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## **Population Assessment of Tobacco and Health (PATH) Study [United States] Public-Use Files**

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*United States Department of Health and Human Services. Food and Drug Administration. Center for Tobacco Products*

Data and Biospecimen Collection Nonresponse Bias Analysis for Wave 2

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## **PATH Study Wave 2 Data and Biospecimen Collection Nonresponse Bias Analysis Report**



**January 5, 2018**

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# Introduction

# 1

Westat prepared this report as a reference document for researchers using the Population Assessment of Tobacco and Health (PATH) Study interview and biomarker data. This report focuses on Wave 2 response rates and potential nonresponse biases for select demographic and outcome measures; a similar report for Wave 1 is also available (the Wave 1 Data and Biospecimen Collection Nonresponse Bias Analysis Report).

This report is organized as follows: Section 1 includes a summary of the PATH Study sample design as well as the findings presented in the PATH Study Wave 1 Data and Biospecimen Collection Nonresponse Bias Analysis Report on the Wave 1 response rates and nonresponse bias analysis. Section 2 presents the Wave 2 response rates, how well the responding sample represented the population, and the statistical approach for addressing nonresponse. Section 3 summarizes the findings and considers their implications.

## 1.1 Sample Design

This section provides an overview of the sample design for the PATH Study. Information on the study background and overall design is also provided in Chapter 2 of the PATH Study Restricted Use Files User Guide.

### 1.1.1 Overview of Sample Design for Wave 1

The target population of the PATH Study at Wave 1 was the civilian, non-institutionalized U.S. population (i.e., including the 50 states and the District of Columbia) 9 years of age and older at that point in time. Thus, active duty military personnel and those residing in an institutional setting were excluded. College students living away from home during the school year were identified as members of their permanent residence (e.g., parents' home). For Wave 1, a four-stage stratified area probability sample design was used with a two-phase design for sampling the adult cohort at the final stage. The sampling rates for adults varied by age, race, and tobacco-use status. At the first stage, a stratified sample of geographical primary sampling units (PSUs) was selected, in which a

PSU was a county or group of counties. For the second stage, within each selected PSU, smaller geographical segments (consisting of one or more census blocks) were formed and then a sample of these segments was drawn. At the third stage, a sample of addresses within sampled segments was drawn from listings of addresses; the main source of these addresses was obtained from the Postal Service (USPS) Computerized Delivery Sequence Files (CDSFs). The CDSFs provide very high coverage of the residential addresses in the U.S.

The fourth stage was the random selection of persons within sampled households. A roster of all the members in the sampled household was constructed using the Household Screener. An adult household member, the household screener respondent, was asked to list members of the household and provide demographic as well as, for each adult, tobacco-use information. This information was used in sampling three main groups of interest:

- Adults (up to two adults per household);
- Children ages 12 to 17 (referred to as “youth,” generally up to two per household); and
- Children ages 9 to 11 (referred to as “shadow youth,” generally up to two per household) to be enrolled in the youth cohort in later waves of the study on reaching 12 years of age.

Two-phase sampling was used for adult selection due to potential misreporting by the household screener respondent of the tobacco-use status of other adult household members. The Phase 1 sampling depended on the age, race, and tobacco-use information obtained from the Household Screener. The Phase 2 sampling was based on self-reported age, race, and tobacco-use status, obtained by interviewing the individuals sampled at Phase 1. The sampling rates for the two phases were designed to achieve large enough sample sizes for young adults (ages 18 to 24) and adult tobacco users of all ages.

The PATH Study completed 32,320 Adult Interviews and 13,651 Youth Interviews in Wave 1. All Adult Interview respondents were asked to provide urine and blood specimens; 21,801 provided a urine specimen and 14,520 provided a blood specimen.

### **1.1.2 Overview of Sample Design for Wave 2**

Wave 2 of the PATH Study was the first follow-up wave for participants in Wave 1. The target population for Wave 2 was the Wave 1 target population residing in the U.S. at Wave 2 with the

exception of those who were incarcerated. Thus, Wave 1 respondents who later joined the military or entered a health care institution (e.g., nursing home) were members of the target population and eligible for Wave 2 data collection for the PATH Study. At Wave 2, only Wave 1 respondents who died, resided outside the U.S., or were in a correctional facility were ineligible for a Wave 2 interview.

Attempts were made to contact the Wave 1 youth and adult respondents as well as members of the shadow youth sample established at Wave 1. Youth from the shadow youth sample who turned age 12 by Wave 2 (aged-up youth) and were permitted by a parent or guardian to participate in the study were asked for assent to be interviewed for the first time at Wave 2. Similarly, persons in the youth sample at Wave 1 who reached age 18 by Wave 2 (aged-up adults) were asked to complete the Adult Interview as well as to provide urine and blood specimens.

The PATH Study completed 28,362 Adult Interviews and 12,172 Youth Interviews in Wave 2. The study subsampled 14,465 adults for urine collection from adults who provided urine at Wave 1; among these subsampled adults, 12,561 completed the Wave 2 interview and 12,109 provided a urine specimen again at Wave 2. The study also collected urine and blood specimens from consenting aged-up adults (1,587 urine specimens and 908 blood specimens).

## **1.2 Summary of Wave 1 Findings**

The PATH Study Wave 1 interview data and biospecimen collections started on September 12, 2013 and ended on December 14, 2014. The PATH Study Wave 1 Data and Biospecimen Collection Nonresponse Bias Analysis Report provides detailed findings on the Wave 1 response rates, representativeness of the responding sample, and the statistical approach for addressing nonresponse. This section summarizes those findings.

### **1.2.1 Wave 1 Response Rates**

Section 5.1.1 of the PATH Study Restricted Use Files User Guide describes the weight construction for Wave 1 of the PATH Study, and a brief summary also appears in Section 2.3.1 of this report. Inverse probability of selection (IPS) weights were used to compute the Wave 1 weighted response rates and to examine potential nonresponse bias. The final raked weights from Wave 1 were then

used to demonstrate the effectiveness of the nonresponse weighting adjustments in reducing potential nonresponse bias.

The weighted response rates for the PATH Study Household Screener, Adult and Youth Interviews, and biospecimen collections in Wave 1 are provided in Table 1-1.

**Table 1-1. Summary of PATH Study Wave 1 response rates**

<b>Collection</b>	<b>Unweighted response rate, based on Wave 1 sample</b>	<b>Weighted response rate, based on Wave 1 sample</b>
Household Screener	54.1%	54.0%
Adult Interview	74.8%	74.0%
Youth Interview	78.2%	78.4%
Urine	67.5%	63.6%
Blood	44.9%	43.0%

Differences in weighted response rates were modest for tobacco-use status and demographic subgroups (not shown in Table 1-1). The largest differential weighted response rate, 11.5 percentage points, was for the age of adults who provided urine specimens, which suggests a heightened potential for nonresponse bias. Notably, the differential weighted response rates for blood collection, ranging from 3.2 percentage points for ethnicity to 5.8 percentage points for race, were more consistent with those of other PATH Study collections at Wave 1.

## **1.2.2 Representativeness of Wave 1 Responding Sample**

A nonresponse bias analysis indicated that estimates of select demographic and tobacco-use variables calculated from the PATH Study Wave 1 sample with the inverse probability of selection weights were comparable to those produced by national cross-sectional surveys. However, the completed household screening interviews from the Wave 1 sample appeared to underrepresent single- and two-person households relative to the 1-year 2013 American Community Survey (ACS) counts. The estimated percentage of persons who were non-Black and 25 years of age or older, from the household rosters, was also smaller than the corresponding estimate from the ACS.

Compared to the 1-year 2013 ACS, persons of “other” race and males were underrepresented among Wave 1 Adult Interview respondents and those providing blood or urine specimens, while adults in the age range of 18 to 24 or 25 to 44 were overrepresented among interview respondents

and those providing urine specimens. Hispanics were overrepresented among Adult Interview respondents and urine providers, but not among those who provided blood specimens.

When compared to national cross-sectional surveys that measure adult tobacco use [the Tobacco Use Supplement to the Current Population Survey (TUS-CPS), the National Health Interview Survey (NHIS), the National Health and Nutrition Examination Survey (NHANES), and the National Survey on Drug Use and Health (NSDUH)], estimates of adult cigarette smoking from the PATH Study Wave 1 sample were roughly in the middle of the range of estimates for cigarette smoking. There is no indication of nonresponse bias with respect to this measure.

Estimates of demographic characteristics of youth in Wave 1 aligned with the 1-year 2013 ACS for most demographic characteristics. However, the estimated percentage of youth who were Hispanic from the PATH Study was significantly higher than the corresponding percentage estimated from the ACS.

PATH Study estimates of youth cigarette smoking from the Wave 1 sample were at the low end of estimates in comparison with national cross-sectional surveys that measure youth tobacco use (NHANES, NSDUH, and the National Youth Tobacco Survey (NYTS)). However, estimates based on these comparison surveys were from 2011 through 2013 while those based on the PATH Study were from September 2013 through December 2014, and evidence suggests that the use of traditional cigarettes is declining among youth. Although the difference in the time periods of the surveys is not by itself large enough to account for the different estimates, it is one of a number of factors that may explain the different estimates.

### **1.2.3 Statistical Approach for Addressing Wave 1 Nonresponse**

The approach used to reduce potential nonresponse bias in the PATH Study is to adjust the weights of respondents at the household, adult, and youth levels to account for nonrespondents. Results of applying this approach to the Wave 1 sample indicated the nonresponse adjustments were successful for reducing the discrepancy between the PATH Study estimates and 1-year estimates from the 2013 ACS with respect to demographic characteristics. Raked weights used for adults responding to the Adult Interview reduced differences between the PATH Study and ACS for adults providing biospecimens as well, for sex and ethnicity. The raking did not reduce differences in the age distributions for the persons providing blood specimens, however. Additional sets of nonresponse-adjusted weights were therefore created for the persons who provided biospecimens, separately for

urine and blood. Further biospecimen weights were created for the sets of person for whom urine and/or blood specimens were sent for laboratory analysis.

Estimates of adult cigarette smoking using the IPS weights (before nonresponse adjustment) were in line with estimates from other surveys; agreement in these estimates was preserved using the nonresponse-adjusted weights. Weighting adjustments for youth corrected for the slight overestimate of the percentage of Hispanics among youth in Wave 1 but had little effect on the other demographic characteristics (i.e., IPS-weighted estimates already agreed with the ACS values) and estimates of youth cigarette smoking.

The PATH Study Wave 2 interview data and biospecimen collections started on October 23, 2014 and ended on October 30, 2015.<sup>1</sup> This section presents findings on the response rates for Wave 2, the representativeness of the responding sample, and the study's statistical approach for addressing nonresponse.

## 2.1 Wave 2 Response Rates

This section summarizes the Adult Interview and Youth Interview response rates for Wave 2 of the PATH Study, as well as the response rates for the biospecimen collections. The Wave 2 interview response rates are conditional on Wave 1 participation; the Wave 2 biospecimen response rates are conditional on response to the Wave 2 Adult Interview. The PATH Study Wave 2 Adult Interview and Youth Interview collected extensive self-report information through in-person data collection using audio computer-assisted self-interviewing (ACASI). The Adult Interview gathered information from adults (18 years old and older) about tobacco-use behaviors, attitudes, knowledge, and health conditions, as well as information on demographics, environmental factors, family and peer influences, substance use, and general physical and mental health status. The Youth Interview gathered information from youth (12 to 17 years old) on topics similar to those in the Adult Interview. Youth were asked about their tobacco use and attitudes about tobacco, and for information on demographics, environmental factors, family and peer influences, substance use, and mental health. The PATH Study completed 28,362 Adult Interviews and 12,172 Youth Interviews in Wave 2.

Wave 2 interview response rates were calculated separately for the following subgroups:

- Continuing adults: persons who completed a Wave 1 Adult Interview and were eligible for the Wave 2 Adult Interview.

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<sup>1</sup> A small number of blood collections for Wave 2 were completed in November 2015.



- Continuing youth: persons who completed a Wave 1 Youth Interview and were known or estimated to be age 17 or younger at Wave 2, and thus were eligible for the Wave 2 Youth Interview.
- Aged-up adults: persons who completed a Wave 1 Youth Interview and were known or estimated to have reached age 18 at Wave 2, and thus were eligible for the Wave 2 Adult Interview.
- Aged-up youth: Wave 1 shadow youth who were known or estimated to have reached age 12 at Wave 2, and thus were eligible for the Wave 2 Youth Interview.

A Wave 1 participant who was a nonrespondent at Wave 2 does not have a Wave 2 interview date, so his/her Wave 2 age was determined using the date of birth or age information collected in Wave 1 as well as any updated information obtained between Waves 1 and 2. Each Wave 1 participant had an “anniversary month” for Wave 2, which was approximately 1 year after the Wave 1 interview was completed (or, for shadow youth, 1 year after parental permission was obtained). The age classification date for a Wave 2 nonrespondent is 2 months after the last day of his/her anniversary month or the scheduled end date of the Wave 2 data collection (October 31, 2015), whichever is earlier.<sup>2</sup> Age as of the age classification date was used to categorize Wave 1 youth who were nonrespondents in Wave 2. That is, a Wave 1 youth who did not respond in Wave 2 was classified as a continuing youth if his/her age was determined to be 17 or younger on the age classification date; otherwise he/she was classified as an aged-up adult. A similar classification rule was used for persons who were shadow youth at Wave 1. A Wave 1 shadow youth who did not respond in Wave 2 was classified as an aged-up youth if he/she was determined to have attained age 12 on or before the age classification date.

Table 2-1 displays the case counts according to their adult/youth/shadow youth classification in Wave 1 and their classification in Wave 2.

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<sup>2</sup> The purpose of the “anniversary month” concept was to provide a reasonable target period for completing the Wave 2 interview that would improve the likelihood of the interviews taking place 1 year after each individual’s Wave 1 interview, by giving the field interviewers a target for their data collection efforts. The Wave 2 anniversary month is defined as the calendar month containing the date of the earliest Wave 1 interview completed by a member of the study participant’s household, 1 year after the Wave 1 interview. Given the challenges of contacting and scheduling the interviews, the target period encompassed 4 months, starting with the month before the anniversary month and ending 2 months after the anniversary month; however, if necessary, efforts to complete the interview could continue past this period. In theory, data collection efforts for nonrespondents could continue up to the last day of the data collection period; because a reasonable cutoff date was needed for defining the ages of nonrespondents, the end of the target period was chosen as a consistent and justifiable standard.

**Table 2-1. Case counts by Wave 1 adult/youth/shadow youth classification and Wave 2 adult/youth/shadow youth classification**

Wave 1 classification	Wave 2 classification	Unweighted count
Adult	Continuing adult	32,320
Youth	Aged-up adult	2,239
Youth	Continuing youth	11,412
Shadow youth	Aged-up youth	2,555
Shadow youth	Shadow youth	4,652

The Wave 2 interview response rates are presented for demographic and tobacco-use subgroups defined using Wave 1 characteristics. This is necessary because Wave 2 characteristics are not available for Wave 2 nonrespondents. All persons asked to provide a biospecimen at Wave 2 completed the Wave 2 Adult Interview so the subgroup definitions for the biospecimen response rates use Wave 2 data for characteristics where information was updated (age and tobacco-use status), and Wave 1 data otherwise.

### 2.1.1 Response Rates for Continuing Adults and Continuing Youth

This section reports interview response rates for continuing adults, who completed the Adult Interview at Wave 1, and continuing youth, who completed the Youth Interview at Wave 1 and remained eligible for the Youth Interview at Wave 2.

#### **Method**

The response rate for Wave 2 was calculated as the ratio of the number of Wave 2 complete cases to the number of cases eligible for the Wave 2 interview, which is essentially the American Association for Public Opinion Research (AAPOR) Response Rate 3 (RR3) (AAPOR, 2015).

The response rate for continuing adults, denoted as  $RR_{CA}$ , was calculated using the equations below:

$$RR_{CA} = C_{CA} / (C_{CA} + N_{CA} + e_{CA} * U_{CA})$$

$$e_{CA} = (C_{CA} + N_{CA}) / (C_{CA} + N_{CA} + I_{CA})$$

where

- $C_{CA}$  = number of Wave 2 completed cases among continuing adults;
- $N_{CA}$  = number of Wave 2 nonrespondents known to be eligible among continuing adults;
- $U_{CA}$  = number of Wave 2 nonrespondents with eligibility unknown among continuing adults;
- $I_{CA}$  = number of Wave 2 ineligible cases among continuing adults; and
- $e_{CA}$  = estimated proportion of nonrespondents with unknown eligibility who were eligible among continuing adults.

The response rate for continuing youth, denoted as  $RR_{CY}$ , was calculated using the equations below:

$$RR_{CY} = C_{CY} / (C_{CY} + N_{CY} + e_{CY} * U_{CY})$$

$$e_{CY} = (C_{CY} + N_{CY}) / (C_{CY} + N_{CY} + I_{CY})$$

where

- $C_{CY}$  = number of Wave 2 completed cases among continuing youth;
- $N_{CY}$  = number of Wave 2 nonrespondents known to be eligible among Wave 1 youth respondents who were age 17 or younger on the age classification date;
- $U_{CY}$  = number of Wave 2 nonrespondents with eligibility unknown among Wave 1 youth respondents who were age 17 or younger on the age classification date;
- $I_{CY}$  = number of Wave 2 ineligible cases among Wave 1 youth respondents who were age 17 or younger on the age classification date; and
- $e_{CY}$  = estimated proportion of nonrespondents with unknown eligibility who were eligible among Wave 1 youth respondents who were age 17 or younger on the age classification date.

Both unweighted and weighted response rates were calculated. For the unweighted response rates, the numbers of cases used in the calculations are the actual case counts. For the weighted response rates, the numbers of cases used in the calculations are the sums of Wave 1 IPS weights, in accordance with AAPOR guidance (see AAPOR, 2015, p.51). The unweighted response rate measures the success of field operations in obtaining responses from the sample group. The weighted response rate estimates the proportion of the population represented by the sample group that would have responded if they all had been asked to participate in the study, and provides a measure of the potential impact of nonresponse on the quality of weighted estimates.

## Results

Tables 2-2 and 2-3 provide unweighted and weighted Wave 2 response rates by Wave 1 characteristics for continuing adults and continuing youth. In addition to the overall row, each table includes rows on age, sex, race, and ethnicity subgroups based on self-reported data from the Wave 1 Interviews. Both tables also include rows on tobacco-use status. Persons with missing values for these characteristics from Wave 1 were excluded from the response rate calculation for the particular characteristic.

**Table 2-2. PATH Study Wave 2 response rates by Wave 1 characteristics: Adult Interview (continuing adults)**

Characteristic at Wave 1 <sup>a</sup>	C <sub>CA</sub> : Adult Interview, completed (n)	I <sub>CA</sub> : Ineligible (n)	N <sub>CA</sub> : Nonresponse known to be eligible (n)	U <sub>CA</sub> : Nonresponse with unknown eligibility (n)	Unweighted RR <sub>CA</sub> : Unweighted response rate for Wave 2 (%)	Weighted RR <sub>CA</sub> : Weighted response rate for Wave 2 (%)
Overall	26,447	275	4,047	1,551	82.6	83.1
Tobacco-use status <sup>b</sup>						
Current established user	11,682	146	1,753	788	82.2	82.1
Not current established user	14,038	113	2,136	728	83.1	83.8
Age						
18-24	7,325	45	1,097	645	80.8	81.2
25-44	9,226	60	1,351	632	82.3	82.6
45-64	7,375	87	1,110	246	84.5	84.6
65+	2,516	83	483	28	83.1	82.9
Sex						
Male	13,069	173	2,167	900	81.0	81.8
Female	13,555	102	1,875	650	84.1	84.2
Race						
White alone	18,989	199	3,086	970	82.4	83.3
Black alone or in combination with some other race	4,644	40	516	338	84.5	84.4
Other	2,169	23	341	193	80.3	80.2
Ethnicity						
Hispanic	4,526	45	580	385	82.5	82.7
Non-Hispanic	21,530	222	3,391	1,145	82.6	83.3

<sup>a</sup> The characteristics are as reported in the Adult Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> A tobacco user is defined as someone who uses one or more of the tobacco products covered by the Wave 1 Adult Interview. A 'current established user' of a given tobacco product is someone who currently uses the product every day or some days and: for cigarettes, has smoked at least 100 cigarettes in their lifetime and, for any other tobacco product, has reported they ever used that product regularly. The products covered by the Wave 1 Adult Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, and dissolvable tobacco.

**Table 2-3. PATH Study Wave 2 response rates by Wave 1 characteristics: Youth Interview (continuing youth)**

Characteristic at Wave 1 <sup>a</sup>	C <sub>cy</sub> : Youth Interview, completed (n)	I <sub>cy</sub> : Ineligible (n)	N <sub>cy</sub> : Nonresponse known to be eligible (n)	U <sub>cy</sub> : Nonresponse with unknown eligibility (n)	Unweighted RR <sub>cy</sub> : Unweighted response rate for Wave 2 (%)	Weighted RR <sub>cy</sub> : Weighted response rate for Wave 2 (%)
Overall	10,081	15	964	352	88.5	88.4
Tobacco-use status <sup>b</sup>						
Ever user	1,665	4	170	91	86.5	86.6
Never user	8,006	11	737	245	89.1	89.0
Age						
12-13	4,164	6	381	133	89.0	88.9
14-17	5,917	9	582	219	88.1	88.0
Sex						
Male	5,164	11	510	155	88.6	88.5
Female	4,892	4	445	196	88.4	88.4
Race						
White alone	6,497	7	662	190	88.4	88.4
Black alone or in combination with some other race	1,882	2	149	107	88.0	87.7
Other	1,143	5	95	36	89.7	89.4
Ethnicity						
Hispanic	2,907	7	244	131	88.6	88.5
Non-Hispanic	6,982	7	698	213	88.5	88.4

<sup>a</sup> The characteristics are as reported in the Youth Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> An 'ever user' is someone who has ever used one or more of the tobacco products covered by the Wave 1 Youth Interview. A 'never user' is someone who has never used any of those tobacco products. Ever use of a tobacco product is defined as having ever used the product, even one or two times. The products covered by the Wave 1 Youth Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, dissolvable tobacco, bidis, and kreteks.

The weighted response rates are 83.1 percent for continuing adults and 88.4 percent for continuing youth. The unweighted response rates are approximately the same as the weighted response rates. For continuing adults, it appears that females had higher response rates than males, 18- to 24-year-olds had lower response rates than older age groups, adults who identified as Black or White alone had higher response rates than those of "other" race, and current established tobacco users at Wave 1 had slightly lower response rates than those who were not. The response rates are similar for most subgroups of continuing youth, but are slightly higher among Wave 1 never users of tobacco. Slight variation in response rates by subgroups is to be expected in large-scale data collection efforts. Although there is some variability among the response rates for the various subgroups of interest, none of the subgroup differences in Tables 2-2 and 2-3 suggests a reason for concern.

## 2.1.2 Response Rates for Aged-up Adults and Aged-up Youth

This section reports response rates for aged-up adults, who completed the Youth Interview at Wave 1 and were eligible for the Adult Interview at Wave 2, and aged-up youth, who were shadow youth at Wave 1 and were eligible for the Youth Interview at Wave 2. The Wave 2 Youth Interview was the first interview for responding aged-up youth, and aged-up adult respondents completed the Adult Interview for the first time.

### **Method**

The methods described in Section 2.1.1 for calculating the response rates were also used to calculate the response rates for aged-up adults and aged-up youth. For aged-up adults, the response rate, denoted as  $RR_{AUA}$ , was calculated using the equations below:

$$RR_{AUA} = C_{AUA} / (C_{AUA} + N_{AUA} + e_{AUA} * U_{AUA})$$

$$e_{AUA} = (C_{AUA} + N_{AUA}) / (C_{AUA} + N_{AUA} + I_{AUA})$$

where

- $C_{AUA}$  = number of Wave 2 completed cases among persons who completed the Youth Interview at Wave 1 and were administered the Adult Interview at Wave 2;
- $N_{AUA}$  = number of Wave 2 nonrespondents known to be eligible among Wave 1 youth respondents who attained age 18 by the age classification date;
- $U_{AUA}$  = number of Wave 2 nonrespondents with eligibility unknown among Wave 1 youth respondents who attained age 18 by the age classification date;
- $I_{AUA}$  = number of Wave 2 ineligible cases among Wave 1 youth respondents who attained age 18 by the age classification date; and
- $e_{AUA}$  = estimated proportion of nonrespondents with unknown eligibility who were eligible among Wave 1 youth respondents who attained age 18 by the age classification date.

The response rate for aged-up youth, denoted as  $RR_{AUY}$ , was calculated using the equations below:

$$RR_{AUY} = C_{AUY} / (C_{AUY} + N_{AUY} + e_{AUY} * U_{AUY})$$

$$e_{AUY} = (C_{AUY} + N_{AUY}) / (C_{AUY} + N_{AUY} + I_{AUY})$$

where

- $C_{AU Y}$  = number of Wave 2 completed cases among persons who were shadow youth at Wave 1 and were administered the Youth Interview at Wave 2;  
 $N_{AU Y}$  = number of Wave 2 nonrespondents known to be eligible among Wave 1 shadow youth who were age 12 by the age classification date;  
 $U_{AU Y}$  = number of Wave 2 nonrespondents with eligibility unknown among Wave 1 shadow youth who were age 12 by the age classification date;  
 $I_{AU Y}$  = number of Wave 2 ineligible cases among Wave 1 shadow youth who were age 12 by the age classification date; and  
 $e_{AU Y}$  = estimated proportion of nonrespondents with unknown eligibility who were eligible among Wave 1 shadow youth who were age 12 by the age classification date.

As was done for continuing adults and youth, both unweighted and weighted response rates were calculated for aged-up adults and youth. For the unweighted response rates, the numbers of cases used in the calculations are the actual case counts. For the weighted response rates, the numbers of cases used in the calculations are the sums of Wave 1 IPS weights (AAPOR, 2015).

## Results

Table 2-4 provides Wave 2 response rates by Wave 1 characteristics for the Adult Interview for aged-up adults, and Table 2-5 provides Wave 2 response rates by Wave 1 characteristics for the Youth Interview for aged-up youth. In addition to the overall row, each table includes rows on sex, race, and ethnicity subgroups; Table 2-4 also includes rows on tobacco-use status (which is not available for aged-up youth). There are no rows corresponding to age subgroups in Table 2-4 or Table 2-5, because most of the aged-up adults are 18 years old and most of the aged-up youth are 12 years old. Information from the Wave 1 Youth Interview was used to define the demographic and tobacco-use characteristics for the aged-up adults, and information from the Wave 1 Household Screener was used to define the demographic characteristics for the aged-up youth. Persons with missing values for these characteristics were excluded from the response rate calculation for that characteristic.

**Table 2-4. PATH Study Wave 2 response rates by Wave 1 characteristics: Adult Interview (aged-up adults)**

Characteristic at Wave 1 <sup>a</sup>	CAUA: Adult Interview, completed (n)	IAUA: Ineligible (n)	NAUA: Nonresponse known to be eligible (n)	UAUA: Nonresponse with unknown eligibility (n)	Unweighted RRAUA: Unweighted response rate for Wave 2 (%)	Weighted RRAUA: Weighted response rate for Wave 2 (%)
Overall	1,915	9	219	96	85.9	85.7
Tobacco-use status <sup>b</sup>						
Ever user	810	3	80	46	86.6	86.2
Never user	1,061	6	133	47	85.5	85.4
Sex						
Male	956	6	123	46	85.0	84.7
Female	956	2	96	50	86.8	86.6
Race/ethnicity						
Non-Hispanic White alone	954	3	136	37	84.7	84.5
Other	944	6	83	58	87.0	86.8

<sup>a</sup> The characteristics are as reported in the Youth Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> An 'ever user' is someone who has ever used one or more of the tobacco products covered by the Wave 1 Youth Interview. A 'never user' is someone who has never used any of those tobacco products. Ever use of a tobacco product is defined as having ever used the product, even one or two times. The products covered by the Wave 1 Youth Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, dissolvable tobacco, bidis, and kreteks.

**Table 2-5. PATH Study Wave 2 response rates by Wave 1 characteristics: Youth Interview (aged-up youth)**

Characteristic at Wave 1 <sup>a</sup>	CAUY: Youth Interview, completed (n)	IAUY: Ineligible (n)	NAUY: Nonresponse known to be eligible (n)	UAUY: Nonresponse with unknown eligibility (n)	Unweighted RRAUY: Unweighted response rate for Wave 2 (%)	Weighted RRAUY: Weighted response rate for Wave 2 (%)
Overall	2,091	5	367	92	82.0	82.1
Sex						
Male	1,055	3	179	58	81.7	81.7
Female	1,036	2	188	34	82.4	82.5
Race/ethnicity						
Non-Hispanic White alone	1,008	2	190	25	82.4	82.6
Other	1,078	3	176	67	81.6	81.5

<sup>a</sup> The characteristics are as reported in the Household Screener at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

The weighted response rates are 85.7 percent for aged-up adults and 82.1 percent for aged-up youth. For both aged-up adults and aged-up youth, the variability of response rates by subgroups is small.



For aged-up adults, the differences in response rates by subgroup range from 0.8 percentage point for tobacco-use status to 2.3 percentage points for race/ethnicity. For aged-up youth, the differences in response rates by subgroup are 0.8 percentage point for sex and 1.1 percentage points for race/ethnicity.

### 2.1.3 Biospecimen Collections

This section addresses the response rates for the collection of urine and blood specimens from continuing adults and aged-up adults who completed a Wave 2 Adult Interview and were asked to provide a specimen. Biospecimens are intended to provide a basis for the assessment of between-person differences and within-person changes in markers of tobacco exposure, and to detect and compare indicators of conditions and related disease processes associated with the use of tobacco products. Field interviewers collected the urine specimens; on separate visits, phlebotomists collected the blood specimens. Among Wave 2 Adult Interview respondents, a subsample of continuing adults were asked to provide a urine specimen and all aged-up adults were asked to provide urine and blood specimens.

#### **Method**

Tables 2-6 and 2-7 provide overall unweighted response rates<sup>3</sup> for the biospecimen collections, and response rates by tobacco-use status and demographic subgroups, for continuing adults and aged-up adults, respectively. The response rates are conditional on a completed Wave 2 Adult Interview and the adult having been asked to provide a specimen. The response rates were calculated using the following formula:

$$\text{RRU} = (\text{Number of adults who provided a specimen}) / (\text{Number of adults from whom a specimen was requested})$$

This is the same formula used to compute the biospecimen response rates for Wave 1. However, all Adult Interview respondents were asked to provide urine and blood biospecimens in Wave 1. The denominator for the Wave 2 urine response rate in Table 2-6 is the 12,561 continuing adults who

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<sup>3</sup> Weighted response rates are not provided because the subset of continuing adults asked to provide a urine specimen at Wave 2 does not represent a readily interpretable portion of the population. Similarly, while most aged-up adults were age 18 at Wave 2, some were older due to the actual time elapsed between the Wave 1 and Wave 2 interviews.

completed the Wave 2 Adult Interview and were asked for a urine specimen. The denominator for the Wave 2 urine and blood response rates in Table 2-7 is the 1,915 aged-up adults who completed the Wave 2 Adult Interview.

**Table 2-6. PATH Study Wave 2 response rates by respondent characteristics: Urine collection (continuing adults)**

Characteristic <sup>a</sup>	A: Adults requested to provide urine (n)	Urine	
		B: Collected (n)	Unweighted response rate for Wave 2 <sup>c</sup> (%)
Overall	12,561	12,109	96.4
Tobacco-use status <sup>b</sup>			
Current established user	7,973	7,724	96.9
Not current established user	4,529	4,329	95.6
Age			
18-24	3,322	3,193	96.1
25-44	4,944	4,787	96.8
45-64	3,450	3,325	96.4
65+	845	804	95.1
Sex			
Male	6,484	6,225	96.0
Female	6,069	5,878	96.9
Race			
White alone	8,849	8,537	96.5
Black alone or in combination	2,399	2,315	96.5
Other	1,031	989	95.9
Ethnicity			
Hispanic	2,123	2,024	95.3
Non-Hispanic	10,266	9,924	96.7

<sup>a</sup> The sex, race, and ethnicity characteristics are as reported in the Wave 1 Adult Interview. The age information and tobacco-use status are as reported in the Wave 2 Adult Interview. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> A tobacco user is defined as someone who uses one or more of the following tobacco products covered by the Wave 2 Adult Interview: cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-products, and dissolvable tobacco. A 'current established user' of a given tobacco product is someone who currently uses the product every day or some days and: for cigarettes, has smoked at least 100 cigarettes in their lifetime and, for any other tobacco product, has reported they ever used that product regularly.

<sup>c</sup> Response rate = B/A.

Table 2-7. PATH Study Wave 2 response rates by respondent characteristics: Biospecimen collections (aged-up adults)

Characteristic <sup>a</sup>	A: Adult Interviews completed (n)	Urine		Blood	
		B: Collected (n)	Unweighted response rate for Wave 2 <sup>c</sup> (%)	B: Collected (n)	Unweighted response rate for Wave 2 <sup>c</sup> (%)
Overall	1,915	1,587	82.9	908	47.4
Tobacco-use status <sup>b</sup>					
Current established user	328	295	89.9	177	54.0
Not current established user	1,577	1,285	81.5	727	46.1
Sex					
Male	956	792	82.8	457	47.8
Female	956	792	82.8	450	47.1
Race					
White alone	1,257	1,034	82.3	596	47.4
Black alone or in combination	347	299	86.2	161	46.4
Other	212	173	81.6	109	51.4
Ethnicity					
Hispanic	515	426	82.7	251	48.7
Non-Hispanic	1,383	1,145	82.8	648	46.9

<sup>a</sup> The sex, race, and ethnicity characteristics are as reported in the Wave 1 Youth Interview. The tobacco-use status is as reported in the Wave 2 Adult Interview. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> A tobacco user is defined as someone who uses one or more of the following tobacco products covered by the Wave 2 Adult Interview: cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-products, and dissolvable tobacco. A 'current established user' of a given tobacco product is someone who currently uses the product every day or some days and: for cigarettes, has smoked at least 100 cigarettes in their lifetime and, for any other tobacco product, has reported they ever used that product regularly.

<sup>c</sup> Response rate = B/A.

In addition to the overall row, each table includes rows on tobacco-use status, sex, race, and ethnicity subgroups. Table 2-6 includes rows on age subgroups; this is not necessary for Table 2-7 because the age range among Wave 2 aged-up adults is narrow. Information from the Wave 2 Adult Interview was used to define the age categories and tobacco-use status; information from the Wave 1 Adult or Youth Interview was used to define the sex, race, and ethnicity categories (because these characteristics were not re-asked of Wave 2 adults). Adults with missing values for such characteristics were excluded from the response rate calculation for that characteristic.

## Results

As shown in Table 2-6, the unweighted response rate for urine was 96.4 percent among continuing adults from whom a specimen was requested. The response rates vary little across the various tobacco-use status and demographic subgroups.

As shown in Table 2-7, the unweighted response rate for urine among aged-up adults was 82.9 percent. It appears that current established tobacco users at Wave 2 had a higher tendency to provide urine specimens than those who were not, and Black aged-up adults had a higher response rate for the urine specimen collection than aged-up adults of other races. There is little variation in urine specimen response rates by sex or ethnicity among aged-up adults.

The unweighted response rate for blood among aged-up adults was 47.4 percent. The differential unweighted response rate for subgroups of respondents ranges from 0.7 percentage point for sex to 7.9 percentage points for tobacco-use status.

## 2.2 Representativeness of Wave 2 Responding Sample

The standard approach for an analysis of nonresponse bias in the first follow-up of a longitudinal cohort study such as the PATH Study is to compare Wave 2 respondents with Wave 2 nonrespondents with respect to characteristics from Wave 1 (Bose and West, 2002; Javitz and Wagner, 2005; Brownstein et al., 2009). By so doing, the study can assess the extent to which differential nonresponse among population subgroups may affect estimates. Results are presented on the characteristics of respondents to the Wave 2 Adult and Youth Interviews, and on aged-up adults from whom biospecimens were collected at Wave 2. The response rates for urine collection from continuing adults are above 95 percent and vary little for all the subgroups in Table 2-6; further analysis of potential nonresponse bias for this aspect of Wave 2 biospecimen collection is therefore not warranted.

Analyses of bias for the Wave 2 interviews are presented for demographic and tobacco-use subgroups based on Wave 1 characteristics because Wave 2 characteristics are not available for Wave 2 nonrespondents. All persons asked to provide a biospecimen at Wave 2 completed the Wave 2 Adult Interview so the subgroup definitions for the biospecimen nonresponse analysis use Wave 2 data for characteristics where information was updated (tobacco-use status), and Wave 1 data otherwise. The adjective describing the wave to which each characteristic pertains may not be repeated every time these characteristics are mentioned. The reader is therefore cautioned to pay close attention to the information provided in the methods sections of this report, and in the table column headers and footnotes, regarding the wave to which each characteristic corresponds.

The PATH Study measures a range of tobacco-use behaviors; many of these variables are not available in other studies. However, responses to the PATH Study questions on current cigarette

smoking can be compared with estimates from other surveys that ask about cigarette smoking behavior. A separate component of the nonresponse bias analysis investigates possible differences between cigarette smoking estimates calculated from Wave 2 of the PATH Study and independent estimates of those quantities from other studies for the most similar time periods for which estimates were available.

## 2.2.1 Method

The method used in the PATH Study to assess potential interview nonresponse bias begins by comparing estimates of Wave 1 demographic characteristics and tobacco use for Wave 2 respondents with corresponding estimates for Wave 2 nonrespondents.<sup>4</sup> These comparisons are made separately for continuing adults, continuing youth, aged-up adults, and aged-up youth. To assess potential nonresponse bias associated with the collection of urine and blood specimens from aged-up adults at Wave 2, estimates of Wave 1 demographic characteristics and Wave 2 tobacco use are compared for specimen providers and non-providers, separately for each type of biospecimen.

Section 5.1.1 of the PATH Study Restricted Use Files User Guide describes the weight construction for Wave 1 of the PATH Study. The final raked weights from Wave 1 were designed to reduce the potential nonresponse bias from Wave 1. For Wave 2, the interview nonresponse bias analysis uses the raked weights from Wave 1. Differences between the weighted estimates of Wave 1 characteristics for Wave 2 respondents and nonrespondents therefore identify characteristics that might be associated with nonresponse bias due to attrition between the first two waves of the study, after compensating for Wave 1 nonresponse and possible undercoverage.

Section 5.1.2 of the PATH Study Restricted Use Files User Guide describes the weight construction for Wave 2 of the PATH Study. The final raked weights for Wave 2 were designed to reduce the potential nonresponse bias due to attrition between Waves 1 and 2. For Wave 2, the biospecimen nonresponse bias analysis uses the raked weights from Wave 2 because all aged-up adults asked to provide urine and blood specimens were Wave 2 Adult Interview respondents. Differences between the weighted estimates of characteristics for Wave 2 specimen providers and non-providers therefore identify characteristics that might be associated with bias due to biospecimen nonresponse at Wave 2, after accounting for Wave 1 nonresponse and possible undercoverage, and attrition between the first two waves of the study.

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<sup>4</sup> Persons determined to be ineligible for Wave 2 (see Section 1.1.2) are not included in this analysis.

Wave 2 cigarette smoking estimates were compared to estimates based on data from the following surveys: TUS-CPS, 2010-2011; NHIS, 2014; NHANES, 2013-2014; NSDUH, 2014; and NYTS, 2014. Appendix A describes the questions used to define current cigarette smoking on each of these surveys as well as the PATH Study, and outlines differences in target populations among these surveys and the PATH Study. This second component of the nonresponse bias analysis uses the Wave 1 IPS weights. Differences between the weighted estimates of current cigarette smoking behavior reported by Wave 2 respondents therefore identify characteristics that might be associated with bias due to nonresponse at Wave 1 or attrition between the first two waves of the study.

In the tables presented in Section 2.2.2, the unweighted counts and estimates of percentages calculated using weights exclude respondents with missing values for that item. The estimates calculated from other surveys that are used for comparison purposes also exclude missing values. The proportions of item missingness are generally very low in both the PATH Study and the surveys that are used for comparison purposes.

Point estimates for the PATH Study were calculated using the Wave 1 final weights or Wave 1 IPS weights or Wave 2 final weights, as described above. The corresponding replicate weights were used to calculate variances, and account for the complex sampling features of stratification and clustering. Precisions for the PATH Study estimates are reported using 95 percent confidence intervals based on the modified Wilson confidence interval approach (Wilson, 1927; SAS Institute, 2013). Estimates from TUS-CPS, NHANES, NHIS, NSDUH, and NYTS<sup>5</sup> also have sampling error, so 95 percent confidence intervals are reported for the estimates from those surveys as well.<sup>6</sup> SAS software version 9.4 was used to calculate all point estimates and confidence intervals.

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<sup>5</sup> Estimates from TUS-CPS were obtained from United States Department of Commerce (2012) published tables. Estimates from NHANES, NHIS, NYTS, and NSDUH were calculated from their respective public use files (Centers for Disease Control and Prevention (2015a, 2015b, 2015c), Center for Behavioral Health Statistics and Quality (2015a)).

<sup>6</sup> The modified Wilson confidence interval approach was used to compute the 95 percent confidence intervals for NHANES, NHIS, NSDUH, and NYTS; the TUS-CPS documentation does not state what method was used to produce the confidence intervals that appear in the published tables. If the confidence interval from the PATH Study estimate does not overlap with the confidence interval from the comparison study, then the results are significantly different at the 0.05 significance level. Schenker and Gentleman (2001) show that this results in a conservative test. In general, if a 95 percent confidence interval for the percentage of adults who are current cigarette smokers from the PATH Study includes a fixed value X, then a hypothesis test of the null hypothesis that the percentage of adults who are current smokers equals X would have p-value > 0.05 and therefore the difference between the PATH Study estimate and the estimate from the external survey is not statistically significant. No adjustments were made for multiple testing; however, results are reported here for all of the comparisons performed, and all of these were pre-planned comparisons.

## 2.2.2 Results

Tables 2-8 and 2-9 compare Wave 1 demographic characteristics<sup>7</sup> and tobacco-use rates, respectively, for Wave 2 continuing adult respondents with nonrespondents. Tables 2-10 and 2-11 present similar comparisons for continuing youth at Wave 2. Tables 2-12 and 2-13 present the comparisons for Wave 2 aged-up adult respondents and nonrespondents. Table 2-14 compares Wave 1 demographic characteristics for Wave 2 aged-up youth respondents with nonrespondents (tobacco use was not measured for shadow youth at Wave 1). If nonresponse at Wave 2 is not associated with demographic characteristics or Wave 1 tobacco use, then the estimates calculated using the Wave 1 final weights would be expected to be similar for Wave 2 respondents and nonrespondents.

In Tables 2-8, 2-10, 2-12, and 2-14, the percentages sum to 100 percent (for both Wave 2 respondents and nonrespondents) over the categories associated with each characteristic. For example, the estimated percentage of males and the estimated percentage of females add to 100 percent for Wave 2 respondents and for Wave 2 nonrespondents. In Tables 2-9, 2-11, and 2-13, the percentages are estimated tobacco-use rates for each category of each characteristic (and therefore do not sum to 100 percent across categories).

The results in Table 2-8 show that males, 18- to 24-year-olds, those with high school education, and current established tobacco users at Wave 1 are underrepresented among continuing adult respondents; and 45- to 64-year-olds, persons with health insurance, and those with at least a bachelor's degree are overrepresented among respondents. Table 2-9 shows that estimates of Wave 1 current established tobacco use are lower overall, and for males, 18- to 44-year-olds, and non-Hispanic Whites among continuing adult respondents. Tables 2-10 and 2-11 show that estimates of Wave 1 ever use of tobacco are lower for continuing youth respondents than nonrespondents. Table 2-11 shows that estimates of Wave 1 ever use of tobacco are also lower for females, 14- to 17-year-olds, and non-Hispanic Whites among continuing youth respondents. If no further weighting adjustments were performed, to the extent that these characteristics are associated with the PATH Study's outcomes, then those outcomes may be affected by nonresponse bias. However, this concern is addressed by the weighting adjustments used to create the final Wave 2 weights and the corresponding results described in Section 2.3.

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<sup>7</sup> Health insurance coverage is also included in Table 2-8.

No evidence of potential nonresponse bias was found for aged-up adults or aged-up youth based on the estimates in Tables 2-12, 2-13, and 2-14 because all the confidence intervals for estimates of difference between Wave 2 respondents and nonrespondents include zero.<sup>8</sup>

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<sup>8</sup> Testing whether or not a  $100(1-\alpha)$  percent confidence interval for a difference between two population proportions includes zero is equivalent to a two-sided test of the null hypothesis that the difference is zero at the  $\alpha$  significance level (see, for example, Hanushek and Jackson, 1977).



Table 2-8. Comparison of Wave 2 continuing Adult Interview respondents with nonrespondents

Characteristic at Wave 1 <sup>a</sup>	Wave 2 continuing adult respondents		Wave 2 continuing adult nonrespondents		Difference in weighted percentages [respondents – nonrespondents] [95% confidence interval]
	Unweighted count	Weighted percentage, using adult Wave 1 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using adult Wave 1 final weights [95% confidence interval]	
Sex					
Male	13,069	47.2% [46.6%, 47.8%]	3,067	51.4% [49.6%, 53.2%]	-4.2% [-6.4%, -2.0%]
Female	13,355	52.8% [52.2%, 53.4%]	2,525	48.6% [46.8%, 50.4%]	4.2% [2.0%, 6.4%]
Age group					
18-24	7,325	12.8% [12.4%, 13.2%]	1,742	14.2% [13.3%, 15.1%]	-1.4% [-2.4%, -0.3%]
25-44	9,226	34.2% [33.6%, 34.7%]	1,983	35.5% [34.2%, 36.9%]	-1.4% [-3.0%, 0.3%]
45-64	7,375	35.1% [34.6%, 35.7%]	1,356	31.9% [30.4%, 33.5%]	3.2% [1.3%, 5.1%]
65+	2,516	17.9% [17.4%, 18.4%]	511	18.4% [16.9%, 20.0%]	-0.5% [-2.4%, 1.4%]
Race/ethnicity					
Non-Hispanic White alone	15,760	66.2% [65.6%, 66.7%]	3,371	65.1% [63.5%, 66.6%]	1.1% [-0.8%, 3.0%]
Other	10,248	33.8% [33.3%, 34.4%]	2,116	34.9% [33.4%, 36.5%]	-1.1% [-3.0%, 0.8%]
Health insurance					
Yes	21,262	85.9% [85.3%, 86.5%]	4,281	83.3% [81.8%, 84.6%]	2.6% [1.1%, 4.2%]
No	4,919	14.1% [13.5%, 14.7%]	1,186	16.7% [15.4%, 18.2%]	-2.6% [-4.2%, -1.1%]
Education					
< HS or GED	5,271	16.4% [15.9%, 16.8%]	1,097	17.8% [16.5%, 19.1%]	-1.4% [-3.0%, 0.1%]
HS	6,054	23.8% [23.3%, 24.3%]	1,421	26.5% [24.9%, 28.1%]	-2.7% [-4.5%, -0.8%]
Some college, no degree	9,306	31.2% [30.6%, 31.8%]	1,923	30.7% [29.2%, 32.2%]	0.5% [-1.3%, 2.2%]

Table 2-8. Comparison of Wave 2 continuing Adult Interview respondents with nonrespondents (continued)

Characteristic at Wave 1 <sup>a</sup>	Wave 2 continuing adult respondents		Wave 2 continuing adult nonrespondents		Difference in weighted percentages [respondents – nonrespondents] [95% confidence interval]
	Unweighted count	Weighted percentage, using adult Wave 1 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using adult Wave 1 final weights [95% confidence interval]	
Education (continued)					
Bachelor degree +	5,684	28.6% [28.1%, 29.2%]	1,087	25.0% [23.4%, 26.8%]	3.6% [1.6%, 5.6%]
Tobacco-use status <sup>b</sup>					
Current established user	11,682	23.5% [22.8%, 24.2%]	2,541	25.6% [24.5%, 26.8%]	-2.1% [-3.4%, -0.9%]
Not current established user	14,038	76.5% [75.8%, 77.2%]	2,864	74.4% [73.2%, 75.5%]	2.1% [0.9%, 3.4%]

<sup>a</sup> The characteristics are as reported in the Adult Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> A tobacco user is defined as someone who uses one or more of the tobacco products covered by the Wave 1 Adult Interview. A 'current established user' of a given tobacco product is someone who currently uses the product every day or some days and: for cigarettes, has smoked at least 100 cigarettes in their lifetime and, for any other tobacco product, has reported they ever used that product regularly. The products covered by the Wave 1 Adult Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, and dissolvable tobacco.

Table 2-9. Comparison of Wave 1 tobacco-use\* rates for Wave 2 continuing Adult Interview respondents with nonrespondents

Characteristic at Wave 1 <sup>a</sup>	Wave 2 continuing adult respondents		Wave 2 continuing adult nonrespondents		Difference in weighted percentages [respondents – nonrespondents] [95% confidence interval]
	Unweighted count	Weighted percentage, using adult Wave 1 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using adult Wave 1 final weights [95% confidence interval]	
Overall	25,720	23.5% [22.8%, 24.2%]	5,405	25.6% [24.5%, 26.8%]	-2.1% [-3.4%, -0.9%]
Sex					
Male	12,727	29.0% [28.0%, 30.0%]	2,961	33.2% [31.5%, 34.9%]	-4.2% [-6.2%, -2.2%]
Female	12,972	18.6% [17.8%, 19.3%]	2,439	17.7% [16.2%, 19.2%]	0.9% [-0.6%, 2.4%]
Age group					
18-24	7,209	28.1% [26.7%, 29.6%]	1,708	32.6% [30.2%, 35.1%]	-4.5% [-6.9%, -2.0%]
25-44	9,045	28.5% [27.5%, 29.6%]	1,938	31.1% [29.1%, 33.2%]	-2.6% [-5.0%, -0.1%]
45-64	7,113	23.0% [22.0%, 24.0%]	1,293	24.5% [22.2%, 26.9%]	-1.5% [-3.7%, 0.7%]
65+	2,348	10.8% [9.6%, 12.1%]	460	10.4% [7.9%, 13.5%]	0.4% [-1.9%, 2.7%]
Race/ethnicity					
Non-Hispanic White alone	15,421	24.6% [23.7%, 25.6%]	3,272	28.7% [27.1%, 30.2%]	-4.1% [-5.6%, -2.6%]
Other	9,919	21.3% [20.4%, 22.2%]	2,039	20.3% [18.4%, 22.4%]	1.0% [-1.3%, 3.3%]

<sup>a</sup> The characteristics are as reported in the Adult Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

\* Defined as current established use of tobacco. A tobacco user is defined as someone who uses one or more of the tobacco products covered by the Wave 1 Adult Interview. A 'current established user' of a given tobacco product is someone who currently uses the product every day or some days and: for cigarettes, has smoked at least 100 cigarettes in their lifetime and, for any other tobacco product, has reported they ever used that product regularly. The products covered by the Wave 1 Adult Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, and dissolvable tobacco.

Table 2-10. Comparison of Wave 2 continuing Youth Interview respondents with nonrespondents

Characteristic at Wave 1 <sup>a</sup>	Wave 2 continuing youth respondents		Wave 2 continuing youth nonrespondents		Difference in weighted percentages [respondents – nonrespondents] [95% confidence interval]
	Unweighted count	Weighted percentage, using youth Wave 1 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using youth Wave 1 final weights [95% confidence interval]	
Sex					
Male	5,164	51.4% [50.5%, 52.4%]	665	50.6% [47.9%, 53.3%]	0.8% [-2.3%, 3.9%]
Female	4,892	48.6% [47.6%, 49.5%]	641	49.4% [46.7%, 52.1%]	-0.8% [-3.9%, 2.3%]
Age group					
12-13	4,164	41.1% [40.1%, 42.1%]	514	39.4% [36.8%, 42.1%]	1.7% [-1.0%, 4.3%]
14-17	5,917	58.9% [57.9%, 59.9%]	801	60.6% [57.9%, 63.2%]	-1.7% [-4.3%, 1.0%]
Race/ethnicity					
Non-Hispanic White alone	4,731	54.6% [53.6%, 55.5%]	616	53.8% [50.7%, 57.0%]	0.7% [-2.9%, 4.3%]
Other	5,141	45.4% [44.5%, 46.4%]	667	46.2% [43.0%, 49.3%]	-0.7% [-4.3%, 2.9%]
Tobacco-use status <sup>b</sup>					
Ever user	1,665	16.9% [16.0%, 17.9%]	261	20.4% [18.2%, 22.7%]	-3.4% [-5.7%, -1.2%]
Never user	8,006	83.1% [82.1%, 84.0%]	982	79.6% [77.3%, 81.8%]	3.4% [1.2%, 5.7%]

<sup>a</sup> The characteristics are as reported in the Youth Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> An 'ever user' is someone who has ever used one or more of the tobacco products covered by the Wave 1 Youth Interview. A 'never user' is someone who has never used any of those tobacco products. Ever use of a tobacco product is defined as having ever used the product, even one or two times. The products covered by the Wave 1 Youth Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, dissolvable tobacco, bidis, and kreteks.

Table 2-11. Comparison of Wave 1 tobacco-use\* rates for Wave 2 continuing Youth Interview respondents with nonrespondents

Characteristic at Wave 1 <sup>a</sup>	Wave 2 continuing youth respondents		Wave 2 continuing youth nonrespondents		Difference in weighted percentages [respondents – nonrespondents] [95% confidence interval]
	Unweighted count	Weighted percentage, using youth Wave 1 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using youth Wave 1 final weights [95% confidence interval]	
Overall	9,671	16.9% [16.0%, 17.9%]	1,243	20.4% [18.2%, 22.7%]	-3.4% [-5.7%, -1.2%]
Sex					
Male	4,922	18.0% [16.9%, 19.2%]	619	21.4% [18.2%, 25.0%]	-3.4% [-7.0%, 0.2%]
Female	4,727	15.8% [14.7%, 17.0%]	616	19.4% [16.5%, 22.8%]	-3.7% [-6.9%, -0.4%]
Age group					
12-13	3,923	7.8% [6.9%, 9.0%]	473	7.9% [5.7%, 10.7%]	-0.0% [-2.7%, 2.7%]
14-17	5,748	23.1% [21.9%, 24.3%]	769	28.1% [24.9%, 31.6%]	-5.1% [-8.4%, -1.8%]
Race/ethnicity					
Non-Hispanic White alone	4,555	17.6% [16.4%, 19.0%]	583	24.0% [20.6%, 27.8%]	-6.4% [-9.8%, -2.9%]
Other	4,930	16.3% [15.1%, 17.4%]	633	16.6% [13.7%, 20.1%]	-0.4% [-3.7%, 3.0%]

<sup>a</sup> The characteristics are as reported in the Youth Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

\* Defined as ever use of tobacco. An 'ever user' is someone who has ever used one or more of the tobacco products covered by the Wave 1 Youth Interview. Ever use of a tobacco product is defined as having ever used the product, even one or two times. The products covered by the Wave 1 Youth Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, dissolvable tobacco, bidis, and kreteks.

Table 2-12. Comparison of Wave 2 aged-up Adult Interview respondents with nonrespondents

Characteristic at Wave 1 <sup>a</sup>	Wave 2 aged-up adult respondents		Wave 2 aged-up adult nonrespondents		Difference in weighted percentages [respondents – nonrespondents] [95% confidence interval]
	Unweighted count	Weighted percentage, using youth Wave 1 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using youth Wave 1 final weights [95% confidence interval]	
Sex					
Male	956	50.3% [48.1%, 52.6%]	169	54.3% [48.8%, 59.8%]	-4.0% [-10.3%, 2.3%]
Female	956	49.7% [47.4%, 51.9%]	146	45.7% [40.2%, 51.2%]	4.0% [-2.3%, 10.3%]
Race/ethnicity					
Non-Hispanic White alone	954	54.7% [52.4%, 56.9%]	173	58.9% [52.5%, 65.0%]	-4.2% [-11.4%, 3.0%]
Other	944	45.3% [43.1%, 47.6%]	141	41.1% [35.0%, 47.5%]	4.2% [-3.0%, 11.4%]
Tobacco-use status <sup>b</sup>					
Ever user	810	42.9% [40.4%, 45.5%]	126	40.5% [34.7%, 46.5%]	2.4% [-4.3%, 9.1%]
Never user	1,061	57.1% [54.5%, 59.6%]	180	59.5% [53.5%, 65.3%]	-2.4% [-9.1%, 4.3%]

<sup>a</sup> The characteristics are as reported in the Youth Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> An 'ever user' is someone who has ever used one or more of the tobacco products covered by the Wave 1 Youth Interview. A 'never user' is someone who has never used any of those tobacco products. Ever use of a tobacco product is defined as having ever used the product, even one or two times. The products covered by the Wave 1 Youth Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, dissolvable tobacco, bidis, and kreteks.

Table 2-13. Comparison of Wave 1 tobacco-use\* rates for Wave 2 aged-up Adult Interview respondents with nonrespondents

Characteristic at Wave 1 <sup>a</sup>	Wave 2 aged-up adult respondents		Wave 2 aged-up adult nonrespondents		Difference in weighted percentages [respondents – nonrespondents] [95% confidence interval]
	Unweighted count	Weighted percentage, using youth Wave 1 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using youth Wave 1 final weights [95% confidence interval]	
Overall	1,871	42.9% [40.4%, 45.5%]	306	40.5% [34.7%, 46.5%]	2.4% [-4.3%, 9.1%]
Sex					
Male	932	46.5% [42.8%, 50.3%]	164	44.0% [35.7%, 52.5%]	2.6% [-7.4%, 12.5%]
Female	936	39.4% [36.3%, 42.5%]	142	36.4% [27.9%, 45.9%]	3.0% [-6.5%, 12.5%]
Race/ethnicity					
Non-Hispanic White alone	936	46.7% [42.9%, 50.5%]	169	43.8% [36.5%, 51.3%]	2.9% [-4.8%, 10.6%]
Other	918	38.1% [34.1%, 42.2%]	136	36.0% [26.8%, 46.4%]	2.1% [-9.4%, 13.6%]

<sup>a</sup> The characteristics are as reported in the Youth Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

\* Defined as ever use of tobacco. An 'ever user' is someone who has ever used one or more of the tobacco products covered by the Wave 1 Youth Interview. Ever use of a tobacco product is defined as having ever used the product, even one or two times. The products covered by the Wave 1 Youth Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, dissolvable tobacco, bidis, and kreteks.

Table 2-14. Comparison of Wave 2 aged-up Youth Interview respondents with nonrespondents

Characteristic at Wave 1 <sup>a</sup>	Wave 2 aged-up youth respondents		Wave 2 aged-up youth nonrespondents		Difference in weighted percentages [respondents – nonrespondents] [95% confidence interval]
	Unweighted count	Weighted percentage, using shadow youth Wave 1 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using shadow youth Wave 1 final weights [95% confidence interval]	
Sex					
Male	1,055	49.9% [47.8%, 52.1%]	237	51.4% [46.8%, 55.9%]	-1.4% [-6.9%, 4.0%]
Female	1,036	50.1% [47.9%, 52.2%]	222	48.6% [44.1%, 53.2%]	1.4% [-4.0%, 6.9%]
Race/ethnicity					
Non-Hispanic White alone	1,008	52.4% [50.2%, 54.5%]	215	51.3% [46.7%, 55.9%]	1.1% [-4.4%, 6.5%]
Other	1,078	47.6% [45.5%, 49.8%]	243	48.7% [44.1%, 53.3%]	-1.1% [-6.5%, 4.4%]

<sup>a</sup> The characteristics are as reported in the Household Screener at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.



Table 2-15 compares the characteristics of aged-up adults who provided a urine specimen with those of aged-up adults who did not provide a urine specimen. Table 2-16 presents a similar analysis for the collection of blood specimens from aged-up adults. If nonresponse to the Wave 2 biospecimen collection is not associated with demographic characteristics or Wave 2 tobacco use, then the estimates calculated using the Wave 2 final weights would be expected to be similar for Wave 2 specimen providers and non-providers. Based on the results in Tables 2-15 and 2-16, no evidence of nonresponse bias was found for sex and race/ethnicity. However, for both urine and blood, current established tobacco users are overrepresented among aged-up adults who provided specimens at Wave 2. This finding is consistent with the biospecimen response rates shown in Table 2-7.

Tables 2-17 and 2-18 address the second component of the nonresponse bias analysis and compare estimates of cigarette smoking calculated from Wave 2 of the PATH Study to independent estimates of those quantities from other studies.

Table 2-17 presents the estimates of prevalence of current cigarette smoking<sup>9</sup> for adults based on the Wave 2 Adult Interview, for the adult population as a whole and for subgroups. These estimates are accompanied by 95 percent confidence intervals for the percentage of current cigarette smokers for the PATH Study estimates. The unweighted estimates are much higher than the weighted estimates due to the oversampling of adult tobacco users at Wave 1. The last five columns are the estimates of smoking prevalence from TUS-CPS, NHIS, NHANES, and NSDUH, respectively, along with 95 percent confidence intervals from those surveys. Note that these estimates exclude missing values.

The estimates of current smoking prevalence differ from survey to survey. Many potential reasons can explain these disparities, including that each survey has sampling error. Beyond that, however, the surveys differ in question order, context, design, mode of administration, and year of data collection.

In general, the TUS-CPS estimates of smoking prevalence are lower than estimates from the other surveys, including the PATH Study. This may be related to the proxy responses used in the TUS-CPS. The rotation group structure of the TUS-CPS may result in underestimates of smoking prevalence, as smokers are more likely to drop out over the course of the panel survey (Song, 2013).

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<sup>9</sup> For the PATH Study, following common practice for tobacco surveys, a current cigarette smoker is someone who (1) has smoked at least 100 cigarettes in his or her lifetime and (2) currently smokes cigarettes every day or some days. The questions used to define current cigarette smoking for each survey are provided in Appendix A.

Table 2-15. Comparison of Wave 2 aged-up adult urine specimen providers with non-providers of urine

Characteristic <sup>a</sup>	Wave 2 aged-up adult urine providers		Wave 2 aged-up adult non-providers of urine		Difference in weighted percentages [providers – non-providers] [95% confidence interval]
	Unweighted count	Weighted percentage, using adult Wave 2 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using adult Wave 2 final weights [95% confidence interval]	
Sex					
Male	792	50.8% [48.3%, 53.2%]	164	50.4% [44.9%, 55.9%]	0.4% [-6.2%, 7.0%]
Female	792	49.2% [46.8%, 51.7%]	164	49.6% [44.1%, 55.1%]	-0.4% [-7.0%, 6.2%]
Race/ethnicity					
Non-Hispanic White alone	781	54.8% [52.4%, 57.3%]	173	56.4% [50.9%, 61.6%]	-1.5% [-7.4%, 4.4%]
Other	790	45.2% [42.7%, 47.6%]	154	43.6% [38.4%, 49.1%]	1.5% [-4.4%, 7.4%]
Tobacco-use status <sup>b</sup>					
Current established user	295	18.7% [16.5%, 21.0%]	33	10.7% [7.0%, 16.1%]	8.0% [2.7%, 13.2%]
Not current established user	1,285	81.3% [79.0%, 83.5%]	292	89.3% [83.9%, 93.0%]	-8.0% [-13.2%, -2.7%]

<sup>a</sup> The sex and race/ethnicity characteristics are as reported in the Wave 1 Youth Interview. The tobacco-use status is as reported in the Wave 2 Adult Interview. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> A tobacco user is defined as someone who uses one or more of the following tobacco products covered by the Wave 2 Adult Interview: cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-products, and dissolvable tobacco. A 'current established user' of a given tobacco product is someone who currently uses the product every day or some days and: for cigarettes, has smoked at least 100 cigarettes in their lifetime and, for any other tobacco product, has reported they ever used that product regularly.

Table 2-16. Comparison of Wave 2 aged-up adult blood specimen providers with non-providers of blood

Characteristic <sup>a</sup>	Wave 2 aged-up adult blood providers		Wave 2 aged-up adult non-providers of blood		Difference in weighted percentages [providers – non-providers] [95% confidence interval]
	Unweighted count	Weighted percentage, using adult Wave 2 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using adult Wave 2 final weights [95% confidence interval]	
Sex					
Male	457	52.0% [48.7%, 55.2%]	499	49.6% [46.5%, 52.7%]	2.4% [-2.7%, 7.5%]
Female	450	48.0% [44.8%, 51.3%]	506	50.4% [47.3%, 53.5%]	-2.4% [-7.5%, 2.7%]
Race/ethnicity					
Non-Hispanic White alone	445	55.1% [51.8%, 58.3%]	509	55.1% [52.0%, 58.2%]	-0.1% [-5.5%, 5.4%]
Other	454	44.9% [41.7%, 48.2%]	490	44.9% [41.8%, 48.0%]	0.1% [-5.4%, 5.5%]
Tobacco-use status <sup>b</sup>					
Current established user	177	20.2% [17.2%, 23.5%]	151	14.7% [12.5%, 17.3%]	5.4% [1.4%, 9.5%]
Not current established user	727	79.8% [76.5%, 82.8%]	850	85.3% [82.7%, 87.5%]	-5.4% [-9.5%, -1.4%]

<sup>a</sup> The sex and race/ethnicity characteristics are as reported in the Wave 1 Youth Interview. The tobacco-use status is as reported in the Wave 2 Adult Interview. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> A tobacco user is defined as someone who uses one or more of the following tobacco products covered by the Wave 2 Adult Interview: cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-products, and dissolvable tobacco. A 'current established user' of a given tobacco product is someone who currently uses the product every day or some days and: for cigarettes, has smoked at least 100 cigarettes in their lifetime and, for any other tobacco product, has reported they ever used that product regularly.

Table 2-17. Current cigarette smoking based on Wave 2 Adult Interview respondents: IPS weights

Characteristic at Wave 2	Unweighted count	PATH Study: Unweighted percentage	PATH Study: Weighted percentage, using adult IPS weights [95% confidence interval]	Percentage from 2010-2011 TUS-CPS [95% confidence interval]	Percentage from 2014 NHIS [95% confidence interval]	Percentage from 2013-2014 NHANES [95% confidence interval]	Percentage from 2014 NSDUH, original definition <sup>a</sup> [95% confidence interval]	Percentage from 2014 NSDUH, modified definition <sup>a</sup> [95% confidence interval]
Current smoker	28,324	34.2%	18.9% [18.1%, 19.9%]	16.1% [15.8%, 16.3%]	16.7% [16.1%, 17.4%]	20.0% [17.8%, 22.3%]	22.7% [22.1%, 23.2%]	20.9% [20.3%, 21.4%]
Current smoker, male	14,002	35.3%	21.2% [20.2%, 22.3%]	18.0% [17.7%, 18.4%]	18.8% [18.0%, 19.7%]	21.6% [19.4%, 24.1%]	25.5% [24.7%, 26.3%]	23.6% [22.8%, 24.4%]
Current smoker, female	14,296	33.2%	17.1% [16.2%, 18.1%]	14.2% [13.9%, 14.5%]	14.8% [13.9%, 15.7%]	18.4% [15.6%, 21.6%]	20.1% [19.3%, 20.8%]	18.3% [17.6%, 19.2%]
Current smoker, age 18-24	8,167	22.9%	18.3% [17.2%, 19.4%]	17.1% [16.4%, 17.8%]	16.7% [14.2%, 19.5%]	23.4% [19.2%, 28.3%]	NA <sup>b</sup>	NA
Current smoker, age 25-44	9,865	40.3%	23.5% [22.2%, 24.8%]	17.9% [17.5%, 18.4%]	20.0% [19.0%, 21.0%]	23.1% [20.7%, 25.7%]	NA	NA
Current smoker, age 45-64	7,525	42.4%	20.1% [19.0%, 21.2%]	17.8% [17.4%, 18.2%]	18.0% [17.0%, 19.0%]	21.6% [17.6%, 26.2%]	NA	NA
Current smoker, age 65+	2,763	23.9%	8.2% [7.2%, 9.3%]	7.8% [7.5%, 8.2%]	8.5% [7.7%, 9.4%]	8.4% [6.9%, 10.1%]	NA	NA
Current smoker, Hispanic	5,031	25.0%	14.4% [13.3%, 15.5%]	10.9% [10.4%, 11.5%]	11.2% [10.2%, 12.2%]	13.7% [11.4%, 16.3%]	18.5% [17.0%, 20.1%]	15.2% [13.8%, 16.6%]
Current smoker, White non-Hispanic	16,700	37.1%	19.4% [18.2%, 20.6%]	17.5% [17.2%, 17.8%]	18.2% [17.3%, 19.1%]	20.9% [17.7%, 24.5%]	23.9% [23.2%, 24.7%]	22.7% [21.9%, 23.4%]
Current smoker, other non-Hispanic	6,140	33.7%	21.8% [20.6%, 23.1%]	NA	16.2% [15.2%, 17.2%]	21.7% [18.9%, 24.8%]	21.8% [20.4%, 23.3%]	19.4% [18.0%, 20.9%]
Current every-day smoker	28,324	26.3%	14.5% [13.7%, 15.4%]	12.7% [12.4%, 12.9%]	12.8% [12.3%, 13.4%]	16.1% [14.2%, 18.2%]	NA	NA
Current some-days smoker	28,324	7.9%	4.4% [4.2%, 4.7%]	3.4% [3.3%, 3.5%]	3.9% [3.6%, 4.2%]	3.9% [3.2%, 4.7%]	NA	NA

<sup>a</sup> NSDUH's definition of a current cigarette smoker is someone who has smoked part or all of a cigarette in the past 30 days, which is more expansive than the definition used in the other surveys. However, NSDUH contains questions on lifetime smoking and current smoking. The modified definition uses these questions to construct a measure of "current smoking" that is comparable to that of the other surveys (Ryan et al., 2012). The construction of this variable is described in Appendix A.

<sup>b</sup> Detailed age information was not available in the public use file for NSDUH 2014.

Table 2-18. Cigarette smoking\* based on Wave 2 Youth Interview respondents: IPS weights

Characteristic at Wave 2	Unweighted count	PATH Study: Unweighted percentage	PATH Study: Weighted percentage, using youth IPS weights [95% confidence interval]	Percentage from 2013-2014 NHANES [95% confidence interval]	Percentage from 2014 NSDUH [95% confidence interval]	Percentage from 2014 NYTS [95% confidence interval]
Ever tried cigarette smoking, even one or two puffs	12,148	11.8%	11.9% [11.1%, 12.8%]	18.7% [15.3%, 22.6%]	14.4% [13.6%, 15.3%]	21.7% [20.2%, 23.3%]
Ever tried smoking, male	6,208	11.8%	12.1% [11.0%, 13.2%]	19.2% [14.3%, 25.4%]	14.6% [13.5%, 15.7%]	22.5% [20.8%, 24.2%]
Ever tried smoking, female	5,911	11.7%	11.7% [10.8%, 12.8%]	18.0% [13.0%, 24.4%]	14.2% [13.1%, 15.4%]	21.0% [19.2%, 22.9%]
Ever tried smoking, age 12-13	4,150	3.9%	4.0% [3.4%, 4.7%]	5.1% [3.0%, 8.6%]	3.8% [3.1%, 4.6%]	10.3% [8.6%, 12.3%]
Ever tried smoking, age 14-17	7,998	15.8%	16.0% [14.9%, 17.1%]	25.2% [20.8%, 30.2%]	19.4% [18.2%, 20.6%]	27.4% [25.4%, 29.4%]
Have smoked in past 30 days	12,068	4.0%	4.0% [3.6%, 4.5%]	3.9% [2.7%, 5.5%]	5.0% [4.6%, 5.5%]	5.8% [5.2%, 6.5%]

\* Defined as ever tried a cigarette, even one or two puffs. For comparison, an additional measure of current smoking commonly applied to youth (having smoked at all in the past 30 days) is also included in this table.

The PATH Study and NSDUH both use ACASI administration for the tobacco-use questions so that the interviewer does not see responses to the questions. By contrast, TUS-CPS, NHIS, and NHANES have direct questioning by an interviewer: NHIS and NHANES are conducted in person, and TUS-CPS is conducted in person and by telephone. The contexts and purposes of these surveys also differ: CPS is a general survey on unemployment, NHIS and NHANES are general health surveys, and NSDUH is a cross-sectional survey on substance use (including tobacco use) and health, including mental health. Unlike the cross-sectional prevalence surveys, the PATH Study is designed for research purposes and uses a longitudinal cohort design to assess within-person change and between-person differences in tobacco-use behaviors and health over time. Other differences among the questions used in the instruments of these different studies are outlined in Appendix A.

Table 2-17 indicates the IPS-weighted estimates of adult current smoking from Wave 2 of the PATH Study are most similar to estimates from NHIS and NHANES. All of the 95 percent confidence intervals for percent of current cigarette smokers constructed from the PATH Study overlap with the confidence intervals for NHIS, NHANES, or both. Estimates from TUS-CPS tend to be below the estimates from the PATH Study, NHIS, and NHANES; estimates from NSDUH tend to be above the estimates from the PATH Study, NHIS, and NHANES. No evidence was found to indicate nonresponse bias in the PATH Study with respect to current cigarette smoking behavior among adults, in the sense that the PATH Study's estimates are all within the range of estimates from comparable surveys.

Table 2-18 provides estimates from the PATH Study for two common measures of cigarette smoking prevalence among Wave 2 youth respondents compared with estimates from NHANES, NSDUH, and NYTS.<sup>10</sup> Different measures of smoking are used in this report for youth than for adults. The primary measure of cigarette smoking among youth in this report is whether the youth has ever tried smoking a cigarette, even one or two puffs (see Appendix A). Another measure is current smoking, defined as having smoked at all in the past 30 days. Both are shown in Table 2-18.

Differences in target populations and administration among the youth surveys might lead to differences in their estimates. In addition, the youth survey estimates have sampling error, as demonstrated by the confidence intervals about the estimates from the comparison surveys.

Questions and their orderings also differ among the surveys, as described in Appendix A, as do the modes of administration. The PATH Study, NHANES, and NSDUH use ACASI for the questions

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<sup>10</sup> TUS-CPS does not interview persons younger than 18 about tobacco use.

about tobacco use by youth, and these are administered individually in a household or mobile examination center setting. The NYTS is a pencil-and-paper survey that is self-administered in the classroom. Currivan et al. (2004) found that even when telephone ACASI was used, estimates of youth smoking prevalence were lower for a telephone survey of youth smoking than for a school-based survey of the same population (see also Fowler and Stringfellow, 2001, for a discussion of higher smoking rates in school-based surveys). In addition, school-based surveys often include students who are older than 17, which is the upper age limit for youth in the PATH Study.

The PATH Study's estimates of youth smoking are lower than comparable estimates from NHANES and NSDUH. Part of this difference may be sampling error and part may be attributable to differences among the survey wordings and administrations. Moreover, the comparison surveys are from different time periods. According to the Center for Behavioral Health Statistics and Quality (CBHSQ) (2015b), cigarette smoking among teens is dropping (from 2013 to 2014, the percentage of youth who had ever tried smoking dropped by 0.3 percentage point among 12- to 13-year-olds, 2.4 percentage points among 14- to 15-year-olds, and 2.1 percentage points among 16- to 17-year-olds, with similar decreases from 2012 to 2013). The lower percentages found by the PATH Study may reflect, in part, a continuation of this trend. However, some of the differences among the estimates of youth smoking prevalence may be attributable to nonresponse bias or measurement error on the part of one or more of the surveys.

## **2.3 Statistical Approach for Addressing Wave 2 Nonresponse**

### **2.3.1 Interviews**

The primary approach for addressing nonresponse is to use weight adjustments that account for differential response propensities across subgroups. This section describes the weighting adjustments used to address the areas of potential nonresponse bias identified in Section 2.2 and evaluates their effectiveness.

Among numerous sources, the handbook on household surveys by the United Nations (2005, Chapter 6) and Särndal and Lundström (2005) discuss the methods and theory of using weight adjustments for nonresponse. For Wave 1, these adjustments were done at the household level and at the person level. The Wave 1 household-level weighting adjustments calibrated the estimates to household-level population estimates for census region and household composition and size



developed from the 1-year 2013 ACS (which provides high precision and accuracy due to a large sample size and high response rate). Such weighting adjustments also correct for disparities among other characteristics that might be associated with the characteristics involved in the weighting adjustments. After accounting for household-level nonresponse, households with at least one person sampled for the PATH Study were identified, and each sampled person within a household was assigned the corresponding household weight with an adjustment to account for his/her probability of selection. These weights were then adjusted to account for nonresponse to the Wave 1 interview (for adults and youth) or to non-participation in the study (for shadow youth). After this adjustment for nonresponse, the weights were calibrated using a raking process to person-level population estimates also developed from the 1-year 2013 ACS. Outlier values of the sample weights were trimmed if called for, and the weights were re-raked after any such trimming.

For Wave 2, the same general approach was used for adults, youth, and shadow youth (all as defined at Wave 1), separately. The final person-level weights assigned to Wave 1 respondents served as the initial weights for use in developing the Wave 2 weights. These weights were adjusted to account for nonresponse to the Wave 2 interview and the resulting weights raked to control totals. However, some of these control totals were sample-based rather than population-based and they reflected characteristics of the Wave 1 population (the baseline period for this sample).

Raking to sample-based control totals, often employed with longitudinal studies (see, for example, Brick, Le, and West (2003)) can help limit drifting from some important baseline characteristics that might arise through the applications of nonresponse adjustments over time. Lundström and Särndal (1999) provide a theoretical discussion of the use of calibrating weights to sample-based controls as well as providing empirical evidence that such calibration can serve to reduce both variance and nonresponse bias.

Details of the Wave 2 weighting procedures can be found in Section 5.1.2 of the PATH Study Restricted Use Files User Guide.

Tables 2-19 through 2-25 repeat the analyses in Tables 2-8 through 2-14; however, the Wave 2 nonrespondent estimates are replaced by estimates for the Wave 1 respondents who remained eligible at Wave 2, and the Wave 2 respondent estimates use the Wave 2 final weights (rather than the Wave 1 final weights). Differences between the weighted estimates for Wave 2 and Wave 1 respondents therefore reflect the extent to which the Wave 2 weighting process corrected for potential attrition bias. Across all seven tables, the biggest difference found was 0.8 percent (for non-Hispanic White aged-up adults, see Table 2-24) and this was not statistically significant at the



.05 level. These results suggest that the Wave 2 weighting nonresponse adjustments were highly effective.

Table 2-19 shows that the Wave 2 weighting process corrected for potential nonresponse bias associated with Wave 1 demographic characteristics and health insurance coverage among continuing adults at Wave 2. All the differences between the point estimates are essentially zero. The astute reader will notice that the 95 percent confidence intervals around the difference estimates barely exclude zero for a small number of subgroups (males and 18- to 44-year-olds), however this is primarily due to the large sample sizes.<sup>11</sup>

Table 2-20 demonstrates the effectiveness of the Wave 2 weighting process on Wave 1 tobacco-use estimates for continuing adults. The differences between the point estimates are not substantive, despite the 95 percent confidence intervals indicating that estimates overall and for males and non-Hispanic Whites are marginally lower among Wave 2 respondents. The confidence intervals around the estimates of difference between Wave 1 and Wave 2 respondents are narrow reflecting high correlation between the two groups over time and the use of sample-based raking to select Wave 1 tobacco-use estimates.

Among continuing youth, using the Wave 2 final weights, Table 2-21 shows that 12- to 13-year-olds are slightly underrepresented among Wave 2 respondents compared to Wave 1 respondents. However, the magnitude of the difference is not practically meaningful. Table 2-22 shows no evidence of nonresponse bias for Wave 1 estimates of ever tobacco use among continuing youth at Wave 2.

Similarly, no evidence of potential nonresponse bias was found for aged-up adults or aged-up youth based on the estimates in Tables 2-23, 2-24, and 2-25.

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<sup>11</sup> Part of the explanation also lies in technical subtleties associated with the Wave 2 weighting process. Persons ineligible at Wave 2 were included with the Wave 2 respondents when raking to Wave 1 demographics and tobacco-use estimates but are excluded from the estimates in the table. Also, cases with missing values for the tobacco-use estimates used in the Wave 2 raking process were pooled with cases with non-missing values during raking whereas they are excluded from the estimates in the table.

Table 2-19. Comparison of Wave 2 continuing Adult Interview respondents with Wave 1 Adult Interview respondents

Characteristic at Wave 1 <sup>a</sup>	Wave 2 continuing adult respondents		Wave 1 adult respondents <sup>c</sup>		Difference in weighted percentages [Wave 2 – Wave 1] [95% confidence interval]
	Unweighted count	Weighted percentage, using adult Wave 2 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using adult Wave 1 final weights [95% confidence interval]	
Sex					
Male	13,069	47.9% [47.3%, 48.5%]	16,136	47.9% [47.4%, 48.5%]	-0.0% [-0.0%, -0.0%]
Female	13,355	52.1% [51.5%, 52.7%]	15,880	52.1% [51.5%, 52.6%]	0.0% [0.0%, 0.0%]
Age group					
18-24	7,325	13.0% [12.6%, 13.5%]	9,067	13.1% [12.7%, 13.4%]	-0.0% [-0.0%, -0.0%]
25-44	9,226	34.4% [33.8%, 35.0%]	11,209	34.4% [33.9%, 34.9%]	-0.0% [-0.0%, -0.0%]
45-64	7,375	34.6% [34.0%, 35.2%]	8,731	34.6% [34.1%, 35.1%]	0.0% [-0.0%, 0.0%]
65+	2,516	18.0% [17.5%, 18.5%]	3,027	18.0% [17.6%, 18.4%]	0.0% [-0.0%, 0.1%]
Race/ethnicity					
Non-Hispanic White alone	15,760	65.9% [65.4%, 66.5%]	19,131	66.0% [65.5%, 66.5%]	-0.0% [-0.1%, 0.0%]
Other	10,248	34.1% [33.5%, 34.6%]	12,364	34.0% [33.5%, 34.5%]	0.0% [-0.0%, 0.1%]
Health insurance					
Yes	21,262	85.5% [84.8%, 86.1%]	25,543	85.5% [84.9%, 86.0%]	-0.0% [-0.2%, 0.2%]
No	4,919	14.5% [13.9%, 15.2%]	6,105	14.5% [14.0%, 15.1%]	0.0% [-0.2%, 0.2%]
Education					
< HS or GED	5,271	16.6% [16.2%, 17.1%]	6,368	16.6% [16.2%, 17.0%]	-0.0% [-0.0%, 0.0%]
HS	6,054	24.3% [23.8%, 24.8%]	7,475	24.3% [23.8%, 24.7%]	0.0% [-0.0%, 0.1%]
Some college, no degree	9,306	31.1% [30.6%, 31.7%]	11,229	31.1% [30.6%, 31.6%]	0.0% [-0.0%, 0.1%]
Bachelor degree +	5,684	28.0% [27.4%, 28.5%]	6,771	28.0% [27.5%, 28.5%]	-0.0% [-0.1%, 0.0%]

Table 2-19. Comparison of Wave 2 continuing Adult Interview respondents with Wave 1 Adult Interview respondents (continued)

Characteristic at Wave 1 <sup>a</sup>	Wave 2 continuing adult respondents		Wave 1 adult respondents <sup>c</sup>		Difference in weighted percentages [Wave 2 – Wave 1] [95% confidence interval]
	Unweighted count	Weighted percentage, using adult Wave 2 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using adult Wave 1 final weights [95% confidence interval]	
Tobacco-use status <sup>b</sup>					
Current established user	11,682	23.8% [23.2%, 24.4%]	14,223	23.9% [23.3%, 24.5%]	-0.1% [-0.1%, -0.0%]
Not current established user	14,038	76.2% [75.6%, 76.8%]	16,902	76.1% [75.5%, 76.7%]	0.1% [0.0%, 0.1%]

<sup>a</sup> The characteristics are as reported in the Adult Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> A tobacco user is defined as someone who uses one or more of the tobacco products covered by the Wave 1 Adult Interview. A 'current established user' of a given tobacco product is someone who currently uses the product every day or some days and: for cigarettes, has smoked at least 100 cigarettes in their lifetime and, for any other tobacco product, has reported they ever used that product regularly. The products covered by the Wave 1 Adult Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, and dissolvable tobacco.

<sup>c</sup> Excludes those who were ineligible at Wave 2.

Table 2-20. Comparison of Wave 1 tobacco-use\* rates for Wave 2 continuing Adult Interview respondents with Wave 1 Adult Interview respondents

Characteristic at Wave 1 <sup>a</sup>	Wave 2 continuing adult respondents		Wave 1 adult respondents <sup>b</sup>		Difference in weighted percentages [Wave 2 – Wave 1] [95% confidence interval]
	Unweighted count	Weighted percentage, using adult Wave 2 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using adult Wave 1 final weights [95% confidence interval]	
Overall	25,720	23.8% [23.2%, 24.4%]	31,125	23.9% [23.3%, 24.5%]	-0.1% [-0.1%, -0.0%]
Sex					
Male	12,727	29.6% [28.7%, 30.4%]	15,688	29.8% [28.9%, 30.6%]	-0.2% [-0.3%, -0.1%]
Female	12,972	18.4% [17.7%, 19.1%]	15,411	18.4% [17.7%, 19.1%]	-0.0% [-0.1%, 0.0%]
Age group					
18-24	7,209	29.0% [27.6%, 30.4%]	8,917	29.0% [27.6%, 30.4%]	-0.0% [-0.1%, 0.0%]
25-44	9,045	28.8% [27.8%, 29.8%]	10,983	29.0% [28.1%, 29.9%]	-0.2% [-0.5%, 0.1%]
45-64	7,113	23.2% [22.2%, 24.2%]	8,406	23.2% [22.3%, 24.1%]	-0.1% [-0.4%, 0.2%]
65+	2,348	10.8% [9.6%, 12.1%]	2,808	10.7% [9.6%, 11.9%]	0.1% [-0.3%, 0.5%]
Race/ethnicity					
Non-Hispanic White alone	15,421	25.2% [24.3%, 26.1%]	18,693	25.3% [24.4%, 26.2%]	-0.1% [-0.2%, -0.0%]
Other	9,919	21.0% [20.2%, 21.8%]	11,958	21.1% [20.4%, 21.8%]	-0.1% [-0.2%, 0.0%]

<sup>a</sup> The characteristics are as reported in the Adult Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> Excludes those who were ineligible at Wave 2.

\* Defined as current established use of tobacco. A tobacco user is defined as someone who uses one or more of the tobacco products covered by the Wave 1 Adult Interview. A 'current established user' of a given tobacco product is someone who currently uses the product every day or some days and: for cigarettes, has smoked at least 100 cigarettes in their lifetime and, for any other tobacco product, has reported they ever used that product regularly. The products covered by the Wave 1 Adult Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, and dissolvable tobacco.

Table 2-21. Comparison of Wave 2 continuing Youth Interview respondents with Wave 1 youth respondents who were continuing youth at Wave 2

Characteristic at Wave 1 <sup>a</sup>	Wave 2 continuing youth respondents		Wave 1 youth respondents <sup>c</sup>		Difference in weighted percentages [Wave 2 – Wave 1] [95% confidence interval]
	Unweighted count	Weighted percentage, using youth Wave 2 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using youth Wave 1 final weights [95% confidence interval]	
Sex					
Male	5,164	51.4% [50.4%, 52.4%]	5,829	51.3% [50.4%, 52.3%]	0.0% [-0.0%, 0.1%]
Female	4,892	48.6% [47.6%, 49.6%]	5,533	48.7% [47.7%, 49.6%]	-0.0% [-0.1%, 0.0%]
Age group					
12-13	4,164	40.7% [39.8%, 41.7%]	4,678	40.9% [40.0%, 41.8%]	-0.2% [-0.2%, -0.1%]
14-17	5,917	59.3% [58.3%, 60.2%]	6,718	59.1% [58.2%, 60.0%]	0.2% [0.1%, 0.2%]
Race/ethnicity					
Non-Hispanic White alone	4,731	54.5% [53.5%, 55.5%]	5,347	54.5% [53.5%, 55.4%]	0.0% [-0.1%, 0.1%]
Other	5,141	45.5% [44.5%, 46.5%]	5,808	45.5% [44.6%, 46.5%]	-0.0% [-0.1%, 0.1%]
Tobacco-use status <sup>b</sup>					
Ever user	1,665	17.1% [16.3%, 17.9%]	1,926	17.3% [16.4%, 18.3%]	-0.2% [-0.7%, 0.3%]
Never user	8,006	82.9% [82.1%, 83.7%]	8,988	82.7% [81.7%, 83.6%]	0.2% [-0.3%, 0.7%]

<sup>a</sup> The characteristics are as reported in the Youth Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> An 'ever user' is someone who has ever used one or more of the tobacco products covered by the Wave 1 Youth Interview. A 'never user' is someone who has never used any of those tobacco products. Ever use of a tobacco product is defined as having ever used the product, even one or two times. The products covered by the Wave 1 Youth Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, dissolvable tobacco, bidis, and kreteks.

<sup>c</sup> Excludes those who were ineligible at Wave 2 and also excludes Wave 1 youth who were aged-up adults at Wave 2.

Table 2-22. Comparison of Wave 1 tobacco-use\* rates for Wave 2 continuing Youth Interview respondents with Wave 1 youth respondents who were continuing youth at Wave 2

Characteristic at Wave 1 <sup>a</sup>	Wave 2 continuing youth respondents		Wave 1 youth respondents <sup>b</sup>		Difference in weighted percentages [Wave 2 – Wave 1] [95% confidence interval]
	Unweighted count	Weighted percentage, using youth Wave 2 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using youth Wave 1 final weights [95% confidence interval]	
Overall	9,671	17.1% [16.3%, 17.9%]	10,914	17.3% [16.4%, 18.3%]	-0.2% [-0.7%, 0.3%]
Sex					
Male	4,922	18.1% [17.1%, 19.2%]	5,541	18.4% [17.3%, 19.6%]	-0.3% [-1.0%, 0.3%]
Female	4,727	16.1% [15.1%, 17.2%]	5,343	16.2% [15.2%, 17.4%]	-0.1% [-0.7%, 0.4%]
Age group					
12-13	3,923	7.8% [6.8%, 8.9%]	4,396	7.8% [6.9%, 8.9%]	-0.1% [-0.4%, 0.2%]
14-17	5,748	23.3% [22.3%, 24.5%]	6,517	23.7% [22.5%, 24.9%]	-0.3% [-1.1%, 0.5%]
Race/ethnicity					
Non-Hispanic White alone	4,555	18.0% [16.9%, 19.1%]	5,138	18.4% [17.1%, 19.8%]	-0.4% [-1.0%, 0.2%]
Other	4,930	16.3% [15.3%, 17.4%]	5,563	16.3% [15.2%, 17.4%]	0.0% [-0.6%, 0.6%]

<sup>a</sup> The characteristics are as reported in the Youth Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> Excludes those who were ineligible at Wave 2 and also excludes Wave 1 youth who were aged-up adults at Wave 2.

\* Defined as ever use of tobacco. An 'ever user' is someone who has ever used one or more of the tobacco products covered by the Wave 1 Youth Interview. Ever use of a tobacco product is defined as having ever used the product, even one or two times. The products covered by the Wave 1 Youth Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, dissolvable tobacco, bidis, and kreteks.

Table 2-23. Comparison of Wave 2 aged-up Adult Interview respondents with Wave 1 youth respondents who were aged-up adults at Wave 2

Characteristic at Wave 1 <sup>a</sup>	Wave 2 aged-up adult respondents		Wave 1 youth respondents <sup>c</sup>		Difference in weighted percentages [Wave 2 – Wave 1] [95% confidence interval]
	Unweighted count	Weighted percentage, using adult Wave 2 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using youth Wave 1 final weights [95% confidence interval]	
Sex					
Male	956	50.7% [48.5%, 53.0%]	1,125	50.9% [48.9%, 53.0%]	-0.2% [-0.6%, 0.2%]
Female	956	49.3% [47.0%, 51.5%]	1,102	49.1% [47.0%, 51.1%]	0.2% [-0.2%, 0.6%]
Race/ethnicity					
Non-Hispanic White alone	954	55.1% [52.9%, 57.3%]	1,127	55.3% [53.2%, 57.4%]	-0.2% [-0.6%, 0.2%]
Other	944	44.9% [42.7%, 47.1%]	1,085	44.7% [42.6%, 46.8%]	0.2% [-0.2%, 0.6%]
Tobacco-use status <sup>b</sup>					
Ever user	810	43.1% [40.9%, 45.4%]	936	42.6% [40.3%, 44.9%]	0.6% [-1.7%, 2.8%]
Never user	1,061	56.9% [54.6%, 59.1%]	1,241	57.4% [55.1%, 59.7%]	-0.6% [-2.8%, 1.7%]

<sup>a</sup> The characteristics are as reported in the Youth Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> An 'ever user' is someone who has ever used one or more of the tobacco products covered by the Wave 1 Youth Interview. A 'never user' is someone who has never used any of those tobacco products. Ever use of a tobacco product is defined as having ever used the product, even one or two times. The products covered by the Wave 1 Youth Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, dissolvable tobacco, bidis, and kreteks.

<sup>c</sup> Excludes those who were ineligible at Wave 2 and also excludes Wave 1 youth who were continuing youth at Wave 2.

Table 2-24. Comparison of Wave 1 tobacco-use\* rates for Wave 2 aged-up Adult Interview respondents with Wave 1 youth respondents who were aged-up adults at Wave 2

Characteristic at Wave 1 <sup>a</sup>	Wave 2 aged-up adult respondents		Wave 1 youth respondents <sup>b</sup>		Difference in weighted percentages [Wave 2 – Wave 1] [95% confidence interval]
	Unweighted count	Weighted percentage, using adult Wave 2 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using youth Wave 1 final weights [95% confidence interval]	
Overall	1,871	43.1% [40.9%, 45.4%]	2,177	42.6% [40.3%, 44.9%]	0.6% [-1.7%, 2.8%]
Sex					
Male	932	46.6% [43.4%, 49.8%]	1,096	46.1% [42.9%, 49.4%]	0.5% [-2.6%, 3.5%]
Female	936	39.7% [36.6%, 42.9%]	1,078	39.0% [36.0%, 42.0%]	0.7% [-2.2%, 3.6%]
Race/ethnicity					
Non-Hispanic White alone	936	47.0% [43.8%, 50.2%]	1,105	46.2% [42.8%, 49.7%]	0.8% [-2.3%, 3.8%]
Other	918	38.1% [35.0%, 41.3%]	1,054	37.8% [34.4%, 41.4%]	0.3% [-2.8%, 3.4%]

<sup>a</sup> The characteristics are as reported in the Youth Interview at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> Excludes those who were ineligible at Wave 2 and also excludes Wave 1 youth who were continuing youth at Wave 2.

\* Defined as ever use of tobacco. An 'ever user' is someone who has ever used one or more of the tobacco products covered by the Wave 1 Youth Interview. Ever use of a tobacco product is defined as having ever used the product, even one or two times. The products covered by the Wave 1 Youth Interview are cigarettes, traditional cigars, cigarillos, little filtered cigars, pipes, smokeless tobacco, snus, hookah, e-cigarettes, dissolvable tobacco, bidis, and kreteks.



Table 2-25. Comparison of Wave 2 aged-up Youth Interview respondents with Wave 1 shadow youth who were aged-up youth at Wave 2

Characteristic at Wave 1 <sup>a</sup>	Wave 2 aged-up youth respondents		Wave 1 shadow youth <sup>b</sup>		Difference in weighted percentages [Wave 2 – Wave 1] [95% confidence interval]
	Unweighted count	Weighted percentage, using youth Wave 2 final weights [95% confidence interval]	Unweighted count	Weighted percentage, using shadow youth Wave 1 final weights [95% confidence interval]	
Sex					
Male	1,055	50.3% [48.1%, 52.4%]	1,292	50.2% [48.3%, 52.1%]	0.1% [-0.3%, 0.4%]
Female	1,036	49.7% [47.6%, 51.9%]	1,258	49.8% [47.9%, 51.7%]	-0.1% [-0.4%, 0.3%]
Race/ethnicity					
Non-Hispanic White alone	1,008	52.1% [50.0%, 54.3%]	1,223	52.2% [50.2%, 54.1%]	-0.0% [-0.4%, 0.3%]
Other	1,078	47.9% [45.7%, 50.0%]	1,321	47.8% [45.9%, 49.8%]	0.0% [-0.3%, 0.4%]

<sup>a</sup> The characteristics are as reported in the Household Screener at Wave 1. For each characteristic, the sum of the counts in all the categories may not be equal to the count in the overall row due to missing values.

<sup>b</sup> Excludes those who were ineligible at Wave 2 and also excludes Wave 1 shadow youth who were continuing shadow youth at Wave 2.

Estimates of Wave 2 adult cigarette smoking prevalence in Table 2-26 using the Wave 2 final weights are similar to the estimates using the Wave 1 IPS weights; both are in the range of values obtained by other surveys. The use of the Wave 2 weights resulted in a slight decrease in estimated cigarette smoking prevalence for females and non-White non-Hispanics.

Table 2-27 examines the effect of the Wave 2 final weights on estimates calculated for youth. Cigarette smoking prevalence estimates with the Wave 1 IPS weights and with the Wave 2 weights were generally lower than estimates from other surveys although, as noted above, the surveys took place in different time periods.

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Table 2-26. Current cigarette smoking based on Wave 2 Adult Interview respondents

Characteristic at Wave 2	Un-weighted count	PATH Study: Unweighted percentage	PATH Study: Weighted percentage, using adult IPS weights [95% confidence interval]	PATH Study: Weighted percentage, using adult Wave 2 final weights [95% confidence interval]	Percentage from 2010-2011 TUS-CPS [95% confidence interval]	Percentage from 2014 NHIS [95% confidence interval]	Percentage from 2013-2014 NHANES [95% confidence interval]	Percentage from 2014 NSDUH, original definition <sup>a</sup> [95% confidence interval]	Percentage from 2014 NSDUH, modified definition <sup>a</sup> [95% confidence interval]
Current smoker	28,324	34.2%	18.9% [18.1%, 19.9%]	18.6% [18.1%, 19.2%]	16.1% [15.8%, 16.3%]	16.7% [16.1%, 17.4%]	20.0% [17.8%, 22.3%]	22.7% [22.1%, 23.2%]	20.9% [20.3%, 21.4%]
Current smoker, male	14,002	35.3%	21.2% [20.2%, 22.3%]	21.3% [20.6%, 22.0%]	18.0% [17.7%, 18.4%]	18.8% [18.0%, 19.7%]	21.6% [19.4%, 24.1%]	25.5% [24.7%, 26.3%]	23.6% [22.8%, 24.4%]
Current smoker, female	14,296	33.2%	17.1% [16.2%, 18.1%]	16.2% [15.6%, 16.8%]	14.2% [13.9%, 14.5%]	14.8% [13.9%, 15.7%]	18.4% [15.6%, 21.6%]	20.1% [19.3%, 20.8%]	18.3% [17.6%, 19.2%]
Current smoker, age 18-24	8,167	22.9%	18.3% [17.2%, 19.4%]	18.4% [17.4%, 19.4%]	17.1% [16.4%, 17.8%]	16.7% [14.2%, 19.5%]	23.4% [19.2%, 28.3%]	NA <sup>b</sup>	NA
Current smoker, age 25-44	9,865	40.3%	23.5% [22.2%, 24.8%]	23.6% [22.6%, 24.6%]	17.9% [17.5%, 18.4%]	20.0% [19.0%, 21.0%]	23.1% [20.7%, 25.7%]	NA	NA
Current smoker, age 45-64	7,525	42.4%	20.1% [19.0%, 21.2%]	19.7% [18.8%, 20.6%]	17.8% [17.4%, 18.2%]	18.0% [17.0%, 19.0%]	21.6% [17.6%, 26.2%]	NA	NA
Current smoker, age 65+	2,763	23.9%	8.2% [7.2%, 9.3%]	8.0% [7.0%, 9.1%]	7.8% [7.5%, 8.2%]	8.5% [7.7%, 9.4%]	8.4% [6.9%, 10.1%]	NA	NA
Current smoker, Hispanic	5,031	25.0%	14.4% [13.3%, 15.5%]	14.5% [13.6%, 15.5%]	10.9% [10.4%, 11.5%]	11.2% [10.2%, 12.2%]	13.7% [11.4%, 16.3%]	18.5% [17.0%, 20.1%]	15.2% [13.8%, 16.6%]
Current smoker, White non-Hispanic	16,700	37.1%	19.4% [18.2%, 20.6%]	19.4% [18.6%, 20.1%]	17.5% [17.2%, 17.8%]	18.2% [17.3%, 19.1%]	20.9% [17.7%, 24.5%]	23.9% [23.2%, 24.7%]	22.7% [21.9%, 23.4%]
Current smoker, other non-Hispanic	6,140	33.7%	21.8% [20.6%, 23.1%]	19.3% [18.3%, 20.3%]	NA	16.2% [15.2%, 17.2%]	21.7% [18.9%, 24.8%]	21.8% [20.4%, 23.3%]	19.4% [18.0%, 20.9%]
Current every-day smoker	28,324	26.3%	14.5% [13.7%, 15.4%]	14.1% [13.7%, 14.6%]	12.7% [12.4%, 12.9%]	12.8% [12.3%, 13.4%]	16.1% [14.2%, 18.2%]	NA	NA
Current some-days smoker	28,324	7.9%	4.4% [4.2%, 4.7%]	4.5% [4.2%, 4.7%]	3.4% [3.3%, 3.5%]	3.9% [3.6%, 4.2%]	3.9% [3.2%, 4.7%]	NA	NA

<sup>a</sup> NSDUH's definition of a current cigarette smoker is someone who has smoked part or all of a cigarette in the past 30 days, which is more expansive than the definition used in the other surveys. However, NSDUH contains questions on lifetime smoking and current smoking. The modified definition uses these questions to construct a measure of "current smoking" that is comparable to that of the other surveys (Ryan et al., 2012). The construction of this variable is described in Appendix A.

<sup>b</sup> Detailed age information was not available in the public use file for NSDUH 2014.

Table 2-27. Cigarette smoking\* based on Wave 2 Youth Interview respondents

Characteristic at Wave 2	Unweighted count	PATH Study: Unweighted percentage	PATH Study: Weighted percentage, using youth IPS weights [95% confidence interval]	PATH Study: Weighted percentage, using youth Wave 2 final weights [95% confidence interval]	Percentage from 2013-2014 NHANES [95% confidence interval]	Percentage from 2014 NSDUH [95% confidence interval]	Percentage from 2014 NYTS [95% confidence interval]
Ever tried cigarette smoking, even one or two puffs	12,148	11.8%	11.9% [11.1%, 12.8%]	11.7% [11.0%, 12.3%]	18.7% [15.3%, 22.6%]	14.4% [13.6%, 15.3%]	21.7% [20.2%, 23.3%]
Ever tried smoking, male	6,208	11.8%	12.1% [11.0%, 13.2%]	11.8% [10.9%, 12.7%]	19.2% [14.3%, 25.4%]	14.6% [13.5%, 15.7%]	22.5% [20.8%, 24.2%]
Ever tried smoking, female	5,911	11.7%	11.7% [10.8%, 12.8%]	11.5% [10.7%, 12.4%]	18.0% [13.0%, 24.4%]	14.2% [13.1%, 15.4%]	21.0% [19.2%, 22.9%]
Ever tried smoking, age 12-13	4,150	3.9%	4.0% [3.4%, 4.7%]	3.8% [3.2%, 4.4%]	5.1% [3.0%, 8.6%]	3.8% [3.1%, 4.6%]	10.3% [8.6%, 12.3%]
Ever tried smoking, age 14-17	7,998	15.8%	16.0% [14.9%, 17.1%]	15.7% [14.9%, 16.5%]	25.2% [20.8%, 30.2%]	19.4% [18.2%, 20.6%]	27.4% [25.4%, 29.4%]
Have smoked in past 30 days	12,068	4.0%	4.0% [3.6%, 4.5%]	4.0% [3.6%, 4.4%]	3.9% [2.7%, 5.5%]	5.0% [4.6%, 5.5%]	5.8% [5.2%, 6.5%]

\* Defined as ever tried a cigarette, even one or two puffs. For comparison, an additional measure of current smoking commonly applied to youth (having smoked at all in the past 30 days) is also included in this table.

## 2.3.2 Biospecimens

The results in Tables 2-15 and 2-16 show estimates from the aged-up adults who provided urine or blood specimens, respectively, at Wave 2, but not all specimens collected will be analyzed in the laboratory. The biospecimens chosen initially for laboratory analysis come from aged-up adults who are in specified tobacco-use categories.<sup>12</sup> In other categories of tobacco use, no samples were selected for laboratory analysis. Consequently, the samples of biospecimens from Wave 2 aged-up adults that are analyzed initially are not representative of the population of adults age 18 as a whole. An additional set of nonresponse-adjusted weights was developed to facilitate the analyses of the subpopulations represented by these samples. These weighting adjustments addressed issues such as the overrepresentation of current established tobacco users among aged-up adults who provided urine and/or blood specimens, and the selection of adults whose biospecimens were sent for laboratory analysis.

## 2.4 Summary of Wave 2 Findings

### 2.4.1 Wave 2 Response Rates

Table 2-28 summarizes the PATH Study Wave 2 interview and biospecimen collection response rates. The weighted and unweighted response rates (conditioning on Wave 1 response) for continuing adults, continuing youth, aged-up adults, and aged-up youth are all above 80 percent. The differential weighted response rates to the Wave 2 interview were modest for tobacco-use status and demographic subgroups (see Tables 2-2 to 2-5). Unweighted response rates to the urine collection were consistently high among subgroups of continuing adults (see Table 2-6). The largest differential unweighted response rates were for the current established tobacco-use status of aged-up adults asked to provide urine and blood specimens: response rates for current established users were about 8 percentage points higher for both types of biospecimen than for other aged-up adults (see Table 2-7), which suggests a heightened potential for nonresponse bias.

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<sup>12</sup> Urine specimens from some continuing adults at Wave 2 were also chosen for laboratory analysis.

Table 2-28. Summary of PATH Study Wave 2 response rates

Group	Unweighted response rate	Weighted response rate
Continuing adults, Adult Interview	82.6%	83.1%
Continuing youth, Youth Interview	88.5%	88.4%
Aged-up adults, Adult Interview	85.9%	85.7%
Aged-up youth, Youth Interview	82.0%	82.1%
Continuing adults, urine collection	96.4%	
Aged-up adults, urine collection	82.9%	
Aged-up adults, blood collection	47.4%	

## 2.4.2 Representativeness of Wave 2 Responding Sample

Nonresponse bias analysis indicates that estimates of many key demographic and Wave 1 tobacco-use variables calculated using the Wave 1 final weights are comparable for Wave 2 interview respondents and nonrespondents. However, males, 18- to 24-year-olds, those with high school education, and current established tobacco users at Wave 1 are underrepresented among continuing adult respondents; and 45- to 64-year-olds, persons with health insurance, and those with at least a bachelor's degree are overrepresented among respondents (see Table 2-8). Estimates of current established tobacco use are lower overall, and for males, 18- to 44-year-olds, and non-Hispanic Whites among continuing adult respondents (see Table 2-9). Estimates of ever use of tobacco are lower overall (Table 2-10), and for females, 14- to 17-year-olds, and non-Hispanic Whites among continuing youth respondents compared to nonrespondents (see Table 2-11). No evidence of potential nonresponse bias was found for aged-up adults or aged-up youth (see Tables 2-12 to 2-14). Based on these results, for some subgroups, the PATH Study may experience attrition patterns that are similar to those in other longitudinal surveys. Cunradi et al. (2005) and Young et al. (2006) have found that smokers were less likely to be retained in subsequent waves of surveys than nonsmokers.

Results of the Wave 2 biospecimen nonresponse bias analysis for aged-up adults revealed no evidence of nonresponse bias with respect to sex and race/ethnicity; however, current established tobacco users were overrepresented among both urine and blood specimen providers (see Tables 2-15 and 2-16). No nonresponse bias analysis was necessary for urine collection from continuing adults due to the high response rate of 96.4 percent (see Table 2-6).

When compared to national cross-sectional surveys that measure tobacco use (TUS-CPS, NHIS, NHANES, and NSDUH), estimates of adult cigarette smoking from the PATH Study Wave 2

sample are roughly in the middle of the range of estimates on smoking (see Table 2-17). There is no indication of nonresponse bias with respect to this measure.

PATH Study estimates of the select youth cigarette smoking measures from the Wave 2 sample are at the low end of estimates in comparison with national cross-sectional surveys that measure tobacco use (NHANES, NSDUH, and NYTS) (see Table 2-18). However, estimates from the comparison surveys are from 2013 through 2014 while those from the PATH Study are from October 2014 through October 2015, and evidence suggests the use of traditional cigarettes is declining among youth. The difference among surveys on time period alone is not large enough to account for the different estimates; as indicated in Section 2.2.2, time period is one of a number of factors that may explain the different estimates.

### **2.4.3 Statistical Approach for Addressing Wave 2 Nonresponse**

The approach used to reduce potential nonresponse bias in Wave 2 of the PATH Study was to adjust the Wave 1 final weights of respondents at the adult and youth levels to account for nonrespondents. Results of applying this approach to the Wave 2 sample indicate the nonresponse adjustments essentially eliminated discrepancies between estimates based on Wave 1 respondents and estimates based on Wave 2 respondents with respect to demographic characteristics and Wave 1 tobacco use, for all age groups.

A separate set of weights was developed to address nonresponse among the adults selected for biospecimen collection at Wave 2 and to facilitate the analyses of these subpopulations.

Estimates of adult cigarette smoking at Wave 2 using the Wave 1 IPS weights (before any nonresponse adjustments) are in line with estimates from other surveys; agreement in these estimates was preserved using the Wave 2 final weights. Weighting adjustments for youth had little effect on the Wave 2 estimates of youth cigarette smoking.



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## Conclusions and Implications for Study Going Forward

# 3

This section summarizes the findings presented in this report on the PATH Study's Wave 1 and Wave 2 response rates, representativeness of the responding samples, and approach to addressing nonresponse. The section closes with a discussion of the implications of the conclusions for the study going forward.

### 3.1 Conclusions

For the Wave 1 Household Screener and Adult Interview, the nonresponse bias analysis showed that many characteristics of respondents in Wave 1 aligned with the 1-year estimates from the 2013 ACS. Exceptions were found for single-person households, education, and ethnicity when comparing PATH Study estimates using IPS weights to 1-year 2013 ACS estimates. Estimates of cigarette smoking among adults in Wave 1 were within the range of estimates found by other national health studies. Moreover, when the sample estimates were adjusted for nonresponse using the raked weights, they more closely approximated the ACS estimates, and adult cigarette smoking rates remained essentially the same.

For the Wave 1 Youth Interview, the nonresponse bias analysis showed that many characteristics of respondents were consistent with the 1-year estimates from the 2013 ACS, with the exception of ethnicity. When the sample estimates were adjusted for nonresponse among youth, they more closely approximated the 2013 ACS estimates, but the ever-tried cigarette smoking rates for youth in Wave 1 remained lower than those found by other national studies.

For the Wave 1 urine and blood collections, the nonresponse bias analysis showed that many of the characteristics of respondents were generally aligned with estimates of these characteristics from the 1-year 2013 ACS. In addition, when the sample estimates were adjusted for nonresponse, they were found to approximate the ACS estimates more closely.

For Wave 2, the nonresponse bias analysis showed that many characteristics of Wave 2 respondents aligned with those of Wave 2 nonrespondents. Some exceptions were found when comparing estimates for continuing adults (current established tobacco use was lower overall, and for males, 18-

to 44-year-olds, and non-Hispanic Whites among respondents) and for continuing youth (ever use of tobacco was lower overall, and for females, 14- to 17-year-olds, and non-Hispanic Whites among respondents). For continuing adults, males, 18- to 24-year-olds, those with high school education, and current established tobacco users at Wave 1 were underrepresented among respondents; and 45- to 64-year-olds, persons with health insurance, and those with at least a bachelor's degree were overrepresented among respondents. However, estimates of cigarette smoking among adults in Wave 2 were within the range of estimates found by other national health studies. Moreover, when the estimates of Wave 1 characteristics based on the Wave 2 sample were adjusted for nonresponse using the Wave 2 final weights, they were almost identical to the estimates based on the Wave 1 sample and Wave 1 final weights. The Wave 2 adult cigarette smoking rates remained essentially the same using the Wave 2 final weights (compared to using the Wave 1 IPS weights), but the ever-tried cigarette smoking rates for youth remained lower than those found by other national studies. Among aged-up adults, current established tobacco users were more likely to provide urine and blood specimens; urine collection rates were very high among continuing adults.

### 3.2 Implications for Study Going Forward

Findings from the Wave 1 and Wave 2 nonresponse bias analyses have important implications for the PATH Study. First, the study should continue implementing new approaches to increase response rates for subsequent waves. The PATH Study is continually seeking ways to boost the response rates. For example, beginning in Wave 2, it enhanced its efforts to communicate by text message and email with participants who indicated they may be contacted in these ways. In each wave, the PATH Study varies the appearance of materials it provides participants to enhance their interest and engagement. In addition, the study provides a certificate of appreciation to participating youth, and it takes extra steps to interview continuing adults who have relocated to group quarters facilities since their initial interviews. Participants continue to access information about the study on the participant pages of the PATH Study website; adult participants may update their contact information on this website, as well as by returning update forms mailed to them and by calling a toll-free telephone number. The study employs special interviewers with skills in refusal conversion and has a cadre of experienced traveling interviewers that help to augment staffing in specific areas. For tracing difficult-to-locate cases, the study has examined the effectiveness of various on-line search services; as needed, it accesses multiple services for a given case. For Wave 4, the PATH Study further expanded its engagement activities to include the use of short videos, displayed on field interviewer laptops (e.g., for participants who are reluctant to participate) and on the study

website. In these videos and other materials, the study provided information on the scope of the PATH Study, to underline the message participants are contributing to a large and important effort that will increase understanding of tobacco use and health.

Second, data analyses will need to consider carefully the achieved sample sizes and adjustments may be necessary, such as combining some subgroups in analyses. Future planning for longitudinal analyses will need to account for the declining rates of cigarette smoking in the U.S. population in general, notably among youth. For the PATH Study, the trends observed among youth mean smaller sample sizes for youth cigarette smokers and therefore less statistical power for examining within-person changes among this group. At the same time, the larger sample size of youth nonsmokers provides more power for examining the initiation of cigarette smoking over time. The impact of the smaller sample size for youth cigarette smokers must also be considered in the context of the recent and rapid increase of youth use of alternative tobacco products such as e-cigarettes and hookah (CDC, 2015d).

Third, on an ongoing and consistent basis, the PATH Study should examine the sample sizes achieved, as well as those projected for future data collection. In this way, it would be possible to detect differential rates of attrition among subgroups early and make extra efforts to retain persons in subgroups of special analytic interest. For example, the Wave 4 design includes the selection of a new shadow youth sample, as well as new samples of youth and adults to replenish the Wave 1 sample, taking into account the subgroup sample sizes in the continuing cohort.

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## Appendix A

### Cigarette Smoking Questions in the PATH Study and Other Surveys

Table A-1 lists the questions used to ask about current smoking status of adults in the PATH Study and in the surveys used for comparison and describes the populations included in the estimates from those surveys.

Note that although the questions used to define current cigarette smoking are similar among the surveys, small differences could have an effect on the answers given. In the PATH Study, the question used to establish whether a respondent has smoked at least 100 cigarettes in his or her lifetime has closed response categories:

“How many cigarettes have you smoked in your entire life? A pack usually has 20 cigarettes in it.”

For adults:

- 1. 1 or more puffs but never a whole cigarette;
- 2. 1 to 10 cigarettes (about ½ pack total);
- 3. 11 to 20 cigarettes (about ½ pack to 1 pack);
- 4. 21 to 50 cigarettes (more than 1 pack but less than 3 packs);
- 5. 51 to 99 (more than 2 ½ packs but less than 5 packs); and
- 6. 100 or more cigarettes (5 packs or more).

For youth:

- 1 or more puffs but never a whole cigarette;
- 1 cigarette;
- 3. 2 to 10 cigarettes (about ½ pack total);
- 4. 11 to 20 cigarettes (about ½ pack to 1 pack);
- 5. 21 to 50 cigarettes (more than 1 pack but less than 3 packs);

- 6. 51 to 99 (more than 2 ½ packs but less than 5 packs); and
- 7. 100 or more cigarettes (5 packs or more).

In TUS-CPS, NHIS, and NHANES, however, the question “Have you smoked at least 100 cigarettes in your entire life?” calls for a yes/no response.

The positioning of the questions also differs among the surveys. In the PATH Study, the cigarette smoking questions are near the beginning of the adult questionnaire, and the respondent knows that the questionnaire is about tobacco-use behaviors. In TUS-CPS, the smoking questions are near the beginning of the adult questionnaire on tobacco, but the survey is administered as part of the CPS. In NHIS, the smoking questions follow a long series of questions on health problems (breathing problems, diabetes, hernias, hemorrhoids, etc.). These question contexts may be associated with differences in responses.

Table A-2 lists the questions used to define youth cigarette smoking in the PATH Study, NHANES, NSDUH, and NYTS.

Table A-1. Questions used to define adult current cigarette smoking in the PATH Study, TUS-CPS, NHIS, NHANES, and NSDUH

PATH Study	TUS-CPS*	NHIS	NHANES	NSDUH (original definition)	NSDUH (modified definition)**
<b>Question to define current smoking (answers defining current smoking given in parentheses)</b>					
["Have you ever smoked a cigarette, even one or two puffs?" (Wave 1 question, yes) or "In the past 12 months, have you smoked a cigarette, even one or two puffs" (Wave 2 question, yes)] and "Do you now smoke cigarettes every day, some days, or not at all?" (every day or some days) and "How many cigarettes have you smoked in your entire life? A pack usually has 20 cigarettes in it." (100 or more cigarettes (5 packs or more))	"Have you smoked at least 100 cigarettes in your entire life?" (yes) and "Do you now smoke cigarettes every day, some days, or not at all?" (every day or some days)	"Have you smoked at least 100 cigarettes in your ENTIRE LIFE?" (yes) and "Do you NOW smoke cigarettes every day, some days or not at all?" (every day or some days)	"[Have you/Has SP] smoked at least 100 cigarettes in {your/his/her} entire life?" (yes) and "[Do you/Does SP] now smoke cigarettes every day, some days or not at all?" (every day or some days)	"Have you ever smoked part or all of a cigarette?" (yes) and "During the past 30 days, have you smoked part or all of a cigarette?" (yes)	"Have you ever smoked part or all of a cigarette?" (yes) and "During the past 30 days, have you smoked part or all of a cigarette?" (yes) and "Have you smoked at least 100 cigarettes in your entire life?" (yes)
<b>Age range included in estimate</b>					
18+	18+	18+	18+	18+	18+
<b>Exclusions from population</b>					
<p>The Wave 1 target population included only the U.S. civilian, non-institutionalized population.</p> <p>The target population for Wave 2 was the Wave 1 target population residing in the U.S. at Wave 2, except for those who were incarcerated at that time. Thus, it includes Wave 1 respondents who were on active duty or living in a health care institution (e.g., a nursing home) but not those in a correctional facility at Wave 2.</p>	Includes only the U.S. civilian, non-institutionalized population.	Includes only the civilian noninstitutionalized population residing in the U.S. at the time of the interview. Several segments of the population are excluded, such as: persons in long-term care institutions; persons on active duty with the Armed Forces; persons in correctional facilities; and U.S. nationals living in foreign countries.	Includes only the U.S. civilian, non-institutionalized population.	Includes only the U.S. civilian, non-institutionalized population. Excludes homeless persons who do not use shelters, military personnel on active duty, and residents of institutional group quarters, such as jails and hospitals.	Includes only the U.S. civilian, non-institutionalized population. Excludes homeless persons who do not use shelters, military personnel on active duty, and residents of institutional group quarters, such as jails and hospitals.

Table A-1. Questions used to define adult current cigarette smoking in the PATH Study, TUS-CPS, NHIS, NHANES, and NSDUH (continued)

PATH Study	TUS-CPS*	NHIS	NHANES	NSDUH (original definition)	NSDUH (modified definition)**
<b>Proxy responses allowed</b>					
No	Yes	Yes, for individuals physically or mentally incapable of responding.	No	No	No

\*Proxies are allowed if fourth callback, the person will not return before closeout, or the household is getting irritated. See [http://appliedresearch.cancer.gov/studies/tus-cps/surveys/tuscps\\_english\\_2010.pdf](http://appliedresearch.cancer.gov/studies/tus-cps/surveys/tuscps_english_2010.pdf), p3.

\*\*The modified definition is given in Ryan et al. (2012).

Table A-2. Questions used to define youth cigarette smoking in the PATH Study, NHANES, NSDUH, and NYTS

PATH Study	NHANES	NSDUH	NYTS
<b>Question to define ever tried cigarette smoking (answers defining ever tried cigarette smoking given in parentheses)</b>			
“Have you ever tried cigarette smoking, even one or two puffs?” (Wave 1 question for all youth, and Wave 2 question for aged-up youth, yes) or “In the past 12 months, have you smoked a cigarette, even one or two puffs?” (Wave 2 question for continuing youth, yes)	“About how many cigarettes have you smoked in your entire life?” (1 or more puffs to 100 or more cigarettes)	Have you ever smoked part or all of a cigarette?” (yes)	“Have you ever tried cigarette smoking, even one or two puffs?” (yes)
<b>Questions for determining whether have smoked in past 30 days</b>			
[“Have you ever tried cigarette smoking, even one or two puffs?” (Wave 1 question for all youth, and Wave 2 question for aged-up youth, yes) or “In the past 12 months, have you smoked a cigarette, even one or two puffs?” (Wave 2 question for continuing youth, yes)] and “When was the last time you smoked a cigarette, even one or two puffs?” (earlier today, not today but sometime in the past 7 days, not in the past 7 days but sometime in the past 30 days)	“On how many of the past 30 days did {you/SP} smoke a cigarette?” (1-30)	“Have you ever tried cigarette smoking, even one or two puffs?” (yes) and [“During the past 30 days, have you smoked part or all of a cigarette?” (yes) or “During the past 30 days, that is since [DATEFILL], on how many days did you smoke part or all of a cigarette?” (1-30)].	“During the past 30 days, on how many days did you smoke cigarettes?” (1-30)
<b>Age range included in estimate</b>			
12-17	12-17	12-17	12-17

Table A-2. Questions used to define youth cigarette smoking in the PATH Study, NHANES, NSDUH, and NYTS (continued)

PATH Study	NHANES	NSDUH	NYTS
<b>Exclusions from population</b>			
<p>The Wave 1 target population included only the U.S. civilian, non-institutionalized population.</p> <p>The target population for Wave 2 was the Wave 1 target population residing in the U.S. at Wave 2, except for those who were incarcerated at that time. Thus, it includes Wave 1 respondents who were on active duty or living in a health care institution (e.g., a nursing home) but not those in a correctional facility at Wave 2.</p>	Includes only the U.S. civilian, noninstitutionalized population.	Includes only the U.S. civilian, noninstitutionalized population. Excludes homeless persons who do not use shelters, military personnel on active duty, and residents of institutional group quarters, such as jails and hospitals.	Only includes youth who are public and private school students enrolled in regular middle schools and high schools in grades 6 through 12 in the 50 U.S. States and the District of Columbia. Alternative schools, special education schools, Department of Defense operated schools, vocational schools that serve only pull-out populations, and students enrolled in regular schools unable to complete the questionnaire without special assistance, are excluded.
<b>Other comments</b>			
	<p>Youth with missing values for the response to the question about number of lifetime cigarettes smoked were excluded from the estimates of ever tried cigarette smoking.</p> <p>Youth with missing values for the response to the question about number of cigarettes smoked in the past 30 days were excluded from the estimates of past 30 day cigarette use unless the value was missing because the youth had never smoked a cigarette in his/her lifetime. Youth who had never smoked were treated as having smoked zero cigarettes in the past 30 days.</p>		Self-administered survey in classroom.