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# Transitions to smokeless tobacco use among adult cigarette smokers in the Population Assessment of Tobacco and Health (PATH) Study, Waves 3–5 (2015–2019)

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## ABSTRACT

**Objective** Examine patterns of dual use of cigarettes and smokeless tobacco and complete switching over time among adult current cigarette smokers using data from the Population Assessment of Tobacco and Health Study Wave 3 (2015–2016), Wave 4 (2016–2018) and Wave 5 (2018–2019).

**Methods** We examined four tobacco use states among 6834 exclusive smokers and 372 dual users at Wave 3 with two waves of follow-up data: exclusive cigarette use, exclusive smokeless tobacco use, dual use and use of neither product.

**Results** Among exclusive smokers at Wave 3, only 1.6% (95% CI: 1.3% to 2.1%) transitioned to dual use at Wave 4, and 0.1% (95% CI: 0.07% to 0.2%) switched to exclusive smokeless tobacco use. Among exclusive smokers who switched to dual use, 53.1% (95% CI: 40.9% to 64.9%) returned to exclusive cigarette smoking, 34.3% (95% CI: 23.8% to 46.6%) maintained dual use and 12.6% (95% CI: 7.0% to 21.7%) did not smoke cigarettes after an additional wave of follow-up. Dual users at Wave 3 were likely to maintain their dual use status at Wave 4, 51.2% (95% CI: 46.1% to 56.3%) and Wave 5, 47.9% (95% CI: 40.1% to 55.8%).

**Conclusions** Very few cigarette smokers transition to smokeless tobacco use, and among those who do, dual use is more common than exclusive smokeless tobacco use. Further, the majority of exclusive cigarette smokers who transition to dual use at Wave 4 continue smoking cigarettes at Wave 5, either as dual users or as exclusive smokers.

pulmonary disease (COPD), oral cancer, stroke and heart disease for exclusive SLT use (compared with no tobacco use) are much lower than relative risks for exclusive current cigarette smoking compared with never smokers.<sup>4–7</sup> For example, a pooled analysis comparing the risk of ischaemic heart disease among SLT users with non-users found an increased risk of 1.2,<sup>6</sup> while the relative risk of ischaemic heart disease among smokers with non-smokers is 2.5 for men and 2.9 for women.<sup>8</sup> Examining transitions between cigarette smoking and SLT use over time, and the stability of those transitions, are important to inform harm reduction efforts and understand the likelihood of complete switching and dual use among current cigarette smokers.

## METHODS

### Sample

This paper describes patterns of dual use and complete switching among adult current cigarette smokers using data from the Population Assessment of Tobacco and Health (PATH) Study Wave 3 (2015–2016), Wave 4 (2016–2018) and Wave 5 (2018–2019). The PATH Study is an ongoing, nationally representative longitudinal cohort study of tobacco use and health among adults and youth  $\geq 12$  years old in the US. Details on survey interview procedures, questionnaires, sampling, weighting and information on accessing the data are available online (<https://doi.org/10.3886/Series606>). Adults at Wave 3, including youth at Wave 2 who aged into the adult sample at Wave 3, were included in the analysis.

## MEASURES

Participants were classified as current cigarette smokers if they reported smoking cigarettes every day or on some days. Participants were classified as current SLT users if they reported using any SLT product (loose and pouched snus, moist snuff, dip, spit or chewing tobacco) every day or on some days. For this analysis, all SLT products, including snus, were combined.

Exclusive cigarette smokers were defined as current smokers who did not report current use of SLT. Dual users reported current use of both combustible cigarettes and SLT. Tobacco use categories were determined independent of other tobacco

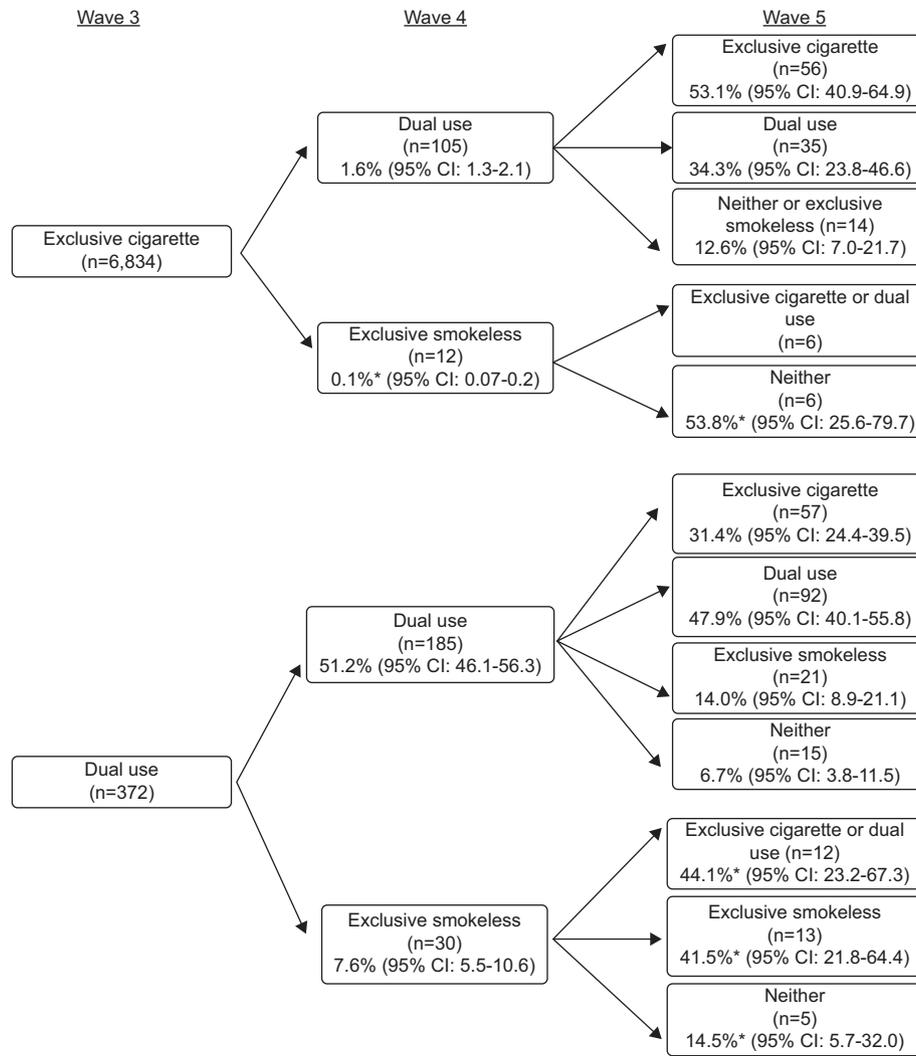
## INTRODUCTION

While cigarette smoking prevalence has declined in the USA, smokeless tobacco (SLT) use, including chewing tobacco, snuff, dip, spit and snus, has remained constant or increased slightly since the early 2000s.<sup>1</sup> In 2019, 4.3% of US adults aged 18 years and older had used SLT in the last year.<sup>2</sup> Among cigarette smokers, 3.5% of adults were current SLT users in 2017.<sup>3</sup> Complete switching to SLT use may represent a harm reduction alternative to cigarette smoking. Differences in health risks between SLT use and smoking have been observed in epidemiological studies. In particular, the relative risks of lung cancer, chronic obstructive



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**Figure 1** Transition to smokeless tobacco use among adult cigarette smokers, Population Assessment for Tobacco and Health, Wave 3 (2015–2016), Wave 4 (2016–2018) and Wave 5 (2018–2019). There was 1 year between data collection for Wave 3 and Wave 4, and 2 years between data collection Wave 4 and Wave 5. Wave 4 data collection began 1 December 2016 and ended 3 January 2018.

\*Estimate should be interpreted with caution because it has low statistical precision. It is based on a denominator sample size of less than 50, or the coefficient of variation of the estimate or its complement is larger than 30%.

product use (eg, hookah, e-cigarettes, traditional cigar, filtered cigar and cigarillos). The four tobacco use states (exclusive cigarette use, exclusive SLT use, dual use, and use of neither product) were coded as mutually exclusive categories. Participants with missing information on either cigarette or SLT use in Waves 3–5 or missing wave 5 all-wave weights for the Wave 1 cohort (n=233) were excluded from the analysis.

**ANALYSIS**

We analysed SLT use patterns among 6834 exclusive cigarette smokers and 372 dual users at Wave 3 with two waves of follow-up data. Logit-based transformation CIs were calculated. All analyses used Wave 5 all-wave weights for the Wave 1 cohort and were conducted in SAS-callable SUDAAN (V.11.0.3).

**RESULTS**

Among 6834 exclusive cigarette smokers at Wave 3, 87.0% (95% CI: 85.8% to 88.1%) maintained exclusive cigarette use at Wave 4, and 11.2% (95% CI: 10.2% to 12.3%) were no longer smoking cigarettes at Wave 4. By Wave 4, only 1.6% (95% CI:

1.3% to 2.1%) transitioned to dual use, and 0.1% (95% CI: 0.07% to 0.2%) (Estimate should be interpreted with caution because it has low statistical precision. It is based on a denominator sample size of less than 50, or the coefficient of variation of the estimate or its complement is larger than 30%.) switched to exclusive SLT use (figure 1). The majority (53.1%, 95% CI: 40.9% to 64.9%) of the 105 exclusive cigarette smokers at Wave 3, who were dual users at Wave 4, returned to exclusive cigarette use at Wave 5; an additional 34.3% (95% CI: 23.8% to 46.6%) maintained their dual use, and 12.6% (95% CI: 7.0% to 21.7%) were using exclusive SLT or neither.

Among 372 dual users at Wave 3, 51.2% (95% CI: 46.1% to 56.3%) remained dual users at Wave 4. A further 32.8% (95% CI: 28.1% to 37.9%) transitioned to exclusive cigarette smoking at Wave 4, 8.3% (95% CI: 5.9% to 11.5%) were using neither product and 7.6% (95% CI: 5.5% to 10.6%) switched to exclusive SLT use. Respondents who maintained dual use from Wave 3 to Wave 4 predominately continued to smoke cigarettes at Wave 5; 47.9% (95% CI: 40.1% to 55.8%) continued dual use and 31.4% (95% CI: 24.4% to 39.5%) were exclusive cigarette

smokers. A small percentage of respondents who maintained dual use at Wave 3 and Wave 4 were exclusive SLT users (14.0%, 95% CI: 8.9% to 21.1%) at Wave 5.

Baseline use of other tobacco products (cigars (traditional cigars, filtered cigars and cigarillos), hookahs, pipes) was more common among dual users (n=158, 37.6% (95% CI: 32.3% to 43.2%)) than exclusive smokers (n=1227, 16.0% (95% CI: 15.2% to 17.0%)). Among Wave 5 exclusive SLT users who were either dual users or exclusive cigarette smokers at Wave 3, 11.7% (95% CI: 5.5% to 23.4%) used other combusted tobacco products (Estimate should be interpreted with caution because it has low statistical precision. It is based on a denominator sample size of less than 50, or the coefficient of variation of the estimate or its complement is larger than 30%).

## DISCUSSION

This paper examined changes in cigarette and SLT use over a 4-year period using a nationally representative sample of US adults. We found that among exclusive cigarette smokers, a low percentage (0.1%) exclusively used SLT after one wave of follow-up, and a slightly higher percentage (1.6%) adopted dual SLT use. However, these transitions were much less common than continuing smoking or quitting cigarettes entirely. Further, very few exclusive cigarette smokers who transitioned to SLT remained SLT users; the majority returned to exclusive cigarette use after two waves of follow-up.

Similar to previous research, we found that transitioning from cigarette smoking to SLT use was uncommon. A systematic review reported low proportions of users switching from exclusive combustible cigarette smoking to exclusive SLT use (0%–1.4%) and from exclusive cigarette smoking to dual use (0.1%–3.2%).<sup>9</sup> Analysis of the follow-up matched samples of the Tobacco Use Supplement to the Current Population Survey (TUS-CPS) data from 2010 to 2011 found that most current, exclusive, male users of either SLT or cigarettes remained exclusive single product users during follow-up (58.7%–74.9%) and 31.6% remained dual users.<sup>1</sup> Further analysis of TUS-CPS data showed that the proportion who transitioned from cigarette smoking to SLT use was very low (0.5%, 95% CI: 0.0% to 1.0%).<sup>10</sup> Findings from the National Adult Tobacco Survey found that the proportion of recent quitters who reported completely switching from cigarettes to SLT in the past year was 4.6% in 2012–2013 and 4.5% in 2013–2014. Among all past-year smokers, the proportion who switched from cigarettes to SLT and currently did not smoke cigarettes was 0.5% (95% CI: 0.4% to 0.7%).<sup>11</sup> The present analysis provides recent data on the stability of transitions to SLT, which will continue to be important for public health efforts in the future.

Dual users at Wave 3 were likely to maintain their dual use status at Wave 4 and Wave 5, and more dual users transitioned to exclusive cigarette smoking than to exclusive SLT use. However, exclusive SLT use at Wave 4 was more common among dual users at Wave 3 (7.6%) than among exclusive smokers at Wave 3 (0.1%), suggesting that for some people dual use might lead to potentially less harmful tobacco products or to cigarette cessation, whereas for others it might be a prolonged state. Previous research found that dual users are more likely to endorse certain cessation-related attitudes and behaviours,<sup>12</sup> which may explain why more dual users discontinued cigarette smoking after one wave of follow-up. An earlier PATH Study analysis also found that among SLT users who smoked cigarettes, a small minority switch to exclusive SLT use after one wave of follow-up.<sup>11</sup> Continuous dual use may have a public health benefit if it results

## What this paper adds

Previous research found that very few cigarette smokers transition to exclusive smokeless use, and dual use is more common than switching. However, the tobacco marketplace is frequently changing, and updated data on this topic are missing. Likewise, previous research has not examined smokeless use patterns over several years. In a nationally representative longitudinal study, 0.1% of exclusive cigarette smokers and 7.6% of dual users of cigarette and smokeless tobacco switched to exclusive smokeless use after 1 year of follow-up, while many more became or remained dual users (1.6% and 51.2%, respectively). Among exclusive smokers who switched to dual use, 53.1% returned to exclusive cigarette smoking, 34.3% maintained dual use and 12.6% did not smoke cigarettes after an additional wave of follow-up.

in less consumption of combusted products, but this study did not measure whether dual users reduced their cigarette consumption over time.<sup>12 13</sup>

As a large-scale longitudinal study, the PATH Study contains detailed information about tobacco use patterns over time for a variety of tobacco products. This analysis used two waves of follow-up, allowing for the examination of tobacco use patterns over 4 years. However, the analysis had some limitations. Use of tobacco products was self-reported and subject to recall bias. There is a possibility that the effects of participating in previous rounds of survey collection may have conditioned responses; however, the effect of this is likely minimal and outweighed by the benefits of the longitudinal data. There was a small available sample size of exclusive SLT users at Wave 4, which limited our ability to describe transitions and draw conclusions for subsequent waves. Some observations were excluded due to missing data (n=233), but there is no evidence of differential misclassification due to exclusion of missing observations. We did not examine whether individuals switching to SLT intended to quit smoking, and measured current cigarette and SLT use rather than established use. Using established cigarette smoking, which commonly has a threshold of 100 lifetime cigarettes, results in a smaller sample size, but does not meaningfully or statistically change the results. There was 1 year of follow-up between Wave 3 and Wave 4, and 2 years of follow-up between Wave 4 and Wave 5, which may limit our ability to identify some transitions.

Despite these limitations, this analysis demonstrates that few cigarette smokers are transitioning to SLT, and among those that do, dual use is more common than exclusive SLT use. Further, the majority of exclusive cigarette smokers who transitioned to dual use at Wave 4 continued smoking cigarettes at Wave 5, either as dual users or as exclusive smokers. Future research could help better understand why some dual users discontinue cigarette smoking while others do not. Research that examines tobacco use patterns among dual users could help inform whether there is a benefit from prolonged dual use.

**Contributors** RAJ and HRD led the conceptual design. RAJ drafted the initial manuscript and all authors critically revised it. CR and DR conducted the statistical analysis and all authors contributed to interpretation of results. All authors approved the work for journal publication and agree to be accountable for all aspects of the work.

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**Competing interests** None declared.

**Patient consent for publication** Not required.

**Ethics approval** This study involves human participants. The PATH Study was conducted by Westat and approved by the Westat Institutional Review Board. Participants gave informed consent to participate in the study before taking part.

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