (1.5)	6.7
College of Pharmacy	24	9 (1.7)	37.5	1 (0.9)	4.2	2 (1.5)	8.3
Others	259	129 (24.6)	49.8	29 (27.4)	11.2	35 (26.1)	13.5
Missing data	151	68 (13.0)	45.0	17 (16.0)	11.3	19 (14.2)	12.6
Knowledge that SHS is harmful							
Yes	1038	429 (81.7)	41.3	54 (50.9)	5.2	100 (74.6)	9.6
No	44	38 (7.2)	86.4	20 (18.9)	45.5	19 (14.2)	43.2
Unsure	55	46 (8.8)	83.6	25 (23.6)	45.5	12 (9.0)	21.8
Missing data	40	12 (2.3)	30.0	7 (6.6)	17.5	3 (2.2)	7.5
Attitudes toward tobacco-free policy							
Favor	932	361 (68.8)	38.7	29 (27.4)	3.1	81 (60.4)	8.7
Oppose	134	102 (19.4)	76.1	51 (48.1)	38.1	39 (29.1)	29.1
Unsure	70	49 (9.3)	70.0	19 (17.9)	27.1	12 (9.0)	17.1
Missing data	41	13 (2.5)	31.7	7 (6.6)	17.1	2 (1.5)	4.9

^a Ever-smoker, current smoker, and user of other tobacco products are not mutually exclusive. Hence, the row totals do not add to 100 %

Table 3 Determinants of tobacco use among university personnel in the tobacco-free campus ($n = 1,177$)

Characteristics	Ever-smoker			Current smoker			User of other tobacco products		
	Unadjusted OR (95 % CI)	AOR (95 % CI)	P value	Unadjusted OR (95 % CI)	AOR (95 % CI)	P value	Unadjusted OR (95 % CI)	AOR (95 % CI)	P value
Age ^a (years)									
30–39	0.93 (0.55–1.58)	0.93 (0.53–1.62)	0.79	4.11 (1.13–8.96)*	5.64 (1.31–9.26)*	0.02*	0.37 (0.14–0.92)*	0.21 (0.07–0.70)*	0.01*
40–49	0.67 (0.41–1.12)	0.61 (0.35–1.06)	0.08	2.76 (0.75–10.16)	1.76 (0.39–8.04)	0.47	0.71 (0.31–1.64)	0.34 (0.11–1.06)	0.06
50–59	0.68 (0.42–1.11)	0.71 (0.42–1.19)	0.19	1.68 (0.46–6.17)	2.51 (0.56–11.25)	0.23	0.72 (0.33–1.58)	0.39 (0.14–1.12)	0.08
>60	0.90 (0.52–1.57)	1.04 (0.57–1.90)	0.89	0.73 (0.14–3.80)	0.83 (0.12–5.77)	0.85	0.81 (0.33–1.97)	0.28 (0.08–0.94)*	0.04*
20–29 (referent)									
Gender									
Female	0.93 (0.69–1.24)	1.02 (0.72–1.44)	0.91	0.86 (0.46–1.60)	1.76 (0.67–4.61)	0.25	0.06 (0.04–0.11)*	0.05 (0.03–0.10)*	<0.0001*
Male (referent)									
Race									
Non-Caucasians	1.06 (0.65–1.75)	1.10 (0.65–1.87)	0.72	0.42 (0.10–1.80)	0.32 (0.06–1.87)	0.21	0.72 (0.28–1.83)	0.50 (0.15–1.72)	0.27
Caucasians (referent)									
Employment status									
Administrator/professional	0.87 (0.62–1.24)	0.92 (0.64–1.33)	0.66	0.57 (0.27–1.22)	0.71 (0.28–1.81)	0.47	1.83 (0.94–3.54)	1.14 (0.48–2.70)	0.76
Faculty	0.64 (0.46–0.89)*	0.60 (0.40–0.90)*	0.01*	0.66 (0.32–1.34)	0.76 (0.25–2.28)	0.63	3.01 (1.63–5.56)	1.12 (0.46–2.75)	0.80
Others	0.62 (0.30–1.31)	0.52 (0.23–1.15)	0.11	2.32 (0.64–8.39)	1.71 (0.28–10.26)	0.56	1.75 (0.43–4.08)	1.21 (0.22–6.56)	0.82
Clerical/support staff (referent)									
Professional affiliation									
College of Arts and Sciences	0.99 (0.54–1.82)	1.19 (0.62–2.29)	0.60	1.54 (0.46–5.16)	4.06 (0.85–9.46)	0.08	1.33 (0.48–3.64)	3.69 (1.04–3.00)	0.04
College of Education	0.94 (0.48–1.85)	1.14 (0.55–2.37)	0.72	0.46 (0.09–2.24)	0.45 (0.06–3.60)	0.45	0.81 (0.25–2.58)	6.57 (1.51–8.64)*	0.01*
College of Medicine	0.89 (0.49–1.62)	1.01 (0.52–1.97)	0.98	0.56 (0.15–2.10)	1.63 (0.29–9.16)	0.58	0.78 (0.28–2.20)	3.54 (0.94–6.36)	0.06
College of Nursing	0.88 (0.43–1.79)	1.03 (0.47–2.26)	0.95	0.42 (0.07–2.52)	1.08 (0.10–6.48)	0.95	0.10 (0.01–0.90)*	0.64 (0.05–8.44)	0.74
College of Pharmacy	0.76 (0.28–2.06)	0.76 (0.26–2.23)	0.61	0.71 (0.07–7.52)	0.71 (0.03–6.26)	0.83	0.81 (0.13–5.03)	1.99 (0.22, 8.33)	0.54
College of Public Health	0.79 (0.3–2.00)	1.00 (0.37–2.69)	1.00	^a	^a	^a	1.62 (0.35–7.56)	3.55 (0.49–5.80)	0.21
School of Continuing Studies and Academic Outreach	1.04 (0.41–2.65)	0.91 (0.33–2.54)	0.86	2.50 (0.50–12.51)	4.66 (0.58–7.34)	0.15	^a	^a	^a
College of Clinical and Rehabilitative Health Sciences	1.04 (0.41–2.65)	1.58 (0.59–4.27)	0.36	^a	^a	^a	0.54 (0.09–3.16)	2.48 (0.29–7.52)	0.41
Others	1.21 (0.68–2.18)	1.11 (0.57–2.16)	0.77	0.94 (0.28–3.12)	1.79 (0.35–9.10)	0.48	0.84 (0.31–2.26)	4.30 (1.13–7.37)*	0.03*
College of Business and Technology (referent)									
Knowledge about secondhand smoke is harmful									
SHS is harmful (vs. SHS is not harmful)	0.13 (0.05–0.32)*	0.25 (0.09–0.68)*	0.01*	0.09 (0.04–0.20)*	0.22 (0.07–0.70)*	0.01*	0.21 (0.10–0.47)*	0.25 (0.07–0.90)*	0.03*

Table 3 continued

Characteristics	Ever-smoker			Current smoker			User of other tobacco products		
	Unadjusted OR (95 % CI)	AOR (95 % CI)	P value	Unadjusted OR (95 % CI)	AOR (95 % CI)	P value	Unadjusted OR (95 % CI)	AOR (95 % CI)	P value
Attitudes toward tobacco-free campus policy									
Favor (vs. oppose) (referent)	0.24 (0.15–0.40)*	0.35 (0.20–0.63)*	0.001*	0.08 (0.04–0.15)*	0.11 (0.04–0.27)*	<0.0001*	0.48 (0.27–0.87)*	1.37 (0.48, 3.90)	0.55

*Mean estimates are significant at $P < 0.05$

OR Odds ratio, AOR adjusted odds ratio, CI confidence interval

^a The following categories were deleted due to the small sample sizes and lack of convergence in the regression model: (1) age group 19 years ($n = 5$); (2) College of Public Health ($n = 0$) and College of Clinical and Rehabilitative Health Sciences ($n = 20$) for current smokers; (3) College of continuing studies and Academic Outreach ($n = 2$) for users of other tobacco products

concerned with disaggregating data on tobacco use so that resources could efficiently be allocated towards the attainment of the goal of *Healthy People 2020* and that health education and promotion efforts could be focused on populations that need them the most.

As indicated earlier, occupation is a major indicator of SES, which contributes to gradients in tobacco use [11]. The results of this study show that even in the same occupational setting, this evidence is true, which is why the regression results show that compared to clerical/support staff, faculty members were significantly less likely to be smokers. The disaggregation of data along employment status among people in the same occupational setting showed that the prevalence of current smoking among faculty members (6.1 %) with higher education was significantly lower than administrative/professional (8.1 %) and clerical/support staff (13.1 %). Thus, the results of our study extend our knowledge beyond the association between occupation and tobacco use [11], showing that even in the same occupational setting, the level of educational attainment becomes a major determinant of tobacco use. This phenomenon calls for smoking cessation programs for the workplace [34] that focus on the level of education because education provides the knowledge and skills for a healthy lifestyle [35]. However, even though the regression result is not significant, the finding that the highest prevalence of users of other tobacco products was among faculty members (14.3 %) needs attention. This phenomenon may probably be the result of the college-based tobacco-free policy that prohibits tobacco use (smoke and smokeless tobacco products) on campus except in private cars, thereby denormalizing smoking on campus [19]. In this respect, the usage of other tobacco products should be integrated into health promotion and education programs to ensure that people who stop smoking do not switch to other tobacco products.

The link between education and tobacco use appeared in two additional levels in the study. First, even though the professional affiliation was generally not significant, the results show that employees working in the areas of medicine and health sciences generally used tobacco less than those in the arts and social sciences, suggesting that familiarity with knowledge about the harmful effects of tobacco use probably impacted behaviors [36]. For example, the highest prevalence of current smokers was among those in the College of Arts and Sciences (12.9 %) and School of Continuing Studies and Outreach (13.3 %). The caveat, however, is that a sizeable proportion of people who reported that they currently smoked (8.1 %) is from the College of Medicine, the highest among those from medicine and health sciences. This relatively high level of tobacco use among this category of employees is a subject of concern because the smoking status of a physician may

affect their ability to counsel patients about smoking cessation [37]. In this respect, it is necessary for these personnel who smoke to be informed about the broader psycho-social impact of their behavior on others and be encouraged to participate in cessation services.

The second issue that supports the extant literature is the observed relationship between tobacco use behavior and the level of knowledge on health effects of exposure to SHS [13]. In this study, knowledge of the harmful effects of SHS was the single-most important determinant of the use of all tobacco products among the employees. For example, the prevalence of current smoking among those who reported that SHS is harmful to health was 5.2 %, compared to 45.5 % who reported that it is not. The regression analysis illustrated that knowledge of the harmful effects of SHS decreased the likelihood of being a current smoker by 91 % when unadjusted and by 78 % when adjusted. These results suggest that a significant number of smokers among the study population do not have adequate knowledge of the health effects of SHS. However, since the health effects of SHS is one of the consensus in tobacco control [15] and provide a reason for the success of tobacco control in the USA [38], there is

the need to embed this knowledge in occupational smoking interventions to help close the knowledge gap.

The final issue whose relationship with SES is not apparent, but which needs attention, is the effect of the college-based tobacco-free policy on tobacco use because it is the second strongest determinant of tobacco use in the study population, i.e., smoking prevalence was significantly low among those who favor the tobacco-free policy. For example, the prevalence of smoking was 3.1 % among those who favor the policy, compared to 38.1 % of those against it. The regression results show that support for the policy significantly reduced the likelihood of being a current smoker by 92 % when unadjusted and 89 % when adjusted. When these results are coupled with the results that the college-based tobacco-free policy reduced the volume of cigarette smoked on campus and exposure to SHS as well as improved cleanliness on campus, there is clear indication that the college and university authorities should be concerned with the long-term positive effects of such policies and work to implement them on their campuses because it is one of the most effective measures to curb tobacco use [39, 40]. The decrease in the volume of cigarettes smoked after the implementation of the tobacco-free policy and the perceptions of a negative association between the policy and tobacco use suggest the importance of diffusing a tobacco-free campus policy in TN and the Central Appalachian region [19].

Table 4 Impact of the East Tennessee State University (ETSU) college-based tobacco-free policy ($n = 1,177$)

Smoking frequency	<i>n</i>	%
Number of packs per day before 2008		
1–2 packs	40	3.4
Less than 1 pack	64	5.4
Missing data	1073	91.2
Number of packs per day after 2008		
1–2 packs	31	2.6
Less than 1 pack	72	6.1
Missing data	1074	91.3

Limitations

Responses to the survey were based on self-report, and no independent means was used to determine their validity. Additionally, although the survey was anonymous and all necessary steps [20] were taken to protect respondents' identity, because tobacco use on campus, in university facilities, and on university premises or property has been prohibited since August 2008, some respondents'

Table 5 Perceptions of the impact of the ETSU campus-based tobacco-free policy ($n = 1,177$)

Characteristics	Agree [<i>n</i> (%)]	Unsure [<i>n</i> (%)]	Disagree [<i>n</i> (%)]	Missing [<i>n</i> (%)]
Reduced smoking	847 (72.0)	131 (11.1)	100 (8.5)	99 (8.4)
Reduced exposure to SHS	902 (76.6)	93 (7.9)	83 (7.1)	99 (8.4)
Improved the health of employees	716 (60.8)	240 (20.4)	120 (10.2)	101 (8.6)
Saved money	431 (36.7)	458 (38.9)	184 (15.6)	104 (8.8)
Made campus premises/property cleaner	822 (69.8)	119 (10.1)	130 (11.1)	106 (9.0)
Motivated employees to seek smoking cessation assistance	435 (37.0)	452 (38.4)	186 (15.8)	104 (8.8)
Increased preference for smoke-free environments	644 (54.7)	174 (14.8)	247 (21.0)	112 (9.5)
Promoted non-smoking culture among employees	533 (45.3)	337 (28.6)	201 (17.1)	106 (9.0)
Promoted non-smoking culture in the local communities	467 (39.7)	350 (29.7)	248 (21.1)	112 (9.5)
Reduced cigarette butts on campus	785 (66.7)	138 (11.7)	149 (12.7)	105 (8.9)

willingness to admit that they were current smokers may have been affected, and the same may be true for some non-respondents who currently smoke but who were not willing to participate in the survey; this potential factor may have led to an underestimation of the results. Future research studies should be conducted to address these non-response and information biases in detail. Moreover, the study population may be unique, hampering the ability to extrapolate the findings to other occupational settings in the state and Central Appalachia. Further, there was no baseline data to facilitate an independent assessment of tobacco use among the personnel before August 2008, when the university implemented the tobacco-free policy, which forced us to rely on self-reports that are subject to recall bias. In addition, tobacco use rates in the respondent sample cannot be compared with those in the university employee population due to absence of baseline data. Therefore, this study garners importance by providing the first results of tobacco use among employees in the university, which can be used as a baseline data set for future evaluation studies. However, the strength of the study is that it focused on the most stable segment of the university's population, and not a transient population, such as students, allowing us to assess the prevalence and impact of the policy on tobacco use behavior. The study findings not only provide strong support for the relationship between tobacco use behavior and SES, even in a state and region where the tobacco use is high, but they also extend our knowledge of the link between occupation, SES, and tobacco use to other occupational settings.

Conclusion

The prevalence of tobacco use in TN and Central Appalachia is above the national average. At the same time, estimates of tobacco use prevalence and results from various studies suggest a strong linkage between SES and tobacco use. Since information on tobacco use among population subgroups is sparse, this study focused on delineating the key determinants of usage among people in the same occupational setting, i.e., personnel of a university. We found that there was in general a prevalence of low tobacco use among the university personnel even though the institution is located in a state where a high use of tobacco is prevalent and in a region where the socio-cultural environment is more receptive to tobacco use. Thus, on one level, this finding confirms the evidence on the relationship between tobacco use behavior and SES. On a second level, disaggregation of the tobacco use data suggests the need for occupational cessation programs that mostly target personnel who are aged 30–39 years and male and who work as clerical/support staff because of the

high prevalence of current smokers among this group. Additionally, such programs should include information about the health effects of other tobacco products, including smokeless products, such as snus, snuff, and chewing tobacco, as the usage rate for other tobacco products was high among the respondents to our survey, even among highly educated segments of the study population. Moreover, given the strong link between tobacco use and knowledge of SHS, any health education or cessation program should integrate such information. On a third level, the fact that there was a strong association between tobacco use and the college-based tobacco-free policy and the report that the policy reduced the volume of cigarettes smoked means there should be orchestrated efforts to enhance the receptivity as well as enforcement of the policy. This disaggregation of tobacco use rate by population segments could not only assist in the efficient allocation of scarce resources for health education and promotion and tobacco use cessation programs but also assist the public health community and policymakers to channel efforts to specific sub-populations that need them the most. Taken as a whole, the results of this study suggest that the attainment of the goal of *Healthy People 2020* to reduce tobacco use depends not only on understanding tobacco use in high prevalence areas, such as Central Appalachia, but also tobacco use among population subgroups.

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