



## Brief Original Report

## Softening of monthly cigarette use in youth and the need to harden measures in surveillance

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## ABSTRACT

**Objective:** To assess changes in monthly smoking in its relationship to daily smoking and heavier smoking in high school seniors. Public health agencies often report only “current use” of cigarettes among youth as any use in the past 30 days, even though additional measures are collected. Monthly use is a crude and changing indicator.

**Methods:** Results from 1975 to 2013 from Monitoring The Future Project were plotted and analyzed by linear regression.

**Results:** From 1975 to 2013, the percentage of monthly smokers who smoked daily decreased by 29% (21.2 percentage points) and monthly smokers who smoked 10+ cigarettes/day dropped by 57% (28 percentage points); the percentage of daily smokers who smoked 10+ cigarettes/day decreased by 40% (26.5 percentage points).

**Conclusion:** Additional measures of frequency and intensity of use of cigarettes and other tobacco/nicotine products need to be more regularly reported. These results indicate softening rather than hardening of “current smoking” and have important implications for tobacco surveillance and for tobacco research because of a) increased likelihood of quitting smoking, b) health effects of cigarette smoking, and c) similar and interacting issues related to measuring the use of all tobacco/nicotine products.

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## Introduction

A key indicator of starting cigarette use in young people is how many have smoked at least once during the previous 30 days (Starr et al., 2005). Monthly smoking by youth is widely employed to monitor “current” cigarette use. For example, a current national report on current cigarette use among middle and high school students in the United States uses monthly smoking ( $\geq 1$  cigarette in the past 30 days) to measure current cigarette smoking and provides no further analysis of frequency or intensity of smoking, even though such measures were available (Centers for Disease Control and Prevention, 2013).

We explored changes over four decades in heavier levels of cigarette use associated with monthly use. Michael Russell in 1971 argued that “..., it requires no more than three or four casual cigarettes during adolescence virtually to ensure that a person will eventually become a regular dependent user” (Russell, 1971, p.3). But growing attention focuses on smokers who develop stable patterns of non-daily smoking (Hassmiller et al., 2003; Shiffman et al., 2012). One study followed non-daily smokers for 13 years (to age 21), finding that 26% continued

to be non-daily smokers, 17% became daily smokers, and 57% no longer smoked (Kvaavik et al., 2014). Others have drawn attention to occasional smoking (e.g., Schane et al., 2009), but we wanted to explore systematic changes in relation to monthly smoking and ever smoking. If over the years monthly smoking was becoming more associated with heavier, daily smoking, this would be a “hardening” of smoking as an addiction; if monthly smoking was becoming more associated with lighter and non-daily smoking, this would be a “softening” of smoking as an addictive activity.

## Methods

We analyzed public results from Monitoring The Future (MTF), which provides high quality, representative, yearly national estimates of cigarette use by 12th grade high school students (public and private) for 39 years in the Continental U.S. (Johnston et al., 2014). Use of this public, secondary source data is subject to Institutional Review Board exemption. In addition to measuring cigarette smoking in the past 30 days, it also measures “daily” smoking and smoking at least a half-a-pack of cigarettes per day (i.e., typically 10+ cigarettes per day), using answers to the question, “How frequently have you smoked cigarettes during the past 30 days?” with response options of “Not at all,” “Less than one cigarette per day,” “One to five cigarettes per day,” “About one-half pack per day,” “About one pack per day,” “About one and one-half packs per day,” and “Two or more packs per day.” This

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study is limited by the use of self-report measures and does not represent youth of school age who are not in school. We plot results and provide linear regression lines (with  $R^2$ ).

## Results

For 12th grade students lifetime smoking and monthly smoking have dropped considerably from 1975 to 2013: by 48% or 35.5 percentage points for lifetime smoking and 56% or 20.4 percentage points for monthly smoking (see Fig. 1).

Fig. 2 shows the percentage of monthly smokers a) who are daily smokers and b) who are smokers of half-a-pack+ per day, and c) the percentage of daily smokers who smoke a half-a-pack+ per day. While lifetime and monthly smoking have dropped, daily smoking and heavier daily smoking have also dropped. The percentage of monthly smokers who smoked daily decreased by 29% (21.2 percentage points) and monthly smokers who smoked 10+ cigarettes/day dropped by 57% (28 percentage points). The percentage of daily smokers who smoked 10+ cigarettes/day decreased by 40% (26.5 percentage points); in 1975 a majority (two-thirds) of daily smokers reported half-a-pack+ per day and in 2013 a minority (4 in 10) did so. Linear regression lines are reliable ( $P$ s < .001, 2-tailed).

## Discussion

These results indicate softening rather than hardening of “current smoking” and have important implications for tobacco surveillance and for tobacco research, in relation to a) increased likelihood of quitting smoking, b) health effects of cigarette smoking, and c) similar and interacting issues related to measuring the use of all tobacco/nicotine products.

### Increased quitting

Non-daily smokers are likelier to quit. A follow-up in MTF found that 56.5% of non-daily smoking high school seniors quit smoking 5 to 6 years later, while only 30.1% of 1–5 cigarettes per day smokers quit, only 22.7% of about 10 cigarettes per day smokers quit, and only 15.2% of 20+ smokers quit (National Center for Chronic Disease Prevention and Health Promotion, 2012, p.250). Increased quitting by non-daily smokers has been confirmed in other studies (e.g., Levy et al., 2009).

### Health effects and compensatory smoking

Although dose-effect curves vary, heavier smoking causes more disease and death (National Center for Chronic Disease Prevention and Health Promotion, 2012). For example, there are increases in all-cause mortality from 1–4 cigarettes per day, but also increased mortality as daily cigarette intake increases (Bjartveit and Tverdal, 2005). Non-daily smoking can represent low-levels of exposure. In 2009, a national study of high school students found 37% of non-daily smokers smoked only 1 to 2 days out of 30 and another 49% of non-daily smokers smoked from 3 to 20 days of the 30; and the large majority who smoked on fewer than 21 days per month smoked under 6 cigarettes per day (Jones et al., 2011). Results for smokers 15+ years in 1998–99 showed that 63% of non-daily smokers smoked <16 days; for all non-daily smokers, average intake was 6 cigarettes per smoking day, compared to 19 for daily smokers, and the mean dose of cigarettes per month was 5.5 times higher in daily smokers than non-daily smokers (Hassmiller et al., 2003). Non-daily smoking at low-levels on smoking days, while not safe, should be less dangerous than heavier smoking. As well to prevent initial trial, tobacco control efforts should try to move non-daily smokers to quitting (Schane et al., 2010). Non-daily smoking in youth can also become daily smoking (Bondy et al., 2013): 26% of the non-daily smoking students became daily smokers 5 to 6 years later and 13.8% reported a half-a-pack+ per day (National Centers for Chronic Disease Prevention and Health Promotion, 2012, p.249).

Potential positive health effects of decreased intake in daily smokers could be reduced or eliminated by over-smoking. Essentially daily smoking adults who were using no other tobacco products showed (a) similar cotinine levels from 1988 to 2012, and (b) while daily cigarettes had declined by 29%, cotinine per cigarette had increased by 42% (Jarvis et al., 2014). Observed changes in reported cigarettes per day may, therefore, not be associated with reductions in disease.

### Multiple tobacco/nicotine products

Growing use of other tobacco products and vaping/e-cigarettes has been observed in youth (CDC, 2013) and could also help undermine the value of monthly or daily smoking as an indicator of tobacco/nicotine use (Johnston et al., 2014, p.44). More reports of smoking trends need also to be including the information on frequency and intensity of use that is typically being collected, and such information should become

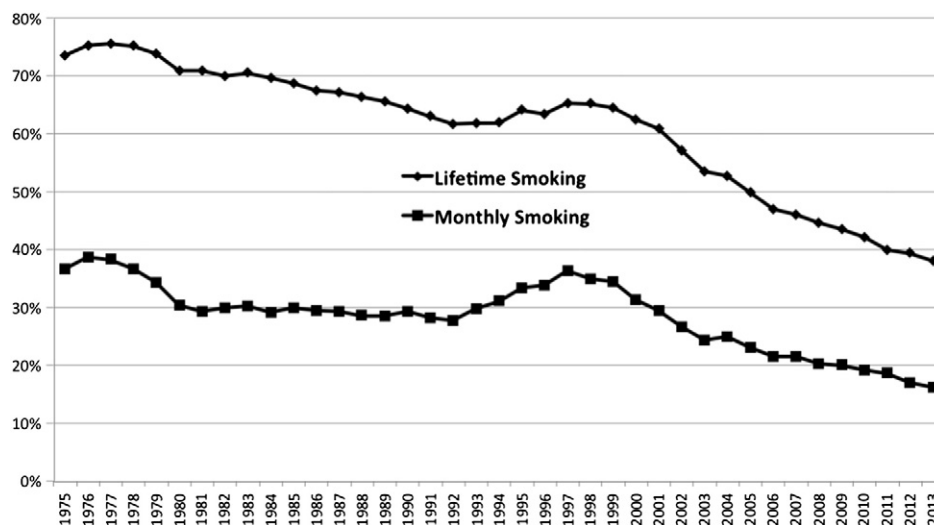
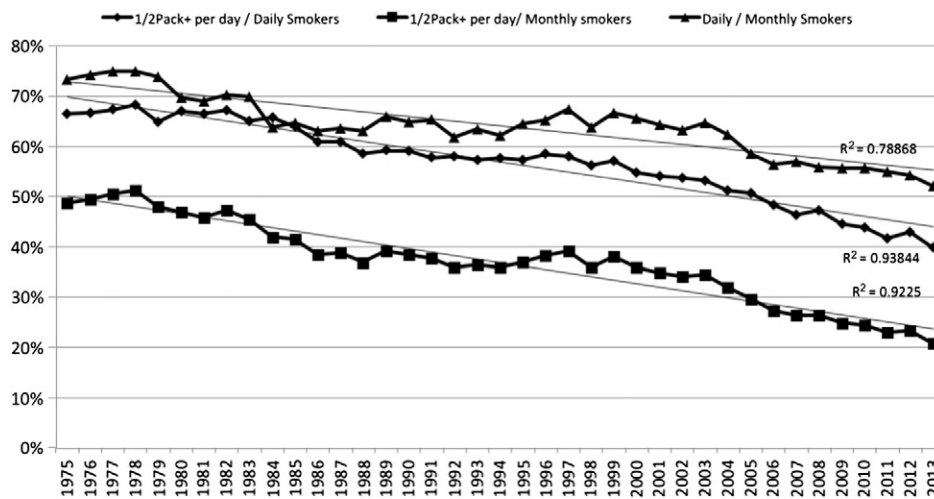


Fig. 1. Shows trends from 1975 to 2013 in lifetime smoking (reporting having ever smoked cigarettes at least once or twice) and monthly smoking (reporting any cigarette smoking in past 30 days) for 12th grade students, data from Monitoring The Future (Johnston et al., 2014).



**Fig. 2.** Shows trends from 1975 to 2013 for 12th grade students in the percentage of monthly smokers (reporting any cigarettes in the past 30 days) a) who are “daily” smokers (reporting at least one cigarette per day during the past 30 days) and b) who are smokers of half-a-pack of cigarettes or more per day (reporting  $\geq$  “about one-half pack per day”), and c) the percentage of “daily” smokers who smoke a half-a-pack of cigarettes or more; data from Johnston et al. (2014).

an expected part of figures and tables reporting trends on tobacco use. Surveillance of tobacco use should also carefully measure the level (frequency/intensity) of all tobacco/nicotine use products, and assessment of the increasing use of electronic cigarettes needs to be mindful of the need to go beyond monthly use as the sole measure.

Public health tobacco surveillance reports should rely less exclusively on monthly smoking, especially since additional questions on frequency and heaviness of use are also collected. When 50% who were “current smokers” in grade 12 were smoking at least 10 cigarettes per day, it was a different problem than when 20% of “current smokers” are such heavy smokers. The natural history of this dependence disorder appears now more complicated than it was for Russell in 1971, when cigarettes were so clearly ‘King’ and modern tobacco control was itself in its youth.

### Conflict of interest statement

No competing interest.

### Acknowledgments

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### References

- Bjartveit, K., Tverdal, A., 2005. Health consequences of smoking 1–4 cigarettes per day. *Tob. Control* 14, 315–320.
- Bondy, S.J., Victor, J.C., Diemert, L.M., et al., 2013. Transitions in smoking status over time in a population-based panel study of smokers. *Nicotine Tob Res* 15, 1201–1210.

- Centers for Disease Control and Prevention (CDC), 2013. Tobacco product use among middle and high school students—United States, 2011 and 2012. *MMWR* 62, 893–897.
- Hassmiller, K.M., Warner, K.E., Mendez, D., Levy, D.T., Romano, E., 2003. Nondaily smokers: who are they? *Am. J. Public Health* 93, 1321–1327.
- Jarvis, M.J., Giovino, G.A., O’Connor, R.J., Kozlowski, L.T., Bernert, J.T., 2014. Variation in nicotine intake in U.S. cigarette smokers over the past 25 years: evidence from NHANES surveys. *Nicotine Tob Res*, <http://dx.doi.org/10.1093/ntr/ntu120> (July 25. PMID: 25063772).
- Johnston, L.D., O’Malley, P.M., Schulenberg, J.E., Miech, R.A., 2014. *Monitoring The Future National Survey Results on Drug use, 1975–2013: Volume I, Secondary School Students*. Institute for Social Research, The University of Michigan, Ann Arbor.
- Jones, S.E., Kann, L., Pechacek, T.F., 2011. Cigarettes smoked per day among high school students in the U.S., 1991–2009. *Am J Prev Med* 41, 297–299.
- Kvaavik, E., von Soest, T., Pedersen, W., 2014. Nondaily smoking: a population-based, longitudinal study of stability and predictors. *BMC Public Health* 14, 123.
- Levy, D.E., Biener, L., Rigotti, N.A., 2009. The natural history of light smokers: a population-based cohort study. *Nicotine Tob Res* 11, 156–163.
- National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2012. *Reports of the Surgeon General, Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General*. Centers for Disease Control and Prevention (US), Atlanta (GA).
- Russell, M.A., 1971. Cigarette smoking: natural history of a dependence disorder. *Br J Med Psychol* 44, 1–16.
- Schane, R.E., Glantz, S.A., Ling, P.M., 2009. Nondaily and social smoking: an increasingly prevalent pattern. *Arch Int Med* 169, 1742–1744.
- Schane, R.E., Ling, P.M., Glantz, S.A., 2010. Health effects of light and intermittent smoking: a review. *Circulation* 121, 1518–1522.
- Shiffman, S., Dunbar, M.S., Scholl, S.M., Tindle, H.A., 2012. Smoking motives of daily and non-daily smokers: a profile analysis. *Drug Alcohol Depend.* 126, 362–368.
- Starr, G., Rogers, T., Schooley, M., Porter, S., Wiesen, E., Jamison, N., 2005. Key outcome indicators for evaluating comprehensive tobacco control programs. *Prevention*. Centers for Disease Control and Prevention, Atlanta, GA.