



Dual and polytobacco use disparities at the intersection of age, sex, race and ethnicity, and income among US adults. Results from the 2018–2019 TUS-CPS

Luis Zavala-Arciniega^{a,*}, Jana L. Hirschtick^a, Rafael Meza^{a,b}, Nancy L. Fleischer^a

^a Department of Epidemiology, University of Michigan School of Public Health, 1415 Washington Heights, Ann Arbor, MI, USA

^b Department of Integrative Oncology, BC Cancer Research Institute, Vancouver, British Columbia, Canada

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ABSTRACT

Aim: We aim to describe disparities in dual and polytobacco use at the intersection of age, sex, race and ethnicity, and income.

Methods: We used the 2018–2019 Tobacco Use Supplement to the Current Population Survey to estimate the prevalence of combinations of dual (two products) and polytobacco (three or more products) use for cigarettes, e-cigarettes, cigars, and smokeless tobacco (n = 135,268). We created five mutually exclusive categories: 1) cigarettes and e-cigarettes, 2) cigarettes and cigars, 3) cigarettes and smokeless tobacco, 4) dual/polyuse without cigarettes, and 5) polyuse with cigarettes. We estimated the dual/polyuse prevalence at the intersection of age (18–34, 35–54, 55+ years), sex (male, female), race and ethnicity (Non-Hispanic White, Non-Hispanic Black, Hispanic, and Non-Hispanic Other), and annual household income (<\$50,000, \$50,000–\$99,999, ≥\$100,000), resulting in 72 sociodemographic categories. We used a visualization tool that allowed for detailed characterization and identification of dual and polytobacco use disparities.

Results: Females were in three of the top four groups with the highest cigarette and e-cigarette dual use. Cigarette and cigar dual use was disproportionately high among low-income Non-Hispanic Black male adults aged 35–54 and 18–34. The highest prevalence of both polyuse with cigarettes and dual/polyuse without cigarettes was among low-income, Non-Hispanic White male adults aged 18–34 years.

Conclusion: We identified the population groups disproportionately using two or more tobacco products. This information is helpful for surveillance and for the implementation of tobacco control policies aimed at decreasing disparities in tobacco use.

1. Introduction

The introduction of new tobacco products since the late 2000s has rapidly changed the tobacco market (O'Connor et al., 2022). Consequently, tobacco use patterns, particularly dual and polytobacco use (use of three or more tobacco products) patterns are evolving (Mattingly et al., 2021). In this context, tobacco use continues as the leading cause of preventable death in the U.S. (U.S. Department of Health and Human Services, 2014). There is a need to monitor dual and polytobacco use disparities to better understand the related consequences for health equity. Previous research has described trends and patterns of dual and polytobacco use by age, sex, race and ethnicity, and socioeconomic status (Mattingly et al., 2021; Hirschtick et al., 2021; Cho et al., 2021;

Sung et al., 2016; Sung et al., 2018; Stanton and Halenar, 2018). However, to our knowledge, no studies exist on disparities or patterns of polytobacco use at the intersection of multiple sociodemographic identities. Therefore, the current study aims to unmask and visualize disparities in dual and polytobacco use at the intersection of age, sex, race and ethnicity, and household income among U.S. adults.

1.1. Trends of dual and polytobacco use

A trends study analyzing two nationally representative surveys among U.S. adults found that from 2014/15 to 2018/19 dual use of cigarettes and e-cigarettes decreased (Mattingly et al., 2021). Moreover, polyuse with cigarettes (i.e., cigarettes, e-cigarettes and smokeless)

* Corresponding author.

E-mail address: lzavala@umich.edu (L. Zavala-Arciniega).

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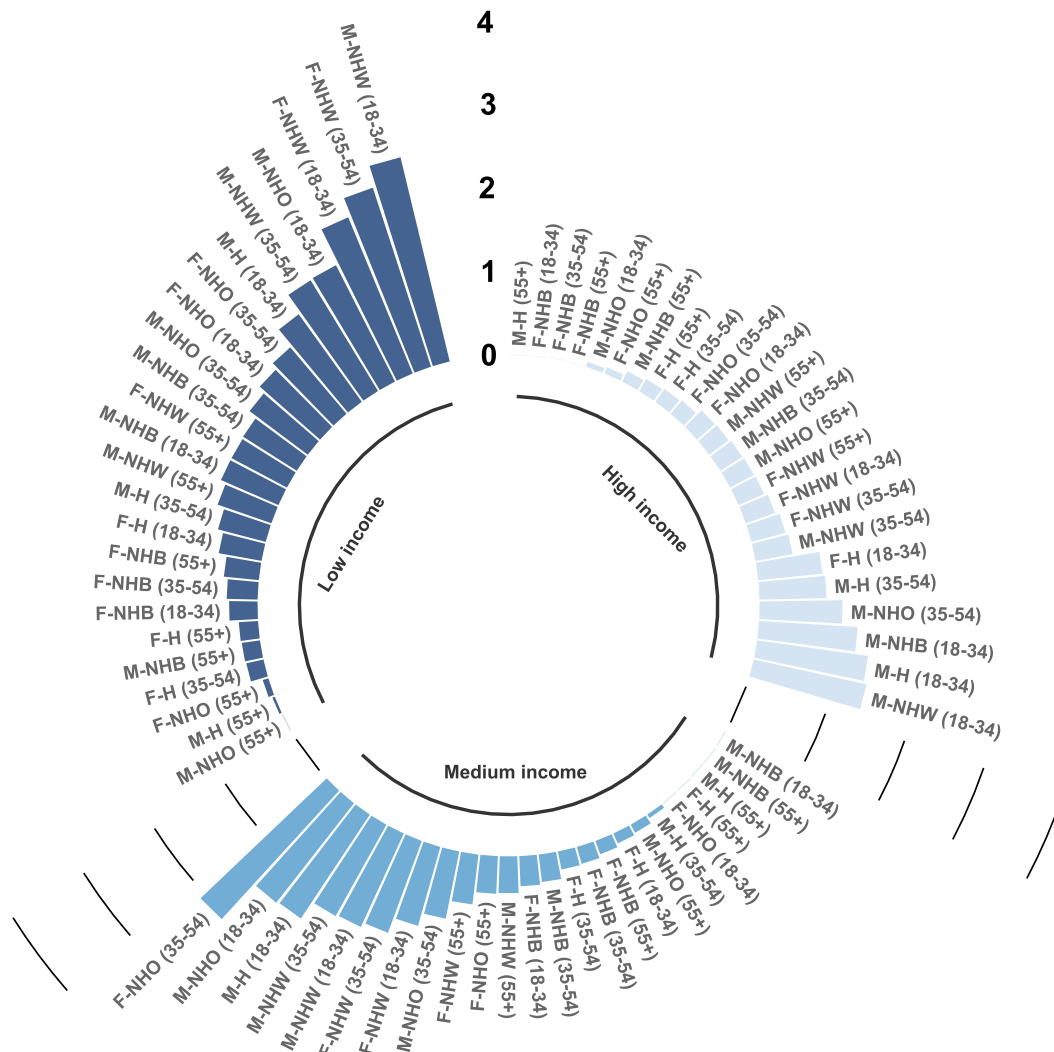


Fig. 1. Prevalence of dual use of cigarettes and e-cigarettes at the intersection of age, sex, race/ethnicity and income among U.S. adults. TUS-CPS 2018–19.

declined in the study period, whereas dual/polyuse without cigarettes (e.g., e-cigarettes, smokeless, and cigars) increased, showing that dual and polytobacco use patterns are dynamic (Mattingly et al., 2021). Another cross sectional nationally representative study of the U.S. adult population reported that current e-cigarette use did not change among people who currently smoked from 2015 to 2018, while e-cigarette use increased among individuals who formerly smoked or never smoked (Owusu et al., 2015).

1.2. Patterns of dual and polytobacco use by sociodemographic characteristics

Studies have reported consistently that dual use of cigarettes and e-cigarettes is higher among young adults compared to older adults (Mattingly et al., 2021; Hirschtick et al., 2021; Kasza et al., 2017). In addition, one study using three nationally representative surveys (2014–15) reported that dual use of cigarettes and smokeless tobacco, cigarettes and other combustibles (cigars, pipes and hookah), and polyuse with cigarettes was higher among men than women, while dual use of cigarettes and e-cigarettes was similar by sex (Hirschtick et al., 2021). This study also found that dual use of cigarettes and e-cigarettes was higher among Non-Hispanic (NH) White individuals while dual use of cigarettes and cigars was higher among NH Black individuals (Hirschtick et al., 2021).

1.3. Disparities in tobacco use from an intersectional perspective

Although few empirical studies examine tobacco use at the intersection of multiple identities, the tobacco research community has identified a need to characterize disparities in tobacco use more comprehensively (Sheffer et al., 2022; Tan et al., 2022). One study, led by our research team, evaluated disparities in cigarette, e-cigarette, cigar, and smokeless tobacco use, separately, at the intersection of age, sex, race and ethnicity, and income using data from the 2018–2019 Tobacco Use Supplement to the Current Population Survey (TUS-CPS) (Zavala-Arciniega et al., 2022). By using an intersectionality approach, we found that the prevalence of tobacco use for each product was at least two times higher among the most affected intersectional subgroup than among groups defined by single social identity, thereby unmasking segments of the population most at risk for tobacco-related health disparities. Another study that used data from Wave 2 of the Population Assessment of Tobacco and Health (PATH) study found that heterosexual adults with low educational attainment had a higher prevalence of smoking than adults who identified as a lesbian, gay, or bisexual and had low educational attainment (Amroussia et al., 2020), highlighting that intersectional analyses do not always reveal use differences that are worse for subgroups of the population that are most marginalized in society. Another study examining cigarette smoking behaviors at the intersection of race and ethnicity and sexual orientation identity using data from the Youth Risk Behavior Survey found that non-Hispanic

Table 1
Analytic sample characteristics for the Tobacco Use Supplement to the Current Population Assessment of Tobacco and Health (2018–19).

| | TUC-CPS (n = 135,268) | | | |
|--|-----------------------|------|-------|------|
| | n | % | 95 CI | |
| | | | LB | UB |
| Age group | | | | |
| 18–34 | 28,906 | 29.8 | 29.8 | 29.9 |
| 35–54 | 42,745 | 32.6 | 32.6 | 32.7 |
| 55+ | 63,617 | 37.5 | 37.5 | 37.6 |
| Sex | | | | |
| Female | 73,898 | 51.9 | 51.8 | 52.0 |
| Male | 61,370 | 48.1 | 48.0 | 48.2 |
| Race/ethnicity | | | | |
| Non-Hispanic White | 98,708 | 63.1 | 63.0 | 63.2 |
| Non-Hispanic Black | 12,809 | 11.8 | 11.7 | 11.9 |
| Hispanic | 14,684 | 16.5 | 16.5 | 16.6 |
| Non-Hispanic Other | 9,067 | 8.5 | 8.5 | 8.6 |
| Household income level | | | | |
| <\$50,000 | 58,548 | 41.6 | 41.3 | 42.0 |
| \$50,000–\$99,000 | 42,482 | 31.3 | 31.0 | 31.5 |
| \$100,000+ | 34,238 | 27.1 | 26.8 | 27.4 |
| Dual use of cigarettes and e-cigarettes | 135,268 | 0.77 | 0.72 | 0.83 |
| Dual use of cigarettes and cigars | 135,268 | 0.49 | 0.45 | 0.53 |
| Dual use of cigarettes and smokeless | 135,268 | 0.18 | 0.16 | 0.21 |
| Polyuse with cigarettes | 135,268 | 0.17 | 0.14 | 0.20 |
| Dual/polyuse without cigarettes | 135,268 | 0.21 | 0.19 | 0.24 |

n = unweighted sample size, % weighted percentage.

LB = Lower Bound; UB = Upper Bound.

Black and Asian/Pacific Islander adolescents who identified as lesbian, gay, or bisexual had a higher prevalence of smoking behaviors (age of initiation, ever and current smoking) compared to non-Hispanic White heterosexual adolescents (Corliss et al., 2014). Most intersectional studies have looked at sexual orientation identity and race and ethnicity or by socioeconomic status, but few look have looked at the intersection of race and ethnicity, socioeconomic status, sex and age. Focus on these social identities is relevant, given that there have been described disparities in tobacco use by sex, age, race and ethnicity and socioeconomic status (SES) when they are examined separately. We believe that patterns of tobacco use should be evaluated using a holistic approach that analyze these four social identities jointly, which will help in understanding tobacco disparities and consequently implementing effective tobacco control policies. Most empirical evidence examines dual and polytobacco use patterns for single social identities, or the intersection of social identities and single product use. We aim to fill this gap by estimating the prevalence of dual and polytobacco use at the intersection of age, sex, race and ethnicity, and income using data from the 2018–2019 Tobacco Use Supplement to the Current Population Survey (TUS-CPS). We also present results using an intersectionality visualization tool.

2. Methods

We used data from the 2018–2019 TUS-CPS, a nationally representative survey of the U.S. adult civilian, non-institutionalized population (US Department of Commerce. Census Bureau, 2020; Bureau, 2019). TUS-CPS is administered by the U.S. Census Bureau and funded by the National Cancer Institute and aims to monitor tobacco use prevalence and evaluate tobacco control policies (US Department of Commerce. Census Bureau, 2020; Bureau, 2019). We used information from July 2018, January 2019, and May 2019 (National Cancer Institute, 2020). Each wave provides representative data for the U.S. population, and the three waves provide state-level representative data (Bureau, 2019). The overall response rate of TUS-CPS 2018–19 was 57.6 % (Mayer et al., 2020). More than 60 % of the TUS-CPS participants responded to questions using Computer Assisted Telephone Interviewing and one-

third by Computer Assisted Personal Interviewing. The TUS-CPS study design included specific questions to generate prevalence estimates for cigarettes, e-cigarettes, cigars, and smokeless tobacco (Bureau, 2019). The sample size of the TUS-CPS 2018–19 was 137,471 observations. After excluding participants with missing information on tobacco use and sociodemographic variables (n = 2,203, 1.6 % of the sample), our analytic sample consisted of 135,268 observations; more details of the TUS-CPS have been published elsewhere (US Department of Commerce. Census Bureau, 2020; Bureau, 2019; National Cancer Institute, 2020). Our study was exempt from the Institutional Review Board review because it was a secondary analysis of de-identified, publicly available data.

2.1. Measures of tobacco use for each product

We classified tobacco product use into four groups based on previous tobacco and TUS-CPS studies (Hirschtick et al., 2021; Chang et al., 2015): cigarettes, e-cigarettes, cigars (regular cigars, cigarillos, and little filtered cigars), and smokeless (dissolvable tobacco, snuff, dip, spit, and chew tobacco). Following standard practice in the U.S., current cigarette use was defined as smoking cigarettes every day or some days among people who had smoked more than 100 cigarettes in their lifetime. For e-cigarettes, cigars, and smokeless tobacco, current use was defined as use every day or some days, but without an established use criterion. We kept cigars as a distinct category, rather than combining with other combustibles like hookah and pipes, because of the higher prevalence of cigar use and established relationship with poor health outcomes (Teutsch et al., 2022; Judkins, 1990). Finally, we derived the smokeless variable by combining questions on dissolvable tobacco and smokeless tobacco like snuff, dip, spit, and chew tobacco. Then, we defined the dual and polytobacco use groups as follows: (1) cigarettes and e-cigarettes, (2) cigarettes and cigars, (3) cigarettes and smokeless, (4) polyuse with cigarettes (i.e., cigarettes plus two or three other products), and (5) dual/polyuse without cigarettes (i.e., two or three products not including cigarettes). We selected these tobacco product combinations to estimate the prevalence of dual/polyuse with cigarettes, the most commonly-used tobacco product among adults, as well as dual/polyuse without cigarettes.

2.2. Intersectionality measure

We used an intersectionality definition that considers four socio-demographic variables: age (18–34, 35–54, 55+ years); sex (male (M), female (F)); race and ethnicity (NH White (NHW), NH Black (NHB), Hispanic (H), NH Other (NHO)); and annual household income (<\$50,000 (low income), \$50,000–\$99,999 (medium income), >=\$100,000 (high income)) to generate a variable of 72 (3 × 2 × 4 × 3) categories (Chang et al., 2015). The average number of adult participants in each category was 1,879, with a range of 141 observations for high-income male NH Black adults aged 18–34 years to 14,253 observations for low-income NH White female adults aged 55 years and over. We selected age cut points based on previous studies to exemplify stages in people's lives critical to tobacco use. For instance, adults aged 18–34 are at an initial phase of tobacco use and are more likely to try new products, like e-cigarettes. Also, previous studies have found that youth and young adults are the subgroup with the highest prevalence of dual use of cigarettes and e-cigarettes (Mattingly et al., 2021). Middle-aged male adults (35–54 years) historically had the highest dual use of cigarettes and cigars (Mattingly et al., 2021), making this age group important as a stand-alone category. Lastly, dual and polytobacco use is lower in general among adults over 55 years old. We selected income cut points based on previous TUS-CPS and tobacco use studies (Mattingly et al., 2021).

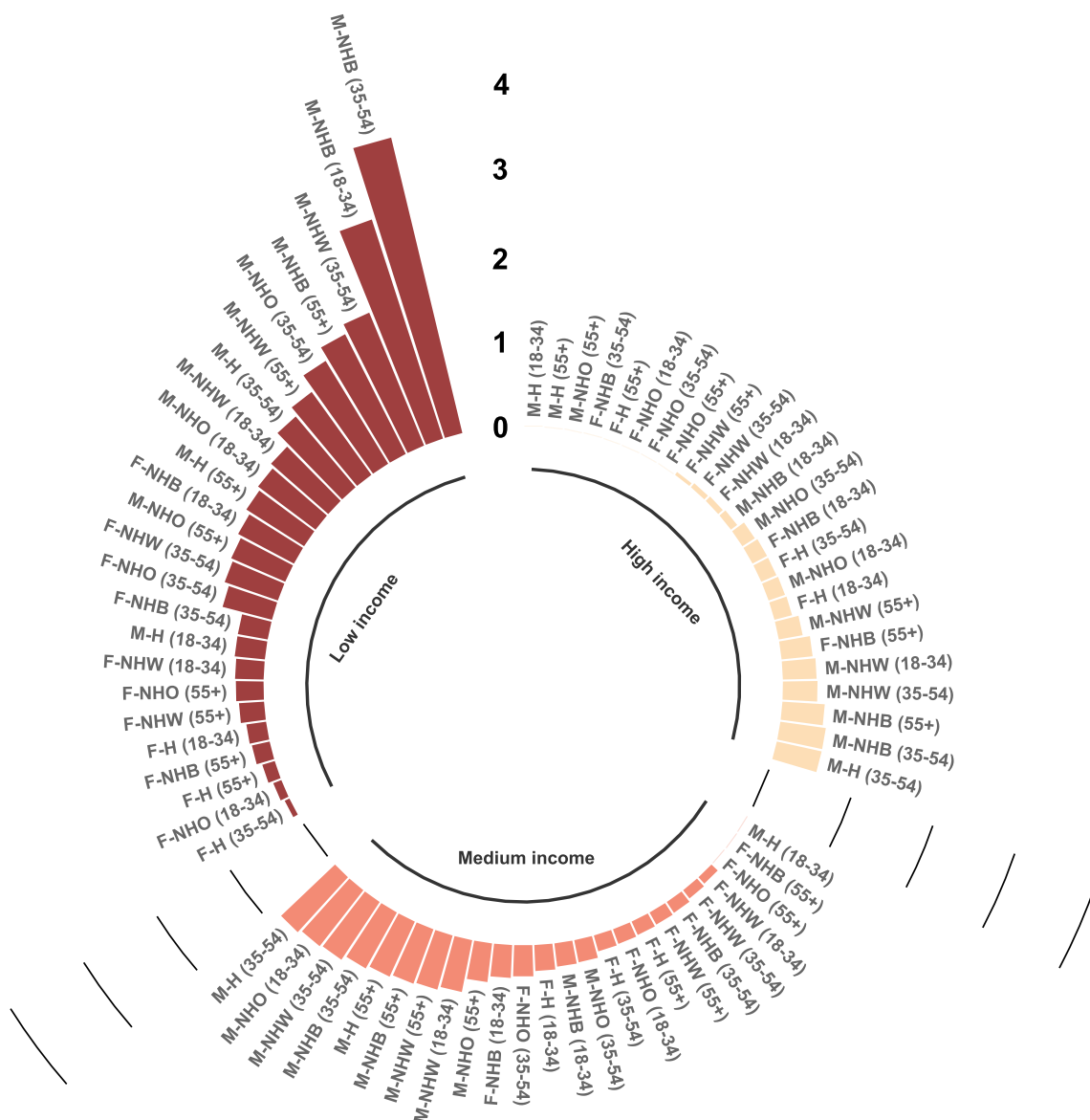


Fig. 2. Prevalence of dual use of cigarettes and cigars at the intersection of age, sex, race/ethnicity and income among U.S. adults. TUS-CPS 2018–19.

2.3. Analysis

After adjusting for the sample design using Balanced Repeated Replication with replicate weights with Fay adjustment at 0.4 (Holford et al., 2016), we estimated dual and polyuse prevalence and 95 % confidence intervals for each of the 72 social intersection categories. We used the intersectionality visualization tool that we previously published to create these figures (Zavala-Arciniega et al., 2022). We used R version 3.6.3 software and the “ggplot2” library. We present the four dual/polyuse intersectionality figures using income as the central organizing social identity in the main figures, and provide a supplementary HTML file that allows readers to explore how the polytobacco intersectionality findings change when presented by age, sex, or race and ethnicity as the main social identity.

3. Results

About half of the population in our sample were female adults (51.9 %), and one third of the sample were Non-Hispanic NH Black (12 %), Hispanic (17 %), and NH Other (9 %). Dual use and polyuse prevalence was lower than 1 % for each combination: dual use of cigarettes + e-

cigarettes (0.77 %), dual use of cigarettes + cigars (0.49 %), dual use of cigarettes + smokeless (0.18 %), polyuse with cigarettes (0.17 %), and dual/polyuse without cigarettes (0.21 %). We performed sensitivity analyses to estimate dual and polytobacco use prevalence by every social identity individually to compare to the dual/polyuse intersectionality results with the conventional approach of examining dual/polytobacco disparities using a single social identity at a time (Supplementary Table 1).

3.1. Dual use of cigarettes and e-cigarettes by age, sex, race and ethnicity, and income, separately and using an intersectional approach

When looking at identities separately, dual use of cigarettes and e-cigarettes was higher among adults aged 18–34 years (1.13 %), than among adults aged 35–54 (0.81 %) and 55 + years (0.45 %), among male (0.85 %) than female adults (0.71 %), and among NH White adults (0.94 %) compared to all other racial and ethnic groups (NH Black = 0.36 %, Hispanic = 0.51 %, and NH Other = 0.66 %) (Supplementary Table 1). When taking an intersectional lens, we found that three of the five categories with the highest dual use of cigarettes and e-cigarettes included NH White low-income adults (Fig. 1 and Supplementary

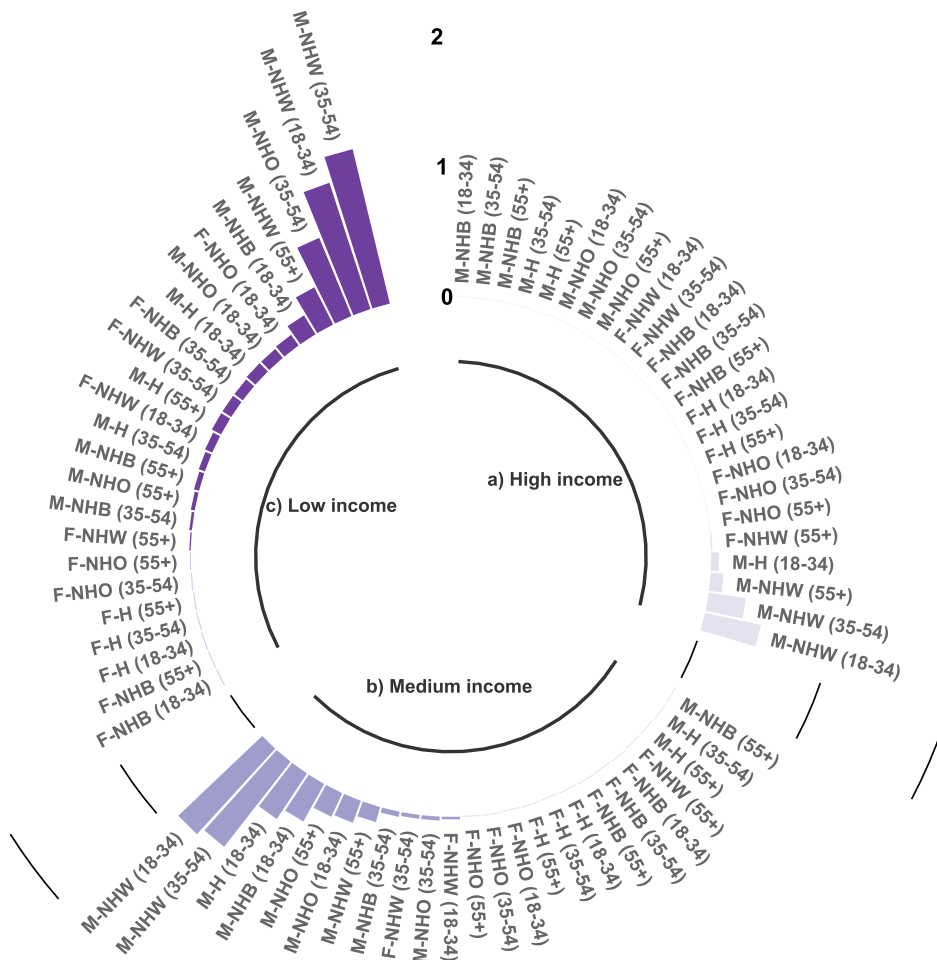


Fig. 3. Prevalence of dual use of cigarettes and smokeless at the intersection of age, sex, race/ethnicity and income among U.S adults. TUS-CPS 2018–19.

Table 2). Dual use of cigarettes and e-cigarettes was also particularly high for three female groups: low-income NH White female adults aged 35–54 years (2.3 %), medium-income NH Other female adults aged 35–54 years (2.1 %), and low-income NH White female adults aged 18–34 years (2.0 %) (Table 1).

3.2. Dual use of cigarettes and cigars stratified by age, sex, race/ethnicity, and income, separately and using an intersectional approach

Dual use of cigarettes and cigars was higher among male adults (0.79 %) than female adults (0.21 %), among NH Black (0.91 %) adults compared to adults from other racial and ethnic backgrounds (NH White = 0.46 %, Hispanic = 0.36 %, and NH Other = 0.34 %), and among low-income (0.75 %) adults than medium-income (0.39 %) and high-income adults (0.20 %) (Supplementary Table 1). When examining dual use of cigarettes and cigars at the intersection of the four identities, we found that low-income NH Black male adults aged 35–54 years (3.6 %) and low-income male adults aged 18–34 years (2.7 %) had the highest prevalence of use (Fig. 2 and Supplementary Table 3).

3.3. Dual use of cigarettes and smokeless stratified by age, sex, race/ethnicity, and income, separately and using an intersectional approach

Dual use of cigarettes and smokeless was higher among male adults (0.35 %) compared to female adults (0.02 %) and NH White (0.25 %) adults compared to all other racial and ethnic groups (NH Black = 0.05 %, Hispanic = 0.05 %, and NH Other = 0.06 %) (Supplementary Table 1). Dual use of cigarettes and smokeless tobacco was higher

among adults aged 18–34 years and 35–54 years compared to adults 55 +. When taking an intersectional perspective, dual use of cigarettes and smokeless was particularly high for low-income NH White male young and middle-aged adults. For example, low-income NH White male adults aged 35–54 (1.2 %) and low-income NH White male adults aged 18–34 years (1.0 %) were the only groups of the population in which the prevalence of dual use of cigarettes and smokeless was equal to or higher than 1 % (Fig. 3 and Supplementary Table 4).

3.4. Polyuse with cigarettes stratified by age, sex, race/ethnicity and income separately and using an intersectionality approach

Polyuse with cigarettes was higher among adults aged 18 to 34 years (0.32 %) compared to adults aged 35–54 (0.17 %) and 55 + years (0.05 %) (Supplementary Table 1). Polyuse with cigarettes was higher among male (0.31 %) compared to female (0.03 %) and low-income (0.22 %) adults compared to high-income (0.08 %) adults. When examining polyuse with cigarettes at the intersection of the four identities, we found the most defining characteristics were sex and age, with male young adults having the highest polyuse with cigarette prevalence (Fig. 4 and Supplementary Table 5). In particular, polyuse with cigarettes was disproportionately high among low-income NH White male adults (1.4 %), low-income NH Other male adults (1.0 %), and high-income Hispanic male adults (1.0 %), all aged 18–34 years.

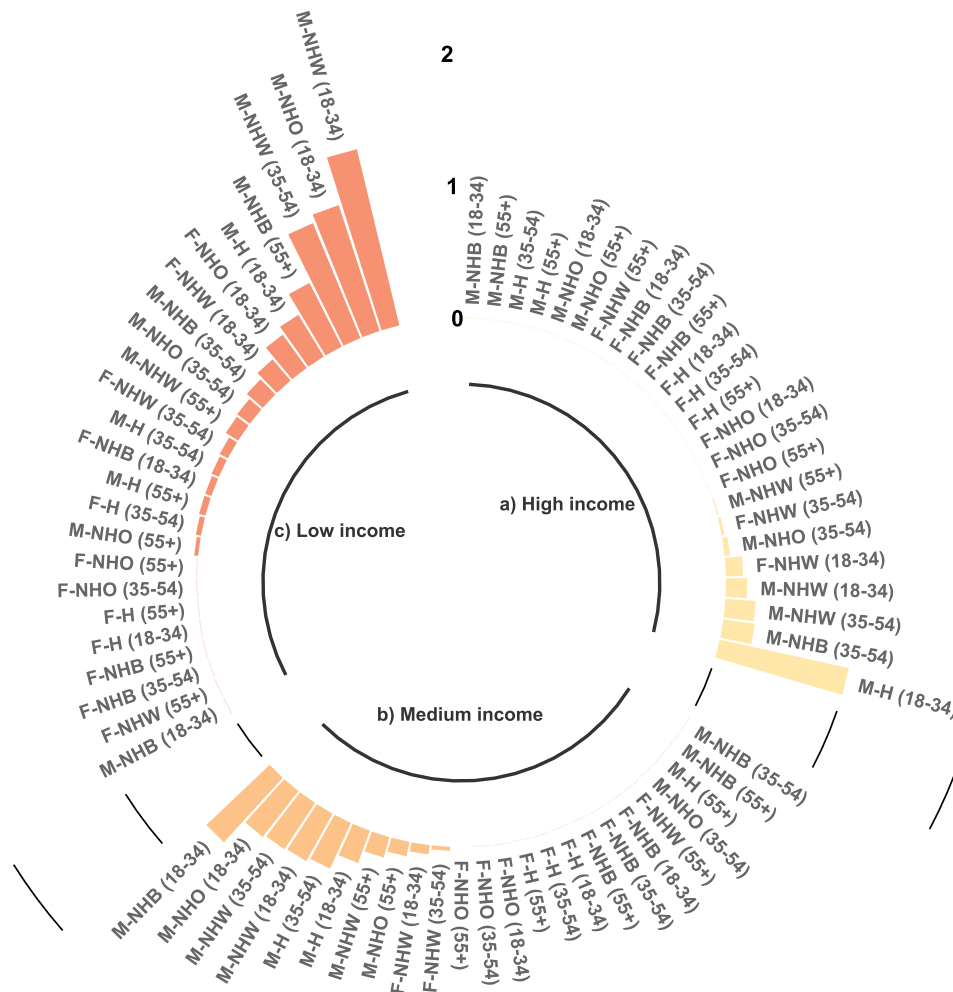


Fig. 4. Prevalence of polyuse with cigarettes at the intersection of age, sex, race/ethnicity and income among U.S. adults. TUS-CPS 2018–19.

3.5. Dual/polyuse without cigarettes stratified by age, sex, race/ethnicity and income separately and using an intersectionality approach

Dual/polyuse without cigarettes was higher among adults aged 18–34 years compared to adults aged 35–54 and 55+ years. In addition, dual/polyuse without cigarettes was higher among males compared to females and NH White adults compared to all other racial and ethnic groups (Supplementary Table 1). When taking an intersectionality lens, the highest prevalence of dual/polyuse without cigarettes was among low-income NH White male adults aged 18–34 (1.2 %), medium-income NH White male adults aged 18–34 (1.1 %), and high-income NH White male adults aged 18–34 years (0.9 %) (Fig. 5 and Supplementary Table 6).

4. Discussion

The main contribution of our study is that it allows identifying and visualizing dual/polyuse high-risk population groups through the intersectionality lens that otherwise would be hidden when examining social identities in isolation. Particularly, we found that dual/polyuse was disproportionately high among some population subgroups. Importantly, we found that dual/poly use was at least two times higher among some intersectional subgroups compared to when we examined one sociodemographic variable at a time. For instance, the prevalence of dual use of cigarettes and cigars was 0.91 % among NH Black adults, but was four times higher among low-income NH Black male adults aged 35–54 (3.6 %). Similarly, the highest prevalence of dual use of cigarettes

and e-cigarettes examining one sociodemographic variable at a time was among adults aged 18–34 years (1.1 %), but use was two times higher among some intersectional groups (low-income NH White male adults aged 18–34 years (2.5 %), and low-income NH White female adults aged 35–54 years (2.3 %)). It is important to highlight that the highest prevalence of polyuse with cigarettes (1.4 %) and dual/polyuse without cigarettes (1.2 %) was among low-income NH White adults aged 18–34, and that these prevalence estimates were three times higher compared to the highest prevalence found analyzing one sociodemographic variable at a time.

One finding from our study especially relevant for health equity is that dual use of cigarettes and cigars was disproportionately high among low-income NH Black male adults aged 18–54 years. This result is somewhat consistent with a previous study that estimated dual/polyuse patterns using one sociodemographic variable, which showed that dual use of cigarettes and other combustibles (cigars, pipes and hookah) was higher among NH Black adults than all other race and ethnicity groups (Hirschtick et al., 2021). Our finding highlights the need to target policies to reduce tobacco use in low-income NH Black communities. Moreover, this finding is relevant in the context that some tobacco-related health disparities are not well understood. For example, NH Black adults have higher cancer incidence and mortality rates compared to NH White adults despite the fact that the prevalence and intensity of cigarette smoking is lower among NH Black adults (Haiman et al., 2006; Froelich, 2020). Future studies using the intersectionality approach should evaluate the link between dual use of cigarettes and cigars and cancer outcomes.

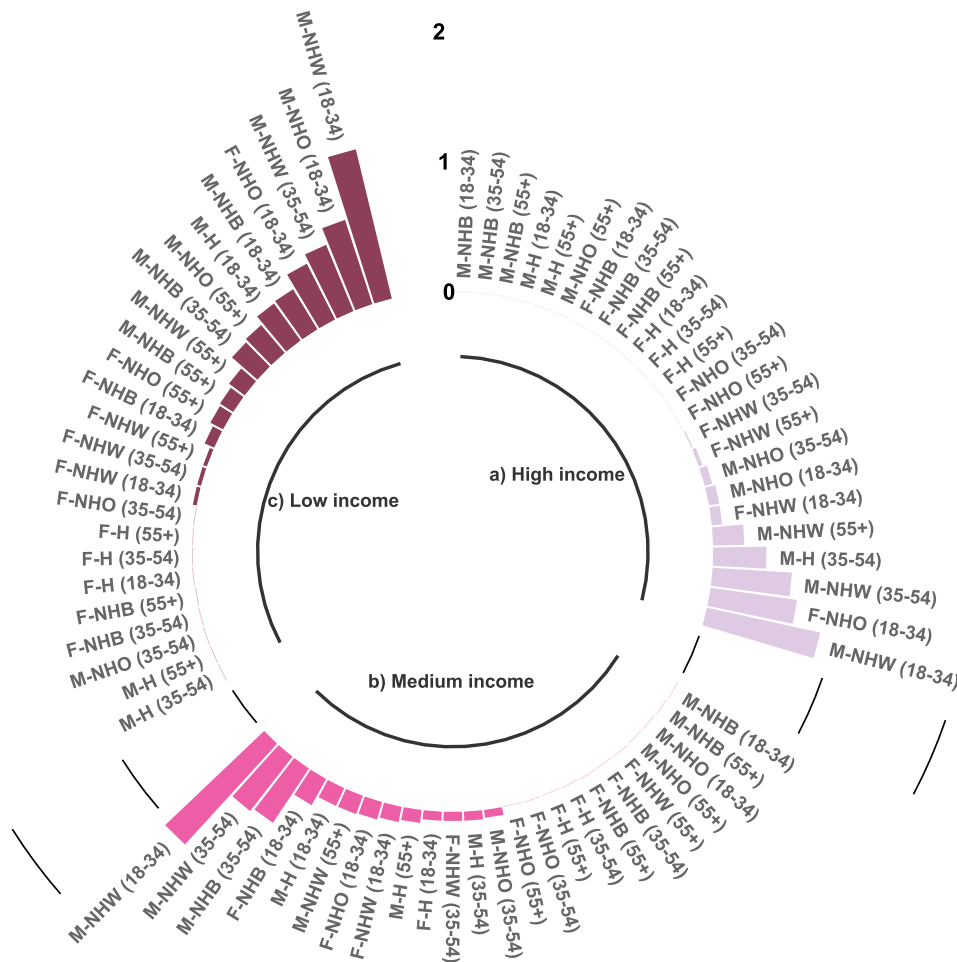


Fig. 5. Prevalence of dual/polyuse without cigarettes at the intersection of age, sex, race/ethnicity and income among U.S. adults. TUS-CPS 2018–19.

Regarding dual use of cigarettes and e-cigarettes, we found that the intersection of age and income were particularly important. For example, dual use of cigarettes and e-cigarettes was higher in low-income groups aged 18–34 years compared to high-income groups aged 35–54 and 55 years and over. Our finding that low-income young adults have the highest prevalence of dual use of cigarettes and e-cigarettes suggest that there is a need to reduce cigarette and e-cigarette advertising and availability in low-income communities. Our result is line with one study that found that tobacco and vape shops are more common in low-income communities compared to high-income communities (Froelich, 2020; Lee et al., 2015). Additionally, three of the top four groups with the highest prevalence of dual use of cigarettes and e-cigarettes included female adults (low-income NH White female adults aged 35–54 years, low-income NH White female adults aged 18–34 years, and medium-income NH Other female adults aged 35–54 years). In contrast a dual/polyuse study reported no differences in the prevalence of dual use of cigarette and e-cigarettes by sex in three nationally representative surveys in the U.S. (Hirschtick et al., 2021).

Low-income NH White male adults aged 18–34 years had the highest prevalence for multiple use patterns: dual use of cigarettes and smokeless tobacco, dual/polyuse without cigarettes, and polyuse with cigarettes. One potential reason for these patterns is that low-income neighborhoods have more tobacco shops on average compared to high-income neighborhoods (Lee et al., 2015). Given that low-income NH White male adults have a high prevalence of cigarette, cigar, and smokeless use (Chang et al., 2015), it is not surprising that they also have the highest dual/polyuse prevalence with these products. Therefore, there is a need to implement tobacco control policies to reduce initiation

and increase smoking cessation in low-income communities.

In addition, the prevalence of dual and polyuse is higher among adults ages 18–34 and 35–54 years old compared to 55+ adults, which is consistent with previous studies (Mattingly et al., 2021; Hirschtick et al., 2021). Therefore, policymakers should consider implementing policies that could reduce access and exposure to tobacco products, such as increasing sale age and banning all the advertising in points of sales. Future research on polytobacco use should explore reasons why dual/polyuse prevalence is lower for people ages 55 and over, which could be related to cohort-specific tobacco use patterns, health-related cessation, or other reasons.

A strength of our research is having access to a large tobacco use dataset from a nationally representative survey, which allows a detailed characterization of dual/polyuse disparities at the intersection of four relevant sociodemographic groups. The identification of these disparities can lead to targeted tobacco control policies as well as new study hypotheses. Moreover, by adapting our visualization tool, researchers can use the available code to evaluate other substance use behavior outcomes through the lens of intersectionality. Nevertheless, our study has several limitations. First, we collapsed 18–34 years into one category to define “young adults.” A more detailed classification would divide this group further; however, doing so would result in an intersectionality variable of 96 categories, which would reduce the statistical power and increase the complexity of interpreting the findings. Second, we did not include other variables that might be relevant, such as sexual orientation identity, and mental health status because these are not available in the TUS-CPS survey. Future studies estimating dual and polyuse disparities should incorporate these variables. Moreover, given that dual and

polytobacco use health disparities are not well understood, future studies should evaluate how dual and polytobacco use at the intersection of multiple social identities affect disparities in premature mortality from cancer and other health outcomes.

5. Conclusion

By using a visualization tool, we identified dual/polytobacco use disparities at the intersection of age, sex, race and ethnicity. Dual use of cigarettes and cigars was high among low-income NH Black male adults, while dual use of cigarettes and e-cigarettes, dual use of cigarettes and smokeless, polyuse with cigarettes, and dual/polyuse with cigarettes was high among low-income NH White males. These results shows the need to implement different tobacco control policies in low-income communities to reduce tobacco use and the attributable burden of the disease.

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CRediT authorship contribution statement

Luis Zavala-Arciniega: . **Jana L. Hirschtick:** Writing – review & editing, Conceptualization. **Rafael Meza:** Writing – review & editing, Supervision, Resources. **Nancy L. Fleischer:** Writing – review & editing, Supervision, Resources, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2024.102631>.

References

- Amroussia, N., Gustafsson, P.E., Pearson, J.L., 2020. Do inequalities add up? Intersectional inequalities in smoking by sexual orientation and education among U. S. adults. *Prev. Med.* 17 (December 2019), 101032 <https://doi.org/10.1016/j.pmedr.2019.101032>.
- Bureau USC. Tobacco Use Supplement May 2019. 2019 (May).
- Chang, C.M., Corey, C.G., Rostron, B.L., Apelberg, B.J., 2015. Systematic review of cigar smoking and all cause and smoking related mortality. *BMC Public Health* 15 (1). <https://doi.org/10.1186/s12889-015-1617-5>.
- Cho, B., Hirschtick, J.L., Usidame, B., et al., 2021. Sociodemographic patterns of exclusive, dual, and polytobacco use among U.S. high school students: a comparison of three nationally representative surveys. *J. Adolesc. Health* 68 (4), 750–757. <https://doi.org/10.1016/j.jadohealth.2020.11.019>.
- Corliss, H.L., Rosario, M., Birkett, M.A., Newcomb, M.E., Buchting, F.O., 2014. Sexual orientation disparities in adolescent cigarette smoking: intersections with race / ethnicity, gender, and age. *Am. J. Public Health* 104 (6), 1137–1148. <https://doi.org/10.2105/AJPH.2013.301819>.
- Froelich, B.W., 2020. Incidence of tobacco & vaping in low- income, ethnically dense communities. *Oncology*.
- Haiman, C., Stram, D., Wilkens, L., et al., 2006. Ethnic and racial differences in the smoking-related risk of lung cancer. *N. Engl. J. Med.* 354 (4), 333–342. <https://doi.org/10.1056/NEJMoa033250>.
- Hirschtick, J.L., Mattingly, D.T., Cho, B., et al., 2021. Exclusive, dual, and polytobacco use among US adults by sociodemographic factors: results from 3 nationally representative surveys. *Am. J. Health Promotion.* 35 (3), 377–387. <https://doi.org/10.1177/0890117120964065>.
- Holford, T.R., Levy, D.T., Meza, R., 2016. Comparison of smoking history patterns among African American and white cohorts in the United States born 1890 to 1990. *Nicotine Tob. Res.* 18, S16–S29. <https://doi.org/10.1093/ntr/ntv274>.
- Judkins, D., 1990. Fay's method for variance estimation. *J. Official Statist.* 6 (3), 223–239.
- Kasza, K.A., Ambrose, B.K., Conway, K.P., et al., 2017. Tobacco-product use by adults and youths in the United States in 2013 and 2014. *N. Engl. J. Med.* 376 (4), 342–353. <https://doi.org/10.1056/nejmsa1607538>.
- Lee, J., Henriksen, L., Rose, S.W., Moreland-Rusell, S., Ribisi, K., 2015. A systematic review of neighborhood disparities in point-of-sale tobacco marketing. *Am. J. Public Health* 105 (9), 8–18. <https://doi.org/10.2105/AJPH.2015.302777>.
- Mattingly, D.T., Zavala-Arciniega, L., Hirschtick, J.L., Meza, R., Levy, D.T., Fleischer, N. L., 2021. Trends in exclusive, dual and polytobacco use among U.S. adults, 2014–2019: Results from two nationally representative surveys. *Int. J. Environ. Res. Public Health* 18(24). doi:10.3390/ijerph182413092.
- Mayer, M., Reyes-Guzman, C., Grana, R., Choi, K., Freedman, N.D., 2020. Demographic characteristics, cigarette smoking, and e-cigarette use among US adults. *JAMA Netw. Open* 3 (10), e2020694. <https://doi.org/10.1001/jamanetworkopen.2020.20694>.
- National Cancer Institute. Tobacco Use Supplement Current Population Survey (TUS-CPS) 2018-2019 Data Brief. Published online 2020:2018-2019.
- O'Connor, R., Schneller, L.M., Felicione, N.J., Talhout, R., Goniewicz, M.L., Ashley, D.L., 2022. Evolution of tobacco products: Recent history and future directions. *Tob. Control* 31 (2), 175–182. <https://doi.org/10.1136/tobaccocontrol-2021-056544>.
- Owusu, D., Huang, J., Weaver, S.R., et al., 2019. Patterns and trends of dual use of e-cigarettes and cigarettes among U.S. adults, 2015–2018. *Preventive Med. Rep.* 16 (May). doi:10.1002/doi:10.1016/j.pmedr.2019.101009.
- Sheffer, C.E., Williams, J.M., Erwin, D.O., Smith, P.H., Carl, E., Ostroff, J.S., 2022. Tobacco-related disparities viewed through the lens of intersectionality. *Nicotine Tob. Res.* 24 (2), 285–288. <https://doi.org/10.1093/ntr/ntab193>.
- Stanton, C.A., Halenar, M.J., 2018. Patterns and correlates of multiple tobacco product use in the United States. *Nicotine Tob. Res.* 20 (Lcc), S1–S4. <https://doi.org/10.1093/ntr/nty081>.
- Sung, H.Y., Wang, Y., Yao, T., Lightwood, J., Max, W., 2016. Polytobacco use of cigarettes, cigars, chewing tobacco, and snuff among US adults. *Nicotine Tob. Res.* 18 (5), 817–826. <https://doi.org/10.1093/ntr/ntv147>.
- Sung, H.Y., Wang, Y., Yao, T., Lightwood, J., Max, W., 2018. Polytobacco use and nicotine dependence symptoms among US adults, 2012–2014. *Nicotine Tob. Res.* 20, S88–S98. <https://doi.org/10.1093/ntr/nty050>.
- Tan, A.S.L., Hinds, J.T., Smith, P.H., Drph, T.A., Sheffer, C.E., Fagan, P., 2022. Incorporating intersectionality as a framework for equity- minded tobacco control research: a call for collective action toward a paradigm shift. *Nicotine Tob. Res.* (April), 1–4.
- Teutsch, S.M., Geller, A.B., Mead, A.M., et al., 2022. Premium Cigars: Patterns of Use, Marketing, and Health Effects. National Academies Press. doi:10.17226/26421.
- U.S. Department of Health and Human Services, 2014. The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General. doi:NBK179276.
- US Department of Commerce. Census Bureau, 2020) National Cancer Institute and Food and Drug Administration co-sponsored Tobacco Use Supplement to the Current Population Survey.
- Zavala-Arciniega, L., Meza, R., Hirschtick, J.L., Fleischer, N.L., 2022. Disparities in cigarette, e-cigarette, cigar, and smokeless tobacco use at the intersection of multiple social identities in the U.S. adult population. Results from the TUS-CPS 2018-2019 survey. *Nicotine Tobacco Res.* (November), 1–10.