



HHS Public Access

Author manuscript

Cancer Epidemiol Biomarkers Prev. Author manuscript; available in PMC 2018 February 01.

Published in final edited form as:

Cancer Epidemiol Biomarkers Prev. 2017 February ; 26(2): 228–239. doi:
10.1158/1055-9965.EPI-16-0028.

Determinants of Light and Intermittent Smoking in the U.S.: Results from Three Pooled National Health Surveys

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Abstract

Background—Light and/or intermittent smokers have been the fastest growing segment of cigarette smokers in the U.S. over the past two decades. Defining their behavioral characteristics is a critical public health priority.

Materials and Methods—Our sample included 78,229 U.S. adults from three pooled contemporary population-based surveys: the 2012 NHIS, 2012 NSDUH, and 2011-2012 NHANES. We classified current smokers into four categories (light and intermittent [LITS], light-daily, heavier-intermittent and heavier-daily) and assessed smoking behaviors, illicit drug use, and mental health indicators using weighted analyses.

Results—Analyses associated smoking categories with nicotine dependence, age of smoking initiation, race/ethnicity and other demographic and behavioral factors. Compared to heavier-daily smokers, smokers who were LITS were most likely to have mild or no nicotine dependence (weighted odds ratio [OR] = 16.92, 95% confidence interval [CI] 13.10-21.85), to start smoking cigarettes regularly after age 21 (OR = 3.42, 95% CI 2.84-4.12), and to be Hispanic (OR = 5.38, 95% CI 4.38-6.61). Additional significant results were found for other categories of smokers.

Conclusion—Based on pooled data from three large national surveys, light and/or intermittent smokers differed in smoking, drug use and mental health behaviors from heavier-daily, former and

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Disclosure of Potential Conflicts of Interest
No potential conflicts of interest.

Financial Support

This study was supported by the Intramural Research Program in the Division of Cancer Epidemiology and Genetics at the National Cancer Institute.

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never smokers. Notable differences by level of smoking frequency and intensity were observed for nicotine dependence, age of smoking initiation and race/ethnicity.

Impact—Our results may help focus preventive measures and policies for the growing number of light and/or intermittent smokers in the U.S. because smoking patterns vary by behavioral and socioeconomic factors.

Introduction

Light smokers [≤ 10 cigarettes per day (CPD)] and intermittent smokers (non-daily smokers, regardless of CPD) account for an increasing proportion of U.S. smokers. In contrast, the number of regular daily smokers has consistently declined over the last two decades, and is presently estimated to be 15.0% of the entire adult U.S. population (1). According to national surveys, the proportion of light smokers increased from 16.4% in 2005 to 26.9% (of current daily smokers) in 2014 (2, 3). Previous studies have measured a parallel trend in the prevalence of intermittent smoking which has ranged from 20% to 40% of all current smokers (4-8). Although diverse definitions and terms have been used to describe this phenomenon (9-19), by all definitions, light and/or intermittent smoking represents an expanding proportion of smokers. Additionally, prior studies have been limited in size, so that sociodemographic patterns of light and/or intermittent smokers remain to be fully characterized.

Previous research has generally reported that light and/or intermittent smokers tend to smoke their first cigarette later in the day, and have lower Fagerström scores (test for nicotine dependence) compared to heavier smokers, both of which reflect lower nicotine dependence. They also tend to be women, younger, members of minority races/ethnicities, and have higher educational status and income level compared to regular daily smokers. These smokers are also more likely to pay attention to health information and report being more socially active. Yet, they are not solely social smokers because they report smoking for enjoyment or positive reinforcement (pleasant or relaxing activities), but also negative reinforcement (stress reduction) (15, 16, 18, 20-24).

Regular smoking has been associated with mental illness, and a larger proportion of adults with mental illness are current smokers compared to adults without it (25). In addition, a significant body of empirical work has shown a bi-directional relationship between smoking and mental illness (26-30). Although the relationship remains complex, individuals with depression may encounter difficulty quitting because of nicotine's role as a reinforcing neurotransmitter (31, 32). However, the relationship between smoking and mental illness has not been well-studied among light and/or intermittent smokers where nicotine dependence is less severe. Regular smoking has also been associated with increased use of illicit drugs, particularly in adolescents (33). Similar to mental illness, there has not been any prior evaluation of this relationship among light and/or intermittent smokers.

Using pooled data of U.S. adult smokers and nonsmokers from three nationally representative surveys, the goals were to: 1) estimate the prevalence of smoking, illicit drug use and other behavioral patterns in light and/or intermittent smokers, former smokers and never smokers; 2) examine the associations of demographic and socioeconomic factors,

smoking behaviors, depression/anxiety and illicit drug use with light and/or intermittent smoking; and 3) evaluate selected interactions of gender and race/ethnicity with smoking, illicit drug use and mental health behaviors.

Materials and Methods

Participants and Procedure

We pooled data from three recent representative surveys of the U.S. population. The eligible population for each survey included all non-institutionalized civilian U.S. residents, excluding patients in long-term care facilities, active duty military personnel, incarcerated persons, and U.S. nationals living abroad.

2012 National Health Interview Survey (NHIS)

The NHIS is a cross-sectional survey mainly using an in-person interviewer-administered household survey (34, 35). Core questions remain similar from year to year, while supplemental questions/modules vary. For the 2012 survey, the sampling plan consisted of 428 primary sampling units (PSUs) from approximately 1,900 geographically defined PSUs across the 50 states and the District of Columbia (34). Asian, African American, and Hispanic individuals were oversampled.

We used the Person-level and Adult Sample files from this survey comprised of 108,131 persons (80,115 adults) and 34,525 adults, respectively (36). The response rate for the Adult file was 79.7% (37). The Person-level file includes data from the core NHIS questions and we extracted sociodemographic and sampling design-related variables for adults aged 18 years old. The Adult Sample file contains data from more detailed ancillary questions, including sociodemographic and health behaviors (e.g. smoking) (1, 38, 39). The respondents in the Adult Sample are a subset of the Person-level file.

2011-2012 National Health and Nutrition Examination Survey (NHANES)

The NHANES assesses the health and nutritional status of U.S. adults and children and includes both interviews and physical examinations. The interview contains core questions on sociodemographics and supplemental questions on dietary and health-related issues, including questions on smoking, alcohol and drug use (40).

NHANES uses a complex survey design, also utilizing PSUs, which are generally single counties, sometimes combined to meet a minimum population size (41). Each year, approximately 15 counties are visited across the country. Hispanic and African American individuals and older populations are oversampled. The 2011-2012 NHANES included 9,756 persons in the Interviewed sample and 9,338 persons in the Examined sample, with response rates of 72.6% and 69.5, respectively (42). The combined adult (18 years old) sample contained 5,864 persons.

2012 National Survey on Drug Use and Health (NSDUH)

The NSDUH involves in-person interviews consisting of a core set of questions and additional supplemental questions (43). The NSDUH follows a two-stage sampling design.

For the first stage, states are stratified into 900 Sampling Regions using census tracts, within contiguous geographic areas. The second stage sampling combines adjacent census blocks within sampled census tracts. Persons aged 12–25 years are oversampled during the second stage sampling. For the 2012 survey, there were 68,309 persons in the sample and the response rate was 73.0% (44). We extracted an adult (>18 years old) sample which included 37,840 respondents.

Measures—Given that cigarette use questions differed slightly by survey, we harmonized the definitions of light and/or intermittent smokers based on the following: 1) smoked 100+ cigarettes in lifetime; 2) smoked every day or some days during the past month; and 3) average number of CPD smoked in the past month (Figure 1). We defined light smoking as ≤ 10 CPD, and intermittent smoking as nondaily use [i.e. “some days” (NHIS and NHANES) or <30 days during the past month (NSDUH)]. We combined these two factors to create four mutually exclusive categories, including merging the light and intermittent smokers (LITS) (Supplemental Figure 1).

Nicotine dependence was assessed according to “time to first cigarette after waking up (TTFC)”, a validated measure (45) in the NHANES and NSDUH surveys. Current use of other tobacco products includes cigars, snuff, chew or smokeless tobacco in NSDUH and “tobacco products other than cigarettes” in NHIS.

Questions for depression and anxiety varied slightly across surveys. The NHIS asked respondents if they had depression or were frequently anxious in the past 12 months. The NSDUH asked respondents if they were, in the past 12 months, told by a doctor that they suffered from depression or anxiety. We created a composite variable based on the presence of either symptom. For illicit drug use, we define “current” as use in the past 30 days and “former” as reporting the most recent use >30 days ago. For the analysis, we constructed a composite variable “use of any illicit drug” based on the use of marijuana, cocaine, or other drug included in the survey(s). NHIS and NHANES both reported the number of hours of sleep as a continuous measure.

Statistical Analysis—We pooled the three surveys and re-standardized the non-response adjusted weight W_{ij}^* for person j in survey i by multiplying W_{ij} by the sample size (N_i) of the i th survey, and dividing that number by the total sample size ($\sum N_i$) of all three surveys to obtain a new weight, $W_{ij}^* = (W_{ij}N_i) / \sum N_i$. This re-standardization ensures that results based on the combined surveys reflect the overall U.S. population. We first assessed patterns of sociodemographic and behavioral characteristics of light and/or intermittent smokers in the pooled data, and used Chi-square and associated p-values for significance testing.

We used multiple imputation (MI) to impute missing values for variables with up to 40% missing data using IVEware (46), and analyzed the $M=5$ imputed datasets, accounting for the random imputation in the variance computation using PROC MIANALYZE (SAS) (47). We restricted imputation to variables with no more than 40% missing values and used a “missing” indicator in the analyses for variables with more missingness; all variables for which we imputed values had $<15\%$ missing data. We did not impute missing values for concurrent use of other tobacco (OT) products (68.0% missing data), depression within the

past year (41.6% missing data), and income level due to the differing wording of the question (NHIS and NSDUH). We observed no substantial differences in our findings when we excluded individuals with missing values in a sensitivity analysis.

To examine associations of smoking status with smoking behaviors, illicit drug use, and mental health indicators, we fitted two weighted polytomous logistic regression models to the data. Each model included sociodemographic (gender, race/ethnicity, marital status, education, annual income, age group) and smoking behavior (quit attempts, use of other types of tobacco, age of smoking initiation, TTFC) covariates, and either a drug use or a mental health composite variable. For comparison, we fitted similar models using either of the composite variables, minimally adjusted for sociodemographic predictors, excluding smoking behaviors. The four levels of the response variable Y were: light (< 10 CPD) intermittent use ($Y = 1$); light-daily use ($Y = 2$); heavier (>10 CPD) intermittent use ($Y = 3$); and heavier-daily use, denoted ($Y = 0$). For a particular exposure X , the model was:

$$P(Y = K) = \frac{e^{\beta_K X}}{1 + \sum_{i=1}^3 e^{\beta_i X}},$$

where β_K denoted the log-odds ratio for $Y = K$ (where K represented one of the three smoking response levels) compared to $Y = 0$ (the referent), with $\beta_0 = 0$ for identifiability.

We conducted analyses using SAS 9.4 (48) and SUDAAN 11.0 (49), and all analyses incorporated re-standardized sampling weights (described above) and survey design variables (PSU and strata) to account for the complex study design and sampling, to correct for non-response, to produce accurate standard errors of parameter estimates, and to weight results to represent the adult U.S. population.

We obtained odds ratios (ORs) and corresponding 95% confidence intervals (95% CI) from weighted polytomous regression models. Using heavier-daily smokers as the referent group, ORs are interpretable as comparisons of a selected outcome group relative to heavier-daily smokers, the control group (e.g. LITS relative to heavier-daily smokers, light-daily smokers relative to heavier-daily smokers, etc.). We tested for homogeneity of ORs across outcome categories using a Wald-type test. Finally, we stratified analyses by gender and race/ethnicity and systematically tested for interactions in the unstratified model. For the interaction analysis, we excluded the “Other” race category (due to the heterogeneous nature of this group).

Results

Participants

The pooled analytic sample contained 78,229 individuals, representing the nearly 235 million adults (> 18 years old) in the current non-institutionalized U.S. population (Supplemental Table 1). There were only 777 respondents with missing smoking status information, so our usable sample contained 77,452 respondents.

Women (51.9%), non-Hispanic (NH)-Whites (66.8%), married individuals (58.0%), those educated with at least some college education (58.6%), those with an annual income of \$50,000 (36.4%), aged 35 to 64 years old (51.9%) and living in the southern region of the U.S. (36.4%) constituted the majority or largest stratum of adults (Table 1).

In the adult U.S. population, there were 22.2% current cigarette smokers, 18.0% former smokers and 59.8% never smokers (Figure 2). Among current smokers, prevalences were 28.2% LITS, 24.9% light-daily, 1.7% heavier-intermittent, and 45.2% heavier-daily.

Light smokers were more likely to try to quit compared to those who did not try, regardless of whether they were intermittent (25.1% vs. 15.5%, respectively) or daily (40.5% vs. 33.6%) smokers (Figure 3a and Supplemental Table 2). Current smokers who concurrently used other forms of tobacco compared to those who did not use them were more likely either LITS (29.6%) or light-daily smokers (24.8%). LITS showed a clear trend towards a later age at smoking initiation (age >21, 32.4%), in contrast to heavier-daily smokers who comprised the largest proportion of current smokers with an early age of initiation, <18 years old (55.7%). Menthol users compared to non-users were more likely lighter smokers, 33.9% vs. 27.4% for LITS and 17.9% vs 13.4% for light-daily smokers. As TTFC increased (corresponding to decreasing nicotine dependence), the proportions of LITS and light-daily smokers increased, whereas those of heavier smokers decreased. LITS were much more likely to fall in the lowest nicotine dependence group (TTFC >60 minutes), 61.6%, in sharp contrast to heavier-daily smokers, where almost three quarters smoked within 5 minutes of waking (highest dependence).

Current, compared to former marijuana or cocaine users, and older (>18 years old) compared to younger first time marijuana or cocaine users, were more likely to be LITS or light-daily cigarette smokers (Figure 3b and Supplemental Table 2). A larger proportion of those who slept 7–8 hours per night compared to <7 or >8 hours of sleep were LITS (22.0%); LITS and light-daily smokers were also less likely to be <7 hour sleepers than heavier-daily smokers. Among light smokers, a larger proportion of daily smokers reported depression or anxiety in the past year.

Modeling

Results from two polytomous logistic regression models including: (i) demographic and socioeconomic predictors; (ii) smoking behaviors; and (iii) either depression/anxiety or any illicit drug use, are presented in Table 2 as associations of LITS, light-daily and heavier-intermittent smoking (each relative to heavier-daily smoking). We summarized the three sets of binomial comparisons below.

LITS vs. Heavier-Daily Smokers

LITS were most likely to be Hispanic (OR = 5.38, 95% CI 4.38–6.61), to have a college degree (OR = 1.95, 95% CI 1.60–2.38), and to be 18–25 years old (OR = 2.85, 95% CI 2.42–3.36) relative to heavier-daily smokers.

Smokers who reported a past year quit attempt were nearly twice as likely to be LITS. Smokers who were concurrent OT users were at over 50% higher risk of being LITS.

Smokers who started smoking at >21 years old were almost 3.5 times more likely to be LITS, whereas smokers who were the least nicotine dependent (TTFC >60 minutes) were nearly 17 times more likely to be LITS. In contrast, those who reported being depressed or anxious in the past year, or using illicit drugs in the past month, were at reduced risk (28% and 22%, respectively) of being LITS.

Light-Daily vs. Heavier-Daily Smokers

The highest risks for light-daily smoking were similar to LITS (but with lower OR estimates) for these predictors: Hispanics, younger age groups, smokers who attempted to quit smoking, and who reported an older age of smoking initiation and the lowest nicotine dependence (TTFC). Additionally, we observed increased odds of light-daily smoking among Non-Hispanic (NH)-African Americans. Women and married smokers also showed slightly elevated odds of light-daily smoking, 52% and 14%, respectively. Smokers who reported depression or anxiety (22%) or using illicit drugs (34% for current and 31% for former users) were at reduced risk of being light-daily smokers.

Heavier-Intermittent Smokers vs. Heavier-Daily Smokers

Persons aged 50–64 years were at 74% increased odds of heavier-intermittent smoking. Additionally, heavier-intermittent smokers were at least twice as likely as heavier-daily smokers to have tried quitting in the past year, to concurrently use another type of tobacco product, to start cigarette smoking later in life, and to be less nicotine dependent (TTFC 31–60 minutes).

Using a test of homogeneity, we found statistically significant differences across outcome categories for age group, ($p = 0.021$ for age 18–25, $p = 0.015$ for age 26–34, $p = 0.013$ for age 50–64), gender ($p = <0.001$), race/ethnicity ($p = <0.001$ for NH-African Americans, $p = <0.001$ for Hispanics), education >college ($p = <0.001$), age at smoking initiation ($p = 0.001$ for age 18–21, $p = 0.002$ for age >21), quit attempt ($p = 0.030$), concurrent OT use ($p = 0.006$), and TTFC >60 minutes ($p = <0.001$) (Supplemental Table 3).

We also fit separate polytomous logistic regression models using each composite illicit drug use or depression/anxiety variable, separately, minimally adjusted for the six sociodemographic predictors in Table 2 (smoking behaviors not included). We obtained similar results as for the fully adjusted models (Table 2), except that in the minimally adjusted models, risk estimates for depression/anxiety and *current* use of any illicit drugs were not statistically significant (at $p < 0.05$) among light-daily smokers, whereas *former* use of any illicit drugs was statistically significant among LITS (Supplemental Table 4).

We tested for interactions of gender and race/ethnicity with smoking behaviors, and either depression/anxiety or illicit drug use in separate models, and found few but notable differences (Supplemental Table 5). Relative to heavier-daily smokers, we observed these significant interactions: 1) Women OT users were less likely to be LITS than men OT users (40% for the model with depression/anxiety and 41% for the model with illicit drug use); 2) Hispanic OT users were at 59% and 60% (respectively for each model) reduced odds of light-daily smoking compared to NH-Whites; and 3) Hispanic depressed/anxious individuals had 45% reduced odds of light-daily smoking compared to NH-Whites.

Discussion

Our analysis using data from nearly 80,000 individuals from three U.S. population-based surveys identified several key characteristics of light and/or intermittent smoking. We found strikingly lower nicotine dependence among both LITS and light-daily smokers compared to heavier-daily smokers, although LITS were less nicotine dependent than light-daily smokers. This finding could also explain why LITS, compared to other smoking groups, were less likely to sleep <7 hours per night. Their lower nicotine dependence could result in fewer sleep interruptions from waking up during the night to smoke (50-53). Our results also showed that heavier-intermittent users were moderately nicotine dependent in spite of their nondaily use. Importantly, although the three groups of light and/or intermittent smokers were less nicotine dependent than heavier-daily smokers, they still comprise about one quarter of smokers with the highest nicotine dependence (TTFC 5 minutes). Therefore, given the associations of nicotine dependency with high risk for cancer (45, 54) and other adverse health outcomes (55-57), this can explain why a subgroup of light smokers are at high risk in spite of nominally lower smoking measures. The lower nicotine dependency in LITS suggests that different cessation strategies may optimally assist these smokers in quitting.

Among the racial/ethnic groups, LITS were most prominently of Hispanic ethnicity, while African Americans were more likely to be light-daily smokers. Our results are supported by other research showing intermittent smokers were more likely to be of minority ethnicities, especially Hispanic, and that Hispanics had the largest proportion of both intermittent and very light smokers (1–5 CPD) (35.7% and 18.9%, respectively), compared to all other racial/ethnic groups (21, 22, 58). Our study likewise confirms other research identifying that younger age groups and those with a higher education were more likely to smoke on a light and intermittent basis (58-62).

LITS were found to start smoking at an older age, mirroring prior research on adolescent intermittent smokers (63). This suggests that public health approaches such as increasing the minimum legal age of purchasing tobacco products to 21 years old (as recently implemented in several U.S. states (64)), could potentially prevent or delay the initiation of tobacco use by adolescents and young adults (65) and further contribute to reducing smoking-related morbidity and mortality. Longitudinal studies are needed to expand these findings; nevertheless, our results are an important step in demonstrating the influence of age of smoking initiation on smoking frequency and intensity.

We explored the relationship of depression, anxiety and illicit drug use among LITS and light-daily smokers. Interestingly, and in contrast to heavier-daily smokers, LITS and light-daily smoking were moderately (22%–34%) less likely to have depression or anxiety, or to use illicit drugs (current or former). Notably, among light smokers, the risk estimate for depression or anxiety was slightly higher among daily smokers than among LITS. This finding is consistent with a relationship between mental health behaviors and a need to smoke on a daily basis as a coping mechanism, supporting the hypothesis that having a mental disorder may contribute to the risk of smoking (to self-mitigate symptoms) and in turn increase the risk of progression to nicotine dependence (30). Our finding is also

concordant with observations that depression predicted continued smoking over time, although continued smoking did not predict depression. As such, depression may manifest as a symptom of nicotine withdrawal (66) and thereby be a further barrier to quitting smoking (67). The frequency of cigarette smoking and depression has also been associated with the frequency of marijuana use (68), but we could not estimate the independent effects of all three factors in our data, possibly due to multicollinearity. However, similar to the study by Crane et al. (2015), we found that the current or former use of any illicit drug (marijuana included) was higher in heavier-daily smokers.

Compared to heavier-daily smokers, LITS were nearly twice as likely to have attempted quitting smoking in the past year. This could be explained by the greater internal locus of control (the person believing they control their behaviors) (20) and fewer signs of nicotine dependence observed in LITS, as well as the greater attentiveness by LITS to health information in the media (22). Alternatively, it is also possible that smokers who attempt to quit may be more likely to reduce their smoking frequency or CPD, and are therefore classified as LITS. In accord with others, we also showed that heavier-intermittent smokers consistently tried to quit smoking (69, 70). These smokers may experience more difficulty than LITS in quitting smoking due to their greater addiction to nicotine, as documented in our findings.

Other studies have suggested that light/intermittent smoking behavior is more likely influenced by stimulus control (i.e., exposure to smoking cues), and concurrent other tobacco and alcohol use compared to heavy-daily smokers (71, 72). We verified that use of tobacco other than cigarettes was higher among heavier-intermittent smokers than among LITS. The ability of intermittent smokers to self-medicate concurrently with other forms of tobacco could slow their transitioning to daily use. Additionally, in agreement with other research which found an association of increased alcohol consumption among light or intermittent smokers (71), we detected an increase in the risk of light-daily smoking among heavy drinkers (results not shown). However, the lack of association among LITS could relate to our alcohol measure that focused on heavy alcohol drinking and not binge drinking. Nevertheless, our observation supports that light and/or intermittent smokers concurrently use other substances such as alcohol to make their smoking experience more pleasurable, as occurs in a social setting (71).

We note some limitations in evaluating these results. First, the relationships between marijuana use, cigarette use, and depression or anxiety are based on cross-sectional data, so follow-up in longitudinal studies such as the Population Assessment of Tobacco and Health (PATH), as they become available, will be of great interest to confirm and extend these observations. Selection bias could also play a role, as non-responders of health surveys are more likely to suffer from psychiatric conditions (73) and persons with mental health problems engage in higher tobacco consumption (74), which may lead to an underestimate of the association between smoking and mental health behaviors. Yet, these surveys are adjusted for non-response so this bias should be minimal.

In addition, we used “missing” indicators for two variables (past year depression and OT) with large (>40%) amounts of missing values, which could have biased these particular

estimates. In spite of the large sample size, power was limited for examining subsets of the population. Variability in the sample size of each survey could potentially create differences in the characteristics of the pooled sample (NSDUH had nearly 38,000 respondents and NHANES less than 6,000). Finally, slight discrepancies in the wording of some of the questions across surveys, such as intermittent smoking, income level and the composite variables for any illicit drug use and depression/anxiety, may increase variations in prevalence estimates or may be measuring characteristics differently.

There are several notable strengths to our study. The pooled data included nearly 80,000 participants, while the survey methodology makes findings representative of all non-institutionalized U.S. adults. In addition, our results help to clarify the characteristics of light and/or intermittent smoking in the U.S. This group of smokers is large, comprising 54.8% of all current smokers, representing over 24 million U.S. adults. These smokers are more likely to be Hispanic, start smoking at a later age and are much less nicotine dependent compared to heavier-daily smokers.

Our findings suggest greater education efforts targeted towards particular smoking subgroups, for example, based on evidence that only two thirds and one third of adolescents believe light smoking and intermittent smoking is very harmful (75). Importantly, light smokers face an additional challenges because their lower smoking intensity has not translated into greater success in quitting smoking (66). Thus, randomized trials of smoking cessation therapies focused on light and/or intermittent smokers would help develop relevant knowledge for clinical implementation among these smokers (76). Our findings that smokers who started smoking after age 21 were >3 times more likely to be LITS, lends strong support to increasing the minimum legal age of purchasing tobacco products to 21 years old, a strategy already implemented by one state (Hawaii), and over 90 localities in eight states, including New York City (77). Further, the increased prevalence of smoking among smokers with depression (78-80) warrants additional emphasis on providing these smokers with behavioral tools to achieve permanent cessation and prevent co-morbidities such as substance use.

In summary, we have provided the largest and most comprehensive description to date of the phenomenon of light and/or intermittent smoking in the U.S. and highlighted important differences among smokers with varying levels of smoking frequency and intensity. Some noteworthy findings were the compelling differences in nicotine dependence and age at smoking initiation observed in LITS, light-daily and heavier-intermittent smokers, the role of race/ethnicity among LITS and light-daily smokers, as well as the association with concomitant use of other substances and mental disorders in these smokers. Our work contributes to a better understanding of the heterogeneity of behaviors in this group of smokers, to develop more targeted interventions in the areas ranging from smoking prevention to cessation, mental health and substance abuse. A remaining challenge is to reach out to light and/or intermittent smokers who do not classify themselves as traditional smokers and who are unmotivated or resistant to quit smoking, or are unaware of the health risk of even small amounts of smoking. Further research is needed to assess those risks and to craft strategies to engage, educate, and encourage this unique group of smokers to attempt cessation and achieve abstinence.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

The authors would like to thank Drs. Sholom Wacholder (deceased), Andrew Bergen, Michele Bloch, Stephanie Land, Gordon Willis and Fangyi Gu, for their guidance and helpful comments on earlier versions of this manuscript.

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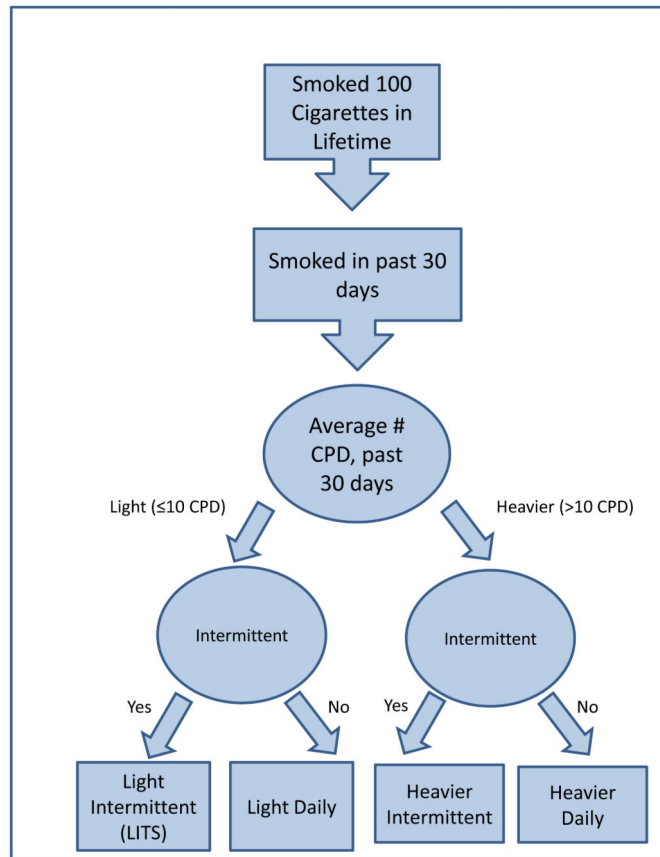


Figure 1.

Definition of Light and/or Intermittent Current Smoking

This diagram represents the questions used in the 2012 National Health Interview Survey, 2011-2012 National Health and Nutrition Examination Survey, and 2012 National Survey on Drug Use and Health to define light and intermittent current smoking.

CPD = Cigarettes per day.

Intermittent = non-daily.

LITS = smokers who are both light and intermittent.

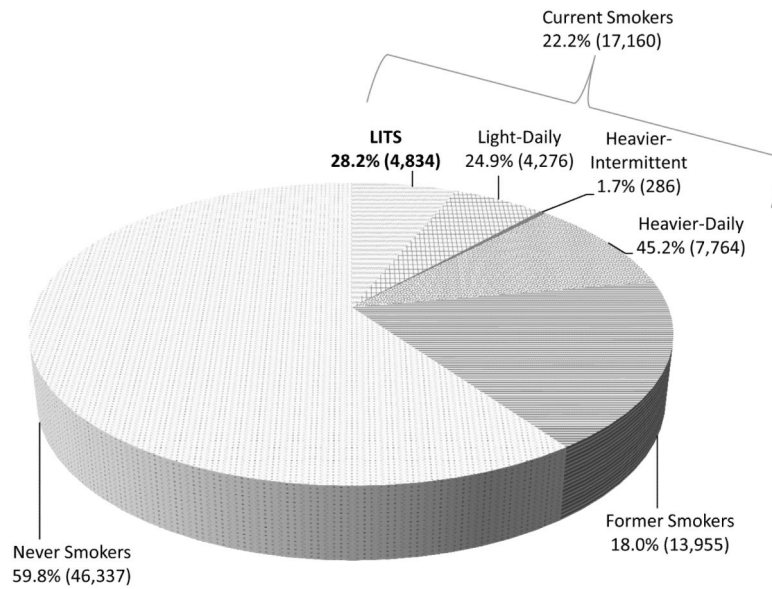


Figure 2. Distribution of Light and/or Intermittent Smokers, United States, 2012
Percentages of current, former and never smokers in the United States. Current smokers are presented as light and intermittent (LITS), light-daily, heavier-intermittent, and heavier-daily smokers. Pooled data from the 2012 National Health Interview Survey, 2011-2012 National Health and Nutrition Examination Survey, and 2012 National Survey on Drug Use and Health.

Intermittent = non-daily.

LITS = smokers who are both light and intermittent.

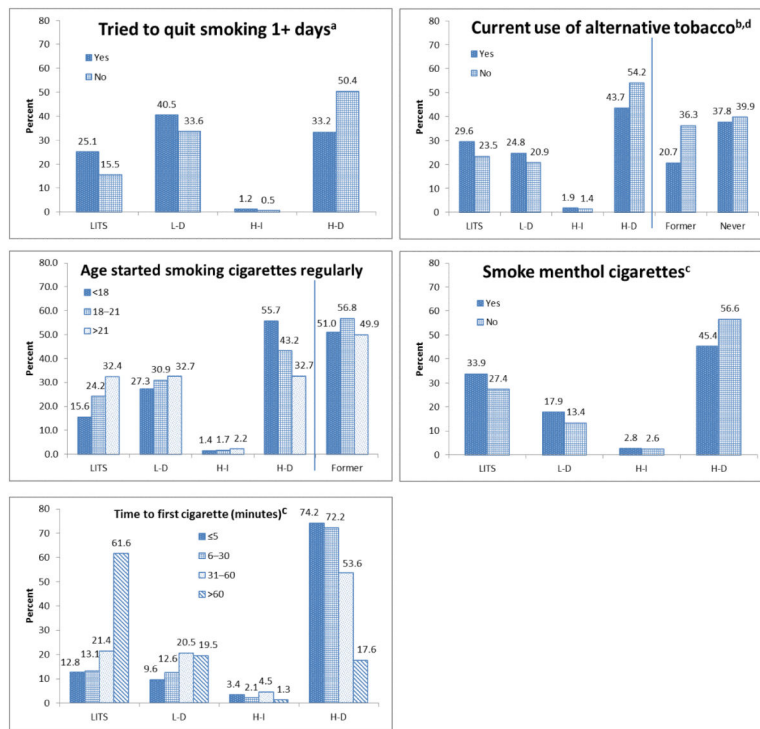


Figure 3a.

Weighted Percentages of Smoking Characteristics for Current Light/Heavier and Intermittent/Daily, Former and Never Cigarette Smokers. Pooled Data from the 2012 National Health Interview Survey (NHIS), 2012 National Survey on Drug Use and Health (NSDUH) and 2011–2012 National Health and Nutrition Examination Survey (NHANES)

Note: LITS = light (=10 CPD) and intermittent smoker, L-D = light-daily smoker, H-I = heavier (>10 CPD)–intermittent smoker, H-D = heavier-daily smoker.

Percentages displayed are weighted. Percentages for categories within current smokers (LITS, L-D, H-I, H-D) sum to 100% and percentages for total current, former and never smokers sum to 100% (not shown).

For each smoking behavior, differences among smoking groups were statistically significant at $p < 0.05$ (Chi-sq test).

^a NHIS & NHANES data only.

^b NHIS & NSDUH data only.

^c NSDUH & NHANES data only.

^d Cigar, snuff, chew, smokeless tobacco.

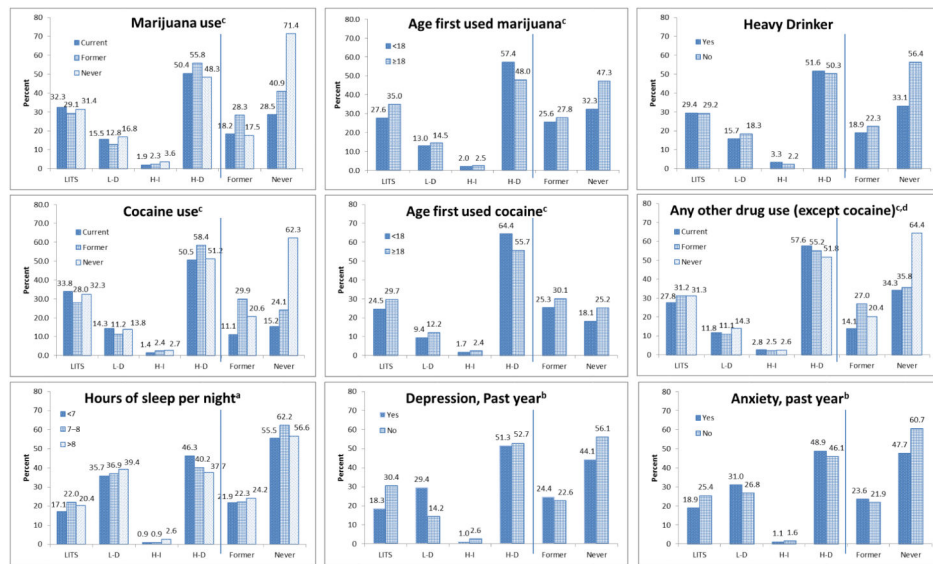


Figure 3b. Weighted Percentages of Behavioral Characteristics for Current Light/Heavier and Intermittent/Daily, Former and Never Cigarette Smokers. Pooled Data from the 2012 National Health Interview Survey (NHIS), 2012 National Survey on Drug Use and Health (NSDUH) and 2011–2012 National Health and Nutrition Examination Survey (NHANES) **Note:** LITS = light (=10 CPD) and intermittent smoker, L-D = light-daily smoker, H-I = heavier (>10 CPD)–intermittent smoker, H-D = heavier-daily smoker.

Percentages displayed are weighted. Percentages for categories within current smokers (LITS, L-D, H-I, H-D) sum to 100% and percentages for total current, former and never smokers sum to 100% (not shown).

For each behavior, differences among smoking groups were statistically significant at $p < 0.05$ (Chi-sq test).

Heavy drinker, based on average number of alcoholic drinks/day, past 12 months.

Current use refers to past 30 days. Former use refers to >30 days from survey.

^a NHIS & NHANES data only.

^b NHIS & NSDUH data only.

^c NSDUH & NHANES data only.

^d "Any other drug" in NSDUH includes use of crack cocaine, heroin, hallucinogens, d-lysergic acid diethylamide (LSD), phencyclidine (PCP), Ecstasy, inhalant, pain relievers, oxycontin, tranquilizers, stimulants, methamphetamines, or sedatives. "Any other drug" in NHANES includes heroin and methamphetamine.

Table 1

Unweighted N and Weighted Percentages for Demographic Characteristics of the 2012 National Health Interview Survey (NHIS), 2012 National Survey on Drug Use and Health (NSDUH) and 2011–2012 National Health and Nutrition Examination Survey (NHANES)

Characteristic		Combined N (%) ^d	NHIS N (%) ^d	NSDUH N (%) ^d	NHANES N (%) ^d
Gender	Male	35,907 (48.1)	15,273 (48.1)	17,737 (48.1)	2,897 (48.3)
	Female	42,322 (51.9)	19,252 (51.9)	20,103 (51.9)	2,967 (51.7)
Race/ethnicity ^a	NH-White	46,409 (66.8)	20,842 (67.2)	23,459 (66.3)	2,108 (66.0)
	NH-Af. American	11,658 (11.8)	5,282 (11.9)	4,821 (11.6)	1,555 (11.7)
	Hispanic	13,180 (14.8)	5,859 (14.9)	6,115 (14.8)	1,206 (14.5)
	Other	6,982 (6.5)	2,542 (6.1)	3,445 (7.3)	995 (7.8)
Marital Status	Not/never	44,570 (42.0)	17,394 (39.7)	24,746 (47.3)	2,430 (38.6)
	Married	33,270 (58.0)	17,053 (60.3)	13,094 (52.7)	3,123 (61.4)
Education	<high school	12,754 (14.3)	5,487 (14.0)	5,935 (14.5)	1,332 (16.7)
	high school grad	22,466 (27.1)	8,938 (26.3)	12,359 (29.7)	1,169 (20.1)
	some college	23,379 (29.8)	10,579 (31.3)	11,143 (26.4)	1,657 (32.2)
	college grad	19,168 (28.8)	9,368 (28.4)	8,403 (29.4)	1,397 (31.0)
Annual Income ^b	I	22,108 (34.6)	7,548 (38.5)	14,560 (30.0)	-
	II	15,059 (29.0)	6,679 (35.1)	8,380 (21.9)	-
	III	19,396 (36.4)	4,496 (26.4)	14,900 (48.2)	-
Age at interview	18–25	23,514 (14.6)	3,970 (14.5)	18,599 (14.7)	945 (14.9)
	26–34	11,899 (15.8)	5,561 (15.8)	5,489 (15.7)	849 (15.2)
	35–49	17,386 (26.0)	8,634 (26.0)	7,386 (25.9)	1,366 (26.4)
	50–64	14,351 (25.9)	8,978 (25.8)	3,919 (25.9)	1,454 (26.4)
	>64	11,079 (17.8)	7,382 (17.8)	2,447 (17.8)	1,250 (17.1)
Region	Northeast	5,774 (18.2)	5,774 (18.2)	-	-
	Midwest	7,193 (22.7)	7,193 (22.7)	-	-
	South	12,536 (36.4)	12,536 (36.4)	-	-
	West	9,022 (22.6)	9,022 (22.6)	-	-
Smoking Group	LITS ^c	4,834 (5.2)	1,331 (3.6)	3,274 (6.8)	229 (4.0)
	Light-Daily	4,276 (4.7)	2,386 (6.6)	1,428 (2.7)	462 (7.3)
	Heavier-Intermittent	286 (0.4)	73 (0.2)	191 (0.6)	22 (0.7)
	Heavier Daily	7,764 (9.7)	2,535 (7.6)	4,847 (11.9)	382 (7.7)
	Former	13,955 (22.2)	7,584 (22.2)	5,112 (21.9)	1,259 (23.9)
	Never	46,337 (57.8)	20,236 (59.9)	22,917 (56.2)	3,184 (56.4)

Note: numbers may not sum to total weighted sample due to missing values.

^aNH = Non-Hispanic

^bIncome categories for NHIS: I, <\$25,000; II, \$25,000-54,999; III, 55,000 and for NSDUH: I, <\$30,000; II, 30,000-49,999; III, 50,000). Combined values reflect sum across surveys.

^cLITS = smokers who are both light and intermittent.

^dUnweighted number of respondents and weighted percentages.

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Table 2

Smoking, Drug Use and Behavioral Characteristics by Smoking Status Among Current Smokers. Polytomous Logistic Regression Results with Pooled Data from the 2012 National Health Interview Survey (NHIS), 2012 National Survey on Drug Use and Health (NSDUH) and 2011-2012 National Health and Nutrition Examination Survey (NHANES)

Variable		10 CPD (Light) smokers		>10 CPD (Heavier) smokers	
		Intermittent (LITS)	Daily	Intermittent	Daily
		OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Gender	Male	1.00	1.00	1.00	
	Female	1.08 (0.94, 1.23)	1.52 (1.34, 1.72)	0.60 (0.35, 1.03)	1.00
Race/ethnicity	NH-White	1.00	1.00	1.00	
	NH-Af. American	3.67 (2.92, 4.60)	3.83 (3.14, 4.68)	1.18 (0.73, 1.91)	
	Hispanic	5.38 (4.38, 6.61)	3.49 (2.76, 4.41)	0.87 (0.42, 1.80)	
	Other	1.81 (1.40, 2.34)	2.35 (1.75, 3.17)	2.24 (0.83, 6.05)	1.00
Marital Status	Not/never married	1.00	1.00	1.00	
	Married	0.99 (0.85, 1.14)	1.14 (1.01, 1.29)	0.93 (0.55, 1.57)	1.00
Education	<high school	0.76 (0.63, 0.92)	0.83 (0.70, 0.99)	1.30 (0.72, 2.35)	
	high school grad	0.81 (0.68, 0.97)	0.92 (0.80, 1.06)	1.25 (0.77, 2.03)	
	some college	1.00	1.00	1.00	
	college grad	1.95 (1.60, 2.38)	1.22 (0.97, 1.53)	1.53 (0.74, 3.20)	1.00
Annual Income ^a	I	0.91 (0.77, 1.08)	1.15 (0.94, 1.39)	1.09 (0.57, 2.08)	
	II	0.82 (0.68, 0.99)	1.01 (0.83, 1.22)	1.09 (0.54, 2.20)	1.00
	III	1.00	1.00	1.00	
Age at interview	18-25	2.85 (2.42, 3.36)	2.72 (2.29, 3.22)	1.47 (0.93, 2.32)	
	26-34	1.86 (1.57, 2.19)	1.50 (1.27, 1.77)	1.02 (0.62, 1.69)	
	35-49	1.00	1.00	1.00	1.00
	50-64	0.93 (0.79, 1.11)	0.82 (0.68, 0.97)	1.74 (1.08, 2.79)	
	>64	0.89 (0.67, 1.19)	0.95 (0.72, 1.26)	1.17 (0.55, 2.50)	
Tried to quit smoking 1 days, past 12 months ^b	Yes	1.96 (1.63, 2.35)	1.61 (1.35, 1.92)	2.51 (1.32, 4.78)	
	No	1.00	1.00	1.00	1.00
Current use of other tobacco ^{c,f}	Yes	1.54 (1.27, 1.88)	1.12 (0.92, 1.36)	2.06 (1.21, 3.51)	1.00
	No	1.00	1.00	1.00	
Age started smoking cigarettes regularly	<18	1.00	1.00	1.00	
	18-21	2.04 (1.77, 2.35)	1.57 (1.37, 1.79)	1.40 (0.92, 2.12)	1.00
	>21	3.42 (2.84, 4.12)	2.33 (1.94, 2.80)	2.60 (1.34, 5.04)	

Variable		10 CPD (Light) smokers		>10 CPD (Heavier) smokers	
		Intermittent (LITS)	Daily	Intermittent	Daily
		OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Time to first cigarette (minutes) ^d	5	1.00	1.00	1.00	
	6-30	1.22 (0.92, 1.62)	1.42 (1.08, 1.87)	0.72 (0.40, 1.29)	1.00
	31-60	2.69 (2.06, 3.50)	3.42 (2.56, 4.57)	2.00 (1.09, 3.68)	
	>60	16.92 (13.10, 21.85)	10.15 (7.55, 13.64)	1.95 (1.00, 3.79)	
Depression or anxiety, past 12 months ^c	Yes	0.72 (0.62, 0.84)	0.78 (0.68, 0.90)	0.67 (0.41, 1.11)	1.00
	No	1.00	1.00	1.00	
Any illicit drug use ^{de}	Current	0.78 (0.62, 0.99)	0.66 (0.48, 0.90)	0.63 (0.30, 1.33)	
	Former	0.85 (0.69, 1.04)	0.69 (0.52, 0.93)	0.73 (0.41, 1.28)	1.00
	Never	1.00	1.00	1.00	

Note: this polytomous logistic regression analysis is restricted to current smokers; former and never smokers were excluded.

Note:

NH = Non-Hispanic

Results from two separate models including: (i) demographic and socioeconomic predictors; (ii) smoking behaviors; and (iii) either depression/anxiety or any illicit drug use.

Missing data was imputed for questions included in the survey; no imputation was done for questions not part of the survey. NHANES and NSDUH have a minimum CPD category of "1 cigarette or less".

TTFC was included in a separate model without the other smoking behaviors because of model convergence. It was adjusted for the demographic variables and included the depression or anxiety composite variable.

Current use refers to past 30 days. Former use refers to >30 days from survey.

^aIncome categories for NHIS: I, <\$25,000; II, \$25,000-54,999; III, 55,000 and for NSDUH: I, <\$30,000; II, 30,000-49,999; III, 50,000).

^bNHIS & NHANES data only.

^cNHIS & NSDUH data only.

^dNSDUH & NHANES data only.

^eThis includes marijuana, cocaine, and "Any other drug". "Any other drug" in NSDUH includes: Crack, heroin, hallucinogen, LSD, PCP, inhalant, pain reliever, Oxycontin, tranquilizer, stimulant, methamphetamine, or sedative. "Any other drug" in NHANES includes hero methamphetamine.

^fCigar, snuff, chew, smokeless tobacco.