

# Smokeless Tobacco Mortality Risks: Analyses of Two Contemporary Nationally Representative Longitudinal Mortality Studies

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**Prepared for Altria Client Services Inc.**

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## Table of Contents

<b><u>EXECUTIVE SUMMARY</u></b>	<b><u>5</u></b>
<b><u>DATA</u></b>	<b><u>6</u></b>
NATIONAL LONGITUDINAL MORTALITY STUDY (NLMS)	6
NATIONAL HEALTH INTERVIEW SURVEY (NHIS)	7
<b><u>ANALYSIS OF DATA</u></b>	<b><u>8</u></b>
ANALYSIS POPULATIONS	9
CAUSES OF DEATH ANALYZED	10
<b><u>RESULTS</u></b>	<b><u>13</u></b>
NINE LEADING CAUSES OF DEATH IN THE UNITED STATES	13
ALL-CAUSE MORTALITY DETAILED ANALYSIS	16
MALIGNANT NEOPLASMS MORTALITY DETAILED ANALYSIS	29
DISEASES OF THE HEART MORTALITY DETAILED ANALYSIS	41
TWELVE CAUSES OF DEATH	54
<b><u>CONCLUSION</u></b>	<b><u>57</u></b>

## List of Figures

FIGURE 1 <u>RISKS: NINE LEADING CAUSES OF DEATH AND ALL-CAUSE MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS</u> <u>POPULATION P0: NEVER SMOKERS EXCLUDING FORMER SLT USERS</u> .....	13
FIGURE 2 <u>RISKS: NINE LEADING CAUSES OF DEATH AND ALL-CAUSE MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS</u> <u>POPULATION P1: NEVER SMOKERS AND CURRENT SMOKERS EXCLUDING FORMER SLT USERS</u> .....	15
FIGURE 3 <u>RISKS: ALL-CAUSE MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS &amp; CURRENT SMOKING VS. NEVER SMOKING</u> <u>POPULATION P1: NEVER SMOKERS AND CURRENT SMOKERS EXCLUDING FORMER SLT USERS</u> .....	18
FIGURE 4 <u>RISKS: ALL-CAUSE MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS</u> <u>POPULATION P1: NEVER SMOKERS AND CURRENT SMOKERS EXCLUDING FORMER SLT USERS</u> .....	19
FIGURE 5 <u>RISKS: ALL-CAUSE MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS</u> <u>POPULATION P2: CURRENT SMOKERS EXCLUDING FORMER SLT USERS</u> .....	21
FIGURE 6 <u>RISKS: ALL-CAUSE MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS</u> <u>POPULATION P3: FORMER SMOKERS</u> .....	23
FIGURE 7 <u>RISKS: ALL-CAUSE MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. FORMER SLT USERS</u> <u>POPULATION P3: FORMER SMOKERS</u> .....	25
FIGURE 8 <u>RISKS: ALL-CAUSE MORTALITY GROUPS COMPARED: VARIOUS TOBACCO USERS VS. NEVER TOBACCO USERS (P<sub>NN</sub>)</u> <u>POPULATION P4: FULL POPULATION: NHIS DATA</u> .....	27
FIGURE 9 <u>RISKS: ALL-CAUSE MORTALITY GROUPS COMPARED: VARIOUS TOBACCO USERS VS. NEVER TOBACCO USERS (P<sub>NN</sub>)</u> <u>POPULATION P4: FULL POPULATION: NLMS DATA</u> .....	28
FIGURE 10 <u>RISKS: MALIGNANT NEOPLASMS MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS &amp; CURRENT SMOKING VS. NEVER SMOKING</u> <u>POPULATION P1: NEVER SMOKERS AND CURRENT SMOKERS EXCLUDING FORMER SLT USERS</u> .....	30
FIGURE 11 <u>RISKS: MALIGNANT NEOPLASMS MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS</u> <u>POPULATION P1: NEVER SMOKERS AND CURRENT SMOKERS EXCLUDING FORMER SLT USERS</u> .....	31
FIGURE 12 <u>RISKS: MALIGNANT NEOPLASMS MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS</u> <u>POPULATION P2: CURRENT SMOKERS EXCLUDING FORMER SLT USERS</u> .....	33
FIGURE 13 <u>RISKS: MALIGNANT NEOPLASMS MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS</u> <u>POPULATION P3: FORMER SMOKERS</u> .....	35
FIGURE 14 <u>RISKS: MALIGNANT NEOPLASMS MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. FORMER SLT USERS</u> <u>POPULATION P3: FORMER SMOKERS</u> .....	37
FIGURE 15 <u>RISKS: MALIGNANT NEOPLASMS MORTALITY GROUPS COMPARED: VARIOUS TOBACCO USERS VS. NEVER TOBACCO USERS (P<sub>NN</sub>)</u> <u>POPULATION P4: FULL POPULATION: NHIS DATA</u> .....	39
FIGURE 16 <u>RISKS: MALIGNANT NEOPLASMS MORTALITY GROUPS COMPARED: VARIOUS TOBACCO USERS VS. NEVER TOBACCO USERS (P<sub>NN</sub>)</u> <u>POPULATION P4: FULL POPULATION: NLMS DATA</u> .....	40
FIGURE 17 <u>RISKS: DISEASES OF THE HEART MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS &amp; CURRENT SMOKING VS. NEVER SMOKING</u> <u>POPULATION P1: NEVER SMOKERS AND CURRENT SMOKERS EXCLUDING FORMER SLT USERS</u> .....	42
FIGURE 18 <u>RISKS: DISEASES OF THE HEART MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS</u> <u>POPULATION P1: NEVER SMOKERS AND CURRENT SMOKERS EXCLUDING FORMER SLT USERS</u> .....	43
FIGURE 19 <u>RISKS: DISEASES OF THE HEART MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS</u> <u>POPULATION P2: CURRENT SMOKERS EXCLUDING FORMER SLT USERS</u> .....	46
FIGURE 20 <u>RISKS: DISEASES OF THE HEART MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS</u> <u>POPULATION P3: FORMER SMOKERS</u> .....	48
FIGURE 21 <u>RISKS: DISEASES OF THE HEART MORTALITY GROUPS COMPARED: CURRENT SLT USERS VS. FORMER SLT USERS</u> <u>POPULATION P3: FORMER SMOKERS</u> .....	50
FIGURE 22 <u>RISKS: DISEASES OF THE HEART MORTALITY GROUPS COMPARED: VARIOUS TOBACCO USERS VS. NEVER TOBACCO USERS (P<sub>NN</sub>)</u> <u>POPULATION P4: FULL POPULATION: NHIS DATA</u> .....	52
FIGURE 23 <u>RISKS: DISEASES OF THE HEART MORTALITY GROUPS COMPARED: VARIOUS TOBACCO USERS VS. NEVER TOBACCO USERS (P<sub>NN</sub>)</u> <u>POPULATION P4: FULL POPULATION: NLMS DATA</u> .....	53
FIGURE 24 <u>RISKS: TWELVE CAUSES OF DEATH GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS</u> <u>POPULATION P0: NEVER SMOKERS EXCLUDING FORMER SLT USERS</u> .....	54
FIGURE 25 <u>RISKS: TWELVE CAUSES OF DEATH GROUPS COMPARED: CURRENT SLT USERS VS. NEVER SLT USERS</u> <u>POPULATION P1: NEVER SMOKERS AND CURRENT SMOKERS EXCLUDING FORMER SLT USERS</u> .....	55

## List of Tables

TABLE 1: 10 LEADING CAUSES OF DEATH IN THE UNITED STATES 2012 .....	11
TABLE 2: TWENTY-THREE CAUSE OF DEATH ACROSS THREE DATASETS.....	12
TABLE 3 <u>RISKS</u> : NINE LEADING CAUSES OF DEATH AND ALL-CAUSE MORTALITY <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. NEVER SLT USERS <u>POPULATION P0</u> : NEVER SMOKERS EXCLUDING FORMER SLT USERS.....	14
TABLE 4 <u>RISKS</u> : NINE LEADING CAUSES OF DEATH AND ALL-CAUSE MORTALITY <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. NEVER SLT USERS <u>POPULATION P1</u> : NEVER SMOKERS AND CURRENT SMOKERS EXCLUDING FORMER SLT USERS.....	16
TABLE 5 <u>RISKS</u> : ALL-CAUSE MORTALITY <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. NEVER SLT USERS <u>POPULATION P1</u> : NEVER SMOKERS AND CURRENT SMOKERS EXCLUDING FORMER SLT USERS.....	20
TABLE 6 <u>RISKS</u> : ALL-CAUSE MORTALITY <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. NEVER SLT USERS <u>POPULATION P2</u> : CURRENT SMOKERS EXCLUDING FORMER SLT USERS.....	22
TABLE 7 <u>RISKS</u> : ALL-CAUSE MORTALITY <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. NEVER SLT USERS <u>POPULATION P3</u> : FORMER SMOKERS.....	24
TABLE 8 <u>RISKS</u> : ALL-CAUSE MORTALITY <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. FORMER SLT USERS <u>POPULATION P3</u> : FORMER SMOKERS.....	26
TABLE 9 <u>RISKS</u> : ALL-CAUSE MORTALITY <u>GROUPS COMPARED</u> : VARIOUS TOBACCO USE VS. NEVER TOBACCO USE (P <sub>NN</sub> ) <u>POPULATION P4</u> : FULL POPULATION: NHIS DATA.....	27
TABLE 10 <u>RISKS</u> : ALL-CAUSE MORTALITY <u>GROUPS COMPARED</u> : VARIOUS TOBACCO USE VS. NEVER TOBACCO USE (P <sub>NN</sub> ) <u>POPULATION P4</u> : FULL POPULATION: NLMS DATA.....	28
TABLE 11 <u>RISKS</u> : ALL-CAUSE MORTALITY <u>GROUPS COMPARED</u> : FORMER SMOKERS WHO ARE CURRENT SLT USERS (P <sub>CF</sub> ) VS. CURRENT SMOKERS WHO ARE NEVER SLT USERS (P <sub>NC</sub> ). <u>POPULATION P4</u> : FULL POPULATION.....	29
TABLE 12 <u>RISKS</u> : MALIGNANT NEOPLASMS MORTALITY <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. NEVER SLT USERS <u>POPULATION P1</u> : NEVER SMOKERS AND CURRENT SMOKERS EXCLUDING FORMER SLT USERS.....	32
TABLE 13 <u>RISKS</u> : MALIGNANT NEOPLASMS MORTALITY <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. NEVER SLT USERS <u>POPULATION P2</u> : CURRENT SMOKERS EXCLUDING FORMER SLT USERS.....	34
TABLE 14 <u>RISKS</u> : MALIGNANT NEOPLASMS MORTALITY <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. NEVER SLT USERS <u>POPULATION P3</u> : FORMER SMOKERS.....	36
TABLE 15 <u>RISKS</u> : MALIGNANT NEOPLASMS MORTALITY <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. FORMER SLT USERS <u>POPULATION P3</u> : FORMER SMOKERS.....	38
TABLE 16 <u>RISKS</u> : MALIGNANT NEOPLASMS MORTALITY <u>GROUPS COMPARED</u> : VARIOUS TOBACCO USERS VS. NEVER TOBACCO USERS (P <sub>NN</sub> ) <u>POPULATION P4</u> : FULL POPULATION: NHIS DATA.....	39
TABLE 17 <u>RISKS</u> : MALIGNANT NEOPLASMS MORTALITY <u>GROUPS COMPARED</u> : VARIOUS TOBACCO USERS VS. NEVER TOBACCO USERS (P <sub>NN</sub> ) <u>POPULATION P4</u> : FULL POPULATION: NLMS DATA.....	40
TABLE 18 <u>RISKS</u> : DISEASES OF THE HEART MORTALITY <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. NEVER SLT USERS <u>POPULATION P1</u> : NEVER SMOKERS AND CURRENT SMOKERS EXCLUDING FORMER SLT USERS.....	44
TABLE 19 <u>RISKS</u> : DISEASES OF THE HEART MORTALITY <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. NEVER SLT USERS <u>POPULATION P2</u> : CURRENT SMOKERS EXCLUDING FORMER SLT USERS.....	47
TABLE 20 <u>RISKS</u> : DISEASES OF THE HEART MORTALITY <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. NEVER SLT USERS <u>POPULATION P3</u> : FORMER SMOKERS.....	49
TABLE 21 <u>RISKS</u> : DISEASES OF THE HEART MORTALITY <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. FORMER SLT USERS <u>POPULATION P3</u> : FORMER SMOKERS.....	51
TABLE 22 <u>RISKS</u> : DISEASES OF THE HEART MORTALITY <u>GROUPS COMPARED</u> : VARIOUS TOBACCO USERS VS. NEVER TOBACCO USERS (P <sub>NN</sub> ) <u>POPULATION P4</u> : FULL POPULATION: NHIS DATA.....	52
TABLE 23 <u>RISKS</u> : DISEASES OF THE HEART MORTALITY <u>GROUPS COMPARED</u> : VARIOUS TOBACCO USERS VS. NEVER TOBACCO USERS (P <sub>NN</sub> ) <u>POPULATION P4</u> : FULL POPULATION: NLMS DATA.....	53
TABLE 24 <u>RISKS</u> : VARIOUS CAUSES OF DEATH <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. NEVER SLT USERS <u>POPULATION</u> : MEN AND WOMEN OF ALL RACES IN P0, P1, P2, P3, P4.....	58
TABLE 25 <u>RISKS</u> : VARIOUS CAUSES OF DEATH <u>GROUPS COMPARED</u> : CURRENT SLT USERS VS. NEVER SLT USERS <u>POPULATION</u> : WHITE MEN IN P0, P1, P2, P3, P4.....	59

## Executive Summary

We analyzed two nationally representative longitudinal mortality studies that include smoking and smokeless tobacco use (SLT<sup>3</sup>) status on more than 364,400 people<sup>4</sup>. These contemporary longitudinal studies track the mortality status through 2011 of people originally surveyed between 1987 and 2005. We analyzed the mortality risks of SLT in various populations including: never, current and former cigarette smokers; all races and limited to whites; men and women grouped together and separately. We analyzed SLT risks for various causes of death.

We performed more than 1,000 separate survival analyses using the NLMS and NHIS data. We report “hazard ratios” to describe the estimated differential mortality risks between different populations. A hazard ratio compares the risk of death from a specified cause in a “target group” to the risk of death from that same cause in a “comparison group”. A hazard ratio is a weighted (reflecting the period of time each individual is observed) relative risk (RR).<sup>5</sup>

We find no evidence of elevated mortality risks associated with SLT use compared to never tobacco users.<sup>6</sup> We find evidence of lower mortality risks associated with SLT use compared to cigarette use. These results are robust across datasets, various populations, and various causes of death.

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<sup>3</sup> Smokeless tobacco use is defined as moist snuff use, chewing tobacco use, or both.

<sup>4</sup> The National Health Interview Survey linked mortality data includes 154,391 respondents from the public-use file. The National Longitudinal Mortality Study linked mortality data includes 210,090 respondents from the public-use file.

<sup>5</sup> The hazard ratio is “broadly equivalent to relative risk (RR).” British Medical Journal (BMJ), Glossary of evidence-based medicine terms.

<sup>6</sup> We also analyzed risks comparing snuff and chew users. We found no statistically significant difference in mortality rates between snuff and chew users.

A full description of our analysis methodology is documented in the computer programs provided with this report.<sup>7</sup> In addition to the analyses presented in this report, we also provide an Excel workbook detailing the complete analyses associated with the results presented in this report and sensitivity analyses supporting the opinions in this report.<sup>8</sup>

## Data

We analyzed two nationally representative longitudinal mortality datasets. These datasets were created by linking national representative cross-sectional survey data (e.g., Current Population Survey or National Health Interview Survey data) to National Death Index data.

### National Longitudinal Mortality Study (NLMS)<sup>9</sup>

The National Longitudinal Mortality Study is a nationally representative, longitudinal mortality study. The NLMS Public Use Microdata Sample (PUMS) Tobacco-Use (TU) file is comprised of samples of Current Population Survey Tobacco Use Supplements (CPS-TUS) administered from 1993 through 2005 linked to National Death Index vital status data. We analyzed version five of the PUMS TU file, which contains demographic,

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<sup>7</sup> We provide all the computer programs necessary to replicate all analyses. These computer programs provide the complete chain of calculations starting with the raw data and producing the final analyses shown in this report and the accompanying excel workbook. All analyses were performed using SAS 9.3.

<sup>8</sup> Wecker Report SLT results.xlsx. The analyses in the “Wecker Report SLT results.xlsx” excel workbook are created by the computer programs provided with this report.

<sup>9</sup> United States Census Bureau, National Longitudinal Mortality Study, Public Use Microdata Sample File Release 5, October 21, 2015. Suitland, Maryland. This paper uses data obtained from the public-use file of the National Longitudinal Mortality Study. The file is provided to persons interested in research by the U.S. Census Bureau. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the National Longitudinal Mortality Study, the Bureau of the Census, or the project sponsors: the National Heart, Lung, and Blood Institute, the National Cancer Institute, the National Institute on Aging, and the National Center for Health Statistics.

vital status, and tobacco use data for 493,282 CPS-TUS respondents. The PUMS TU data have five years of mortality follow-up for all respondents, with each decedent's underlying cause of death assigned to one of 113 aggregate causes. We limit PUMS TU file analyses to respondents at least 18 years old at survey who are never users of both pipe tobacco and cigars, and for whom analysis weight, follow-up time, vital status, and model covariates are known, yielding 210,090 respondents eligible for our analyses and 8,580 deaths. There are 129 deaths among the 3,492 current SLT users in the analysis dataset.

#### National Health Interview Survey (NHIS) <sup>10</sup>

The National Health Interview Survey is an annual, nationally representative survey of the civilian non-institutionalized U.S. population. NHIS surveys from 1986 through 2009 are linked to National Death Index data, with vital status follow-up through December 31, 2011. We analyzed both the publicly available data and the restricted data. The publicly available data include only 10 causes of death.<sup>11</sup> The restricted data include 113 underlying causes of death. We include all surveys where smoking, SLT use, pipe use, and cigar use is identified — these surveys include 1987, 1991-1992, 1998, 2000, and 2005. The linked data include between six and 24 years of mortality follow-up depending on the survey year. There are 154,391 people (29,443 deaths) eligible for our public-use analysis and 154,286 people (29,707 deaths) eligible for our restricted-access analysis. There are 642 deaths among the 3,006 current SLT users included in our public-use analysis dataset,

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<sup>10</sup> National Center for Health Statistics. Office of Analysis and Epidemiology, NCHS Public-use Linked Mortality File, 2015. Hyattsville, Maryland. This paper uses data obtained from the public-use and restricted file of the National Center for Health Statistics. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the National Health Interview Surveys, the National Center for Health Statistics, the Research Data Center, or the Center for Disease Control and Prevention.

<sup>11</sup> The 10 causes of death are: diseases of the heart mortality, malignant neoplasms mortality, chronic lower respiratory diseases mortality, accidents (unintentional injuries) mortality, cerebrovascular diseases mortality, Alzheimer's disease mortality, diabetes mellitus mortality, influenza and pneumonia mortality, nephritis mortality, and all other causes (residual) mortality.

and there are 650 deaths among the 3,005 current SLT users included in our restricted-access analysis dataset.<sup>12</sup>

We analyzed three different periods of mortality follow-up:

- Six-years of mortality follow-up, this includes equal follow-up periods for all surveys included in the analysis.
- Ten-years of mortality follow-up, this includes equal follow-up periods for all surveys included in the analysis except for the 2005 survey which only will include six-years of mortality follow-up.
- Twenty four-years of mortality follow-up, this includes different follow-up periods for all surveys.

All analyses are estimated using the public-use ten-year follow-up unless otherwise noted. Our analyses do not differ importantly between the various follow-up periods, nor do our analyses differ importantly between the public and restricted data. We are prohibited by the National Center for Health Statistics from reporting counts where the number of deaths is less than five when using the restricted NHIS data.

## Analysis of Data

We estimate mortality hazard ratios using Cox proportional hazards regression analyses. We include the following covariates (assessed during the baseline survey): gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, tobacco use, and cigarettes per day (CPD<sup>13</sup>).<sup>14, 15</sup> Pipe tobacco and cigar users are excluded from all analyses.

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<sup>12</sup> Death counts are reported for follow-up through December 31, 2011. In analyses of the public-use 2011 NHIS linked mortality data with follow-up limited to 10 years the 3,006 current SLT users experienced 370 deaths.

<sup>13</sup> CPD is available in the NHIS data but not in the NLMS data.

<sup>14</sup> The NLMS statistical analyses are detailed in two SAS computer programs:

01a\_NLMS\_Public\_5.MortalityAnalysis.sas

01b\_NLMS\_Public\_5.MortalityAnalysis.NoRaceIndicator.sas

<sup>15</sup> The NHIS statistical analyses are detailed in five SAS computer programs:



## Analysis Populations

We define nine mutually exclusive and exhaustive Tobacco Use Groups:

	Never Smoker	Former Smoker	Current Smokers
Never SLT	$p_{NN}$	$p_{NF}$	$p_{NC}$
Current SLT	$p_{CN}$	$p_{CF}$	$p_{CC}$
Former SLT	$p_{FN}$	$p_{FF}$	$p_{FC}$

We define five different analysis populations by various groupings of Tobacco Use Groups:

**P0. *Never smokers excluding former SLT users:***

Population P0 =  $p_{NN} + p_{CN}$ .

	Never Smoker	Former Smoker	Current Smokers
Never SLT	$p_{NN}$		
Current SLT	$p_{CN}$		
Former SLT			

**P1. *Never smokers and current smokers excluding former SLT users:***

Population P1 =  $p_{NN} + p_{CN} + p_{NC} + p_{CC}$ .

	Never Smoker	Former Smoker	Current Smokers
Never SLT	$p_{NN}$		$p_{NC}$
Current SLT	$p_{CN}$		$p_{CC}$
Former SLT			

**P2. *Current smokers excluding former SLT users:***

Population P2 =  $p_{NC} + p_{CC}$ .

	Never Smoker	Former Smoker	Current Smokers
Never SLT			$p_{NC}$
Current SLT			$p_{CC}$
Former SLT			

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Programs for the Public NHIS analysis:

01a\_NHISPublicUse2011FollowUp\_MortalityAnalysis.FullFollowUp.sas

01b\_NHISPublicUse2011FollowUp\_MortalityAnalysis.10yrFollowUp.sas

01c\_NHISPublicUse2011FollowUp\_MortalityAnalysis.6yrFollowUp.sas

01d\_NHISPublicUse2011FollowUp\_MortalityAnalysis.Drop1.sas

Programs for the Restricted NHIS analysis:

01a\_NHISRestrictedAccess2011FollowUp\_MortalityAnalysis.sas

**P3. Former smokers:**

Population P3=  $p_{NF} + p_{CF} + p_{FF}$ .

	Never Smoker	Former Smoker	Current Smokers
Never SLT		$p_{NF}$	
Current SLT		$p_{CF}$	
Former SLT		$p_{FF}$	

**P4. Full population:**

Population includes all 9 Tobacco Use Groups.

	Never Smoker	Former Smoker	Current Smokers
Never SLT	$p_{NN}$	$p_{NF}$	$p_{NC}$
Current SLT	$p_{CN}$	$p_{CF}$	$p_{CC}$
Former SLT	$p_{FN}$	$p_{FF}$	$p_{FC}$

**Causes of Death Analyzed**

We analyzed the nine leading causes of death in the United States and all-cause mortality as identified by the Centers for Disease Control and Prevention (CDC) and recorded in the NLMS and NHIS linked mortality data. We did not analyze deaths from intentional self-harm (suicide) because these deaths are not identified in the NHIS or NLMS data. [Table 1.](#)

**Table 1: 10 Leading Causes of Death in the United States 2012<sup>16</sup>**

Cause of death (based on ICD-10)	Rank <sup>1</sup>	Deaths	Percent of total deaths
All causes . . . . .	...	2,543,279	100.0
Diseases of heart . . . . . (I00–I09,I11,I13,I20–I51)	1	599,711	23.6
Malignant neoplasms . . . . . (C00–C97)	2	582,623	22.9
Chronic lower respiratory diseases . . . . . (J40–J47)	3	143,489	5.6
Cerebrovascular diseases . . . . . (I60–I69)	4	128,546	5.1
Accidents (unintentional injuries) . . . . . (V01–X59,Y85–Y86)	5	127,792	5.0
Alzheimer's disease . . . . . (G30)	6	83,637	3.3
Diabetes mellitus . . . . . (E10–E14)	7	73,932	2.9
Influenza and pneumonia . . . . . (J09–J18)	8	50,636	2.0
Nephritis, nephrotic syndrome and nephrosis . . . . . (N00–N07,N17–N19,N25–N27)	9	45,622	1.8
Intentional self-harm (suicide) . . . . . (*U03,X60–X84,Y87.0)	10	40,600	1.6

We also analyzed the following twelve causes of death recorded in the NLMS and restricted NHIS data:

1. Malignant neoplasms of the digestive organs: all
2. Malignant neoplasms of the digestive organs: esophagus only
3. Malignant neoplasms of the digestive organs: pancreas only
4. Malignant neoplasms of the digestive organs: colon, rectum and anus only
5. Malignant neoplasms of the oral cavity, lip and pharynx
6. Malignant neoplasms of the trachea, bronchus and lung
7. Malignant neoplasms of the genitourinary system
8. Diseases of the circulatory system (including subsets of major cardiovascular disease, and ischemic heart disease)<sup>17</sup>
9. Diseases of the respiratory system
10. Diseases of the respiratory system: influenza and pneumonia only
11. Diseases of the digestive system<sup>18, 19</sup>
12. Diseases of the genitourinary system<sup>20, 21</sup>

<sup>16</sup> National Vital Statistics Report (NVSr), Volume 64, Number 10. Table C. U.S. Department Of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System.

<sup>17</sup> This category includes ICD-10 codes I00 through I99 and contains the “Diseases of the Heart” category found in Table 1.

<sup>18</sup> “Diseases of the digestive system” includes any death for which the underlying cause is ICD-9 code 520 through 579 or ICD-10 code K00 through K95.

<sup>19</sup> Analyses were only performed on restricted-access NHIS data where ICD-9 or ICD-10 code for the underlying cause of death is available. A corresponding analysis of the public-use NLMS data could not be performed because some of the ICD-10 codes in this cause of death category (e.g., K00–K22) are found in an aggregate category that also contains ICD-10 codes not included in this category (e.g., D65–E07).

<sup>20</sup> “Diseases of the genitourinary system” includes any death for which the underlying cause is ICD-9 code 580 through 629 or ICD-10 code N00 through N99.

Table 2 shows causes of death available within the NLMS data, the public NHIS data and the restricted NHIS data.

**Table 2: Twenty-Three Cause of Death Across Three Datasets**

Underlying Cause of Death	ICD-10 Underlying Cause of Death	Cause of Death Available In ...		
		NLMS Public	NHIS Restricted	NHIS Public
All-cause mortality	All	Yes	Yes	Yes
Diseases of the heart	I00-I09, I11, I13, I20-I51	Yes	Yes	Yes
Malignant neoplasms	C00-C97	Yes	Yes	Yes
Chronic lower respiratory diseases	J40-J47	Yes	Yes	Yes
Cerebrovascular diseases	I60-I69	Yes	Yes	Yes
Accidents (unintentional injuries)	V01-X59, Y85-Y86	Yes	Yes	Yes
Alzheimer's disease	G30	Yes	Yes	Yes
Diabetes mellitus	E10-E14	Yes	Yes	Yes
Influenza and pneumonia	J09-J18	Yes	Yes	Yes
Nephritis, nephrotic syndrome and nephrosis	N00-N07, N17-N19, N25-N27	Yes	Yes	Yes
Malignant neoplasms of the digestive organs: all	C00-C16, C18-C22, C25	Yes	Yes	No
Malignant neoplasms of the digestive organs: esophagus only	C15	Yes	Yes	No
Malignant neoplasms of the digestive organs: pancreas only	C25	Yes	Yes	No
Malignant neoplasms of the digestive organs: colon, rectum and anus only	C18-C21	Yes	Yes	No
Malignant neoplasms of the oral cavity, lip and pharynx	C00-C14	Yes	Yes	No
Malignant neoplasms of the trachea, bronchus and lung	C33-C34	Yes	Yes	No
Malignant neoplasms of the genitourinary system	C61, C64-C65, C67	Yes	Yes	No
Diseases of the circulatory system	I00-I99	Yes	Yes	No
- Major cardiovascular diseases	I00-I78	Yes	Yes	No
- Ischemic heart disease	I20-I25	Yes	Yes	No
Diseases of the respiratory system	J00-J98	Yes	Yes	No
Diseases of the digestive system	K00-K95	No	Yes	No
Diseases of the genitourinary system	N00-N99	No	Yes	No

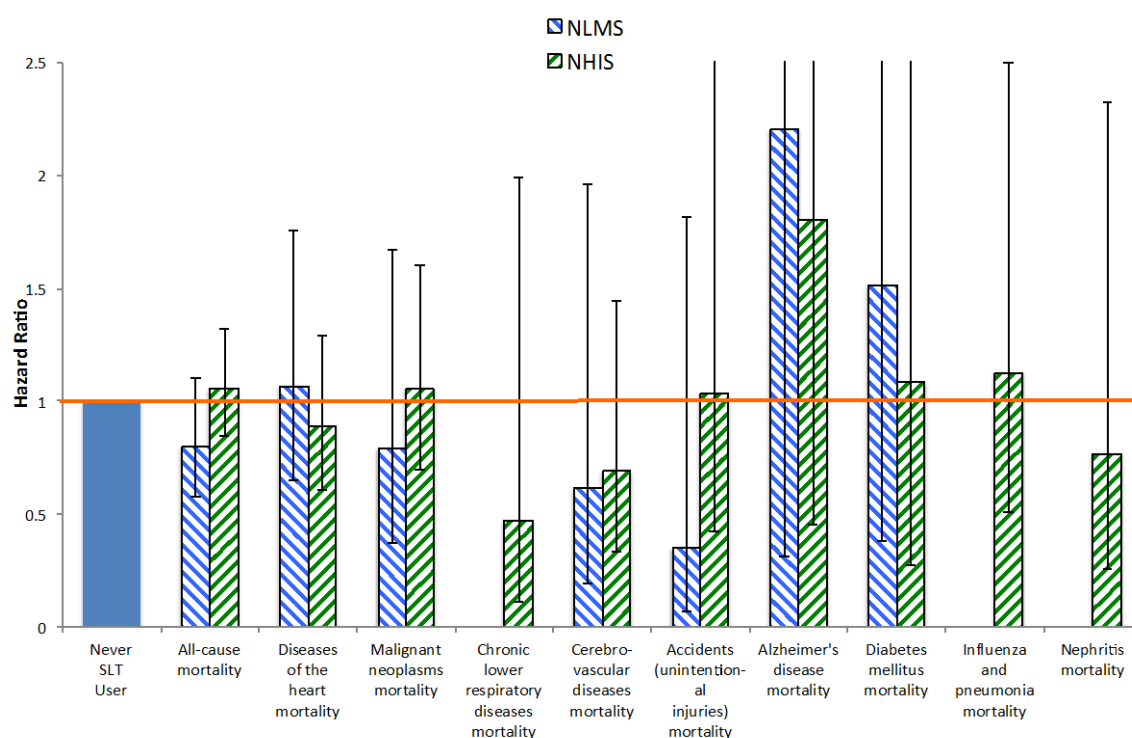
<sup>21</sup> Analyses were only performed on restricted-access NHIS data where ICD-9 or ICD-10 code for the underlying cause of death is available. A corresponding analysis of the public-use NLMS data could not be performed because some of the ICD-10 codes in this cause of death category (e.g., N80-N98) are found in an aggregate category that also contains ICD-10 codes not included in this category (e.g., D65-E07).

## Results

### Nine Leading Causes of Death in the United States

We compare the risks of death from the nine leading causes of death and all-cause mortality of current SLT users vs. never SLT users, among never smokers excluding former SLT users, (Population P0).<sup>22</sup> There are no statistically significantly elevated mortality risks among current SLT users vs. never SLT users in either the NLMS or NHIS data. Figure 1

**Figure 1**  
**Risks: Nine Leading Causes of Death and All-Cause Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P0: Never Smokers Excluding Former SLT Users**<sup>23</sup>



<sup>22</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, and current SLT use.

<sup>23</sup> There were zero SLT users in the NMLS P0 population who died of chronic lower respiratory disease, influenza and pneumonia, or nephritis. The cerebrovascular diseases regression analysis using NLMS analysis did not include a variable for race because the model with the race variable did not converge.

**Table 3**  
**Risks: Nine Leading Causes of Death and All-Cause Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P0: Never Smokers Excluding Former SLT Users**

NHIS Data				
Mortality Outcome	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All-cause	193	1.056	0.845	1.320
Diseases of the heart	52	0.886	0.607	1.294
Malignant neoplasms	42	1.056	0.695	1.604
Chronic lower respiratory diseases	2	0.472	0.112	1.994
Cerebrovascular diseases	10	0.690	0.331	1.440
Accidents (unintentional injuries)	9	1.033	0.423	2.521
Alzheimer's disease	3	1.803	0.454	7.162
Diabetes mellitus	6	1.083	0.268	4.368
Influenza and pneumonia	7	1.126	0.507	2.504
Nephritis	4	0.769	0.255	2.324

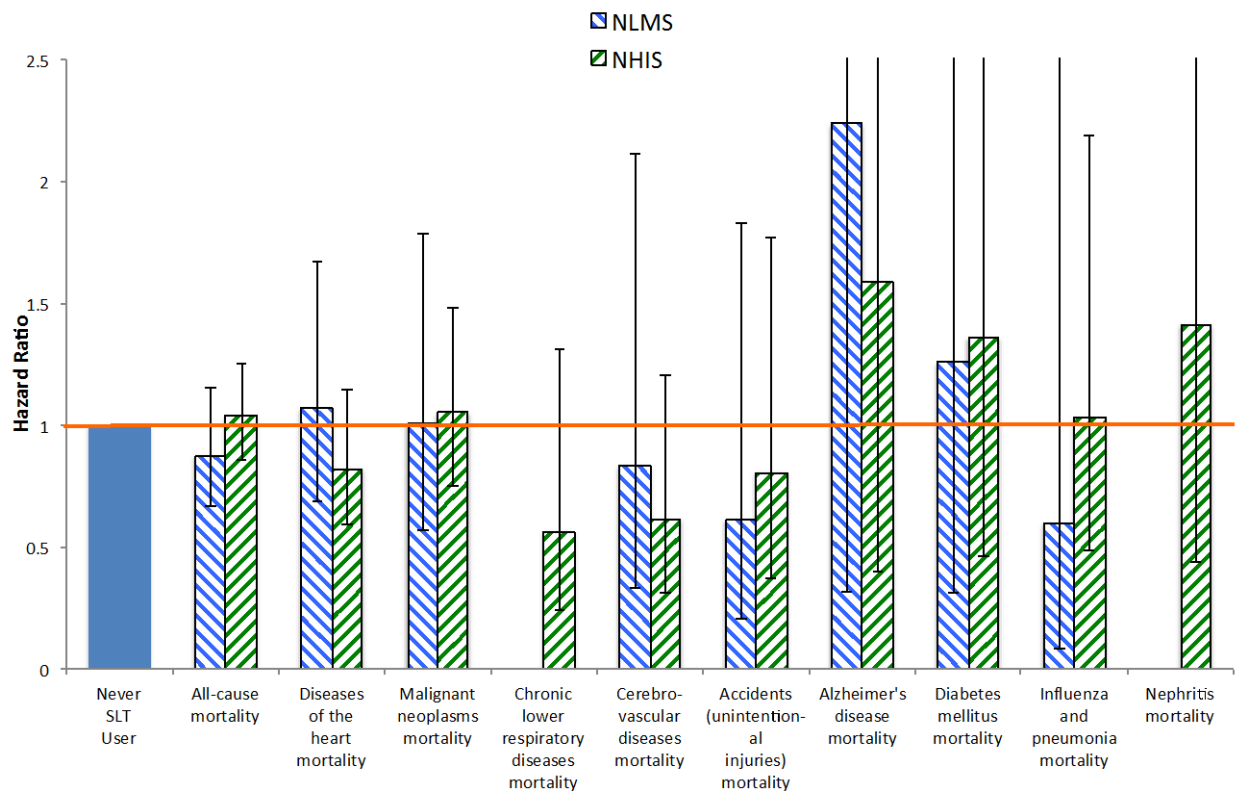
NLMS Data				
Mortality Outcome	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All-cause mortality	48	0.794	0.574	1.098
Diseases of the heart	22	1.065	0.647	1.752
Malignant neoplasms	8	0.790	0.373	1.670
Chronic lower respiratory diseases	0	.	.	.
Cerebrovascular diseases	3	0.611	0.191	1.956
Accidents (unintentional injuries)	2	0.348	0.067	1.812
Alzheimer's disease	1	2.206	0.313	15.557
Diabetes mellitus	2	1.509	0.375	6.069
Influenza and pneumonia	0	.	.	.
Nephritis	0	.	.	.

We compare the risks of death from the nine leading causes of death and all-cause mortality of current SLT users vs. never SLT users, among never smokers and current smokers excluding former SLT users (Population P1).<sup>24</sup> There are no statistically

<sup>24</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current cigarette use, and current SLT use. There was no statistical difference between analyses including CPD or excluding CPD.

significantly elevated mortality risks among current SLT users vs. never SLT users in either the NLMS or NHIS data. Figure 2.

**Figure 2**  
**Risks: Nine Leading Causes of Death and All-Cause Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P1: Never Smokers and Current Smokers Excluding Former SLT Users**<sup>25</sup>



<sup>25</sup> There were zero SLT users in the NMLS P1 population that died of chronic lower respiratory disease, or nephritis.

**Table 4**  
**Risks: Nine Leading Causes of Death and All-Cause Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P1: Never Smokers and Current Smokers Excluding Former SLT Users**

<b>NHIS Data</b>				
Mortality Outcome	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All-cause	243	1.038	0.857	1.257
Diseases of the heart	52	0.886	0.607	1.294
Malignant neoplasms	42	1.056	0.695	1.604
Chronic lower respiratory diseases	2	0.472	0.112	1.994
Cerebrovascular diseases	10	0.690	0.331	1.440
Accidents (unintentional injuries)	9	1.033	0.423	2.521
Alzheimer's disease	3	1.803	0.454	7.162
Diabetes mellitus	6	1.083	0.268	4.368
Influenza and pneumonia	7	1.126	0.507	2.504
Nephritis	4	0.769	0.255	2.324

<b>NLMS Data</b>				
Mortality Outcome	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All-cause mortality	70	0.876	0.665	1.154
Diseases of the heart	27	1.071	0.687	1.668
Malignant neoplasms	15	1.011	0.572	1.787
Chronic lower respiratory diseases	0	.	.	.
Cerebrovascular diseases	6	0.836	0.332	2.109
Accidents (unintentional injuries)	4	0.617	0.208	1.831
Alzheimer's disease	1	2.238	0.318	15.767
Diabetes mellitus	2	1.258	0.312	5.075
Influenza and pneumonia	1	0.600	0.082	4.377
Nephritis	0	.	.	.

#### All-Cause Mortality Detailed Analysis

We compare the risks of death from all-cause mortality of current SLT users vs. never SLT users among never smokers and current smokers excluding former SLT users

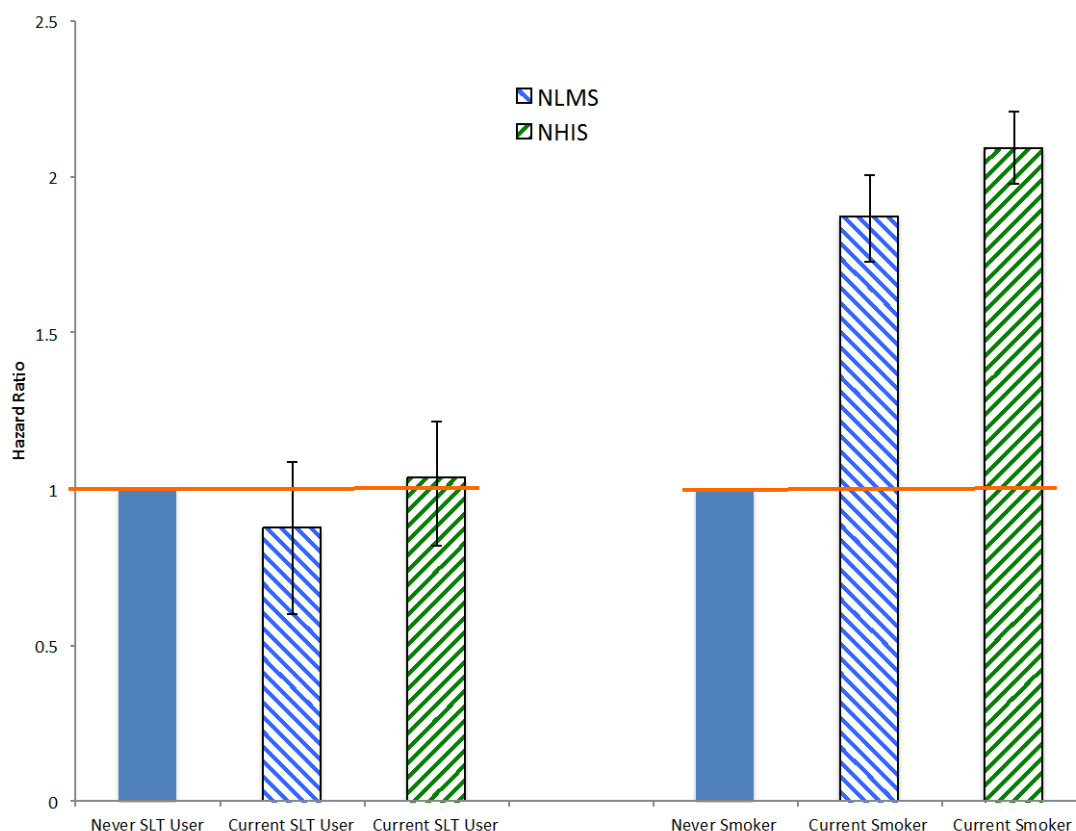


(Population P1).<sup>26</sup> The hazard ratios for current SLT users vs. never SLT users are the same as shown in the first pair of bars (“All-cause mortality”) in [Figure 2](#). There are no statistically significantly elevated risks associated with current SLT users vs. never SLT users in either the NLMS or NHIS data. There are statistically significantly elevated risks associated with current smoking vs. never smoking in both the NLMS and NHIS data. [Figure 3](#).

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<sup>26</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current cigarette use, and current SLT use. CPD is not included in [Figure 1](#). There was no statistical difference between analyses including CPD or excluding CPD.

**Figure 3**  
**Risks: All-Cause Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**& Current Smoking vs. Never Smoking**  
**Population P1: Never Smokers and Current Smokers Excluding Former SLT Users<sup>27</sup>**

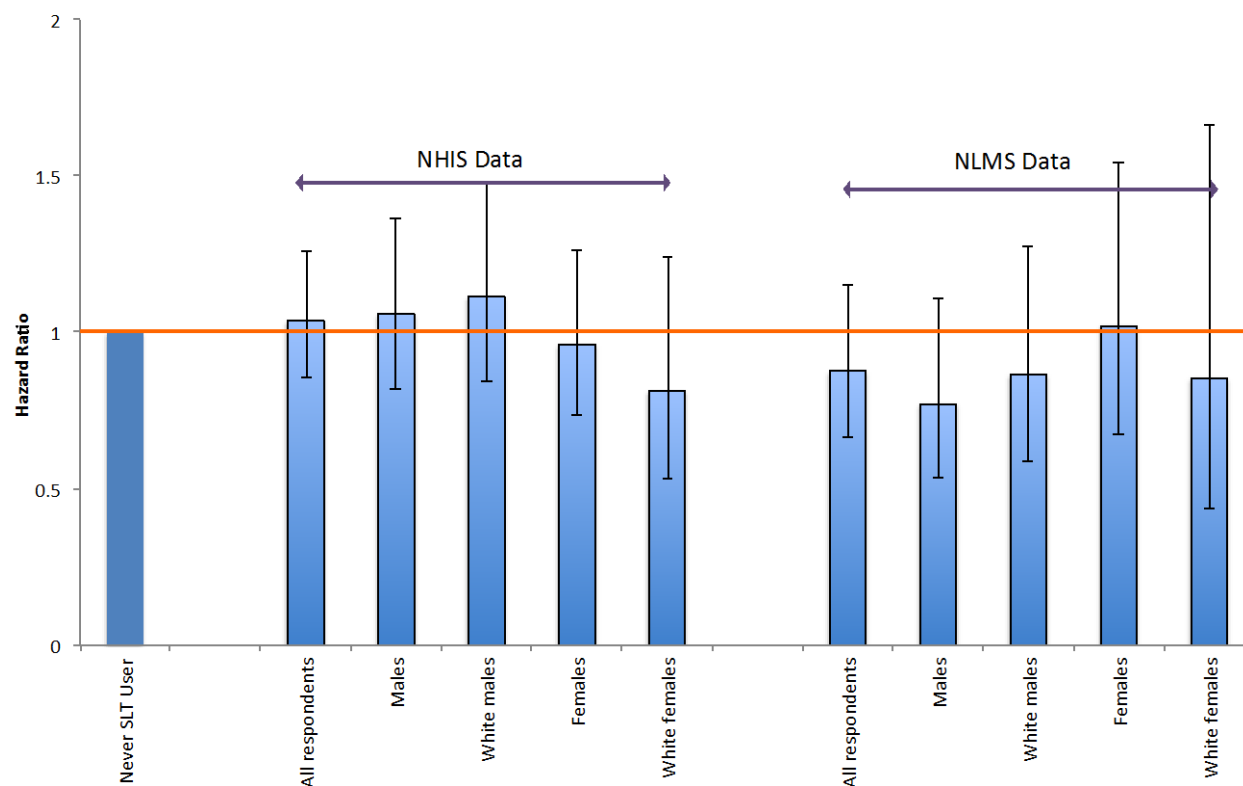


We compare the risks of death from all-cause mortality of current SLT users vs. never SLT users as done in Figure 3, for the subsets: males, white males, females, and white females.<sup>28</sup> There are no statistically significantly elevated risks associated with current SLT users vs. never SLT users in either the NLMS or NHIS data. [Figure 4](#) & [Table 5](#).

<sup>27</sup> We performed the same analysis as shown in this chart except we excluded the current SLT users who were also current smokers ( $p_{cc}$ ), also called dual users, the results in this sensitivity analysis are essentially identical to those shown in this chart. See Wecker Report SLT results.xlsx.

<sup>28</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current cigarette use, and current SLT use. There was no statistical difference between analyses including CPD or excluding CPD.

**Figure 4**  
**Risks: All-Cause Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P1: Never Smokers and Current Smokers Excluding Former SLT Users<sup>29</sup>**



<sup>29</sup> We performed the same analysis as shown in this chart except we excluded the current SLT users who were also current smokers (pcc), also called dual users. The results in this sensitivity analysis are essentially identical to those shown in this chart.

**Table 5**  
**Risks: All-Cause Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P1: Never Smokers and Current Smokers Excluding Former SLT Users**

<b>NHIS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	243	1.038	0.857	1.257
Males	124	1.059	0.820	1.368
White males	98	1.115	0.842	1.477
Females	119	0.963	0.734	1.263
White females	38	0.813	0.533	1.240

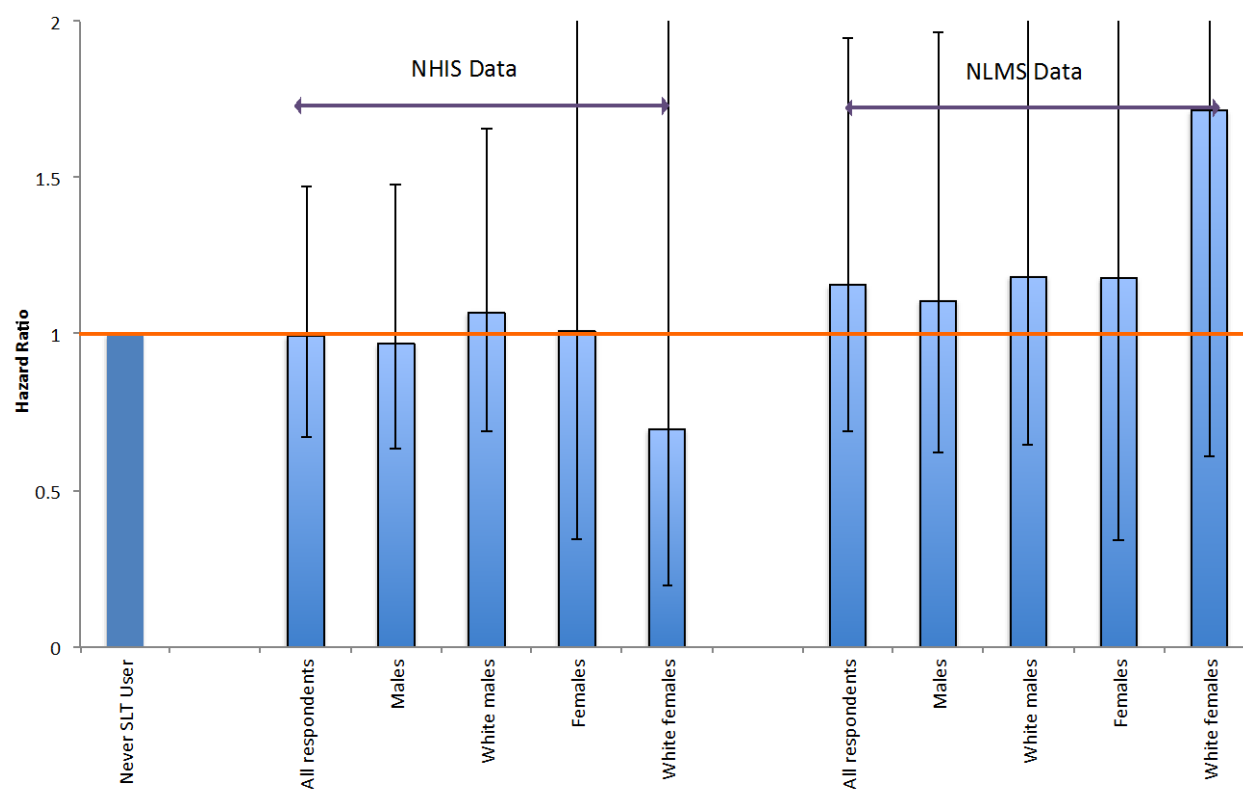
<b>NLMS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	70	0.876	0.665	1.154
Males	44	0.771	0.535	1.111
White males	39	0.866	0.587	1.276
Females	26	1.020	0.675	1.541
White females	11	0.853	0.438	1.659

We compare the risks of death from all-cause mortality of current SLT users vs. never SLT users in exactly the same way as done in [Figure 4](#) & Table 5 except we limited the analysis population to current smokers excluding former SLT users (Population P2).<sup>30</sup> There are no statistically significantly elevated mortality risks among current SLT users vs. never SLT users in either the NLMS or NHIS data. [Figure 5](#) & [Table 6](#).

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<sup>30</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current SLT use, and CPD (not available in the NLMS data).

**Figure 5**  
**Risks: All-Cause Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P2: Current Smokers Excluding Former SLT Users**



**Table 6**  
**Risks: All-Cause Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P2: Current Smokers excluding Former SLT Users**

<b>NHIS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	45	0.994	0.670	1.475
Males	36	0.969	0.635	1.479
White males	32	1.069	0.689	1.659
Females	9	1.009	0.345	2.956
White females	3	0.695	0.195	2.470

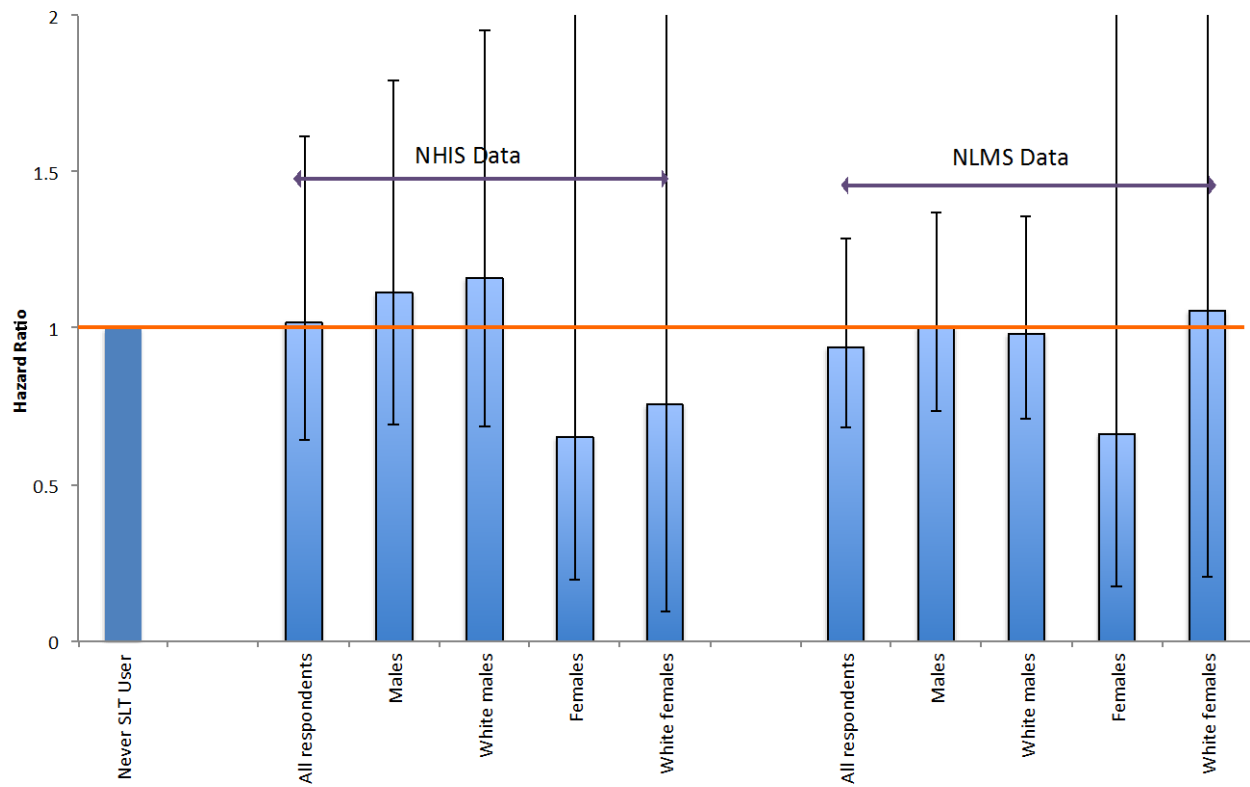
<b>NLMS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	22	1.156	0.687	1.948
Males	19	1.106	0.622	1.967
White males	17	1.184	0.646	2.167
Females	3	1.178	0.340	4.079
White females	2	1.715	0.610	4.821

We compare the risks of death from all-cause mortality of current SLT users vs. never SLT users among former smokers (Population P3). Separate analyses were done for: all respondents, males, white males, females, and white females.<sup>31</sup> There are no statistically significantly elevated risks associated with current SLT users vs. never SLT users in either the NLMS or NHIS data. [Figure 6](#) & [Table 7](#).

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<sup>31</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current SLT use, former SLT use, and CPD (available only in NHIS 1987 for all former smokers).

**Figure 6**  
**Risks: All-Cause Mortality <sup>32</sup>**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P3: Former Smokers**



<sup>32</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current SLT use, former SLT use, and CPD (available only in NHIS 1987 for all former smokers)..

**Table 7**  
**Risks: All-Cause Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P3: Former Smokers**

<b>NHIS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	30	1.019	0.643	1.614
Males	27	1.115	0.694	1.791
White males	25	1.160	0.688	1.956
Females	3	0.652	0.197	2.157
White females	1	0.756	0.093	6.176

<b>NLMS Data<sup>33</sup></b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	59	0.939	0.684	1.289
Males	55	1.005	0.737	1.370
White males	51	0.984	0.713	1.358
Females	4	0.663	0.174	2.525
White females	3	1.058	0.208	5.387

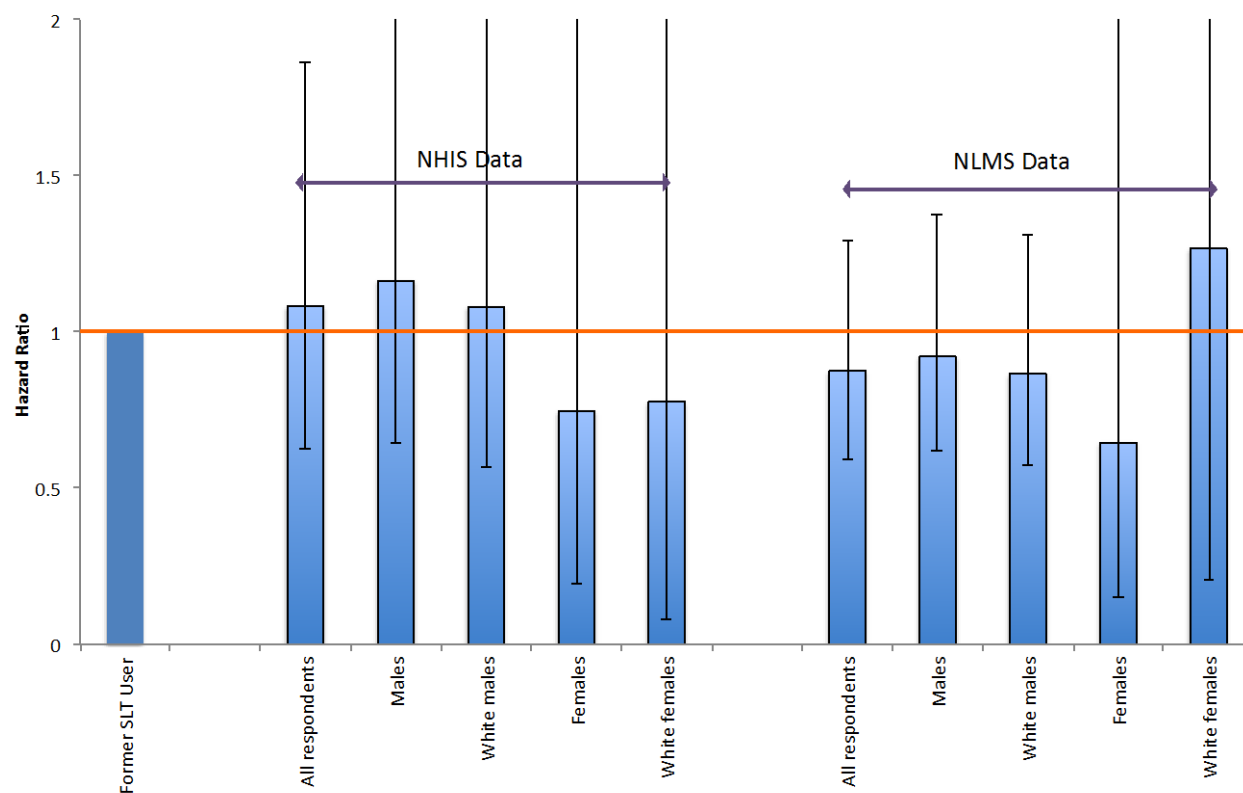
We compare the risks of death from all-cause mortality of current SLT users vs. former SLT users among former smokers (Population P3). Separate analyses were done for: all respondents, males, white males, females, and white females.<sup>34</sup> There are no statistically significantly elevated risks associated with current SLT users vs. never SLT users in either the NLMS or NHIS data. [Figure 7](#) & [Table 8](#).

<sup>33</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current SLT use, and former SLT use. CPD is not included.

<sup>34</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current SLT use, former SLT use, and CPD (available only in NHIS 1987 for all former smokers).



**Figure 7**  
**Risks: All-Cause Mortality<sup>35</sup>**  
**Groups Compared: Current SLT Users vs. Former SLT Users**  
**Population P3: Former Smokers**



<sup>35</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current SLT use, former SLT use, and CPD (available only in NHIS 1987 for all former smokers).

**Table 8**  
**Risks: All-Cause Mortality**  
**Groups Compared: Current SLT Users vs. Former SLT Users**  
**Population P3: Former Smokers**

<b>NHIS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	30	1.082	0.628	1.863
Males	27	1.164	0.643	2.108
White males	25	1.081	0.567	2.062
Females	3	0.746	0.195	2.856
White females	1	0.777	0.080	7.512

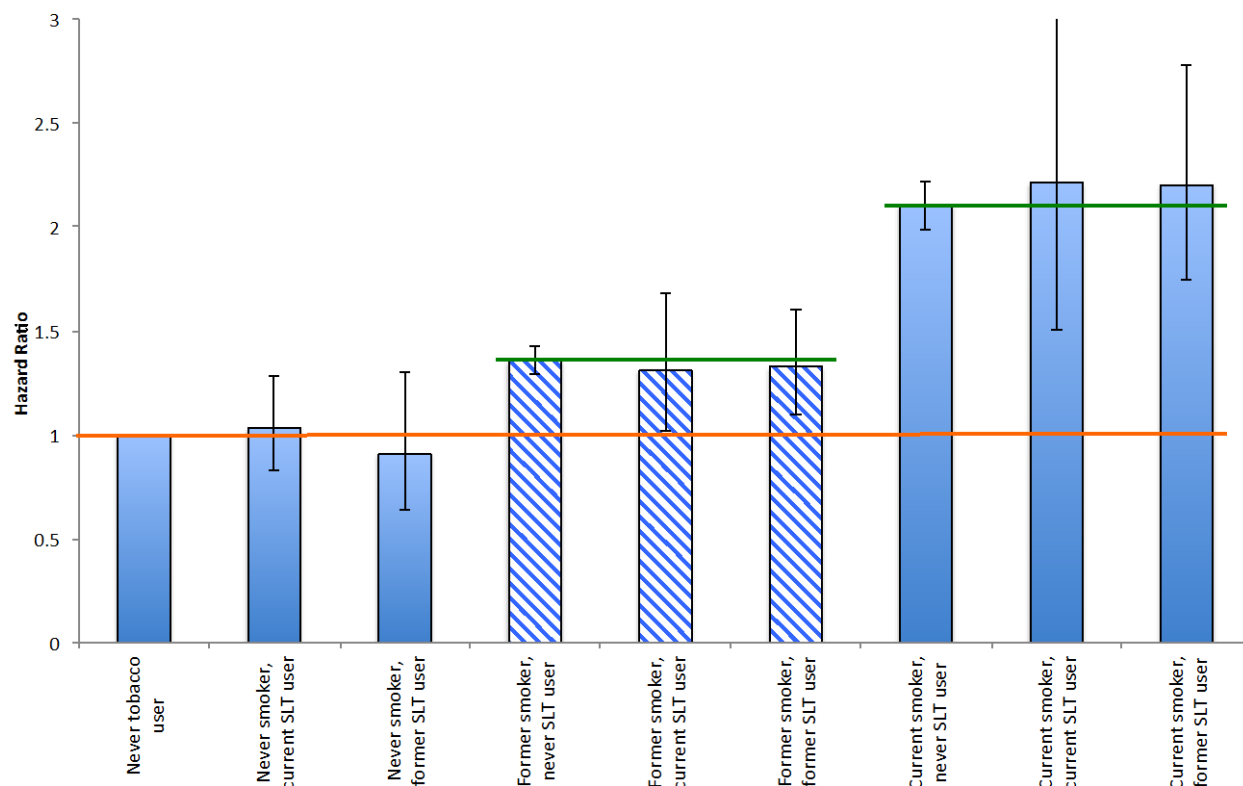
<b>NLMS Data<sup>36</sup></b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	59	0.876	0.593	1.294
Males	55	0.922	0.618	1.374
White males	51	0.867	0.574	1.309
Females	4	0.646	0.153	2.731
White females	3	1.267	0.207	7.757

We compare the risks of death from all-cause mortality for various tobacco use groups vs. never SLT use for the full population (Population P4).<sup>37</sup> There are no statistically significantly elevated risks associated with current SLT users or former SLT users when compared within the same smoking group (i.e., never smoker, former smoker or current smoker) in either the NLMS or NHIS data. There are statistically significantly elevated risks associated with current smoking vs. never smoking and with former smoking vs. never smoking in both the NLMS and NHIS data. [Figure 8](#), [Figure 9](#), [Table 9](#) & [Table 10](#).

<sup>36</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current SLT use, and former SLT use. CPD is not included.

<sup>37</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status and Tobacco Use Group.

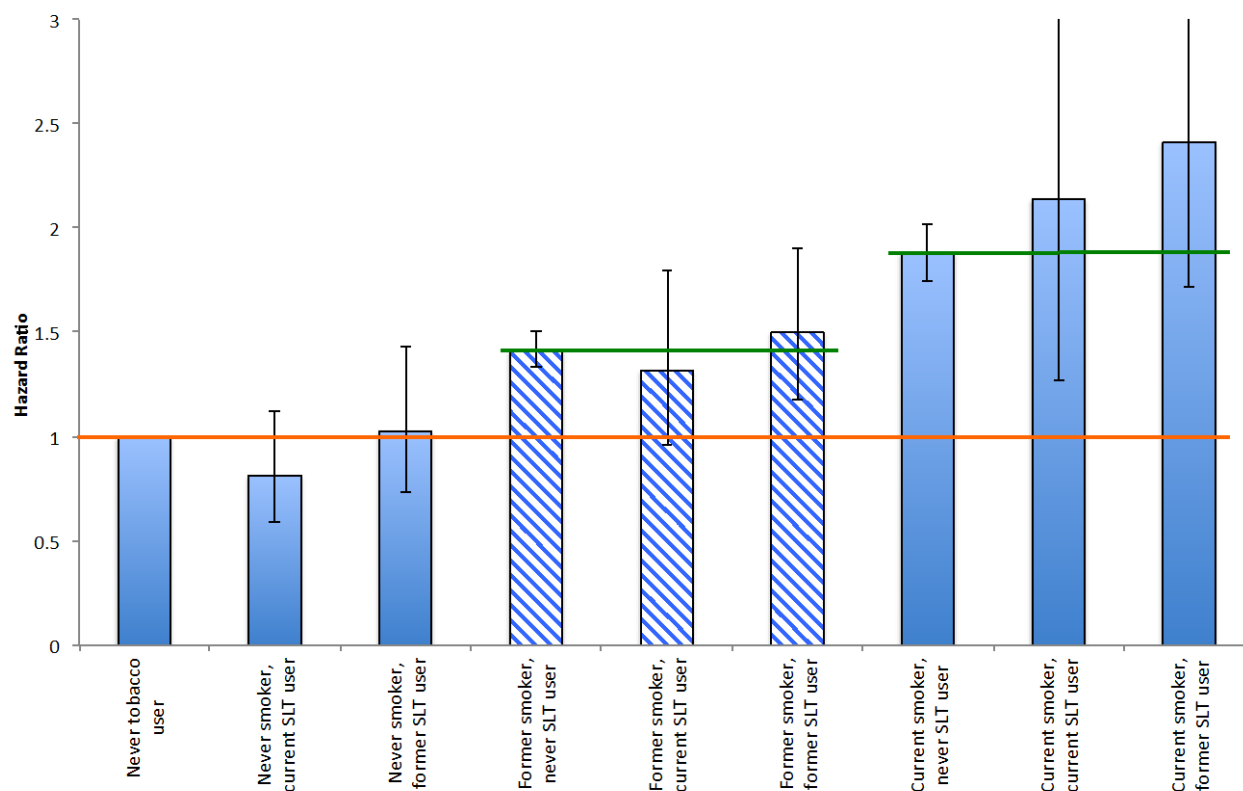
**Figure 8**  
**Risks: All-Cause Mortality**  
**Groups Compared: Various Tobacco Users vs. Never Tobacco Users ( $p_{NN}$ )**  
**Population P4: Full Population: NHIS Data**



**Table 9**  
**Risks: All-Cause Mortality**  
**Groups Compared: Various Tobacco Use vs. Never Tobacco Use ( $p_{NN}$ )**  
**Population P4: Full Population: NHIS Data**

NHIS Data				
	Deaths	Hazard Ratio	Lower CI	Upper CI
Never smoker, current SLT user	193	1.032	0.828	1.285
Never smoker, former SLT user	70	0.911	0.639	1.299
Former smoker, never SLT user	4,348	1.356	1.293	1.422
Former smoker, current SLT user	127	1.309	1.019	1.681
Former smoker, former SLT user	195	1.329	1.099	1.606
Current smoker, never SLT user	3,738	2.102	1.988	2.221
Current smoker, current SLT user	50	2.213	1.504	3.255
Current smoker, former SLT user	128	2.202	1.742	2.783

**Figure 9**  
**Risks: All-Cause Mortality**  
**Groups Compared: Various Tobacco Users vs. Never Tobacco Users ( $p_{NN}$ )**  
**Population P4: Full Population: NLMS Data**



**Table 10**  
**Risks: All-Cause Mortality**  
**Groups Compared: Various Tobacco Use vs. Never Tobacco Use ( $p_{NN}$ )**  
**Population P4: Full Population: NLMS Data**

NLMS Data				
	Deaths	Hazard Ratio	Lower CI	Upper CI
Never smoker, current SLT user	48	0.815	0.590	1.125
Never smoker, former SLT user	48	1.026	0.732	1.436
Former smoker, never SLT user	2,703	1.416	1.334	1.503
Former smoker, current SLT user	59	1.317	0.963	1.802
Former smoker, former SLT user	91	1.500	1.178	1.909
Current smoker, never SLT user	1,505	1.878	1.745	2.022
Current smoker, current SLT user	22	2.138	1.272	3.592
Current smoker, former SLT user	49	2.413	1.719	3.387

I compare two of the hazard ratios shown in [Figure 8](#) — the fifth and seventh bars. The former smokers who are current SLT users (fifth bar) have a statistically significant 38 ( $= 1 - 0.623$ ) percent lower mortality risk compared to current smokers who are never SLT users (seventh bar). Table 11

I compare two of the hazard ratios shown in [Figure 9](#) — the fifth and seventh bars. The former smokers who are current SLT users (fifth bar) have a statistically significant 30 ( $= 1 - 0.701$ ) percent lower mortality risk compared to current smokers who are never SLT users (seventh bar). Table 11.

**Table 11**  
**Risks: All-Cause Mortality**  
**Groups Compared: Former Smokers who are Current SLT Users ( $p_{CF}$ ) vs. Current Smokers who are Never SLT Users ( $p_{NC}$ ).**  
**Population P4: Full Population**

<b>NHIS Data</b>				
	SLT $p_{CF}$ Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	127	0.623	0.485	0.800
Males	106	0.664	0.502	0.878
White males	96	0.604	0.449	0.811
Females	21	0.434	0.267	0.706
White females	12	0.448	0.24	0.835

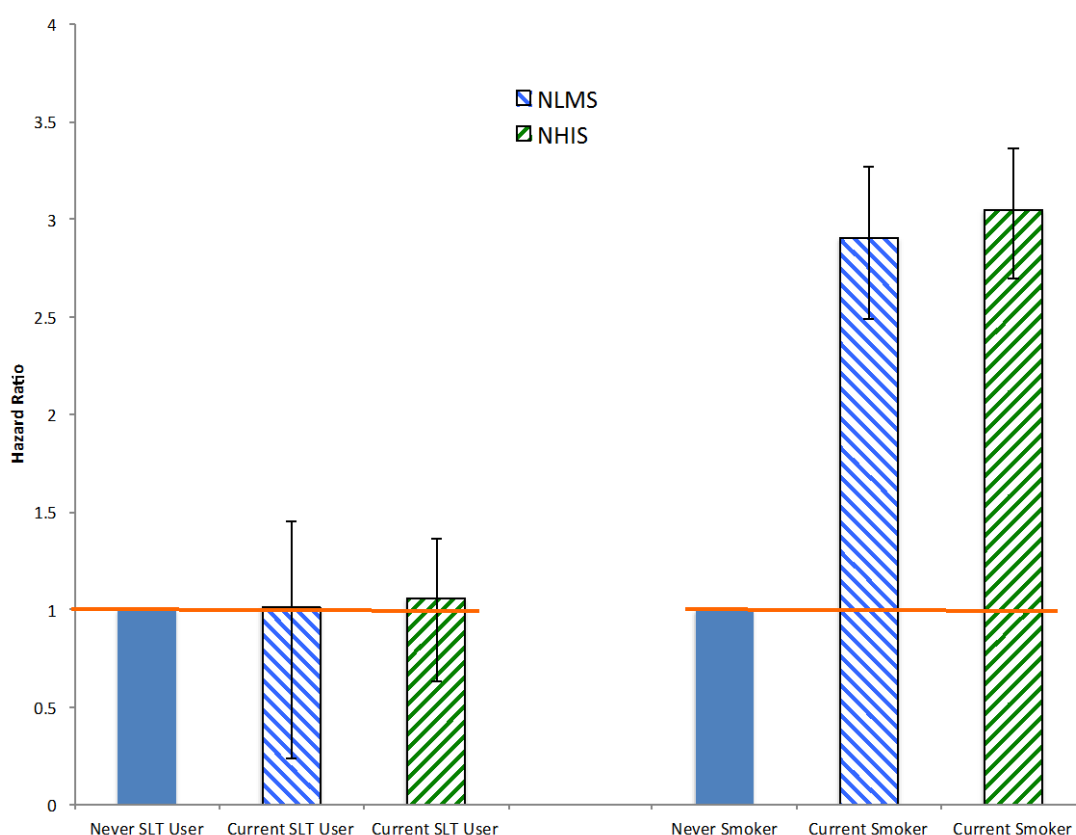
<b>NLMS Data</b>				
	SLT $p_{CF}$ Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	59	0.701	0.511	0.962
Males	55	0.777	0.568	1.064
White males	51	0.729	0.525	1.012
Females	4	0.485	0.127	1.851
White females	3	0.816	0.158	4.204

#### Malignant Neoplasms Mortality Detailed Analysis

We compare the risks of death from malignant neoplasms for current SLT users vs. never SLT users among never smokers and current smokers excluding former SLT users

(Population P1).<sup>38</sup> The hazard ratios for current SLT users vs. never SLT users are the same as shown in the third set of bars (“Malignant neoplasms mortality”) in Figure 2. There are no statistically significantly elevated risks associated with current SLT users vs. never SLT users in either the NLMS or NHIS data. There are statistically significantly elevated risks associated with current smoking vs. never smoking in both the NLMS and NHIS data. Figure 10.

**Figure 10**  
**Risks: Malignant Neoplasms Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**& Current Smoking vs. Never Smoking**  
**Population P1: Never Smokers and Current Smokers Excluding Former SLT Users**<sup>39</sup>

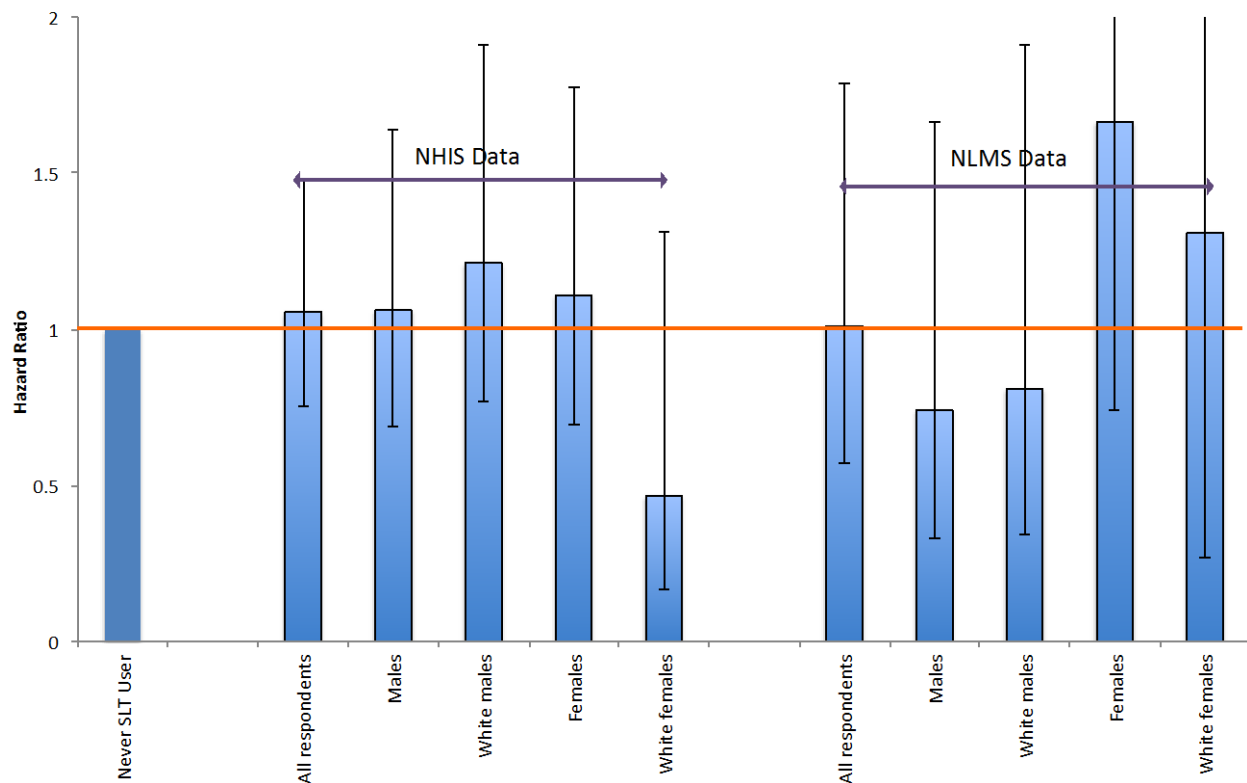


<sup>38</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current cigarette use, and current SLT use. CPD is not included in Figure 10. There was no statistical difference between analyses including CPD or excluding CPD.

<sup>39</sup> We performed the same analysis as shown in this chart except we excluded the current SLT users who were also current smokers (pcc), also called dual users. The results in this sensitivity analysis are essentially identical to those shown in this chart.

We compare the risks of death from malignant neoplasms of current SLT users vs. never SLT users in exactly the same way as done in Figure 10 and we did separate analyses for: males, white males, females, and white females.<sup>40</sup> There are no statistically significantly elevated risks associated with current SLT users vs. never SLT users in either the NLMS or NHIS data. Figure 11 & Table 12.

**Figure 11**  
**Risks: Malignant Neoplasms Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P1: Never Smokers and Current Smokers Excluding Former SLT Users**<sup>41</sup>



<sup>40</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current cigarette use and current SLT use.

<sup>41</sup> We performed the same analysis as shown in this chart except we excluded the current SLT users who were also current smokers (pcc), also called dual users. The results in this sensitivity analysis are essentially identical to those shown in this chart.

**Table 12**  
**Risks: Malignant Neoplasms Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P1: Never Smokers and Current Smokers Excluding Former SLT Users**

<b>NHIS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	60	1.055	0.753	1.480
Males	31	1.062	0.688	1.639
White males	27	1.213	0.769	1.913
Females	29	1.109	0.694	1.773
White females	4	0.466	0.166	1.310

<b>NLMS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	15	1.011	0.572	1.787
Males	8	0.743	0.332	1.662
White males	7	0.811	0.344	1.912
Females	7	1.663	0.743	3.724
White females	2	1.308	0.268	6.377

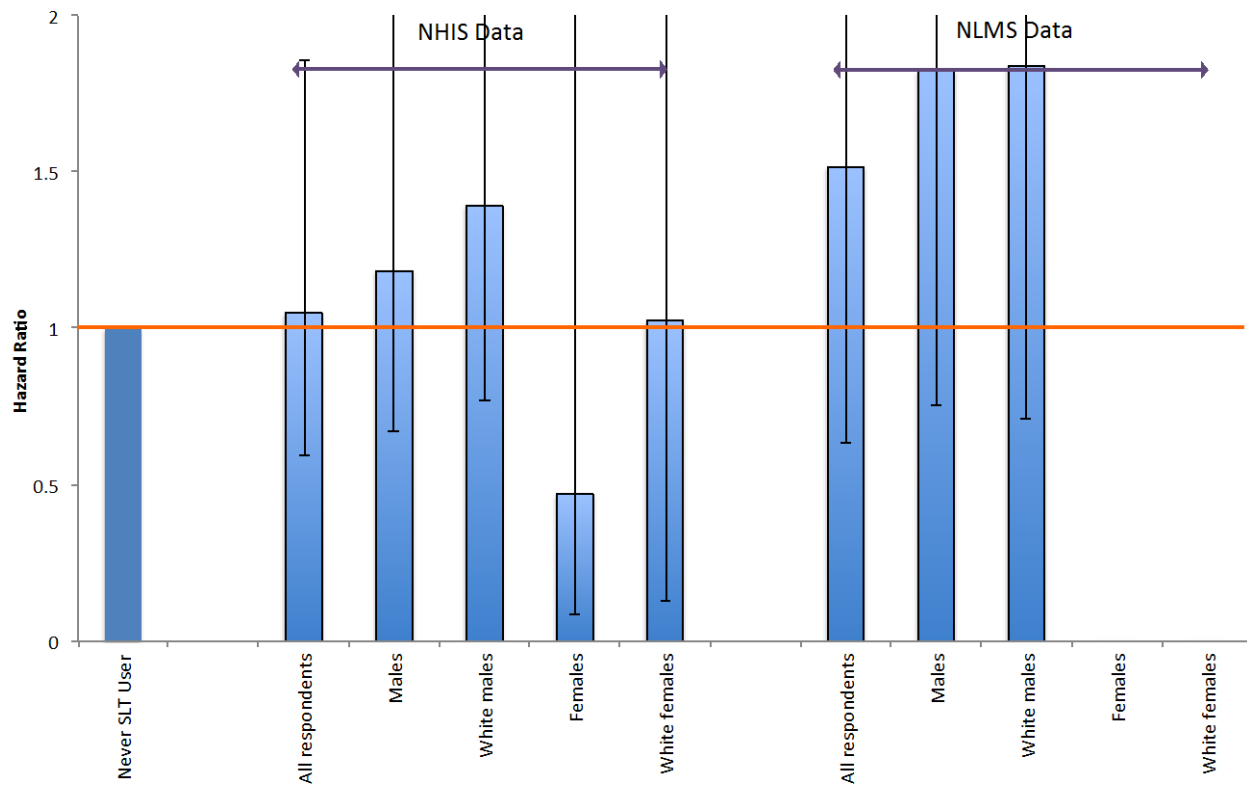
We compare the risks of death from malignant neoplasms of current SLT users vs. never SLT users in exactly the same way as done in [Figure 11](#) & Table 12 except we limited the analysis population to current smokers excluding former SLT users (Population P2).<sup>42</sup> There are no statistically significantly elevated mortality risks among current SLT users vs. never SLT users in either the NLMS or NHIS data. [Figure 12](#) & [Table 13](#).

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<sup>42</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current SLT use, and CPD (not available in the NLMS data).



**Figure 12**  
**Risks: Malignant Neoplasms Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P2: Current Smokers Excluding Former SLT Users<sup>43</sup>**



<sup>43</sup> We performed the same analysis as shown in this chart except we excluded the current SLT users who were also current smokers (pcc), also called dual users. The results in this sensitivity analysis are essentially identical to those shown in this chart.

**Table 13**  
**Risks: Malignant Neoplasms Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P2: Current Smokers excluding Former SLT Users**

**NHIS Data**

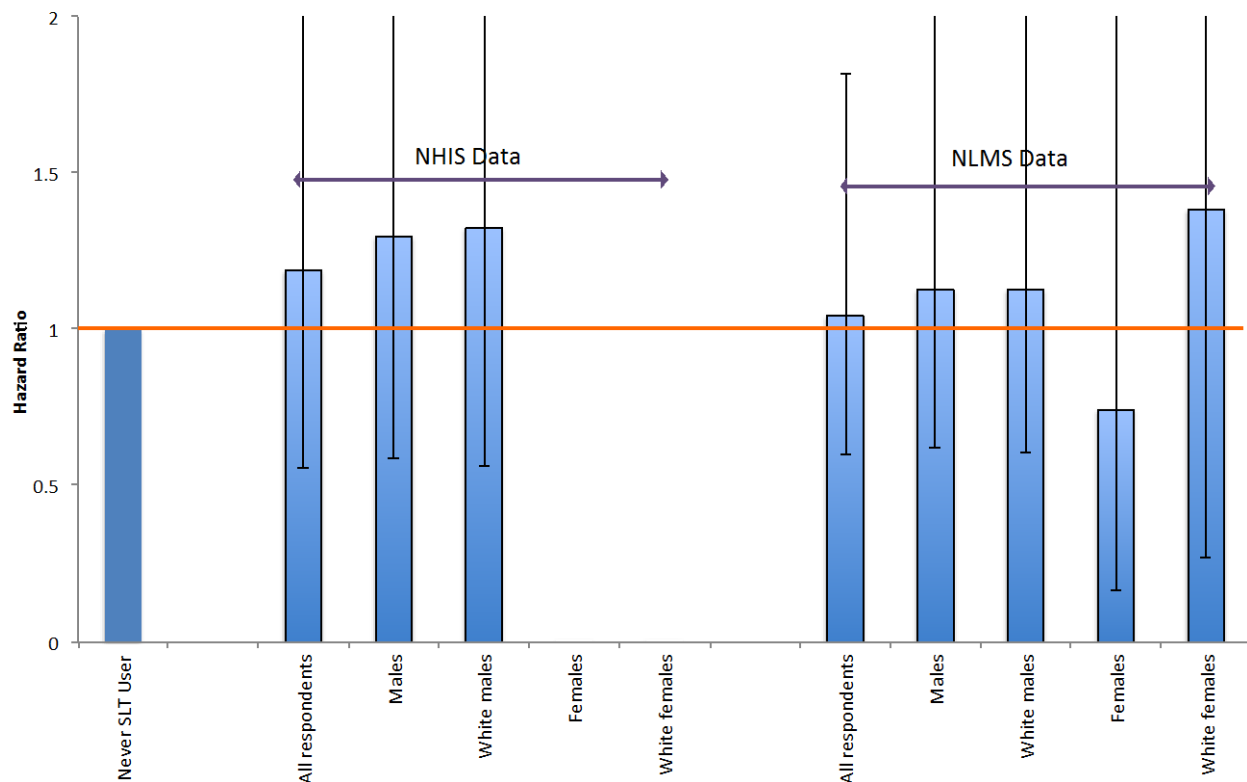
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	15	1.050	0.594	1.857
Males	13	1.184	0.668	2.096
White males	12	1.393	0.770	2.521
Females	2	0.470	0.085	2.601
White females	1	1.025	0.131	8.053

**NLMS Data**

	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	7	1.516	0.633	3.631
Males	7	1.824	0.755	4.405
White males	6	1.839	0.711	4.756
Females	0	.	.	.
White females	0	.	.	.

We compare the risks of death from malignant neoplasms of current SLT users vs. never SLT users among former smokers (Population P3). Separate analyses were done for: all respondents, males, white males, females, and white females.<sup>44</sup> There are no statistically significantly elevated risks associated with current SLT users vs. never SLT users in either the NLMS or NHIS data. Figure 13 & Table 14.

**Figure 13**  
**Risks: Malignant Neoplasms Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P3: Former Smokers**



<sup>44</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current SLT use, former SLT use, and CPD (available only in NHIS 1987 for all former smokers).

**Table 14**  
**Risks: Malignant Neoplasms Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P3: Former Smokers**

<b>NHIS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	8	1.187	0.557	2.529
Males	8	1.297	0.587	2.870
White males	7	1.324	0.561	3.120
Females	0	.	.	.
White females	0	.	.	.

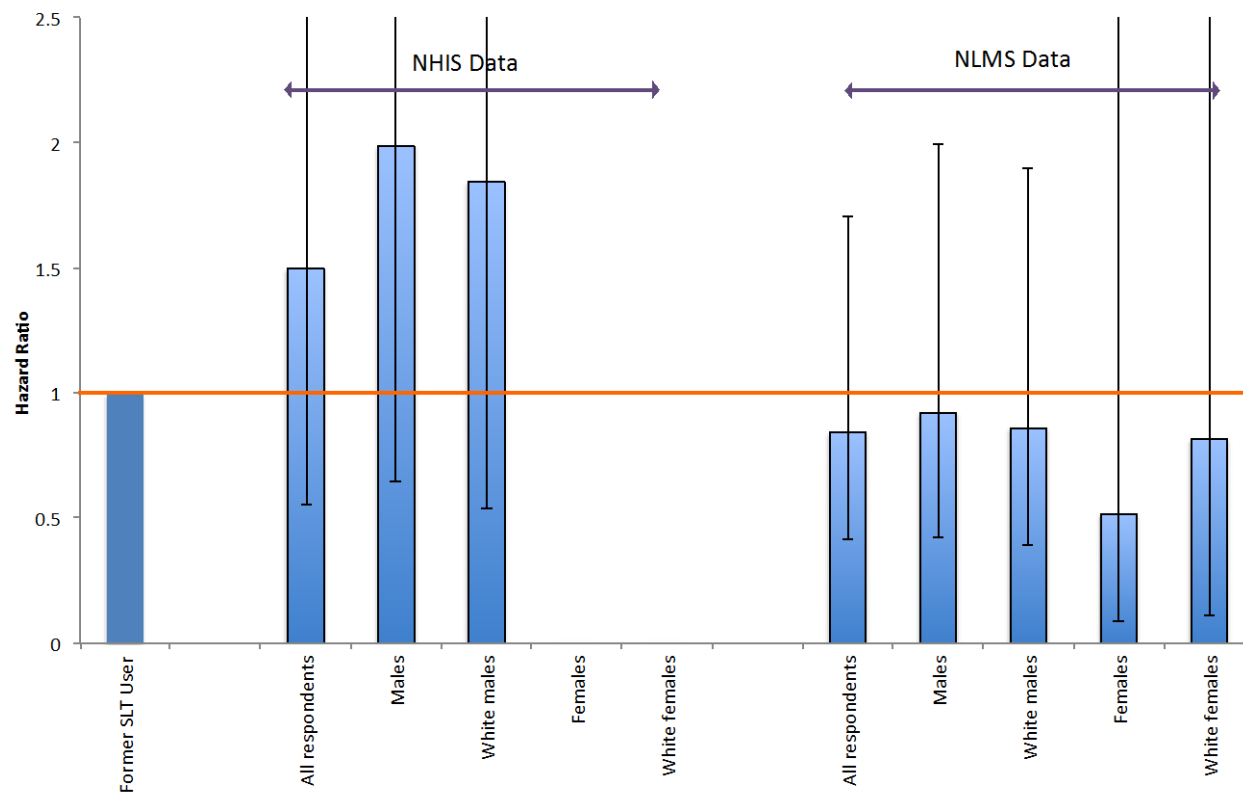
<b>NLMS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	19	1.044	0.600	1.818
Males	17	1.127	0.621	2.044
White males	16	1.127	0.606	2.097
Females	2	0.742	0.163	3.372
White females	2	1.383	0.270	7.099

We compare the risks of death from malignant neoplasms of current SLT users vs. former SLT users among former smokers (Population P3). Separate analyses were done for: all respondents, males, white males, females, and white females.<sup>45</sup> There are no statistically significantly elevated risks associated with current SLT users vs. never SLT users in either the NLMS or NHIS data. [Figure 14](#) & [Table 15](#).

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<sup>45</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current SLT use, former SLT use, and CPD (available only in NHIS 1987 for all former smokers).

**Figure 14**  
**Risks: Malignant Neoplasms Mortality**  
**Groups Compared: Current SLT Users vs. Former SLT Users**  
**Population P3: Former Smokers**



**Table 15**  
**Risks: Malignant Neoplasms Mortality**  
**Groups Compared: Current SLT Users vs. Former SLT Users**  
**Population P3: Former Smokers**

<b>NHIS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	8	1.498	0.554	4.046
Males	8	1.987	0.647	6.098
White males	7	1.845	0.539	6.314
Females	0	.	.	.
White females	0	.	.	.

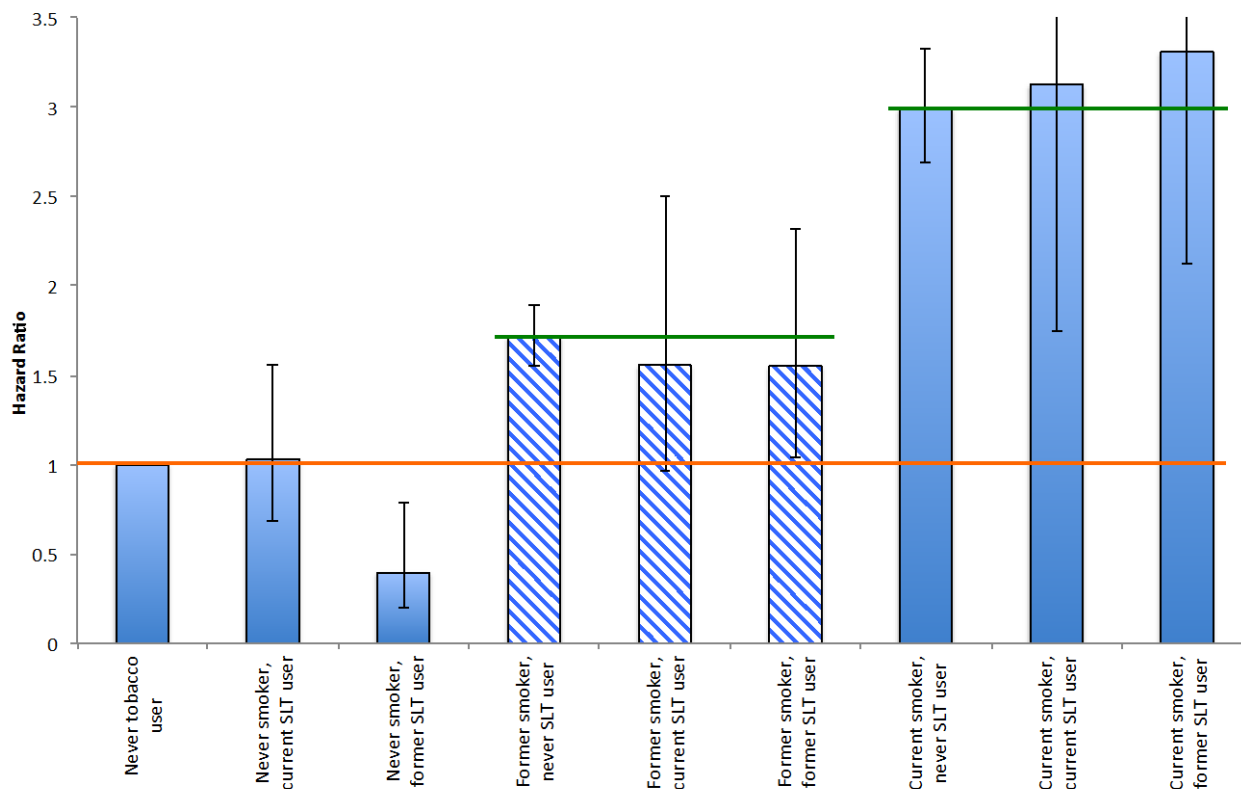
<b>NLMS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	19	0.842	0.416	1.705
Males	17	0.922	0.425	2.000
White males	16	0.859	0.389	1.900
Females	2	0.518	0.089	2.998
White females	2	0.815	0.111	5.964

We compare the risks of death from malignant neoplasms of various tobacco users vs. never SLT users for the full population (Population P4).<sup>46</sup> There are no statistically significantly elevated risks associated with current SLT users or former SLT users when compared within the same smoking group (i.e., never smoker, former smoker or current smoker) in either the NLMS or NHIS data. There are statistically significantly elevated risks associated with current smoking vs. never smoking and with former smoking vs. never smoking in both the NLMS and NHIS data. [Figure 15](#), [Figure 16](#), [Table 16](#) & [Table 17](#).

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<sup>46</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status and Tobacco Use Group.

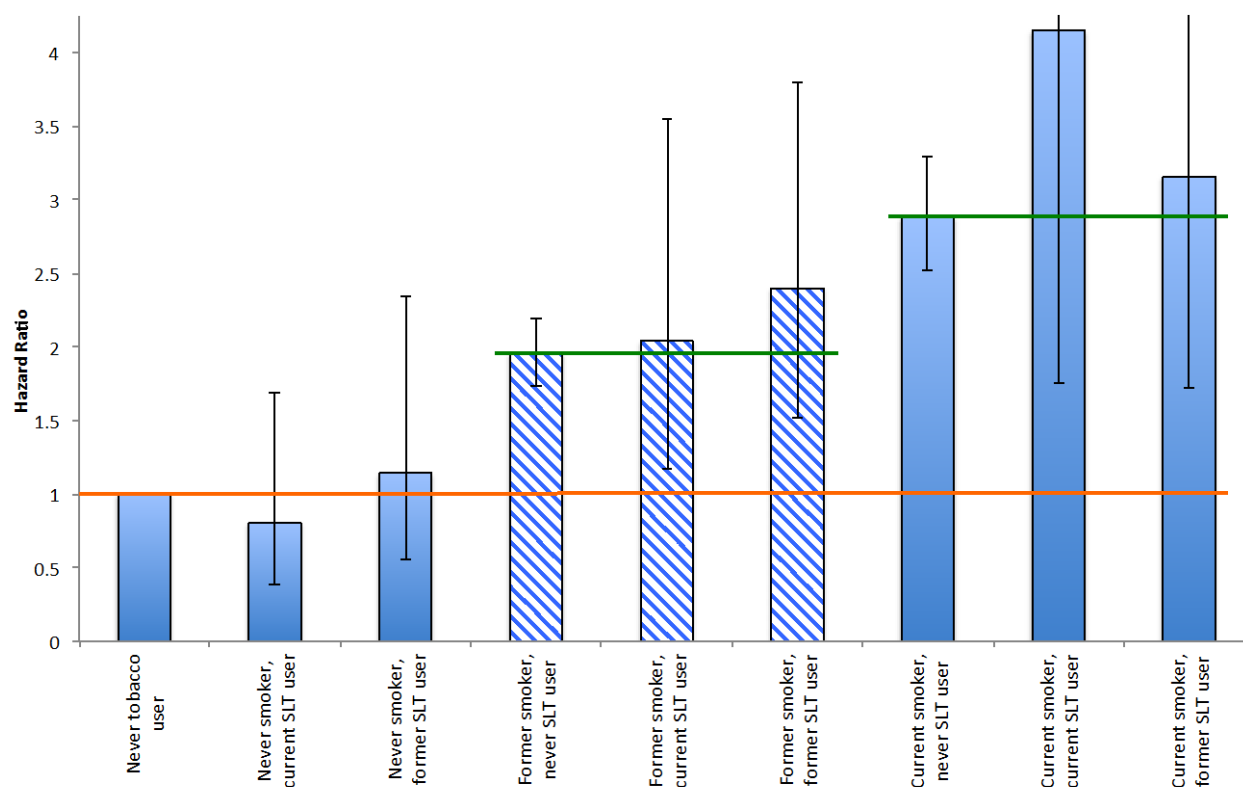
**Figure 15**  
**Risks: Malignant Neoplasms Mortality**  
**Groups Compared: Various Tobacco Users vs. Never Tobacco Users (p<sub>NN</sub>)**  
**Population P4: Full Population: NHIS Data**



**Table 16**  
**Risks: Malignant Neoplasms Mortality**  
**Groups Compared: Various Tobacco Users vs. Never Tobacco Users (p<sub>NN</sub>)**  
**Population P4: Full Population: NHIS Data**

NHIS Data				
	Deaths	Hazard Ratio	Lower CI	Upper CI
Never smoker, current SLT user	42	1.030	0.681	1.558
Never smoker, former SLT user	10	0.396	0.199	0.787
Former smoker, never SLT user	1,121	1.714	1.551	1.893
Former smoker, current SLT user	30	1.556	0.967	2.506
Former smoker, former SLT user	43	1.550	1.038	2.315
Current smoker, never SLT user	1,164	2.990	2.691	3.321
Current smoker, current SLT user	18	3.126	1.747	5.592
Current smoker, former SLT user	36	3.309	2.121	5.161

**Figure 16**  
**Risks: Malignant Neoplasms Mortality**  
**Groups Compared: Various Tobacco Users vs. Never Tobacco Users ( $p_{NN}$ )**  
**Population P4: Full Population: NLMS Data**



**Table 17**  
**Risks: Malignant Neoplasms Mortality**  
**Groups Compared: Various Tobacco Users vs. Never Tobacco Users ( $p_{NN}$ )**  
**Population P4: Full Population: NLMS Data**

NLMS Data				
	Deaths	Hazard Ratio	Lower CI	Upper CI
Never smoker, current SLT user	8	0.805	0.383	1.694
Never smoker, former SLT user	12	1.143	0.556	2.346
Former smoker, never SLT user	758	1.953	1.733	2.200
Former smoker, current SLT user	19	2.040	1.173	3.548
Former smoker, former SLT user	28	2.399	1.516	3.796
Current smoker, never SLT user	520	2.880	2.520	3.291
Current smoker, current SLT user	7	4.148	1.747	9.847
Current smoker, former SLT user	16	3.155	1.720	5.789



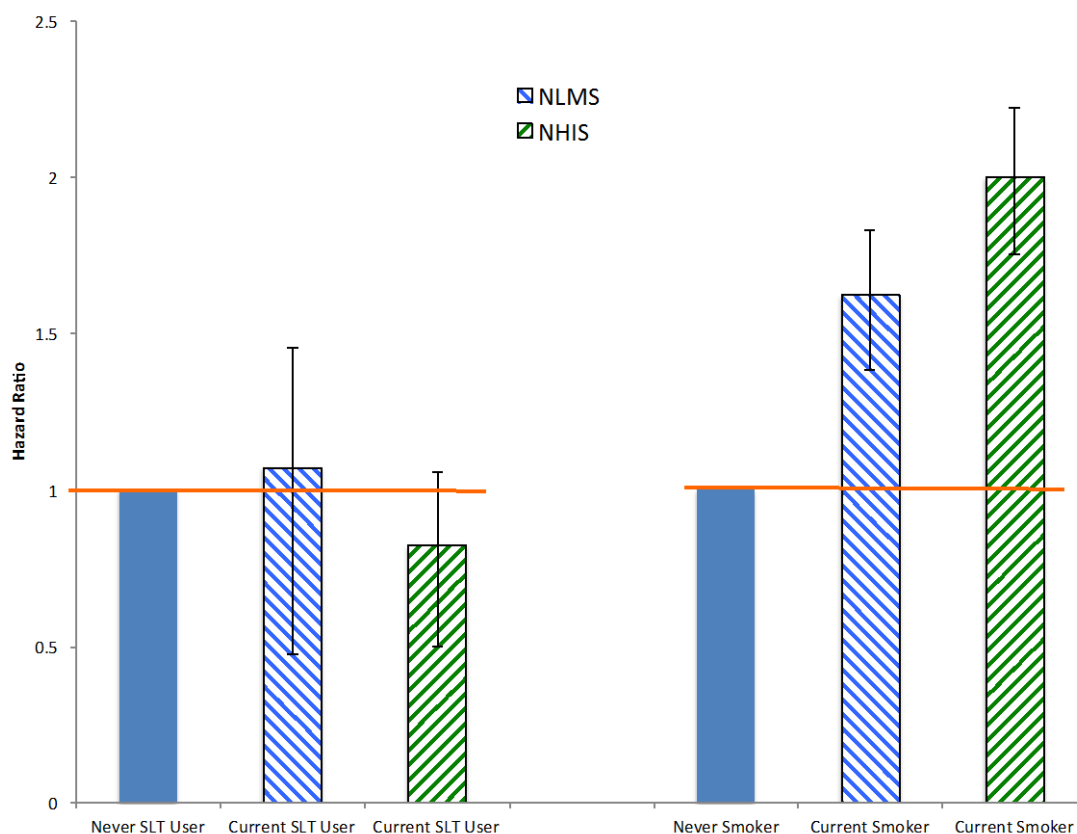
### Diseases of the Heart Mortality Detailed Analysis

We compare the risks of death from diseases of the heart of current SLT users vs. never SLT users among never smokers and current smokers excluding former SLT users (Population P1).<sup>47</sup> The hazard ratios for current SLT users vs. never SLT users are the same as shown in the second set of bars (“Diseases of the heart mortality”) in [Figure 2](#). There are no statistically significantly elevated risks associated with current SLT users vs. never SLT users in either the NLMS or NHIS data. There are statistically significantly elevated risks associated with current smoking vs. never smoking in both the NLMS and NHIS data. [Figure 17](#).

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<sup>47</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current cigarette use, and current SLT use. CPD is not included in [Figure 17](#). There was no statistical difference between analyses including CPD or excluding CPD.

**Figure 17**  
**Risks: Diseases of the Heart Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**& Current Smoking vs. Never Smoking**  
**Population P1: Never Smokers and Current Smokers Excluding Former SLT Users<sup>48</sup>**



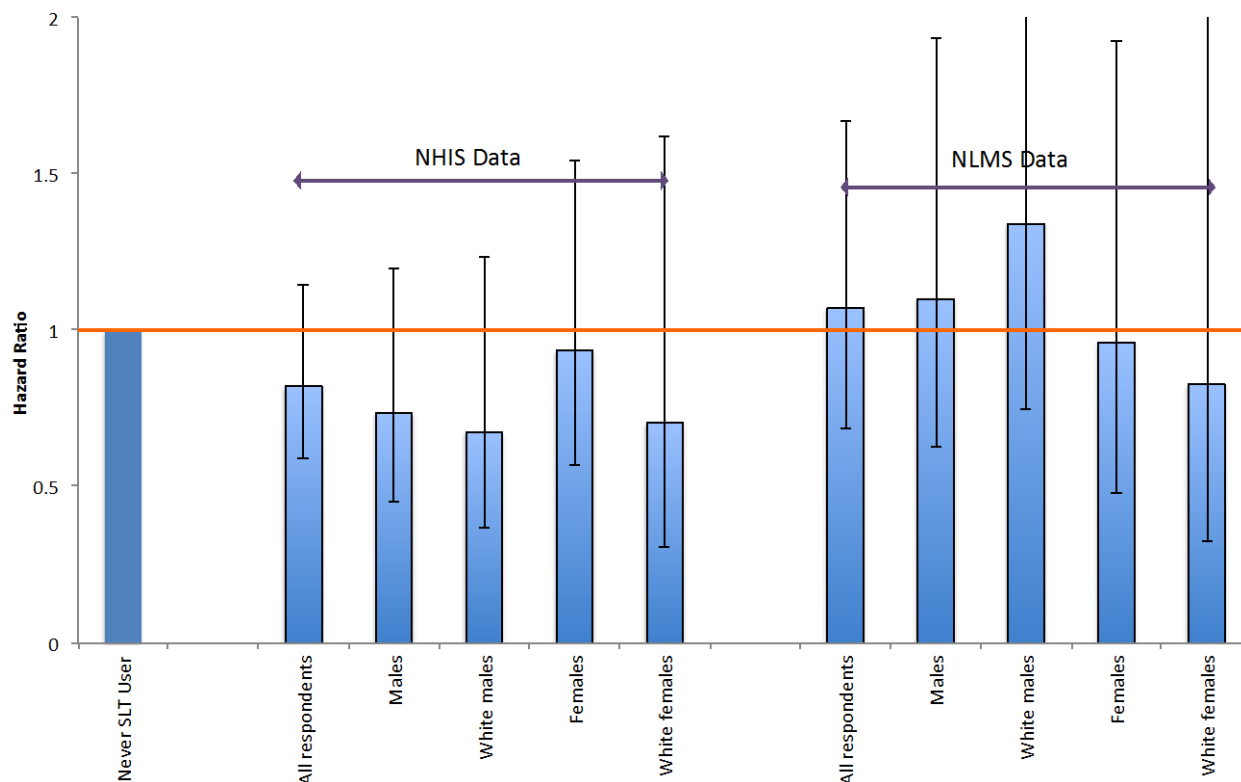
We compare the risks of death from diseases of the heart of current SLT users vs. never SLT users in exactly the same way as done in Figure 17 and we did separate analyses for: males, white males, females, and white females.<sup>49</sup> There are no statistically

<sup>48</sup> We performed the same analysis as shown in this chart except we excluded the current SLT users who were also current smokers (pcc), also called dual users. The results in this sensitivity analysis are essentially identical to those shown in this chart.

<sup>49</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current cigarette use, and current SLT use

significantly elevated risks associated with current SLT users vs. never SLT users in either the NLMS or NHIS data. Figure 18 & Table 18.

**Figure 18**  
**Risks: Diseases of the Heart Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P1: Never Smokers and Current Smokers Excluding Former SLT Users**<sup>50</sup>



<sup>50</sup> We performed the same analysis as shown in this chart except we excluded the current SLT users who were also current smokers (pcc), also called dual users. The results in this sensitivity analysis are essentially identical to those shown in this chart.

**Table 18**  
**Risks: Diseases of the Heart Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P1: Never Smokers and Current Smokers excluding Former SLT Users**

NHIS Data				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	59	0.822	0.590	1.144
Males	27	0.735	0.451	1.197
White males	18	0.673	0.367	1.233
Females	32	0.936	0.567	1.544
White females	11	0.705	0.307	1.618

NLMS Data				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	27	1.071	0.687	1.668
Males	17	1.100	0.625	1.937
White males	16	1.341	0.748	2.403
Females	10	0.961	0.480	1.923
White females	5	0.827	0.322	2.124

In our sensitivity analysis of the results shown in [Figure 18](#) & Table 18 we analyzed the population of never smokers and current smokers *including* former SLT users as shown below. This includes Population P1 plus former SLT users (regardless of when the quit SLT use).

***Never smokers and current smokers including former SLT users:***

Population =  $p_{NN} + p_{CN} + p_{NC} + p_{CC} + p_{FN} + p_{FC}$

	Never Smoker	Former Smoker	Current Smokers
Never SLT	$p_{NN}$		$p_{NC}$
Current SLT	$p_{CN}$		$p_{CC}$
Former SLT	$p_{FN}$		$p_{FC}$

In this sensitivity analysis we found no statistically significantly elevated hazard ratios when analyzing the NLMS data.<sup>51</sup> We did find statistically significantly elevated

<sup>51</sup> See "Wecker Report SLT results.xlsx/P1 w FS - CSLT vs NSLT".

hazard ratios for SLT use vs. never SLT in three heart disease categories<sup>52</sup> use when using the NHIS data. Because the evaluated SLT risks are at odds with the rest of the analyses in this report (and different from the parallel NLMS analysis) we investigated the NHIS data to determine the reason the SLT heart disease risks in the NHIS data appeared to be elevated. We discovered that all three elevated heart disease risks in the NHIS data arise from the inclusion of a single white male former smoker<sup>53</sup> who had a very large sampling weight. This former smoker reported that he had a pre-existing heart condition fifteen years prior to the NHIS survey.

We compare the risks of death from diseases of the heart of current SLT users vs. never SLT users in exactly the same way as done in [Figure 18](#) & [Table 18](#) except we limited the analysis population to current smokers excluding former SLT users (Population P1).<sup>54</sup>

There are no statistically significantly elevated mortality risks among current SLT users vs. never SLT users in either the NLMS or NHIS data. [Table 22](#) & [Table 19](#).

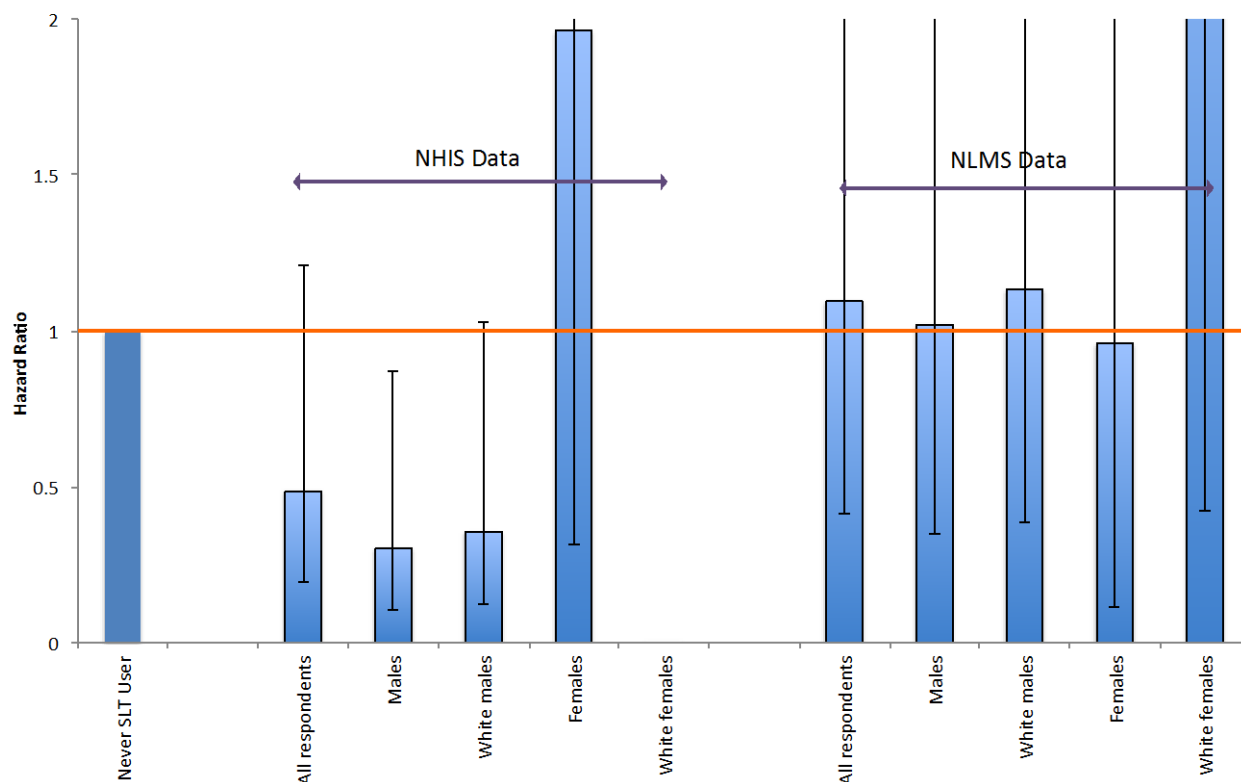
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<sup>52</sup> The three (overlapping) heart disease categories are diseases of the circulatory system; major cardiovascular diseases; diseases of the heart.

<sup>53</sup> This former smoker quit more than 10 years prior to survey.

<sup>54</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current cigarette use, and current SLT use.

**Figure 19**  
**Risks: Diseases of the Heart Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P2: Current Smokers Excluding Former SLT Users**<sup>55</sup>



<sup>55</sup> We performed the same analysis as shown in this chart except we excluded the current SLT users who were also current smokers (pcc), also called dual users. The results in this sensitivity analysis are essentially identical to those shown in this chart.

**Table 19**  
**Risks: Diseases of the Heart Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P2: Current Smokers excluding Former SLT Users**

<b>NHIS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	6	0.486	0.195	1.212
Males	4	0.304	0.106	0.874
White males	4	0.357	0.124	1.029
Females	2	1.962	0.312	12.335
White females	0	.	.	.

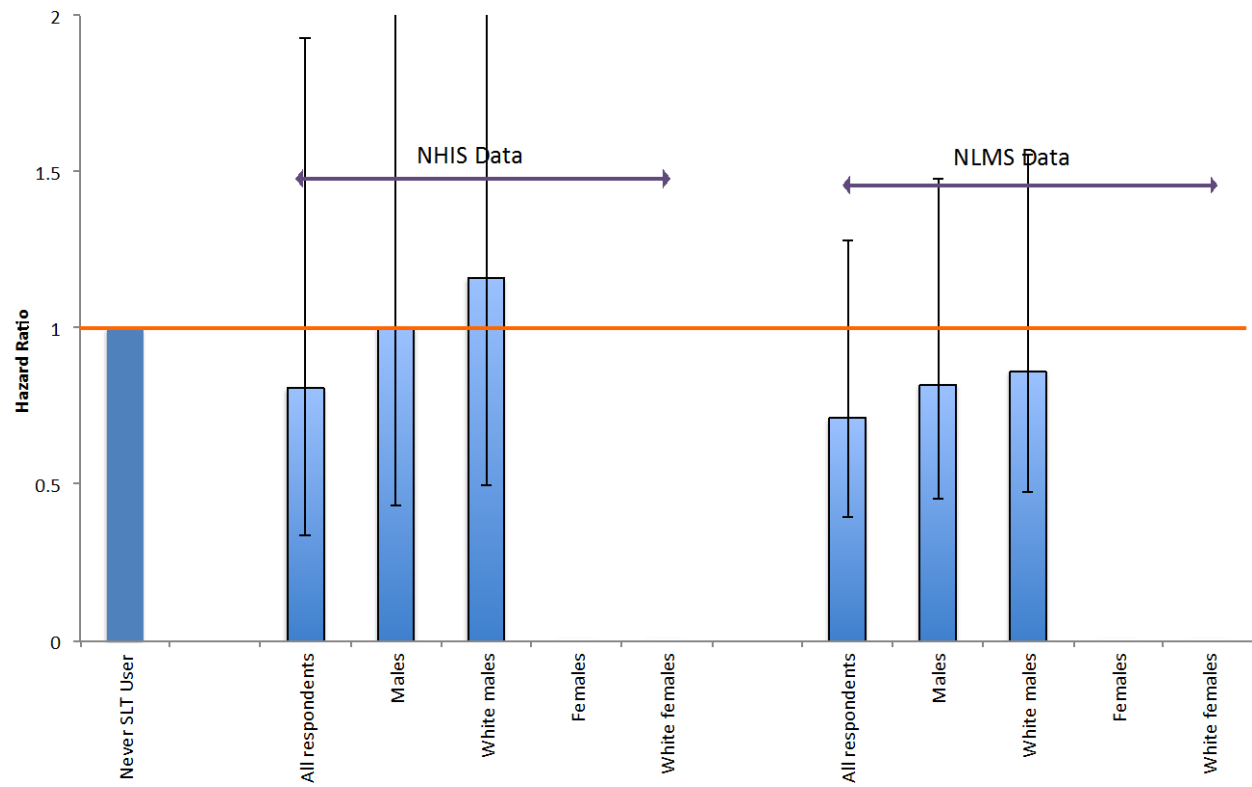
<b>NLMS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	5	1.095	0.415	2.888
Males	4	1.020	0.348	2.990
White males	4	1.134	0.385	3.339
Females	1	0.960	0.115	8.033
White females	1	2.974	0.423	20.917

We compare the risks of death from diseases of the heart of current SLT users vs. never SLT users among former smokers (Population P3). Separate analyses were done for: all respondents, males, white males, females, and white females.<sup>56</sup> There are no statistically significantly elevated risks associated with current SLT users vs. never SLT users in either the NLMS or NHIS data. [Figure 20](#) & [Table 20](#).

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<sup>56</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current SLT use, former SLT use, and CPD (available only in NHIS 1987 for all former smokers).

**Figure 20**  
**Risks: Diseases of the Heart Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P3: Former Smokers**





**Table 20**  
**Risks: Diseases of the Heart Mortality**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P3: Former Smokers**

<b>NHIS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	8	0.808	0.338	1.932
Males	8	1.001	0.429	2.335
White males	8	1.160	0.495	2.716
Females	0	.	.	.
White females	0	.	.	.

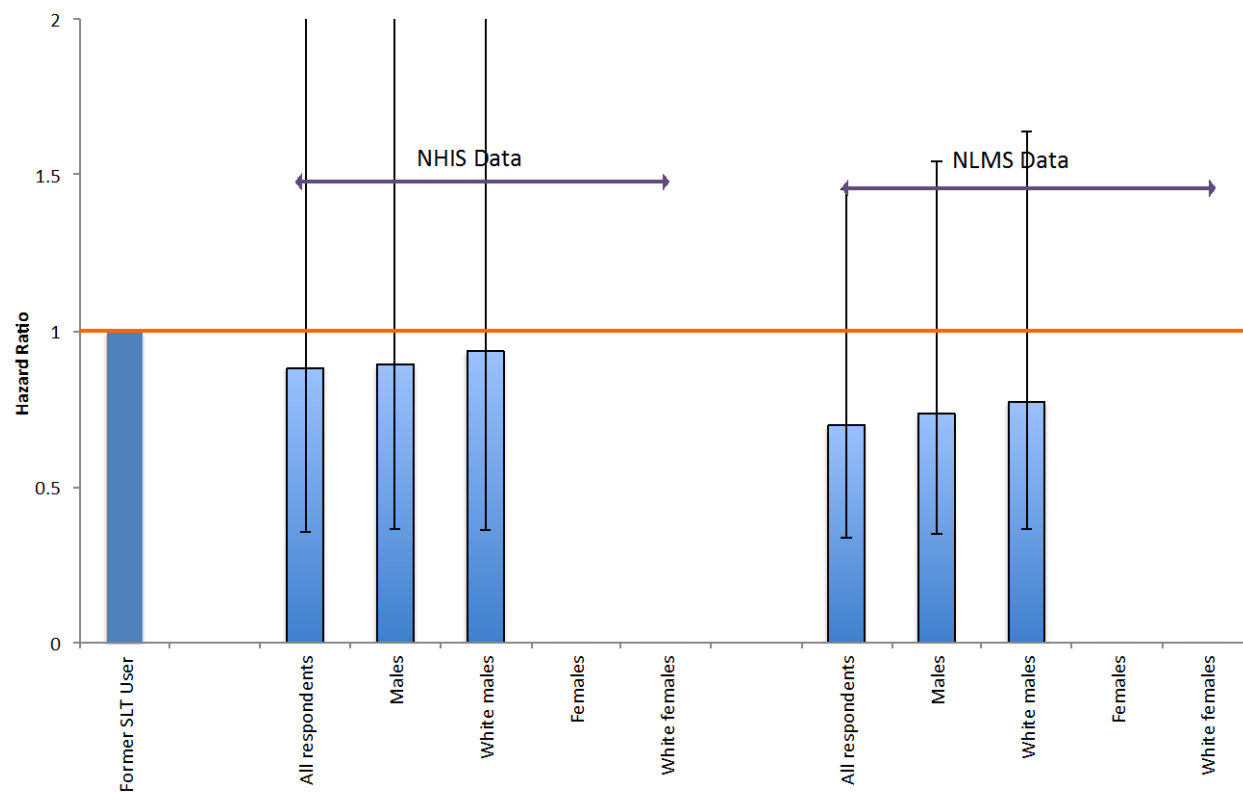
<b>NLMS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	14	0.713	0.396	1.284
Males	14	0.820	0.454	1.478
White males	14	0.860	0.475	1.555
Females	0	.	.	.
White females	0	.	.	.

We compare the risks of death from diseases of the heart of current SLT users vs. former SLT users among former smokers (Population P3). Separate analyses were done for: all respondents, males, white males, females, and white females.<sup>57</sup> There are no statistically significantly elevated risks associated with current SLT users vs. never SLT users in either the NLMS or NHIS data. [Figure 21](#) & [Table 21](#).

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<sup>57</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current SLT use, former SLT use, and CPD (available only in NHIS 1987 for all former smokers).

**Figure 21**  
**Risks: Diseases of the Heart Mortality**  
**Groups Compared: Current SLT Users vs. Former SLT Users**  
**Population P3: Former Smokers**



**Table 21**  
**Risks: Diseases of the Heart Mortality**  
**Groups Compared: Current SLT Users vs. Former SLT Users**  
**Population P3: Former Smokers**

<b>NHIS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	8	0.882	0.356	2.183
Males	8	0.894	0.365	2.189
White males	8	0.935	0.363	2.412
Females	0	.	.	.
White females	0	.	.	.

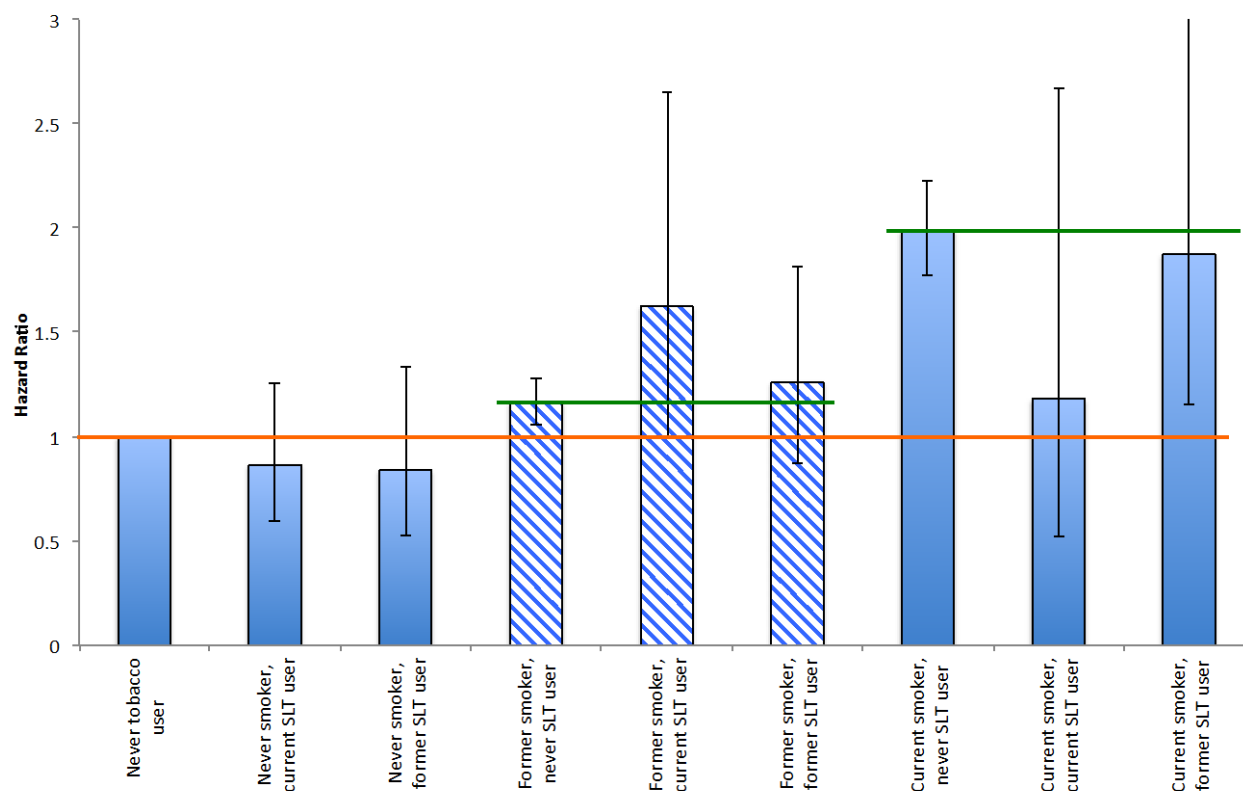
<b>NLMS Data</b>				
	SLT Deaths	Hazard Ratio	Lower CI	Upper CI
All respondents	14	0.699	0.336	1.452
Males	14	0.736	0.351	1.545
White males	14	0.772	0.364	1.639
Females	0	.	.	.
White females	0	.	.	.

We compare the risks of death from diseases of the heart from various tobacco users vs. never SLT users for the full population (Population P4).<sup>58</sup> There are no statistically significantly elevated risks associated with current SLT users or former SLT users when compared within the same smoking group (i.e., never smoker, former smoker or current smoker) in either the NLMS or NHIS data. There are statistically significantly elevated risks associated with current smoking vs. never smoking and with former smoking vs. never smoking in both the NLMS and NHIS data. [Figure 22](#), [Figure 23](#), [Table 22](#) & [Table 23](#).

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<sup>58</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status and Tobacco Use Group.

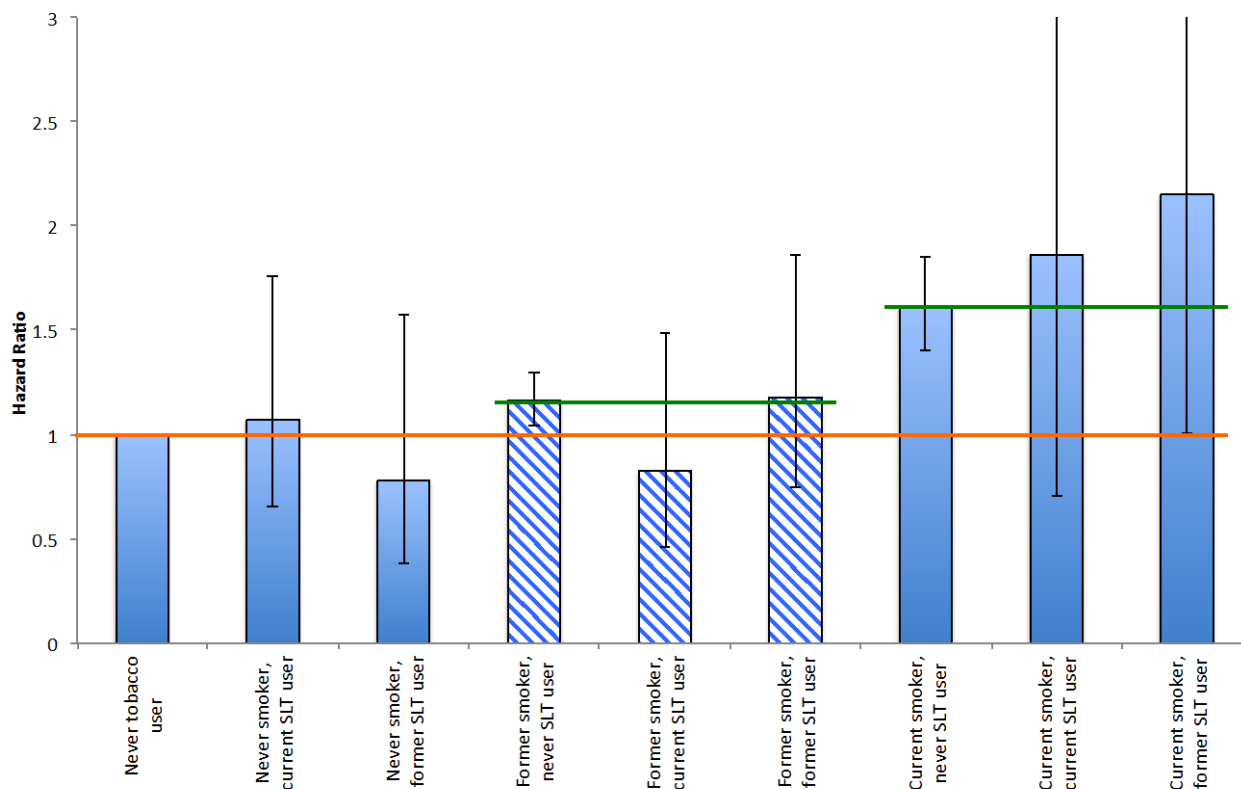
**Figure 22**  
**Risks: Diseases of the Heart Mortality**  
**Groups Compared: Various Tobacco Users vs. Never Tobacco Users ( $p_{NN}$ )**  
**Population P4: Full Population: NHIS Data**



**Table 22**  
**Risks: Diseases of the Heart Mortality**  
**Groups Compared: Various Tobacco Users vs. Never Tobacco Users ( $p_{NN}$ )**  
**Population P4: Full Population: NHIS Data**

NHIS Data				
	Deaths	Hazard Ratio	Lower CI	Upper CI
Never smoker, current SLT user	52	0.864	0.594	1.259
Never smoker, former SLT user	23	0.839	0.528	1.334
Former smoker, never SLT user	1,006	1.165	1.056	1.286
Former smoker, current SLT user	39	1.625	0.994	2.655
Former smoker, former SLT user	50	1.260	0.873	1.818
Current smoker, never SLT user	775	1.987	1.771	2.228
Current smoker, current SLT user	7	1.181	0.523	2.668
Current smoker, former SLT user	23	1.875	1.152	3.050

**Figure 23**  
**Risks: Diseases of the Heart Mortality**  
**Groups Compared: Various Tobacco Users vs. Never Tobacco Users ( $p_{NN}$ )**  
**Population P4: Full Population: NLMS Data**



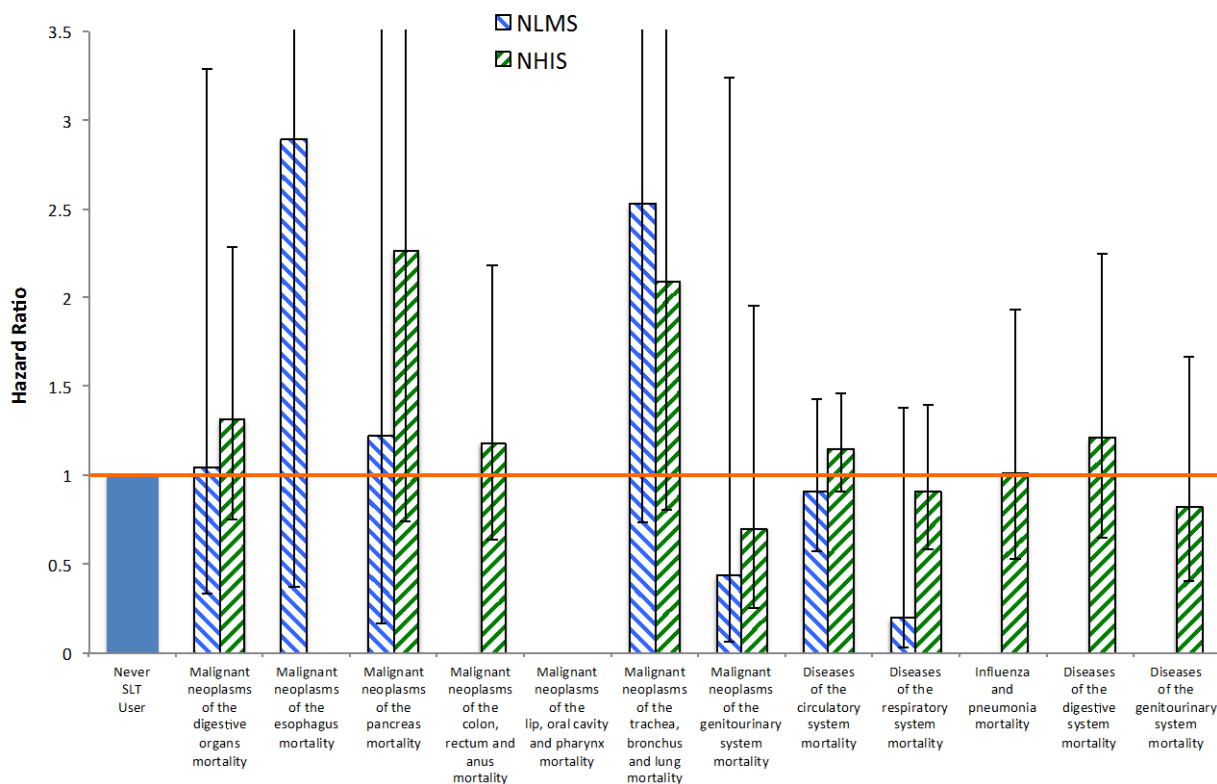
**Table 23**  
**Risks: Diseases of the Heart Mortality**  
**Groups Compared: Various Tobacco Users vs. Never Tobacco Users ( $p_{NN}$ )**  
**Population P4: Full Population: NLMS Data**

NLMS Data				
	Deaths	Hazard Ratio	Lower CI	Upper CI
Never smoker, current SLT user	22	1.073	0.654	1.759
Never smoker, former SLT user	11	0.779	0.385	1.579
Former smoker, never SLT user	749	1.162	1.043	1.295
Former smoker, current SLT user	14	0.828	0.461	1.488
Former smoker, former SLT user	26	1.180	0.749	1.858
Current smoker, never SLT user	378	1.613	1.406	1.851
Current smoker, current SLT user	5	1.863	0.705	4.922
Current smoker, former SLT user	9	2.151	1.008	4.591

## Twelve causes of death

We compare the risks of death from twelve causes of death of current SLT users vs. never SLT users among never smokers excluding former SLT users (Population P0).<sup>59</sup> We used the restricted NHIS data for this analysis because these causes of death are not available in the public NHIS data. There are no statistically significantly elevated mortality risks among current SLT users vs. never SLT users in either the NLMS or NHIS data. Figure 25.

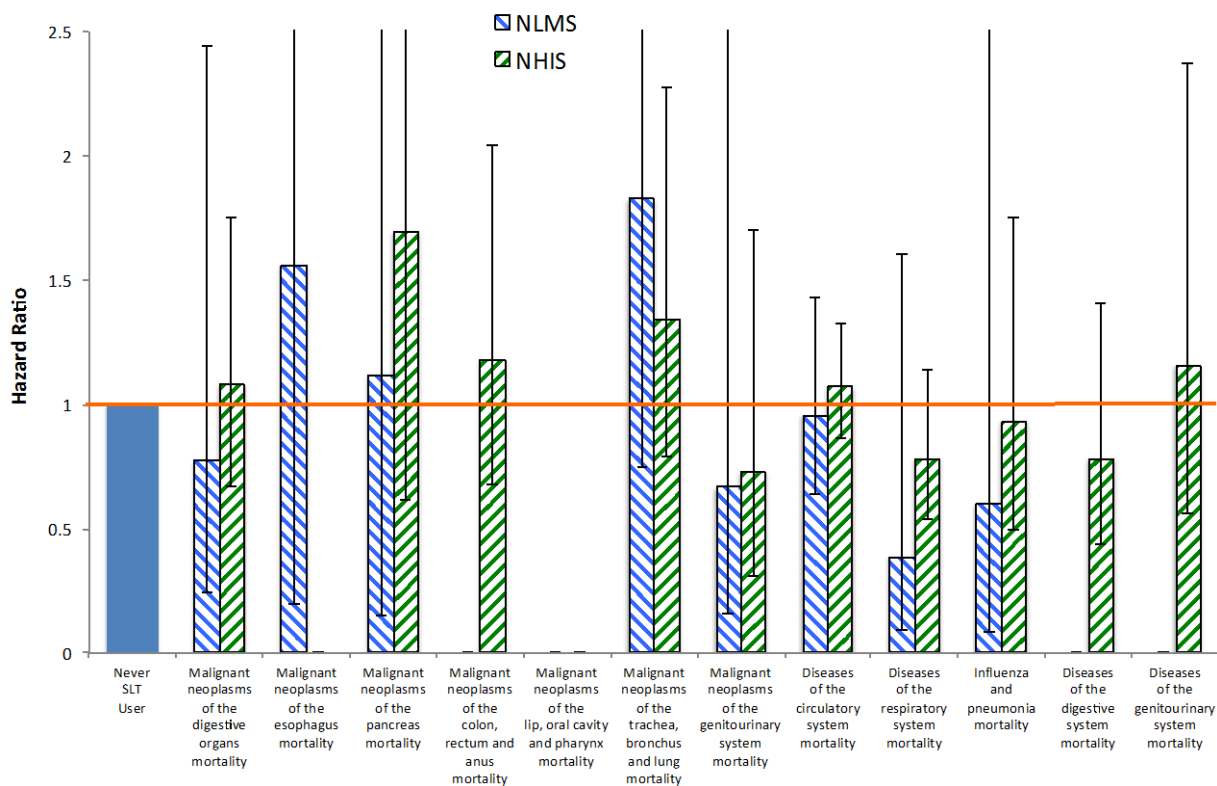
**Figure 24**  
**Risks: Twelve Causes of Death**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P0: Never Smokers Excluding Former SLT Users**



<sup>59</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status and current SLT use.

We also analyzed these same twelve causes of death of current SLT users vs. never SLT users among never smokers and current smokers excluding former SLT users (Population P1).<sup>60</sup> We used the restricted NHIS data for this analysis because these causes of death are not available in the public NHIS data. There are no statistically significantly elevated mortality risks among current SLT use vs. never SLT use in either the NLMS or NHIS data. Figure 25.

**Figure 25**  
**Risks: Twelve Causes of Death**  
**Groups Compared: Current SLT Users vs. Never SLT Users**  
**Population P1: Never Smokers and Current Smokers Excluding Former SLT Users**



<sup>60</sup> We include the following covariates: gender, race (white, non-white), age, BMI (not available in the NLMS data), education, family income, health status, current cigarette use, and current SLT use. CPD is not included in Figure 25. There was no statistical difference between analyses including CPD or excluding CPD.

We attempted to analyze mortality risk for malignant neoplasms of the oral cavity, lip and pharynx among current SLT users. There were less than five deaths<sup>61</sup> among the current SLT users in the restricted NHIS<sup>62</sup> P1 population and zero deaths in NLMS P1 population. Our analysis of the restricted NHIS data was limited to only those diseases with five or more deaths among the current SLT users in the P1 population.<sup>63</sup> Oral cancer deaths are no more than 0.76 percent<sup>64</sup> of the total deaths among the current SLT users in both the NHIS and NLMS datasets. The rarity of oral cancer deaths (less than five) among SLT users in the restricted NHIS and zero deaths among the SLT users in the NLMS data prevents us from estimating hazard ratios for SLT use.

We attempted to analyze mortality risk for malignant neoplasms of the esophagus among current SLT users. There were less than five deaths<sup>65</sup> among the current SLT users in the restricted NHIS<sup>66</sup> P1 population and one death in the NLMS P1 population. Our analysis of the restricted NHIS data was limited to only those diseases with five or more deaths among the current SLT users.<sup>67</sup> The rarity of esophageal cancer deaths among SLT users in the NHIS and NLMS data prevents us from estimate hazard ratios for SLT use.

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<sup>61</sup> We cannot report actual counts where the number of deaths is less than five with the restricted NHIS data.

<sup>62</sup> We used the restricted NHIS data with twenty four-years of mortality follow-up to identify the maximum number of possible deaths.

<sup>63</sup> We are prohibited by the National Center for Health Statistics from reporting counts where the number of deaths is less than five when using the restricted NHIS data.

<sup>64</sup> This is based on the assumption of a maximum of four possible deaths (actual deaths could be lower).

<sup>65</sup> We cannot report actual counts where the number of deaths is less than five with the restricted NHIS data.

<sup>66</sup> We used the restricted NHIS data with twenty four-years of mortality follow-up to identify the maximum number of possible deaths.

<sup>67</sup> We are prohibited by the National Center for Health Statistics from reporting counts where the number of deaths is less than five when using the restricted NHIS data.



## Conclusion

We analyzed risks of 23 causes of death (see [Table 2](#)) comparing primarily current SLT users vs. never SLT users. We also analyzed risks comparing current SLT users vs. former SLT users; current smokers vs. never smokers; and various tobacco use groups vs. never tobacco use.

We analyzed 23 causes of death using three datasets (i.e., NLMS, Restricted NHIS, and Public NHIS) — there are a total of 50 possible analyses.<sup>68</sup> [Table 2](#). Some of the 50 total possible analyses cannot be done because there are either no deaths among the SLT users or, in the case of the restricted NHIS data, the number of deaths within the SLT users is less than five.

We attempted to perform these 50 analyses for five different populations (Populations P0, P1, P2, P3, P4) and five different sex and race groups (i.e., all respondents, males, white males, females, and white females).

Overall, in our comparisons of current SLT users vs. never SLT users among all respondents, we estimated 174 hazard ratios (from 174 separate regression analyses). We found the death rates among current SLT users vs. never SLT users were

- Not statistically significantly different in 169 cases,
- The current SLT users were statistically significantly lower in three cases,
- The current SLT users were statistically significantly higher in three cases,
- And there were 29 analyses where there were no deaths among the current SLT users and, therefore, no hazard ratio was estimated for current SLT users vs. never SLT users. [Table 24](#)

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<sup>68</sup> These analyses are not independent. They include overlapping causes of death and the same people appear in multiple analyses.

**Table 24**  
**Risks: Various Causes of Death**  
**Groups Compared: Current SLT Users vs. Never SLT Users<sup>69</sup>**  
**Population: Men and Women of All Races in P0, P1, P2, P3, P4**

	Number of Analyses	No Statistically Significant Difference	SLT Users Statistically Significantly Lower	SLT Users Statistically Significantly Higher	No SLT deaths
NLMS Data	68	67	0	1	27
Restricted NHIS Data	59	58	1	0	0
Public NHIS Data	48	44	2	2	2
	175	169	3	3	29

Overall, in our comparisons of current SLT users vs. never SLT users among white men, we estimated 133 hazard ratios (from 133 separate regression analyses). We found the death rates among current SLT users vs. never SLT users was

- Not statistically significantly different in 127 cases,
- The current SLT users were statistically significantly lower in three cases,
- The current SLT users were statistically significantly higher in three cases,
- And there were 50 analyses where there were no deaths among the current SLT users and, therefore, no hazard ratio was estimated for current SLT users vs. never SLT users. [Table 25](#)

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<sup>69</sup> Not included in these counts are cases with the number of deaths among the SLT users was less than five in the restricted NHIS data.

**Table 25**  
**Risks: Various Causes of Death**  
**Groups Compared: Current SLT Users vs. Never SLT Users<sup>70</sup>**  
**Population: White Men in P0, P1, P2, P3, P4**

	Number of Analyses	No Statistically Significant Difference	SLT Users Statistically Significantly Lower	SLT Users Statistically Significantly Higher	No SLT deaths
NLMS Data	45	45	0	0	48
Restricted NHIS Data	40	37	2	1	0
Public NHIS Data	48	45	1	2	2
	133	127	3	3	50

We find no consistent evidence that SLT use increases mortality risk.

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<sup>70</sup> Not included in these counts are cases with the number of deaths among the SLT users was less than five in the restricted NHIS data.