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Exploring the Relationship Between Urgent Care Visits on Daily Smoking Intensity: A Cross-Sectional Study Using Zero-Inflated Models

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Abstract

Introduction: Cigarette smoking is a significant public health concern, leading to increased illness and higher healthcare costs. This research aims to investigate how frequencies of visits to urgent care facilities impact the daily cigarette consumption of smokers. Understanding these relationships is crucial for developing public health policies and interventions to reduce smoking rates and lessen the strain on healthcare systems.

Methods: This study draws on data from the 2023 National Health Interview Survey (NHIS) to investigate the relationship between daily cigarette consumption and urgent care visits. A sample of 28,122 adult respondents was analyzed using Zero-Inflated Poisson (ZIP) and Zero-Inflated Negative Binomial (ZINB) models to account for overdispersion and the count nature of the data. Covariates included age, sex, cardiovascular disease (CVD), education level, and health insurance coverage.

Results: Among 28,122 adults, 8% were smokers. In zero-inflated models, urgent care visit frequency showed only weak associations with smoking, while very frequent users (≥5 visits/year) were less likely to be non-smokers (ZIP: Coefficient (β) = −0.35, Standard Error (SE) = 0.16; ZINB: β = -0.36, SE = 0.17). Males (β = 0.15, SE = 0.01) smoked significantly more cigarettes daily compared to females, and higher education levels correlated with increased smoking intensity. The ZINB model was a better fit than the ZIP model, indicated by lower AIC values.

Conclusion: Urgent care settings offer a crucial opportunity for implementing smoking cessation interventions, particularly for high-risk groups such as men and older adults. Integrating brief smoking cessation counseling during visits can reduce daily smoking intensity. Tailored public health interventions addressing sociodemographic disparities are crucial.

Keywords: Ambulatory care, Cigarette smoking, Risky behaviors, Health services, Smoking

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Introduction

In 2020, people who smoked had 4.96 times more urgent medical visits than those who never smoked, which shows an immediate link between smoking and using care services.[1] The investigation of the correlation between cigarette consumption and urgent care visits holds significant importance, particularly in light of the extensively documented adverse health implications associated with smoking.[2] Numerous studies have established a positive correlation between smoking and increased healthcare utilization, particularly in emergency settings.[3,4] Smoking significantly contributes to various diseases and increases healthcare service utilization among middle-aged and elderly adults.[4] Chronic diseases associated with smoking increase the likelihood of frequent healthcare service usage.[5] Another study underscores the correlation between higher healthcare needs and smoking status, revealing that smokers reported more urgent care and recurrent healthcare demands due to health conditions exacerbated by smoking.[6] This highlights the importance of the critical public health challenges posed by smoking, which often require urgent medical attention. Taking these into account, understanding the association between frequent urgent care visits and daily smoking patterns is essential for improving patient outcomes, reducing disease risk, and alleviating the strain on medical resources.

Urgent care visits can be linked to smoking intensity because they often occur during acute health events such as sudden respiratory or cardiovascular symptoms, which heighten risk salience and prompt behavior change. During these events, urgent care encounters can function as "teachable moments," health events that heighten perceived risk and motivation to change, especially when clinicians explicitly connect symptoms to smoking and offer concrete quitting support.[7] In behavioral science, "teachable moment (TM)" is a context in which different health events motivate individuals to adopt behavioral changes to reduce health risk spontaneously.[7] Urgent care visits often reflect immediate, unscheduled care sought for sudden symptom onset or acute flare-ups, which may be more common among individuals with current or heavier smoking due to smoking-related respiratory and cardiopulmonary irritation. In this setting, the visit can also serve as a practical opportunity for brief cessation counseling which motivates individuals to quit smoking, which may not be possible in routine practice.[8] In addition, urgent care can also serve as a point of contact to reinforce or initiate cessation efforts following an acute visit by advising on cessation and offering evidence-based interventions during healthcare encounters.[9]

The understanding of smoking behavior patterns, particularly in relation to urgent care visits, reveals a complex interplay of factors influencing health outcomes. Smokers often have higher rates of hospital admissions and urgent care visits for smoking-related conditions, highlighting the need for health care and prevention efforts tailored to this group, thereby addressing both immediate health concerns and long-term smoking behaviors.[10] Moreover, the patterns of smoking behavior are not uniform across different demographic characteristics. Older adults often have strong smoking habits that can harm their oral health, it is important to intervene quickly to prevent further decline.[11] This highlights a gap in public health efforts, which predominantly focus on younger populations, thereby neglecting older adults who may also require targeted cessation support.[11] Moreover, studies indicate that smoking behaviors significantly impact annual healthcare costs, suggesting that higher smoking rates correlate with increased healthcare expenditures due to frequent urgent care visits and hospitalizations.[12] For instance, the longitudinal analysis of smoking behaviors, particularly among mothers, reveals diverse trajectories of smoking initiation, cessation, and relapse, emphasizing the need for tailored cessation programs.[13,14] Studies reveal that smoking behavior is influenced by various situational and physiological factors, indicating that habitual smoking is not solely driven by addiction but also by environmental cues and personal contexts.[15–17] The challenges of quitting smoking require an approach that takes into account each person's unique situation and behaviors. Smokers with frequent urgent care visits may require enhanced smoking cessation programs and integrated management strategies that address their acute healthcare needs while encouraging lifestyle changes.[18] Therefore, having a deep understanding of the connection between daily smoking patterns and frequent urgent care visits can greatly help in designing effective cessation strategies that consider their needs and promote quitting smoking.

Numerous statistical models have been utilized in research studies to explore the association between urgent care visits and smoking behaviors. In most of the research studies, logistic regression analysis was used to examine how urgent care visits, financial strain, chronic condition, and quality of life are associated with smoking status.[19] Longitudinal logistic and multinomial models have been used to assess the associations between urgent care visits and smoking behaviors among adolescents over time.[20] However, standard logistic or multinomial models require daily cigarette use to be collapsed into broad categories (e.g., smoker vs non-smoker or light vs heavy), which obscures important differences in actual smoking behavior and ignores the underlying count nature of the variable. Also, to capture the full range of smoking patterns in a population where many people do not smoke, it can be beneficial to use zero-inflated models, which allow us to model both the likelihood of being a non-smoker and the intensity of smoking among smokers within the same framework.

Poisson regression is commonly used for modeling count outcomes, assuming that the mean and variance of the outcome are equal.[21] However, daily smoking patterns in a population sample often show overdispersion, where the variance exceeds the mean.[22] Many people in the sample were non-smokers, which can result in an overabundance of zeros in the dataset. Negative binomial regression is another model used for count outcomes, but unlike standard Poisson models, it is better suited to situations where there is overdispersion, where the variance of the outcome is greater than its mean.[21] To account for this, zero-inflated models such as Zero-Inflated Poisson (ZIP) and Zero-Inflated Negative Binomial (ZINB) models might be helpful as they model two distinct processes: one for individuals who never smoke and another for those who may, with the ZINB model also addressing overdispersion.[23] These models are more appropriate than alternatives like linear regression, which would not handle the discrete nature of count data, or logistic regression, which only models binary outcomes rather than the frequency of healthcare visits. Combining these models allows a comprehensive exploration of the data, leading to the most accurate fit for understanding the relationship between smoking and the frequency of urgent care visits.

The primary objective of this research is to investigate the relationship between urgent care visits and the daily cigarette consumption of smokers. By controlling for demographics such as age, gender, and health insurance status through a series of count data models, specifically the ZIP and ZINB, the secondary objective of this study is to identify the most suitable model for predicting the association between cigarette consumption behavior and urgent care usage while addressing issues of overdispersion and excess zeros in the dataset.

Methods

Data and Study Design

This study used a cross-sectional study design using data from the 2023 National Health Interview Survey (NHIS) conducted by the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics (NCHS). Information from "Sample adult Interviews" was used for the study, where the interview participants were US adults aged 18 years and above. The NHIS is an annual household survey representing the civilian non-institutionalized US population. Usually, interviews for the NHIS are conducted in-person modules and followed up via telephone. For over 50 years, the U.S. Census Bureau has sent interviewers to American homes to inquire about various health topics. The National Health Interview Survey (NHIS) is responsible for collecting and analyzing data on a wide range of health-related topics to monitor the overall health of the United States population effectively. The survey results play a pivotal role in providing essential information and monitoring health status, access to healthcare, and progress toward achieving national health objectives.

To understand the context better among the US adults, the study also used NHIS public-use files from 2013 to 2023 to describe trends in daily cigarette smoking and urgent care visits among adults. These earlier years were used only for descriptive trend analyses and not included in regression models.

Participants

For the NHIS 2023, more than 30,000 confidential interviews were conducted during the year with the help of field staff trained by the U.S. Census Bureau. Around 29,522 adult participants participated in the “Sample Adult Interviews” in NHIS 2023. The response rate for the “Sample adults interviews” was 47%.[24] From this, (n = 1,400) data were excluded as missing data information (4.7%). Among the surveyed, 28,122 complete cases of data were selected for the study, considering the availability of information.

Variables of Interest

Dependent Variable

The daily cigarette smoking rate is the primary outcome of this analysis. A self-reported survey item was used to identify the number of cigarettes consumed daily. Participants were first asked whether they had smoked at least 100 cigarettes in their lifetime. Those who answered “yes” were then asked whether they currently smoke every day and to report the average number of cigarettes they smoke in a typical day; this value was used to construct the daily cigarette consumption count variable. Individuals who reported having smoked fewer than 100 cigarettes in their lifetime or an average of zero cigarettes per day were classified as non-smokers.

Independent Variable

The primary independent variable being investigated in this study is urgent care visits, which is defined as the frequency of participant visits to an urgent care facility within the preceding 12 months. This variable has been segmented into five categories: 0 visits, 1 visit, 2 visits, 3 visits, 4 visits, and 5 or more visits.

Covariates

The study utilized various sociodemographic factors and disease status as covariates to account for their potential to confound the relationship between frequencies of urgent care visit and the daily consumption of cigarettes. Covariates used to control for potential confounding factors were, Age was categorized into four groups: 18–24 years old, 25–44 years old, 45–84 years old, and 85 years and above, to account for differences in smoking behavior across age groups. Sex was recorded as either male or female, with the assumption that male participants tend to smoke more than females. The variable for cardiovascular disease was binary, capturing whether participants had ever been diagnosed with coronary heart disease (CHD). This was included because smoking is a known risk factor for cardiovascular conditions, and individuals with these conditions may alter their smoking behavior.[25] Health Insurance Coverage was categorized as either covered or not covered, to examine whether access to healthcare influenced smoking behavior, particularly through access to smoking cessation programs. Additionally, highest educational level was recoded into six categories: No formal education (including participants who never attended school or attended up to the 12th grade without earning a diploma), High school or equivalent (including those with a GED or high school diploma), Some college, Associate degree (covering both occupational/technical and academic programs), Bachelor’s degree, and Graduate degree (including master’s, professional, or doctoral degrees). This categorization was included to account for the potential influence of educational attainment on smoking behavior.

Statistical Analysis

The Zero-Inflated Poisson (ZIP) and Zero-Inflated Negative Binomial (ZINB) regressions were applied to count data, particularly suited for handling the large proportion of zeros and overdispersion in the number of cigarettes smoked per day. These models were selected to account for both smokers and non-smokers in the dataset effectively. ZIP and ZINB models allow for the simultaneous estimation of two processes: the likelihood of being a non-smoker (zero-inflation component) and the number of cigarettes smoked by smokers (count component), making them ideal for datasets with excess zeros.[26]

The parametric components of the model included respondents’ urgent care visits, sex, coronary heart disease (CHD), health insurance coverage, and highest educational level. These components were selected based on their potential associations with smoking behavior. To evaluate model fit in the presence of potential overdispersion, this study estimated both ZIP and ZINB models and compared their fit statistics to determine which specification provided a better fit to the data. The goodness-of-fit for both models was evaluated using the Akaike Information Criterion (AIC), where lower values indicate a better fit. These models provide a nuanced understanding of the association between healthcare utilization, demographic characteristics, and smoking behavior.

All analyses were conducted using R software 4.4.1, with statistical significance set at $P < 0.05$.

Model Estimation

This study utilized ZIP and ZINB regression models to understand the association between urgent care visits and daily smoking patterns while considering excess zeros in the dependent variable. The ZIP and ZINB models are well-suited for count data in cases where a substantial portion of observations have a value of zero (non-smokers), while the remaining observations follow a count distribution (smokers). These models are particularly useful for examining, within a single framework, both the factors associated with the likelihood of smoking and the factors associated with the intensity of smoking among smokers. The ZIP model is specified as follows:

$$\log\left(E\left[Y_i|X_i\right]\right) = X_i^T\beta + \in_i$$

Where Y_i represents the number of cigarettes smoked by individual i, and X_i represents a vector of independent variables, including urgent care visits, age, sex, CHD, health insurance coverage, and educational level. The model is extended to account for the excess zeroes through a logistic regression component that models the probability of being a non-smoker, while the count component models the number of cigarettes smoked among smokers.

In cases of overdispersion, where the variance exceeds the mean, the ZINB model offers a more flexible alternative by introducing a dispersion parameter θ to model the variability in cigarette consumption. The ZINB model extends the ZIP model by incorporating an additional parameter to account for overdispersion, defined as:

$$\log\left(E\left[Y_i|X_i\right]\right) = X_i^T\beta + \theta + \in_i$$

Here, the ZINB model adjusts for the greater variability seen in the data, improving the fit when the number of cigarettes smoked varies significantly among smokers.
The log-likelihood for the ZIP model is given by:

$$\log L_i = \sum\nolimits_{i=1}^{n}[y_i \log\lambda_i - \lambda_i - log\left(y_i!\right)]$$

where λ_i is the expected count of cigarettes smoked by an individual i. The zero-inflation component is modeled separately as:

$$\log\left(\pi_i\right) = Z_i^T\gamma$$

where π_i is the probability that an individual i is a non-smoker, and Z_i represents a set of covariates similar to those in the count component.

For the ZINB model, the log-likelihood is adjusted to account for overdispersion:

$$\log L_i = \sum\nolimits_{i=1}^{n}[y_i \log\lambda_i - \frac{y_i}{\theta}\log\left(1+\theta\lambda_i\right) - \log\left(y_i!\right)]$$

The dispersion parameter θ captures the extent of overdispersion in cigarette consumption data. Both models were estimated using maximum likelihood estimation (MLE), and model fit was assessed using the Akaike Information Criterion (AIC), with lower values indicating a better fit.

Results

Descriptive Statistics

Demographic characteristics of the selected variables are represented in Table 1. Among 28,122 adults, 8% (n = 2,314) reported smoking and 92% (n = 25,808) did not. The majority were aged 45–84 years (60%), followed by 25–44 years (30%), with only 6.3% aged 18–24 years, and 3.7% aged 85 and above. The sample was 54% female and 46% male. Coronary heart disease was reported by 6.3%, while 94% had no such diagnosis. Participants smoked an average of 1.2 cigarettes per day (SD = 5.1).

Most individuals (69%) did not have any urgent care visits in the past year, while 17% had one visit, and only 1.6% reported five or more visits. Health insurance coverage was high, with 93% of participants insured. Education levels were diverse: 25% had a high school education or equivalent, 23% had a bachelor's degree, 15% had some college, 13% had an associate degree, 15% had a graduate degree, and 8.5% had no formal education.

In terms of the group differences, smokers were more often in the 45–84 year age range (70% vs. 59% among non-smokers) and were rarely 85 years or older (0.3% vs. 4.0% among non-smokers). Lack of health insurance was nearly twice as common among smokers as non-smokers (12% vs. 6.4%). A clear educational gradient was observed where smokers were more likely to have no formal education (16% vs. 7.8%) or only high school (39% vs. 24%), and much less likely to hold a bachelor's (10% vs. 24%) or graduate degree (2.7% vs. 16%). Patterns of urgent care use were broadly similar, although smokers had a slightly higher proportion with five or more visits (2.1% vs. 1.6%).

Besides for the outcome variable the number of cigarettes smoked in a day, the variance (25.76) was larger than the mean (1.2), indicating that this count outcome is overdispersed.

Trends Over Time (2019-2023)

Figure 1 shows trends in current cigarette smoking and urgent care use among U.S. adults from 2019–2023. Smoking prevalence declined from 14.0% in 2019 to 10.8% in 2023, whereas the proportion reporting at least one urgent care visit remained fairly stable through 2021 and increased to around one-third of adults in 2022–2023. Notably, while smoking rates steadily declined, urgent care visits spiked in 2022, potentially reflecting external factors such as changes in healthcare access, shifting health-seeking behaviors, or pandemic-related influences. However, these population-level trends do not reflect individual-level associations. To understand that, in the next section, the study focuses on examining the relationship between urgent care visit frequency and daily cigarette consumption using zero-inflated models using the NHIS 2023 data.

Factors Influencing the Intensity of Smoking Behaviors: Count Part

In Table 2, the study utilized Poisson and Negative Binomial

Table 1. Demographic characteristics of sample adults by daily cigarette smoking status (source: NHIS, 2023)

	Variables	Do not smoke, N = 25,808 (91.8%)[1]	Smoke, N = 2,314 (8.2%)[1]	Overall, N = 28,122[1]
Age	18-24 years old	1,745 (6.8%)	35 (1.5%)	1,780 (6.3%)
	25-44 years old	7,748 (30%)	650 (28%)	8,398 (30%)
	45-84 years old	15,282 (59%)	1,622 (70%)	16,904 (60%)
	85 years and above	1,033 (4.0%)	7 (0.3%)	1,040 (3.7%)
Gender	Female	14,157 (55%)	1,122 (48%)	15,279 (54%)
	Male	11,651 (45%)	1,192 (52%)	12,843 (46%)
Presence of coronary heart disease	Yes	1,595 (6.2%)	171 (7.4%)	1,766 (6.3%)
	No	24,213 (94%)	2,143 (93%)	26,356 (94%)
Number of cigarettes smoked in a day		0.0 (0.0)	14.3 (11.2)	1.2 (5.1)
Number of times of urgent care visit	0 times	17,795 (69%)	1,659 (72%)	19,454 (69%)
	1 times	4,488 (17%)	320 (14%)	4,808 (17%)
	2 times	2,112 (8.2%)	198 (8.6%)	2,310 (8.2%)
	3 times	718 (2.8%)	63 (2.7%)	781 (2.8%)
	4 times	282 (1.1%)	25 (1.1%)	307 (1.1%)
	5 or more times	413 (1.6%)	49 (2.1%)	462 (1.6%)
Health insurance coverage status	Not covered	1,648 (6.4%)	274 (12%)	1,922 (6.8%)
	Covered	24,160 (94%)	2,040 (88%)	26,200 (93%)
Highest education level	No formal education	2,024 (7.8%)	368 (16%)	2,392 (8.5%)
	High school or equivalent	6,223 (24%)	892 (39%)	7,115 (25%)
	Some college	3,748 (15%)	416 (18%)	4,164 (15%)
	Associate degree	3,322 (13%)	337 (15%)	3,659 (13%)
	Bachelor's degree	6,311 (24%)	239 (10%)	6,550 (23%)
	Graduate degree	4,180 (16%)	62 (2.7%)	4,242 (15%)

[1]n (%); Mean (SD)

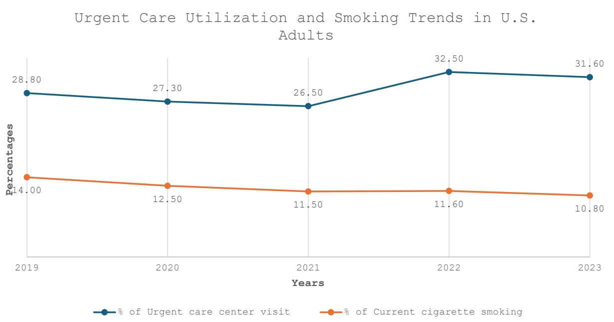

Figure 1. Urgent care utilization and smoking trends among US adults (Source: NHIS 2019-2023)

regression models to investigate factors influencing smoking behavior. The results from both Poisson and Negative binomial models indicated that the number of urgent care visits notably impacts smoking behavior. In particular, as per the ZIP model, individuals reporting one or two urgent care visits exhibited a slight reduction in the frequency of smoking, with more pronounced declines observed for those reporting four visits. Surprisingly, those reporting three visits showed a minimal increase, although this was not statistically significant.

Moreover, gender emerged as a significant factor in ZIP model, with males [coefficient: 0.15; $P < 0.05$] showing an association with smoking higher number of cigarettes per day. However, this association is not significant in ZINB.

Notably, individuals without coronary heart disease and those with health insurance coverage tended to smoke lower number of cigarettes in a day compared to the uninsured, highlighting the potential protective effect of these factors on reducing the number of cigarettes smoked in a day. These insights can guide targeted interventions aimed at optimizing healthcare resource allocation and improving patient outcomes.

Some predictors such as, one urgent-care visit, and gender were statistically significant in the ZIP model but not in the ZINB model. This is expected when counts exhibit overdispersion. Evidence of overdispersion was present in the outcome (mean = 1.2, SD = 5.1; variance ≈ 26.0), with variance greatly exceeding the mean (Var/Mean ≈ 21.7), violating the Poisson equidispersion assumption. As a result, the ZINB produced wider standard errors and more conservative inference for some predictors.

Factors Influencing Non-smoking Behaviors Using Zero-Inflation Models (Poisson and Negative Binomial)

In Table 3, the Poisson and Negative Binomial (NB) Zero-Inflated models highlight key factors influencing non-smoking. For urgent care visits, individuals visiting five or more times had a significantly lower odds of being non-smoker in both models [coefficient: -0.35 (ZIP) and -0.36 (ZINB); $P < 0.05$]. Also, compared with adults with no urgent care visits, those with one visit [coefficient:

Table 2. Comparison of regular count data Poisson and Negative Binomial Models: Factors Influencing Daily Cigarette Consumption (Smokers)

Variable	Poisson Model			Negative Binomial Model		
	β	SE	AOR	β	SE	AOR
Urgent Care Visits						
0 times (ref.)	–	–	–	–	–	–
1 time	-0.05*	0.02	0.97	-0.05	0.04	0.95
2 times	-0.04	0.02	0.96	-0.04	0.05	0.96
3 times	0.04	0.03	1.04	0.04	0.09	1.04
4 times	-0.09	0.06	0.91	-0.10	0.13	1.90
5 or more times	0.001	0.04	1.00	-0.02	0.09	0.99
Age Categories						
18-24 years old (ref.)	–	–	–	–	–	–
25-44 years old	0.04	0.05	1.04	0.01	0.12	1.01
45-84 years old	0.09	0.05	1.10	0.06	0.11	1.07
85 years and above	-0.08	0.12	0.93	-0.08	0.28	0.91
Gender						
Female (ref.)	–	–	–	–	–	–
Male	0.15*	0.01	1.16	0.16	0.03	1.17
Highest education level						
No formal education (ref.)	–	–	–	–	–	–
High school or equivalent	0.02	0.02	0.98	-0.03	0.05	0.97
Some college	-0.04*	0.02	0.96	-0.04	0.05	0.96
Associate degree	-0.03	0.02	0.98	-0.03	0.06	0.97
Bachelor's degree	-0.12	0.02	0.89	-0.12*	0.09	0.88
Graduate degree	-0.18	0.04	0.84	-0.18	0.05	0.84
Coronary Heart Disease						
Yes (ref.)	–	–	–	–	–	–
No	-0.08	0.02	0.93	-0.09	0.05	0.92
Health Insurance Coverage						
Not covered (ref.)			–			–
Covered	-0.03	0.02	0.97	-0.03	0.04	0.97
Log(theta)	--				1.02	

* $P<0.05$
β = Coefficients
SE = Standard Error
AOR = Adjusted Odds Ratio

0.21 (ZIP) and 0.13 (ZINB); $P<0.05$] had slightly higher odds of being non-smokers. Relative to adults aged 18–24 years, adults aged 25–44 [coefficient: -1.45 (ZIP) and -1.80 (ZINB); $P<0.05$] and 45–84 [coefficient: -1.73 (ZIP) and -1.95 (ZINB); $P<0.05$] had much lower odds of being in the non-smoker group, indicating that mid-life and early older adults were more likely to be in the group at risk of smoking. Interestingly, individuals aged 85 and above exhibited higher cigarette consumption.

However, men had lower odds of being non-smokers than women. Compared with adults with no formal education, those with higher education (high school, some college, associate, bachelor's, and especially graduate degrees) had progressively higher odds of being non-smokers. These findings reveal complex interactions between healthcare utilization, demographic characteristics, and smoking intensity.

Model Fitness

Table 4 shows the model fit statistics based on the Akaike information criterion (AIC). The zero-inflated negative binomial (ZINB) model had the lowest AIC value (30858.9), indicating a better fit to the daily cigarette count data than the other models.

Discussion

Overall, our results indicate that the frequency of urgent care visits does not serve as a strong predictor of daily smoking habits among the US adult population. Frequent urgent care users (five or more visits per year) were somewhat more likely to be smokers than non-smokers in the zero-inflated part of the model. However, among smokers, the number of urgent care visits was not clearly related to the likelihood of smoking or the number of cigarettes smoked per day. In contrast, age and education showed much larger associations with smoking status, and

Table 3. Comparison of Zero-Inflated Poisson and Negative Binomial Models: Factors Influencing daily Cigarette Consumption (non-smokers)

Variable	Poisson Model (Zero-Inflation)			Negative Binomial Model (Zero-Inflation)		
	β	SE	AOR	β	SE	AOR
Urgent Care Visits						
0 times (ref.)	–	–	–	–	–	–
1 time	0.21*	0.06	1.14	0.13*	0.06	1.14
2 times	-0.07	0.08	0.86	-0.16	0.08	0.85
3 times	-0.02	0.14	0.87	-0.14	0.14	0.87
4 times	-0.02	0.21	0.97	-0.04	0.21	0.96
5 or more times	-0.35*	0.16	0.70	-0.36*	0.17	0.70
Age Categories						
18-24 years old (ref.)	–	–	–	–	–	–
25-44 years old	-1.45*	0.18	0.16	-1.80*	0.18	0.16
45-84 years old	-1.73*	0.17	0.14	-1.95*	0.17	0.14
85 years and above	0.98*	0.42	2.62	0.98*	0.42	2.61
Gender						
Female (ref.)	–	–	–	–	–	–
Male	-0.22*	0.04	0.80	-0.22*	0.04	0.80
Highest education level						
No formal education (ref.)	–	–	–	–	–	–
High school or equivalent	0.22	0.07	1.24	0.22*	0.07	1.24
Some college	0.44	0.08	1.55	0.44*	0.08	1.55
Associate degree	0.61	0.08	1.84	0.61*	0.08	1.84
Bachelor's degree	1.59	0.09	4.89	1.59*	0.09	4.88
Graduate degree	2.55	0.14	12.75	2.54*	0.14	12.73
Coronary Heart Disease						
Yes (ref.)	–	–	–	–	–	–
No	0.17*	0.09	1.06	0.05	0.09	1.06
Health Insurance Coverage						
Not covered (ref.)	–	–	–	–	–	–
Covered	0.74*	0.07	1.46	0.38*	0.07	1.46

* $P<0.05$
β=Coefficients
SE=Standard Error
AOR=Adjusted Odds Ratio

Table 4. Akaike information criterion (AIC) value comparison for both ZIP and ZINB model

Distribution model	AIC value	Df
Zero-inflated poison Model (ZIP)	39129.5	34
Zero-Inflated Negative Binomial Model (ZINB)	30858.9	35

Df: Degrees of freedom
AIC: Akaike information criterion

gender and education were more important predictors of smoking intensity in the count component. Estimates from the ZIP and ZINB models were similar in direction and magnitude, although the ZINB model provided a better fit to the overdispersed cigarette-count data.

Urgent care settings pose a challenge for tobacco control efforts, as they tend to treat populations with high smoking rates but lack the infrastructure to support lasting cessation. Many patients visit for acute issues unrelated to tobacco use, making it difficult to implement effective smoking cessation initiatives. Many patients who visit urgent care centers smoke, with some estimates showing that up to 48% of them are current smokers in certain U.S. cities, and the reasons they come to urgent care are often not related to issues caused by tobacco.[27] In a multicenter study on patient preferences in urgent care, only 11% of smokers had a smoking-related diagnosis, suggesting that most seek care for issues like trauma or infections, missing chances to address tobacco use.[28] However, Urgent care centers often focus on immediate treatment, which can conflict with the need for long-term counseling that helps people quit smoking. Additionally research explicitly identified competing priorities, time demands, the scope of acute care practice, and a lack of clinician training related to smoking cessation interventions as unique barriers to the incorporation of cessation interventions into routine clinical care.[29] These structural constraints demonstrate that even when providers have the intention to address tobacco use, the clinical environment frequently does not support the provision of meaningful cessation assistance.

The weak association between urgent care visit frequency and daily smoking observed in this study is likely due to the fact that urgent care use is shaped by many factors beyond tobacco use. Prior work has shown that frequent emergency or urgent care visits are driven by poor access to primary care, low income, psychological distress, and chronic illness, rather than any single risk factor.[30,31] Urgent care centers often serve as convenient, short-term access points for acute issues, and many encounters are likely to reflect access issues, injuries, or infections rather than smoking-related illness, which may weaken the observable relationship between visit frequency and daily cigarette consumption.[32,33] Beside this, tobacco screening and cessation support are uneven across health care settings, and that is even lower in emergency and urgent care environments.[34,35] Many healthcare providers feel unprepared to assist their patients in smoking cessation, and a majority of providers do not routinely advise or assist their patients in cessation attempts.[36] Considering these aspects, urgent care encounters may reach some smokers, but they are not yet functioning as systematic points of tobacco intervention in routine practice.

In addition to urgent care visits, demographic factors such as age and sex were found to influence smoking behaviors. Following zero-inflated models results, younger individuals, particularly those aged 18-24, were less likely to smoke more cigarettes daily compared to older age groups. One potential reason can be that older individuals with personal and social stress tend to become addicted to smoking with time.[37] Many older adults started smoking at a younger age when tobacco control policies were weaker, and their long-term dependence on smoking, along with adverse mental and social factors, contributed to the entrenched smoking behavior among older adults.[38–40] Male smokers also demonstrated higher cigarette consumption, consistent with prior research suggesting gender differences in smoking patterns. Smoking remains the single most preventable cause of mortality, and rates among men indicate that at least 35% of men in Western countries and 50% in developing countries continue to smoke.[41] The results align with studies showing that men tend to have higher nicotine dependence and are more resistant to quitting smoking. Moreover, the demographic disparities in smoking behaviors highlight the need for gender- and age-specific cessation programs to address the unique challenges faced by different population groups while developing interventions.[42]

Furthermore, this study found a strong association between education level and daily smoking intensity. Individuals with graduate degrees were less likely to smoke than those with lower educational levels, which supports some prior research indicating that higher education is often linked with lower smoking rates.[43] Smokers with higher education levels might recognize the importance of quitting tobacco and negative health outcomes caused by tobacco consumption better than those with lower levels of education.[44] This relationship occurs due to several factors, such as a higher level of education influencing how individuals think and make decisions on tobacco consumption.[45] Further investigation into the structural and social factors underlying the increase in daily smoking patterns is necessary to better understand the underlying causes and identify possible stressors.

Limitations

The study found effective relationships between daily cigarette consumption and urgent care visits. Due to the study's cross-sectional design, it was not feasible to establish causality. The study relies on self-reported data for daily cigarette consumption and urgent care visits, thus potentially introducing recall bias. Respondents may underreport their smoking habits or the number of urgent care visits, potentially affecting the accuracy of the findings. This study could not distinguish the specific reasons for urgent care visits, because NHIS only captures self-reported use for any cause rather than smoking-related problems, which may dilute the observed relationship between urgent care use and daily cigarette consumption. Furthermore, we did not account for the impact of subjective norms, including social expectations and stigma, on daily smoking habits or the decision to seek support from urgent care. This limited the understanding of how societal pressures might affect daily smoking and healthcare utilization patterns.

Conclusion

This study suggests that, among U.S. adults, how often people use urgent care is only weakly related to whether they smoke or how many cigarettes they smoke per day. On the other hand, age, gender, and education are much stronger drivers of smoking behavior. For public health practice, urgent care on its own is not a reliable strategy to find most smokers, although it is still an important point of contact to offer brief cessation advice and referrals to those who do smoke. To increase effectiveness, urgent care centers could integrate standardized, brief smoking cessation interventions into their regular clinical procedures by adopting universal tobacco screening, providing succinct evidence-based counseling during appointments, and facilitating prompt referrals to quit lines and behavioral support services. Strong tobacco control will still require broad, population-level approaches such as higher tobacco taxes, smoke-free policies, media campaigns, and targeted support in low-education and low-income communities, along with routine tobacco screening and cessation support across many health care settings, including, but not limited to, urgent care.

Authors' Contribution

Conceptualization: Shafeel Umam; Rubaiya Binte Razzak
Data Curation: Shafeel Umam
Formal Analysis: Shafeel Umam
Investigation: Shafeel Umam; Rubaiya Binte Razzak
Methodology: Shafeel Umam; Rubaiya Binte Razzak
Project Administration: Rubaiya Binte Razzak
Software: Shafeel Umam

Visualization: Rubaiya Binte Razzak
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Competing Interests

The authors have no competing interests to declare.

Data Availability Statement

The data supporting the findings of this study are openly accessible in the CDC NHIS 2023 database at: https://www.cdc.gov/nchs/nhis/documentation/2023-nhis.html

Ethical Approval

The National Center for Health Statistics (NCHS) Research Ethics Review Board (ERB) reviewed and approved the NHIS survey content and methods to ensure the protection of study participants' data. All NHIS respondents provided consent prior to participation. All information in the publicly accessible dataset is completely anonymized before its release. All authors declare they have no competing interests.

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