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Differences in Current Cigarette Smoking Between Non-Hispanic Whites and Non-Hispanic Blacks by Gender and Age Group, United States, 2001 – 2013

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Abstract

Introduction—For years, national U.S. surveys have consistently found a lower cigarette smoking prevalence among non-Hispanic (NH) black adolescents and young adults than their NH white counterpart while finding either similar or higher smoking prevalence in NH blacks among older adults. Because these surveys do not collect biomarker information to validate smoking self-reports, we also present results from the National Health and Nutrition Examination Survey (NHANES), which collects cotinine (a nicotine biomarker) to determine if U.S. surveys consistently show racial differences in smoking prevalence.

Methods—We present NH black and NH white current smoking estimates in the Youth Risk Behavior Survey (2001–2013), National Youth Tobacco Survey (2004–2012), National Survey on Drug Use and Health (2002–2012), National Health Interview Survey (2001–2013), and NHANES (2001–2012).

Results—Using cotinine by itself or with self-reports to compare smoking prevalence between NH black and NH white males aged 12 – 25 years, no difference in current smoking was found. For male adult ≥26 years, all surveys consistently found a higher smoking prevalence among NH blacks. For females aged 12 – 25 years, all surveys found a higher smoking prevalence among NH whites. While inconsistent results across surveys were found for those aged ≥26 years, cotinine results showed a higher smoking prevalence among NH black females.

Conclusion—Some racial differences in self-reported smoking are not confirmed when supplemented with serum cotinine to detect current cigarette smokers. Improving the measurement of current smoking is important to accurately evaluate racial smoking differences.

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DECLARATION OF INTERESTS

The authors declare no competing interests.

INTRODUCTION

Over a decade, national U.S. surveys based solely on self-reported information have consistently found an overall lower prevalence of cigarette smoking among Non-Hispanic (NH) black adolescents compared to NH white adolescents.[1,2] The Youth Risk Behavior Surveillance System (YRBSS) reported prevalence of past month cigarette smoking among NH black adolescents in 2013 as 8.2% (95% Confidence Interval [CI] 6.3–10.7%), which is less than half that of NH white adolescents (18.6%, 95%CI 15.7–21.9%).[3] Similar patterns have been observed for young adults in other surveys. For example, data from the 2013 National Survey on Drug Use and Health (NSDUH) showed that current cigarette smoking among young adults aged 18 – 25 was more prevalent among NH whites than NH blacks (35.8% vs. 23.9%).[4] Similarly, in 2013, the National Health Interview Survey (NHIS) showed that the prevalence of cigarette smoking among NH white adults aged 26 years or older was 18.7% compared to 19.5% among NH blacks (unpublished data, the data are available at http://www.cdc.gov/nchs/nhis/nhis_2013_data_release.htm).

A number of factors have been offered to explain the lower smoking prevalence in NH black youth, including parental and peer influence not to smoke, sports involvement, attendance at religious services, and the cost of cigarettes.[1,5–11] National surveys have traditionally estimated smoking prevalence using self-reports, which are considered generally accurate, however, the specific current smoking prevalence varies across surveys.[8,12–18] Furthermore, several national surveys use differing definitions of current smoking status, use different interview settings, mode of survey administration, time of the year when the survey is administered, and other differences between surveys exist which may contribute to varying prevalence estimates.[19–21] For example, school interviews, especially those that are anonymous, provide higher current smoking prevalence estimates among youth than household interviews.[22]

Cotinine, a biomarker of nicotine intake or exposure, is sometimes used to detect cigarette smokers who recently smoked and deny having smoked.[23] However, because the half-life of serum cotinine is about 16–20 hours, as well as the fact that a substantial proportion of adolescents who smoke do not do so on a regular basis (intermittent smokers) as well as a small proportion of adult cigarette smokers (20% – 30% of adults smokers are non-daily smokers), cigarette smoking in the past 30 days may not be able to be detected by serum cotinine levels.[24,25] Thus, even though cotinine levels (blood, saliva, urine) can be used to detect active tobacco use (including cigarette smoking) in the past few days, it is not a gold-standard method to detect cigarette smoking in a longer time period (past 30 days), especially for those who do not smoke frequently where cotinine levels may have not achieved a steady-state. Still, surveys such as NHANES that in addition to smoking self-reports (smoking every day or some days) also collect serum cotinine data can help provide a more complete understanding of current prevalence of cigarette smoking in the United States.

To determine if the differences in current cigarette smoking prevalence observed between NH blacks and NH whites in the U.S. are consistent when using smoking self-reported information as well as cotinine data, we present current smoking information for NH blacks

and NH whites by gender and age group in the 2001–2012 NHANES, 2001–2013 YRBSS, 2004–2012 National Youth Tobacco Survey (NYTS), 2002–2012 NSDUH, and 2002–2013 NHIS.

METHODS

Surveys and Samples

The NHANES is conducted by the U.S. National Center for Health Statistics (NCHS), which is part of the Centers for Disease Control and Prevention (CDC). The survey, which began in 1960, is unique, in that it combines interview questions with physical examinations to evaluate the health and nutritional status of children and adults in the US. Since 1999, NHANES has been conducted continuously, with data released in two-year increments. Approximately 5,000 civilian non-institutionalized individuals <1 year or older participate annually. Participation in the survey is voluntary and confidential. Participants receive reports of study findings and a small incentive for participation. Respondents who are 20 years or older participate in an in-home face-to-face computer-assisted personal interview conducted by a trained professional. The interview is followed by a standard physical examination which on average takes place about 2 weeks later, including collecting blood and urine specimens at a mobile examination center (MEC). At these centers, adolescent respondents (12 – 19 years old) provide health information in an audio computer-assisted self-interview in a private environment, including tobacco use information by private (no face-to-face) computer assisted self-administered questionnaires. Testing for cotinine levels in serum is conducted the same day of the tobacco use interview. More details about survey methodology can be found at http://www.cdc.gov/nchs/nhanes.htm.

The NHIS, like NHANES, is a large data collection program of the NCHS at CDC. Since 1957, it has provided data on trends in diseases, disability, and national health objectives. Respondents of the NHIS are non-institutionalized civilians aged ≥18 years residing in the US sampled using a multistage probability design. Participation is voluntary and a private computer assisted personal interview is conducted by trained professionals in respondents' homes. There is no incentive for participation. NHIS data on smoking are self-reported by respondent. More survey information is available at http://www.cdc.gov/nchs/nhis.htm.

The YRBSS is sponsored by CDC and the NYTS is sponsored both by CDC and FDA. They are anonymous, voluntary, school-based surveys that use self-administered paper-and-pencil questionnaires. Efforts are made to make the survey as private as possible in the conditions of a classroom, e.g. spreading the desks apart, covering responses with a piece of paper, etc. Participants are not incentivized to take either survey.

The YRBSS is a biennial ongoing survey monitoring six health-risk behaviors that can lead to death and disability in youth and adults: injuries; sexual behaviors leading to unintended pregnancy and sexually transmitted infections, including HIV; alcohol and illegal drug use; tobacco use; unhealthy diet; and inadequate physical activity. The survey targets public and private high school students (9^{th}–12^{th} grades). Students in grades 9^{th} – 12^{th} are mainly between the ages of 14 and 18 years of age. Data are available biennially from 1991 to 2013. Further details are available at http://www.cdc.gov/HealthyYouth/yrbs/index.htm.

The NYTS collects national data on key indicators for designing, executing, and evaluating programs to prevent and control tobacco use. The survey measures tobacco-related beliefs, attitudes, behaviors, access to tobacco, exposure to second-hand smoke and tobacco-related influences, as well as demographic data. The survey's respondents are both public and private middle (grades 6^{th} – 8^{th}) and high school (9^{th} – 12^{th}) students from a nationally representative sample. Students in grades 6^{th} – 8^{th} are mainly between the ages 11 and 13 years while students in grades 9^{th} – 12^{th} are mainly between the ages of 14 and 18 years. Data are available for 1999, 2000, 2002, 2004, 2006, 2009, 2011, 2012, and 2013. Survey data and methodology are presented at http://www.cdc.gov/tobacco/data_statistics/surveys/nyts/index.htm.

The NSDUH is sponsored by the Substance Abuse and Mental Health Services Administration (SAMHSA). The data has been collected from 70,000 randomly selected persons aged 12 and older every 2–3 years since 1971 and annually since 1990. At present time, it is a private confidential audio, computer-assisted self-interview provided at home after a previous household screening interview. Since 2002, each participant received monetary incentive to complete the survey. The survey focuses on tobacco, alcohol and illegal substances assessing levels and patterns of use, tracking trends, gauging consequences, and identifying risk groups for the substances consumption and abuse. Most NSDUH survey results are provided for 3 different age groupings: 12 – 17 years old, 18 – 25 years old, and ≥26 years old. More information about NSDUH is available online at https://nsduhweb.rti.org/respweb/homepage.cfm.

More surveys information for each survey can be found in the Supplementary Materials.

Measures

For this study we have used data available for each survey between 2001 and 2013: NHANES 2001–2012, NHIS 2001–2013, NYTS 2004–2012 (2013 NYTS data were not available at the time of this analysis), YRBSS 2001–2013, and NSDUH 2002–2012. The Monitoring the Future Survey, a school-based survey of U.S. students in grades 8^{th}, 10^{th}, and 12^{th} was not included because the authors were not able to have access to the data on time in a way it was comparable (age, race, gender, proper weights) to the other surveys in this study. The specific years of data included vary by each surveys' methodology and data collection years (i.e., YRBSS is collected every other year). To ensure the analysis are precise enough (big enough sample size) when using NHANES data and stratifying the results by race, gender, and age group, a decision was made to use years 2001 – 2012 (2013–2014 not yet available for NHANES). Of all surveys analyzed here, the NHANES is the survey with the smallest sample size for every 2-years worth of data (NHANES only collects data every 2 years in about 15 – 30 U.S. primary sampling units). To ensure that the NHANES data were representative of the U.S. non-institutionalized civil population in a way to compare its results to that of other larger sample-size surveys, the authors decided to select a large span of years (2001 – 2012) for this study.

Analyses were restricted to NH white and NH black persons only, thus, estimates presented in this manuscript are not identical to previously reported current smoking estimates by each survey for the whole U.S. non-institutionalized population (these surveys include current

smoking estimates for all races in their reports). We compared cigarette smoking prevalence between NH whites and NH blacks by gender and age groups. We defined the age groups as follows: 12–17, 18–25, and 26 years or older. Because high school students from the YRBS surveys are mainly 14–18 years old, the students from the NYTS (middle and high school) are mainly between the ages of 11–18 years, and a specific group of respondents from the NSDUH surveys are between the ages of 12 and 17 years, we did not only compared across surveys those aged "12 – 17" years old, we also re-analyzed our comparisons (current smoking estimates) limiting it to only those aged 14 – 17 years in all 3 surveys. Racial differences in current smoking were consistent when results were limited to only 14 – 17 years even though the specific current smoking point estimate prevalence changed some.

Current cigarette smoking—A person was defined as a current cigarette smoker based on the questions used by each survey, thus, the definition of a current cigarette smoker is not the same in each survey. Each survey has screening questions identifying current cigarette smokers; survey participants with negative responses to these screening questions are not asked further questions related to cigarette smoking. YRBSS, NYTS, and NSDUH ask about cigarette smoking in the past 30 days. In these surveys a current cigarette smoker is defined as having smoked ≥1 day in the past 30 days. In contrast, NHIS and NHANES ask if the respondents ever smoked 100 cigarettes in a lifetime and among those who answered yes, asked them if they now smoke every day, on some days, or not at all. Current smoking for NHIS and NHANES samples was defined as those who now smoke every day or on some days. Specific screening criteria and questions for each survey can be found in the Supplementary Materials.

> *Three current cigarette smoking measures using NHANES: 1)* Self-reported current smoking, 2) current smoking using serum cotinine levels of >10.0 ng/mL as a biomarker of active smoking, and 3) a combination of self-reported current cigarette smoking or serum cotinine levels of >10.0 ng/mL to define a current smoker

For the NHANES survey, an adult was defined as a current smoker if: 1) they reported having smoked 100 cigarettes in their lives and having smoked every day or some days, 2) if their serum cotinine level was above 10.0 ng/mL, or 3) they reported having smoked 100 cigarettes in their lives and having smoked every day or some days or if their serum cotinine level was above 10.0 ng/mL. An adolescent was defined as a current smoker if: 1) they reported having smoked ≥1 days in the past 30 days, 2) if their serum cotinine level was above 10.0 ng/mL, or 3) they reported having smoked ≥1 days in the past 30 days or if their serum cotinine level was above 10.0 ng/mL.

Persons aged 12 years or older who reported not using cigarettes but using other tobacco products or using nicotine replacement medications were excluded from the analysis in order for them not to be mistakenly misclassified as cigarette smokers if their cotinine concentration was >10.0 ng/mL.

All data analyses were performed in SUDAAN using procedures appropriate for each survey's sample design. Multiple years of data were combined for each survey and weighted according to each survey's analytical guidelines. Records with missing data were excluded

from the analyses. We have estimated weighted prevalence of cigarette smoking, 95% confidence intervals and statistical significance of the estimate differences (p-value).

RESULTS

Table 1 shows sample size and percent distributions for NH white and NH black respondents by gender and age for the five national surveys included in this study for aggregated years between 2001 and 2013. Sample sizes of respondents (smokers and non-smokers) ranged from 27,987 (NHANES) to 469,482 (NSDUH).

Figure 1 shows the prevalence of current cigarette smoking for NH black and NH white respondents aged 12 – 17 years old by gender for the aggregated years available for each survey as well as their 95% confidence intervals and p-value for racial differences. For girls aged 12 – 17 years old, all surveys, including when cotinine validation was used, found a large difference in cigarette smoking between NH blacks and NH whites. NH whites had a much higher current smoking prevalence ($p<0.01$) than NH blacks. For boys aged 12 – 17 years old, all surveys using self-reports (including NHANES) found that NH whites had a higher current smoking prevalence than NH blacks, however, when cotinine by itself or in conjunction with self-reports was used, no racial difference ($p=0.41$ and $p=0.07$, respectively) in cigarette smoking was found. As previously stated, because there was a concern about YRBS being a high school survey with the majority of respondents aged 14 to 17 years, we also did the analysis limiting the comparison age to those 14 – 17 years old; the results did not change.

Figure 2 shows current cigarette smoking prevalence for males and females aged 18 – 25 years by race. In young adult females, self-report-based surveys showed higher smoking prevalence among NH whites than NH blacks ($p<0.05$, but mostly $p<0.01$). In young males, all surveys using self-reports (NHANES included) found that NH whites had a higher current smoking prevalence than NH blacks, however, when cotinine by itself or in conjunction with self-reports was used, no racial difference ($p=0.21$ and $p=0.11$, respectively) in cigarette smoking was found.

Figure 3 shows cigarette smoking prevalence for NH white and NH black adults aged 26 years or older. For adult women aged ≥26 years, while NSDUH ($p=0.04$) and NHIS ($p<0.01$) found that NH whites had a higher smoking prevalence than NH blacks, however, the NHANES self-reports found no difference in cigarette smoking ($p=0.35$) while estimating current smoking with cotinine levels only ($p<0.01$) or self-reports in conjunction with cotinine levels ($p<0.01$) found a higher smoking prevalence among NH blacks. As for men aged ≥26 years, all surveys c found a higher smoking prevalence among NH blacks ($p<0.01$).

DISCUSSION

The findings from this study confirm that NH black girls' adolescents have a lower cigarette smoking prevalence when compared to their NH white counterparts.[1] In terms of adolescent boys, even though surveys based on self-reports have reported that NH black boys have lower smoking prevalence than NH white boys, this finding was not corroborated

statistically when using the biomarker cotinine to confirm current smoking. While the magnitude of the higher smoking prevalence among NH whites than NH black adolescents was in the range of 50% (12.8 % vs. 8.3% respectively in NYTS) to 80% (11.6% vs. 6.4% respectively in NSDUH) in surveys only using self-reports, the higher smoking prevalence among NH whites than NH black adolescents was of a smaller magnitude of 10% to 20% percent when using cotinine only or self-reports or cotinine. This smaller difference did not attain a statistical significant difference even though the point smoking prevalence estimate was still higher for NH whites than NH blacks. Regardless of the statistical test result, it is clear that the difference in current smoking between NH black and white adolescents is much wider girls that it is for boys.

Similar to differences to current smoking between NH black and NH white adolescent girls, statistically significant differences in a magnitude of 30% to 90% was found for young women aged 18 – 25 years, with NH whites having a higher smoking prevalence. Still, different to those aged 12 – 17 years where the prevalence of smoking was in the range of 3% to 23%, for young adults it was much higher, in the range of 17% to 39%. For young adult males, once again a similar observation to that of adolescent boys was observed in that self-reported surveys found a higher smoking prevalence among NH whites than NH blacks in a magnitude of 40% to 50% while when using cotinine it was in the range of 10%, not enough to be statistically significant. Still, even when not significant, the point estimate for smoking was higher for NH whites than NH blacks.

For female adults aged ≥26 years, while NSDUH and NHIS show about a 10% higher and significant smoking prevalence among NH whites than NH blacks, NHANES self-reports show a non-significant 6% higher smoking prevalence among NH blacks than NH whites, and cotinine by itself or self-reports or cotinine estimates found a 20% significant higher smoking prevalence among NH blacks than NH whites. Among male adults aged ≥26 years, all estimates clearly pointed of a higher smoking prevalence among NH blacks than NH whites.

The validity of self-reported cigarette smoking information has been extensively studied over the years.[6,19,26–29] In a study of factors that affect the accuracy of self-reported smoking status among youth, Brenner and colleagues explained that these factors can be categorized as cognitive (internal) and situational (external).[6] Cognitive factors include not understanding the meaning of the question, not being able to remember the time period for which the question is asked, and not being able to provide an accurate response. Situational factors include the setting (i.e., school, home) where the survey is conducted, the method of survey administration (i.e., self-administered or interviewer-conducted), social desirability of the behavior in the community (i.e., cigarette smoking seen as a grown-up behavior), and the perception of the privacy and/or confidentiality of the responses. Some of these factors may explain some of the discrepancies in the survey smoking prevalence results.

For young adults aged 18 – 25 years, differences in self-report smoking estimates were also observed between surveys, even though adults are legally able to buy and use cigarettes. Still, social stigma may influence self-reports of cigarette smoking. The NHANES cotinine only data showed a higher smoking prevalence than that reported in the NHIS and the

NSDUH. Among adults aged 26 years or older, all surveys consistently showed that NH black men had higher smoking prevalence than NH white men. However, among women aged 26 years or older, NHANES cotinine data showed NH black women having a higher smoking prevalence while NSDUH and NHIS based on self-reported information only found a higher smoking prevalence in NH white women. Thus, inaccuracies in self-reported cigarette smoking seem to apply for some adults as well as adolescents.

Finally, neither self-reports nor current smoking assessed using biomarkers such as serum cotinine are completely accurate. Using serum cotinine to detect active smoking is only highly sensitive for the past few days (1 to 5 days) since last smoked, while self-reported measures of current smoking are designed to capture cigarette smoking for a longer period of time +(either for the past 30 days or “every day” or “some days”). It is possible that in the future cotinine hair or other methods are developed that will provide a standardized external validity measure for current smoking over a longer period of time than serum, saliva, or urine cotinine. However, more research would be needed before cotinine hair analysis can be deemed reliable and valid.[30,31]

Our presentation of current cigarette smoking status using several surveys estimates has some limitations. As previously mentioned, differences exist between surveys with regard to the definition of current cigarette smoking, the setting where the interview was conducted, the mode of the survey administration, incentives provided for participation, the time of the year when the data were collected, as well as differences on data collection of other substances and other tobacco products and nicotine medications. Second, it is possible that some users of other tobacco products and nicotine replacement medications who did not use cigarettes may have forgotten or denied having done, in this case they will have mistakenly be classified as current cigarette smokers who denied smoking if their serum cotinine levels where above the selected cut-off. If so, this could result in higher current smoking estimates in NHANES than in other self-reported surveys and may have also resulted in higher racial differences (NH whites vs. NH blacks) if there were racial differences in such miss-reporting. Third, not all surveys used in this study collected the information during comparable years (annually). By aggregating 12 or 13 years’ worth of data we attempted to reduce variability in the current smoking estimates. Fourth, there is a possibility that differences in cotinine metabolism by race and gender may have biased some of the results. However, we replicated our analyses using Benowitz and colleagues[23] specific cotinine cut-off points that take race, gender, and age into consideration and the results did not change. Finally, in 2012, the most recent year of NHANES data used in this analysis, information about electronic nicotine delivery systems such as e-cigarettes and other tobacco products such as hookah use was not collected. Users of these or other tobacco products who did not smoke cigarettes would have been mistakenly classified as “cigarette smokers” when they did not smoke cigarettes.

CONCLUSION

Some racial differences in self-reported smoking are not confirmed when supplemented with serum cotinine to detect current cigarette smokers. Improving the measurement of current smoking is important to evaluate racial smoking differences. Improving the measurement of

current cigarette smoking status is important to accurately evaluate racial-ethnic variations in current cigarette smoking status.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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REFERENCES

1. Pampel FC. Racial convergence in cigarette use from adolescence to the mid-thirties. J. Health Soc. Behav. 2008; 49(4):484–498. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3163096/pdf/nihms-317390.pdf. [PubMed: 19181051]
2. US Department of Health and Human Services. Preventing Tobacco Use Among Youth and Young Adults: A Report of the Surgeon General. 2012. Available at: http://www.ncbi.nlm.nih.gov/books/NBK99237/.
3. Eaton DK, Kann L, Kinchen S, et al. Youth Risk Behavior Surveillance - United States, 2011. Morbidity and mortality weekly report. Surveillance summaries. 2012; 61(4):1–162. http://www.cdc.gov/mmwr/pdf/ss/ss6104.pdf. [PubMed: 22673000]
4. Center for Behavioral Health Statistics and Quality. 2013 National Survey on Drug Use and Health: Detailed Tables. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2014 Sep 4. http://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabsPDFWHTML2013/Web/PDFW/NSDUH-DetTabsCover2013.pdf. [Accessed November 26, 2014]
5. Jackson C. Perceived legitimacy of parental authority and tobacco and alcohol use during early adolescence. J. Adolesc. Health. 2002; 31(5):425–432. [PubMed: 12401429]
6. Brener ND, Billy JO, Grady WR. Assessment of factors affecting the validity of self-reported health-risk behavior among adolescents: Evidence from the scientific literature. J. Adolesc. Health. 2003; 33(6):436–457. [PubMed: 14642706]
7. Ellickson PL, Perlman M, Klein DJ. Explaining racial/ethnic differences in smoking during the transition to adulthood. Addict. Behav. 2003; 28(5):915–931. [PubMed: 12788265]
8. Fendrich M, Johnson TP. Race/ethnicity differences in the validity of self-reported drug use: Results from a household survey. J. Urban Health. 2005; 82(2 Suppl 3):iii67–iii81. [PubMed: 15933333]
9. Oredein T, Foulds J. Causes of the decline in cigarette smoking among African American youths from the 1970s to the 1990s. Am. J. Public Health. 2011; 101(10):e4–e14. [PubMed: 21852655]
10. Ford JA, Hill TD. Religiosity and Adolescent Substance Use: Evidence From the National Survey on Drug Use and Health. Subst. Use Misuse. 2012; 47(7):787–798. [PubMed: 22443107]
11. Gardiner, PS. [Accessed March 23, 2015] African American teen cigarette smoking: a review; Changing adolescent smoking prevalence: where it is and why. Smoking and Tobacco Control Monograph. 2001. p. 213-226.http://cancercontrol.cancer.gov/Brp/tcrb/monographs/14/m14_14.pdf.
12. Bauman KE, Ennett SE. Tobacco use by black and white adolescents: The validity of self-reports. Am. J. Public Health. 1994; 84(3):394–398. [PubMed: 8129054]
13. Stein LA, Colby SM, O'Leary TA, et al. Response distortion in adolescents who smoke: a pilot study. J. Drug Educ. 2002; 32(4):271–286. [PubMed: 12556133]

14. Wagenknecht LE, Burke GL, Perkins LL, Haley NJ, Friedman GD. Misclassification of smoking status in the CARDIA study: a comparison of self-report with serum cotinine levels. Am. J. Public Health. 1992; 82(1):33–36. [PubMed: 1536331]
15. Caraballo RS, Giovino GA, Pechacek TF. Self-reported cigarette smoking vs. serum cotinine among U.S. adolescents. Nicotine Tob. Res. 2004; 6(1):19–25. [PubMed: 14982684]
16. Wills TA, Cleary SD. The validity of self-reports of smoking: analyses by race/ethnicity in a school sample of urban adolescents. Am. J. Public Health. 1997; 87(1):56–61. [PubMed: 9065227]
17. Kandel DB, Schaffran C, Griesler PC, Hu MC, Davies M, Benowitz N. Salivary cotinine concentration versus self-reported cigarette smoking: Three patterns of inconsistency in adolescence. Nicotine Tob. Res. 2006; 8(4):525–537. [PubMed: 16920650]
18. Yeager DS, Krosnick JA. The validity of self-reported nicotine product use in the 2001–2008 National Health and Nutrition Examination Survey. Med. Care. 2010 Oct 14.48:1128–1132. ed2010. [PubMed: 20940652]
19. Kann L, Brener ND, Warren CW, Collins JL, Giovino GA. An assessment of the effect of data collection setting on the prevalence of health risk behaviors among adolescents. J. Adolesc. Health. 2002; 31(4):327–335. [PubMed: 12359378]
20. Biglan M, Gilpin EA, Rohrbach LA, Pierce JP. Is there a simple correction factor for comparing adolescent tobacco-use estimates from school- and home-based surveys? Nicotine Tob. Res. 2004; 6(3):427–437. [PubMed: 15203776]
21. Klein JD, Thomas RK, Sutter EJ. Self-reported smoking in online surveys: prevalence estimate validity and item format effects. Med. Care. 2007; 45(7):691–695. [PubMed: 17571019]
22. Griesler PC, Kandel DB, Schaffran C, Hu MC, Davies M. Adolescents' inconsistency in self-reported smoking: A comparison of reports in school and in household settings. Public Opin. Q. 2008; 72(2):260–290. [PubMed: 18941620]
23. Benowitz NL, Bernert JT, Caraballo RS, Holiday DB, Wang J. Optimal serum cotinine levels for distinguishing cigarette smokers and nonsmokers within different racial/ethnic groups in the United States between 1999 and 2004. Am. J. Epidemiol. 2008; 169(2):236–248. [PubMed: 19019851]
24. Benowitz NL, Jacob P 3rd. Metabolism of nicotine to cotinine studied by a dual stable isotope method. Clin. Pharmacol. Ther. 1994; 56(5):483–493. [PubMed: 7955812]
25. Caraballo RS, Giovino GA, Pechacek TF, et al. Racial and ethnic differences in serum cotinine levels of cigarette smokers: Third National Health and Nutrition Examination Survey, 1988–1991. JAMA. 1998; 280(2):135–139. [PubMed: 9669785]
26. Gfroerer J, Wright D, Kopstein A. Prevalence of youth substance use: the impact of methodological differences between two national surveys. Drug Alcohol Depend. 1997; 47(1):19–30. [PubMed: 9279494]
27. Hedges, B.; Jarvis, M. Cigarette smoking. In: Prescott-Clarke, P.; Primatesta, P., editors. Health Survey for England. The health of young people '95 – 97 Vol 1, Findings. London: The Stationery Office; 1998. p. 191-221.
28. Turner, CF.; Lessler, JT.; Devore, J. Effects of modes of administration and working on reporting of drug use. In: Turner, CF.; Lessler, JT.; Gfroerer, J., editors. Survey Measurement of Drug Use: Methodological Studies. Rockville (MD): National Institute on Drug Abuse; 1992. p. 177-220.
29. Aquilino WS. Interview mode effects in surveys of drug and alcohol use: A field experiment. Public Opin. Q. 1994; 58(2):210–240.
30. Kim S, Apelberg BJ, Avila-Tang E, et al. Utility and cutoff value of hair nicotine as a biomarker of longterm tobacco smoke exposure, compared to salivary cotinine. Int. J. Environ. Res. Public. Health. 2014; 11(8):8368–8382. [PubMed: 25153466]
31. Lund HM, Gjerde H, de Courtade SM, Oiestad EL, Christophersen AS. A Norwegian study of the suitability of hair samples in epidemiological research of alcohol, nicotine and drug use. J. Anal. Toxicol. 2013; 37(6):362–368. [PubMed: 23689070]

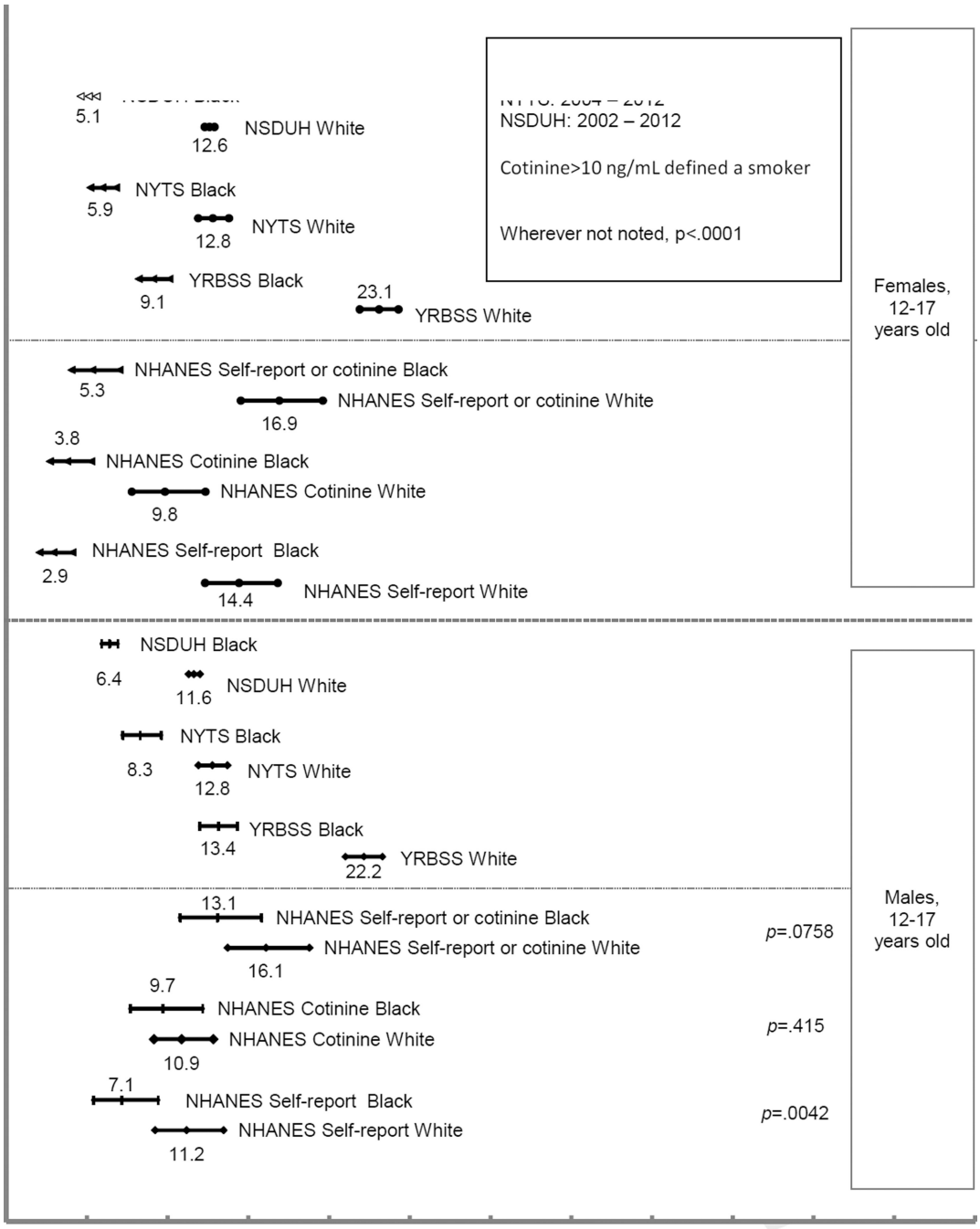

Figure 1.

Cigarette smoking prevalence and 95% confidence intervals among 12 – 17 years old by gender and race in four U.S. national surveys.

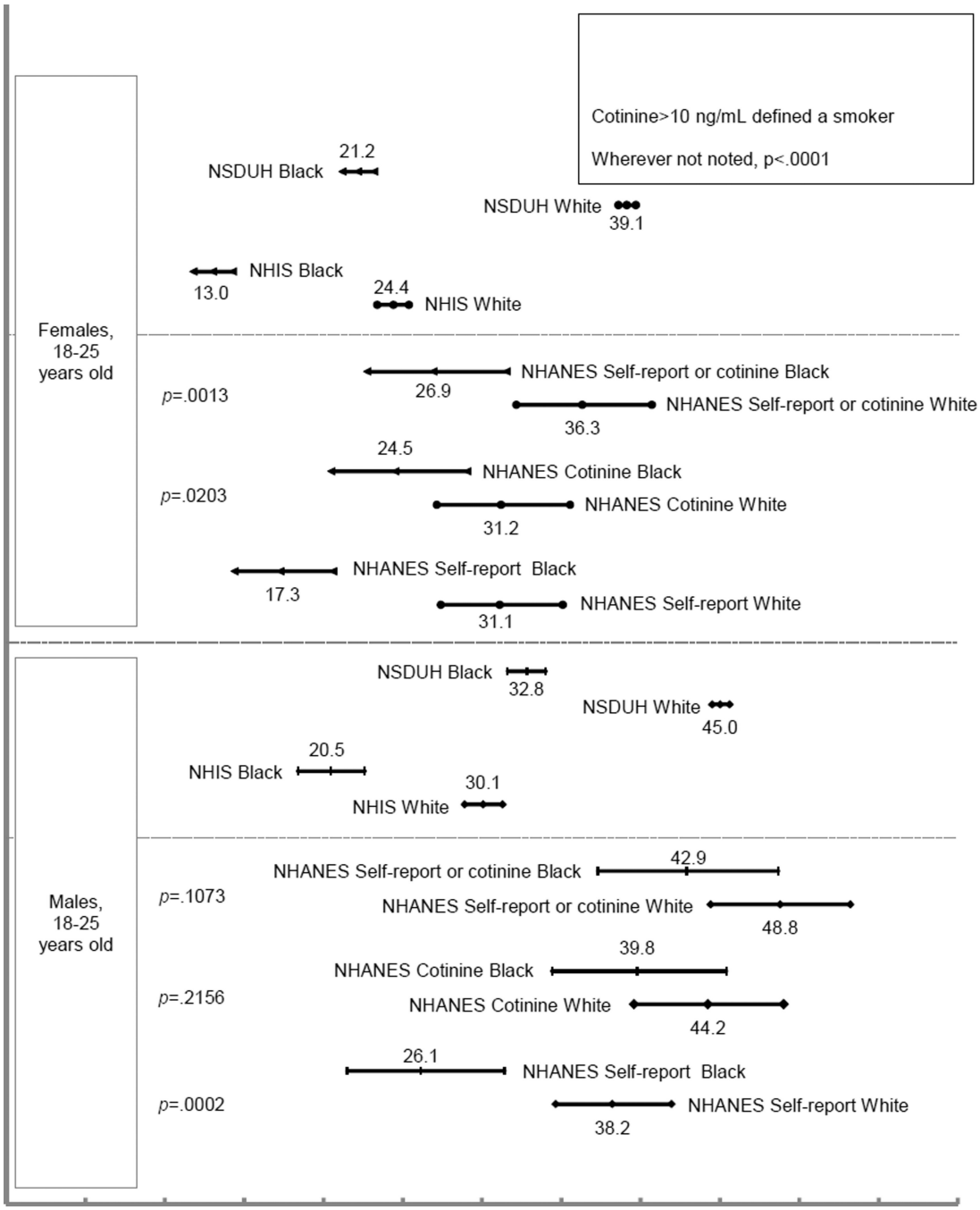

Figure 2.

Cigarette smoking prevalence and 95% confidence intervals among 18 – 25 years old by gender and race in three U.S. national surveys.

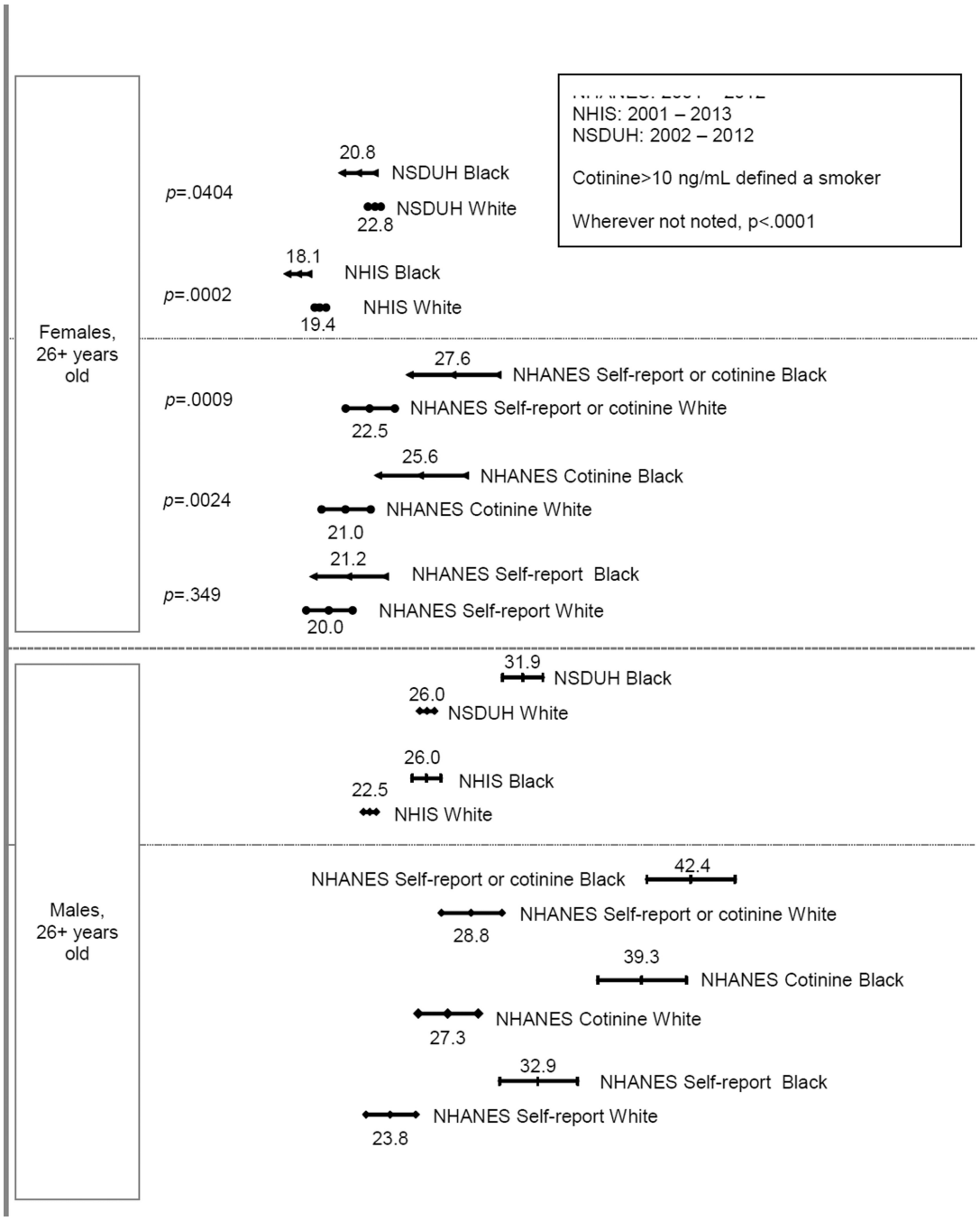

Figure 3.

Cigarette smoking prevalence and 95% confidence intervals among 26+ years old by gender and race in three U.S. national surveys

Nicotine Tob Res. Author manuscript; available in PMC 2017 April 01.

Table 1

Demographic distribution of study participants by sex, race, and age by U.S. National Surveys, 2001 – 2013

	NHANES (2001–2012)		YRBSS* (2001–2013)		NYTS* (2004–2012)		NSDUH (2002–2012)		NHIS (2001–2013)	
Characteristic:	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Race/ethnicity										
- Non-Hispanic white	18,024	85.33	36,670	80.9	44,349	80.18	3,91,745	85.26	2,36,127	85.92
- Non-Hispanic black	9,963	14.67	17,238	19.1	17,038	19.82	77,737	14.74	56,107	14.08
Gender										
- Male	13,799	48.13	26,162	50.09	30,099	49.84	2,25,135	48.1	1,27,988	47.75
- Female	14,188	51.87	27,680	49.91	31,035	50.16	2,44,347	51.9	1,64,246	52.25
Age										
- 12–17	4,728	9.74	53,908	100	61,387	100	1,48,739	9.39	--	--
- 18–25	3,752	12.36	--	--	--	--	1,52,594	12.41	31,246	13.66
- 26 and older	19,507	77.9	--	--	--	--	1,68,149	78.19	2,60,988	86.34
Total	27,987	100	53,908	100	61,387	100	4,69,482	100	2,92,234	100

*Age range for YRBSS and NYTS respondents varied. Respondents aged less than 12 and more than 17 years were excluded from youth analyses.

NHANES: National Health and Nutrition Examination Survey
YRBSS: Youth Risk Behavioral Surveillance System
NYTS: National Youth Tobacco Survey
NSDUH: National Survey on Drug Use and Health
NHIS: National Health Interview Survey