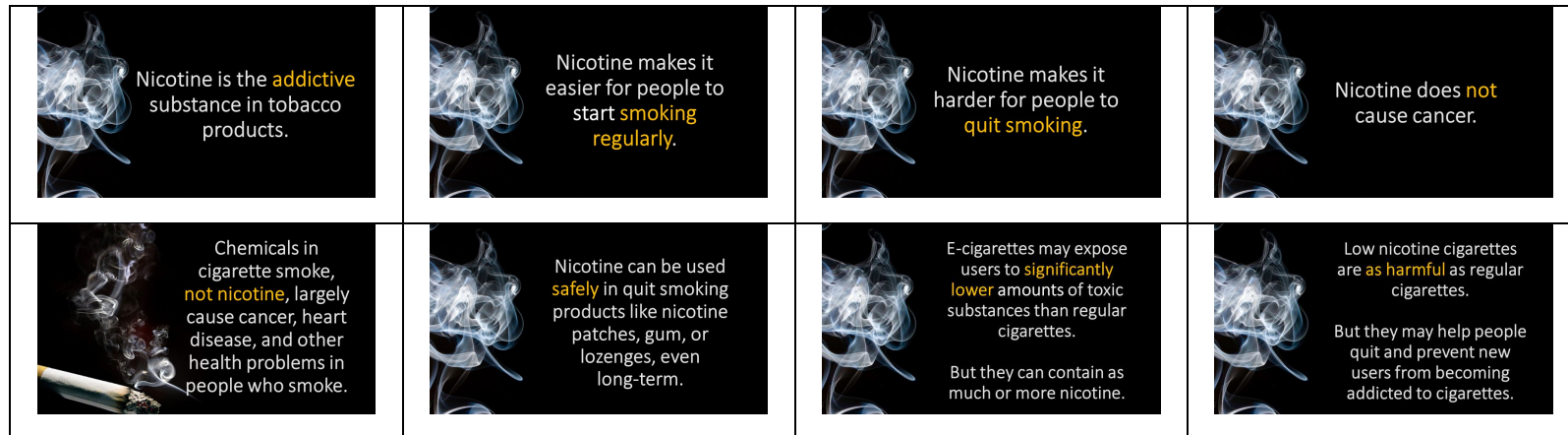Effect of Nicotine Corrective Messaging on Nicotine-Related Beliefs in U.S. Adults: A Randomized Controlled Trial

**Supplemental Appendix**

**Figure S1**. Nicotine corrective messaging (NCM) stimuli and their Flesch-Kincaid reading grade levels



Note: Flesch-Kincaid Reading Grade level across all messages: 9.5

[a] Nicotine is the addictive substance in tobacco products (Flesch-Kincaid Reading Grade level: 11.1)

[b] Nicotine makes it easier for people to start smoking regularly (Flesch-Kincaid Reading Grade level: 9.5)

[c] Nicotine makes it harder for people to quit smoking (Flesch-Kincaid Reading Grade level: 6.2)

[d] Nicotine does not cause cancer (Flesch-Kincaid Reading Grade level: 5.2)

[e] Chemicals in cigarette smoke, not nicotine, largely cause cancer, heart disease, and other health problems in people who smoke (Flesch-Kincaid Reading Grade level: 11.0)

[f] Nicotine can be used safely in quit smoking products like nicotine patches, gum, or lozenges, even long-term (Flesch-Kincaid Reading Grade level: 11.1)

[g] E-cigarettes may expose users to significantly lower amounts of toxic substances than regular cigarettes. But they can contain as much or more nicotine (Flesch-Kincaid Reading Grade level: 10.9)

[h] Low nicotine cigarettes are as harmful as regular cigarettes. But they may help people quit and prevent new users from becoming addicted to cigarettes. (Flesch-Kincaid Reading Grade level: 9.7)

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**Table S1**. Participant characteristics by study condition

| | All (n = 794) | Nicotine Corrective Messaging Intervention (n = 393) | Control (n = 401) | p |
|---|---|---|---|---|
| Sex | | | | 0.089 |
| Female | 400 (50%) | 186 (47%) | 214 (53%) | |
| Male | 394 (50%) | 207 (53%) | 187 (47%) | |
| | | | | |
| Age | | | | 0.747 |
| 18-24 | 55 (7%) | 25 (6%) | 30 (7%) | |
| 25-34 | 162 (20%) | 78 (20%) | 84 (21%) | |
| 35-44 | 124 (16%) | 57 (14%) | 67 (17%) | |
| 45-54 | 123 (15%) | 61 (15%) | 62 (15%) | |
| 55-64 | 145 (18%) | 74 (19%) | 71 (18%) | |
| 65-74 | 135 (17%) | 68 (17%) | 67 (17%) | |
| 75+ | 50 (6%) | 30 (8%) | 20 (5%) | |
| | | | | |
| Race/Ethnicity | | | | 0.525 |
| Hispanic | 152 (19%) | 73 (19%) | 79 (20%) | |
| White, non-Hispanic | 496 (62%) | 243 (62%) | 253 (63%) | |
| Black, non-Hispanic | 77 (10%) | 40 (10%) | 37 (9%) | |
| Asian, non-Hispanic | 19 (2%) | 13 (3%) | 6 (1%) | |
| More than 1 race, non-Hispanic | 34 (4%) | 18 (5%) | 16 (4%) | |
| Other, non-Hispanic | 16 (2%) | 6 (1%) | 10 (2%) | |
| | | | | |
| Education | | | | 0.903 |
| Less than high school | 39 (5%) | 21 (5%) | 18 (4%) | |
| High school/GED | 139 (17%) | 72 (18%) | 67 (17%) | |
| Some college/ Associate's degree | 351 (44%) | 172 (44%) | 179 (45%) | |
| Bachelor's degree | 141 (18%) | 66 (17%) | 75 (19%) | |
| Post-grad degree | 124 (16%) | 62 (16%) | 62 (15%) | |
| | | | | |
| Income | | | | 0.834 |
| Less than $30K | 159 (20%) | 75 (19%) | 84 (21%) | |
| $30K to $59,999 | 237 (30%) | 120 (30%) | 117 (29%) | |
| $60K to $99,999 | 227 (29%) | 116 (29%) | 111 (28%) | |
| $100K or more | 171 (21%) | 82 (21%) | 89 (22%) | |
| | | | | |
| Region | | | | 0.256 |
| Northeast | 114 (14%) | 55 (14%) | 59 (15%) | |
| Midwest | 201 (25%) | 103 (26%) | 98 (24%) | |
| South | 282 (35%) | 128 (33%) | 154 (38%) | |
| West | 197 (25%) | 107 (27%) | 90 (22%) | |
| | | | | |
| Metropolitan | | | | 0.543 |
| Non-metro area | 142 (18%) | 67 (17%) | 75 (19%) | |
| Metro area | 652 (82%) | 326 (83%) | 326 (81%) | |
| | | | | |

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| | All (*n* = 794) | Nicotine Corrective Messaging Intervention (*n* = 393) | Control (*n* = 401) | *p* |
|---|---|---|---|---|
| Internet access | | | | 0.359 |
| Non-internet household | 81 (10%) | 44 (11%) | 37 (9%) | |
| Internet household | 713 (90%) | 349 (89%) | 364 (91%) | |
| | | | | |
| Single Item Literacy Screener | | | | 0.215 |
| Adequate reading ability | 683 (86%) | 332 (84%) | 351 (87%) | |
| Limited reading ability | 111 (14%) | 61 (16%) | 50 (13%) | |
| | | | | |
| Past 30-day tobacco use | | | | |
| Any | 169 (21%) | 80 (20%) | 89 (22%) | 0.527 |
| Cigarette | 119 (15%) | 61 (16%) | 58 (15%) | 0.698 |
| Cigar | 23 (3%) | 11 (3%) | 12 (3%) | 0.866 |
| Little cigar or cigarillo | 29 (4%) | 14 (4%) | 15 (4%) | 0.899 |
| E-cigarette | 47 (6%) | 25 (6%) | 22 (6%) | 0.601 |
| Nicotine replacement therapy | 14 (2%) | 9 (2%) | 5 (1%) | 0.264 |
| | | | | |
| Nicotine/smoking beliefs | | | | |
| Addiction to nicotine is something I am concerned about | | | | 0.062 |
| Not true | 392 (49%) | 177 (45%) | 215 (54%) | |
| Unsure | 75 (10%) | 41 (11%) | 34 (9%) | |
| True | 325 (41%) | 173 (44%) | 152 (38%) | |
| Nicotine is the main substance in tobacco that makes people want to smoke | 3.52 (0.66) | 3.52 (0.67) | 3.52 (0.64) | 0.985 |
| Smoking behavior is something basic about a person that they can't change very much | 1.91 (0.90) | 1.89 (0.91) | 1.94 (0.90) | 0.414 |
| | | | | |
| Cancer beliefs | | | | |
| Cancer is most often caused by a person's behavior or lifestyle | 2.44 (0.80) | 2.43 (0.81) | 2.45 (0.80) | 0.774 |
| It seems like everything causes cancer | 2.61 (0.84) | 2.62 (0.87) | 2.61 (0.81) | 0.889 |

*Note*. Comparisons were tested using Pearson's chi-square test.

Missing data: Past 30-day cigarette use (n=4); past 30-day cigar use (n=1) past 30-day little cigar or cigarillo use (n=3); past 30-day e-cigarette use (n=2); Addiction to nicotine is something I care about (n=2); Nicotine is the main substance in tobacco that makes people want to smoke (n=1); Smoking behavior is something basic about a person that they can't change very much (n=3); Cancer is most often caused by a person's behavior or lifestyle (n=4);  It seems like everything causes cancer (n=11).

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**Table S2**. Unadjusted Wave 4 Outcomes by Study Condition

| | Nicotine Corrective Messaging Intervention (*n* = 290) | Control (*n* = 319) | *p* |
|---|---|---|---|
| | n (%) | n (%) | |
| Thinking about the harm that individual substances within a cigarette may cause, how much harm comes from | | | |
|    Substances produced when raw tobacco burns? | 3.3 (1.3) | 3.3 (1.2) | 0.934 |
|    The nicotine in a cigarette? | 3.4 (1.4) | 3.5 (1.3) | 0.396 |
|    Naturally occurring substances in tobacco? | 2.9 (1.3) | 3.0 (1.2) | 0.435 |
|    Things that are added to cigarettes during the manufacturing process? | 3.6 (1.2) | 3.6 (1.2) | 0.995 |
| | | | |
| Nicotine is the addictive substance in tobacco products. | | | **0.050** |
|    False | 24 (8%) | 12 (4%) | |
|    Unsure | 23 (8%) | 22 (7%) | |
|    True | 243 (84%) | 285 (89%) | |
| | | | |
| **Nicotine false beliefs** | | | |
|    Nicotine is a cause of cancer | | | 0.059 |
|      False | 86 (30%) | 69 (22%) | |
|      Unsure | 79 (27%) | 105 (33%) | |
|      True | 125 (43%) | 145 (45%) | |
| | | | |
|    In your opinion, how large a part of the health risks of cigarette smoking comes from the nicotine itself? | | | 0.579 |
|      None or a very small part | 21 (7%) | 15 (5%) | |
|      A relatively small part | 80 (28%) | 88 (28%) | |
|      A relatively large part | 137 (47%) | 154 (48%) | |
|      A very large part or all of the health risks | 51 (18%) | 62 (19%) | |
| | | | |
|    In your opinion, how large a part of the cancer caused by cigarette smoking comes from the nicotine itself? | | | **0.019** |
|      None or a very small part | 44 (15%) | 23 (7%) | |
|      A relatively small part | 85 (29%) | 105 (33%) | |
|      A relatively large part | 111 (38%) | 134 (42%) | |
|      A very large part or all of the health risks | 50 (17%) | 57 (18%) | |
| | | | |
|    Nicotine false beliefs scale (Mean, SD) | 7.5 (2.3) | 7.8 (2.1) | 0.084 |
| | | | |
| **NRT false beliefs** | | | |
|    It is easy to get addicted to nicotine gum | | | 0.565 |
|      False | 33 (11%) | 28 (9%) | |
|      Unsure | 117 (40%) | 132 (41%) | |
|      True | 140 (48%) | 159 (50%) | |
| | | | |

| | Nicotine Corrective Messaging Intervention (*n* = 290) | Control (*n* = 319) | *p* |
|---|---|---|---|
| Long term use of nicotine from patches or gums is almost as harmful to health as cigarette smoking. | | | 0.087 |
| False | 81 (28%) | 71 (22%) | |
| Unsure | 120 (42%) | 126 (40%) | |
| True | 87 (30%) | 121 (38%) | |
| | | | |
| Are nicotine gum, patches, and lozenges more likely, about the same, or less likely to cause someone to become addicted as regular cigarettes? | | | **0.016** |
| Less likely | 152 (53%) | 145 (46%) | |
| About the same | 115 (40%) | 159 (50%) | |
| More likely | 22 (8%) | 13 (4%) | |
| | | | |
| Are nicotine gum, patches, and lozenges more likely, about the same, or less likely to cause someone to have a heart attack as cigarettes? | | | 0.335 |
| Less likely | 155 (54%) | 152 (48%) | |
| About the same | 117 (41%) | 144 (46%) | |
| More likely | 14 (5%) | 19 (6%) | |
| | | | |
| Are nicotine gum, patches, and lozenges more likely, about the same, or less likely to cause cancer as cigarettes? | | | 0.241 |
| Less likely | 189 (66%) | 190 (60%) | |
| About the same | 88 (31%) | 116 (37%) | |
| More likely | 11 (4%) | 9 (3%) | |
| | | | |
| Relative harm of nicotine products (like gum, patches, lozenges) compared with cigarettes | | | 0.317 |
| A lot less harmful | 72 (25%) | 63 (20%) | |
| A little less harmful | 139 (48%) | 150 (47%) | |
| About the same | 61 (21%) | 89 (28%) | |
| A little more harmful | 10 (4%) | 11 (3%) | |
| A lot more harmful | 6 (2%) | 6 (2%) | |
| | | | |
| NRT false beliefs scale (Mean, SD | 10.9 (2.8) | 11.3 (2.8) | **0.048** |
| | | | |
| **E-cigarette false beliefs** | | | |
| Long term use of e-cigarettes/vapes is almost as harmful to health as cigarette smoking. | | | 0.341 |
| False | 26 (9%) | 24 (8%) | |
| Don't know | 72 (25%) | 66 (21%) | |
| True | 191 (66%) | 227 (72%) | |
| | | | |

| | Nicotine Corrective Messaging Intervention (*n* = 290) | Control (*n* = 319) | *p* |
|---|---|---|---|
| Are e-cigarettes/vapes more likely, about the same, or less likely to cause someone to have a heart attack as cigarettes? | | | 0.291 |
|     Less likely | 76 (26%) | 69 (22%) | |
|     About the same | 182 (63%) | 207 (65%) | |
|     More likely | 30 (10%) | 42 (13%) | |
| | | | |
| Are e-cigarettes/vapes more likely, about the same, or less likely to cause cancer as cigarettes? | | | **0.009** |
|     Less likely | 106 (37%) | 81 (25%) | |
|     About the same | 154 (54%) | 203 (64%) | |
|     More likely | 25 (9%) | 33 (10%) | |
| | | | |
| Relative harm of e-cigarettes compared with cigarettes | | | 0.172 |
|     A lot less harmful | 12 (4%) | 14 (4%) | |
|     A little less harmful | 93 (32%) | 78 (24%) | |
|     About the same | 142 (49%) | 184 (58%) | |
|     A little more harmful | 22 (8%) | 18 (6%) | |
|     A lot more harmful | 19 (7%) | 24 (8%) | |
| | | | |
| E-cigarettes false beliefs scale (Mean, SD | 8.9 (2.2) | 9.2 (2.1) | **0.032** |
| | | | |
| **RNC cigarette false beliefs** | | | |
|     Cigarettes that are lower in nicotine are less likely to cause cancer than regular cigarettes. | 2.3 (0.9) | 2.4 (0.8) | 0.438 |
| | | | |
|     Cigarettes that are lower in nicotine are safer than regular cigarettes. | 2.3 (1.0) | 2.3 (0.9) | 0.912 |
| | | | |
|     Cigarettes that are lower in nicotine are healthier than regular cigarettes. | 2.1 (1.0) | 2.2 (0.8) | 0.422 |
| | | | |
|     Cigarettes that are lower in nicotine have fewer chemicals than regular cigarettes. | 2.4 (1.0) | 2.3 (0.9) | 0.777 |
| | | | |
|     Cigarettes that are lower in nicotine are less addictive than regular cigarettes.[a] | 3.4 (1.0) | 3.6 (0.9) | 0.050 |
| | | | |
|     Smoking cigarettes that are lower in nicotine make it easier to quit smoking completely compared to regular cigarettes.[a] | 3.3 (1.0) | 3.4 (0.9) | 0.119 |
| | | | |
|     Cigarettes that are lower in nicotine also have less tar than regular cigarettes. | 2.7 (0.8) | 2.6 (0.8) | 0.134 |
| | | | |

| | Nicotine Corrective Messaging Intervention (*n* = 290) | Control (*n* = 319) | *p* |
|---|---|---|---|
| High nicotine content cigarettes are worse for your health than low nicotine cigarettes, even if you smoke the same number of each. | 3.0 (1.1) | 3.0 (1.0) | 0.695 |
| A low nicotine cigarette is safer to smoke than a high nicotine cigarette, even if you don't quit. | 2.4 (1.0) | 2.4 (0.9) | 0.832 |
| Low nicotine cigarettes are healthier for you than high nicotine cigarettes even before you quit. | 2.3 (0.9) | 2.4 (0.8) | 0.281 |
| A cigarette brand that says it is low in nicotine means that it is less addictive.[a] | 3.6 (1.0) | 3.7 (0.9) | 0.143 |
| RNC cigarette false beliefs scale (Mean, SD | 29.8 (4.7) | 30.3 (4.1) | 0.174 |

*Note*. Comparisons of categorical variables were conducted using Pearson's chi-square test. Comparisons of continuous variables were conducted using t-test.

[a] These items were reverse coded in scale scores.

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**Table S3.** Effect of study condition on nicotine, NRT, e-cigarette and reduced nicotine content false beliefs at Wave 2 and Wave 4[a]

| | Wave 2 | | | Wave 4 | | |
|---|---|---|---|---|---|---|
| | **n** | **b** | **95% CI** | **n** | **b** | **95% CI** |
| **Nicotine false beliefs** | | | | | | |
| Intent-to-treat[b] | 794 | -0.10 | (-0.30 - 0.10) | 794 | -0.17 | (-0.38 - 0.04) |
| Per protocol | 631 | -0.13 | (-0.38 - 0.13) | 609 | -0.29* | (-0.55 - -0.03) |
| Complete case | 551 | -0.21 | (-0.48 - 0.06) | 551 | -0.28* | (-0.55 - -0.009) |
| | | | | | | |
| **NRT false beliefs** | | | | | | |
| Intent-to-treat[b] | 794 | -0.26 | (-0.55 - 0.02) | 794 | -0.36* | (-0.64 - -0.07) |
| Per protocol | 631 | -0.26 | (-0.61 - 0.08) | 609 | -0.33 | (-0.67 - 0.01) |
| Complete case | 551 | -0.24 | (-0.61 - 0.13) | 551 | -0.39* | (-0.74 - -0.04) |
| | | | | | | |
| **E-cigarette false beliefs** | | | | | | |
| Intent-to-treat[b] | 794 | -0.013 | (-0.23 - 0.20) | 794 | -0.19 | (-0.41 - 0.03) |
| Per protocol | 631 | 0.001 | (-0.26 - 0.26) | 609 | -0.26 | (-0.52 - 0.001) |
| Complete case | 551 | -0.031 | (-0.31 - 0.24) | 551 | -0.29* | (-0.57 - -0.01) |
| | | | | | | |
| **Reduced nicotine content cigarette false beliefs** | | | | | | |
| Intent-to-treat[b] | 794 | -0.24 | (-0.70 - 0.21) | 794 | -0.43 | (-0.93 - 0.06) |
| Per protocol | 631 | -0.33 | (-0.88 - 0.23) | 609 | -0.56 | (-1.16 - 0.03) |
| Complete case | 551 | -0.38 | (-0.98 - 0.21) | 551 | -0.48 | (-1.10 - 0.15) |

** $p < 0.01$, * $p < 0.05$

[a] All models control for baseline false beliefs (e.g., nicotine false beliefs models for Wave 2 and Wave 4 control for nicotine false beliefs at baseline)

[b] Intent to treat analyses use last observation carried forward; assumes no change in outcomes if lost to follow-up

**Table S4.** Effect of study condition on intention to use cigarettes, e-cigarettes, NRT, and RNC cigarettes in the next 12 months among baseline respondents who had not used tobacco in the past 30 days at Wave 2 and Wave 4[a]

| | Wave 2 | | | Wave 4 | | |
|---|---|---|---|---|---|---|
| | n | b | 95% CI | n | b | 95% CI |
| **Intention to use cigarettes** | | | | | | |
| Intent-to-treat[b] | 622 | 0.054* | (0.0088 - 0.098) | 621 | 0.050* | (0.00060 - 0.100) |
| Per protocol | 499 | 0.066* | (0.010 - 0.12) | 482 | 0.061 | (-0.00077 - 0.12) |
| Complete case | 439 | 0.068* | (0.0063 - 0.13) | 438 | 0.044 | (-0.017 - 0.11) |
| | | | | | | |
| **Intention to use e-cigarettes** | | | | | | |
| Intent-to-treat[b] | 620 | 0.023 | (-0.020 - 0.065) | 619 | 0.020 | (-0.028 - 0.068) |
| Per protocol | 497 | 0.034 | (-0.019 - 0.086) | 480 | 0.012 | (-0.047 - 0.071) |
| Complete case | 437 | 0.019 | (-0.037 - 0.076) | 436 | -0.0050 | (-0.060 - 0.049) |
| | | | | | | |
| **Intention to use nicotine replacement products** | | | | | | |
| Intent-to-treat[b] | 620 | 0.010 | (-0.023 - 0.044) | 619 | 0.026 | (-0.017 - 0.070) |
| Per protocol | 499 | 0.017 | (-0.024 - 0.058) | 481 | 0.032 | (-0.020 - 0.083) |
| Complete case | 438 | 0.0093 | (-0.033 - 0.051) | 437 | 0.014 | (-0.034 - 0.062) |
| | | | | | | |
| **Intention to use low nicotine content cigarette** | | | | | | |
| Intent-to-treat[b] | 622 | 0.014 | (-0.025 - 0.053) | 622 | 0.016 | (-0.031 - 0.063) |
| Per protocol | 501 | 0.021 | (-0.027 - 0.069) | 482 | 0.014 | (-0.042 - 0.069) |
| Complete case | 439 | 0.0070 | (-0.040 - 0.054) | 439 | 0.0030 | (-0.053 - 0.059) |

** $p<0.01$, * $p<0.05$

[a] All models control for baseline intention or use

[b] Intent to treat analyses use last observation carried forward; assumes no change in outcomes if lost to follow-up

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**Table S5.** Effect of study condition on total number of days used nicotine or tobacco products in the past 30 days among baseline respondents who had used tobacco in the past 30 days at Wave 2 and Wave 4[a]

| | Wave 2 | | | Wave 4 | | |
|---|---|---|---|---|---|---|
| | n | b | 95% CI | n | b | 95% CI |
| **Total number of days used nicotine or tobacco products** | | | | | | |
| Intent-to-treat[b] | 169 | 1.79 | (-1.85 - 5.43) | 169 | 1.71 | (-1.95 - 5.36) |
| Per protocol | 125 | 1.88 | (-2.86 - 6.62) | 121 | 0.93 | (-3.81 - 5.67) |
| Complete case | 108 | 1.62 | (-3.65 - 6.90) | 108 | 0.57 | (-4.60 - 5.75) |
| | | | | | | |
| **Total number of days used combusted tobacco products** | | | | | | |
| Intent-to-treat[b] | 141 | 2.06 | (-1.31 - 5.43) | 141 | 2.01 | (-1.48 - 5.49) |
| Per protocol | 99 | 3.01 | (-1.79 - 7.81) | 102 | 2.58 | (-1.46 - 6.62) |
| Complete case | 88 | 2.17 | (-3.04 - 7.38) | 91 | 1.95 | (-2.40 - 6.30) |
| | | | | | | |
| **Total number of days used non-combusted nicotine or tobacco products** | | | | | | |
| Intent-to-treat[b] | 61 | 0.41 | (-2.96 - 3.77) | 61 | -3.32 | (-7.56 - 0.93) |
| Per protocol | 39 | 0.22 | (-5.15 - 5.59) | 37 | -5.65 | (-12.0 - 0.69) |
| Complete case | 31 | 1.97 | (-4.26 - 8.21) | 32 | -7.57* | (-14.6 - -0.52) |

** $p<0.01$, * $p<0.05$

[a] All models control for baseline number of days of use

[b] Intent to treat analyses use last observation carried forward; assumes no change in outcomes if lost to follow-up