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Purpose in life and tobacco use among community-dwelling mothers of early adolescents

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SCHOLARONE™
Manuscripts

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2 November 10, 2017
3

4 Dr. Trish Groves
5 Editor-in-Chief
6 *BMJ Open*
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10 Dear Dr. Groves,
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12
13 I wish to submit an original research article for publication in *BMJ Open*, titled “Purpose in life and tobacco
14 use among community-dwelling mothers of early adolescents.” The paper was co-authored by Yuko
15 Morimoto, Syudo Yamasaki, Shuntaro Ando, Shinsuke Koike, Shinya Fujikawa, Sho Kanata, Kaori Endo,
16 Miharu Nakanishi, Stephani L Hatch, Marcus Richards, Kiyoto Kasai, Mariko Hiraiwa-Hasegawa, and
17 Atsushi Nishida.
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19

20
21 This study utilizes the results of questionnaires administered as part of the Tokyo Early Adolescence Survey to
22 investigate the relationship between a sense of purpose in life and tobacco use among mothers of adolescents
23 who are in early middle age. We find that there is a strong inverse relationship between a sense of purpose in
24 life and tobacco use in this population, even after controlling for socioeconomic status indicators, age, and
25 psychological distress. We believe that our study makes a significant contribution to the literature, because it is
26 the first to investigate this relationship using a large population-based sample ($N = 4,063$) of women in early
27 midlife. Further, we believe that this paper will be of interest to the readership of your journal, given that our
28 findings have practical implications for community health professionals involved in promoting tobacco
29 cessation among mid-life women, and especially mothers.
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35 This manuscript has not been published or presented elsewhere in part or in entirety and is not under
36 consideration by another journal. All study participants provided informed consent, and the study’s design was
37 approved by the appropriate ethics review board. We have read and understood your journal’s policies, and we
38 believe that neither the manuscript nor the study violates any of these. There are no conflicts of interest to
39 declare.
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43 Thank you for your consideration. I look forward to hearing from you.
44

45
46 Sincerely,
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48
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1 **TITLE**

2 Purpose in life and tobacco use among community-dwelling mothers of early adolescents

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36 contributors, competing interests, ethical approval, data sharing statements, and strengths and
37 limitations of this study)

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3 38 **ABSTRACT**
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5 39 **Objectives** The rising prevalence of tobacco use and tobacco-attributable deaths among women is of
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8 40 worldwide concern. In particular, smoking prevention for mothers in early midlife is a significant
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11 41 international public health goal. A higher sense of purpose in life is thought to reduce detrimental
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14 42 health behaviours. However, little is known about the association between a sense of purpose in life
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17 43 (PIL) and tobacco use. This study investigates this association among community-dwelling mothers
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20 44 of early adolescents.

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22 45 **Design** This population-based cross-sectional study uses a self-reported questionnaire from the
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25 46 Tokyo Early Adolescence Survey (T-EAS), a large community-based survey conducted in Japan
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28 47 between 2012 and 2014.

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31 48 **Setting** Participants were randomly recruited from the resident registries of three municipalities in
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34 49 Tokyo, Japan.

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37 50 **Participants** A total of 4,478 children and their primary parents participated. Responses from 4,063
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40 51 mothers with no missing data were analysed (M age = 42.0 years [SD=4.2]).

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42 52 **Measures** Participants' tobacco use, including the number of cigarettes smoked per day, was
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45 53 documented using a questionnaire. PIL was assessed using a Purpose in Life scale derived from
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48 54 Ryff's Psychological Well-Being Scale.

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51 55 **Results** Greater PIL was associated with a decreased likelihood of tobacco use, even when adjusted
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54 56 for confounders (OR = 0.80, 95%CI 0.70 to 0.91). Multinomial logistic regression analyses revealed

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3 57 that PIL was inversely associated with tobacco consumption among mothers. These associations
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5 58 remained after controlling for psychological distress, socioeconomic factors, and frequency of
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8 59 alcohol consumption among moderate to heavy smokers (OR = 0.70, 95%CI 0.57 to 0.86), while
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11 60 attenuated among light smokers.

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14 61 **Conclusions** Increasing PIL may be a valuable intervention for reducing tobacco use among women
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17 62 in early midlife. This study can contribute to our understanding of the psychology of smoking
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20 63 behaviour, and shed light on the targeted intervention to reduce tobacco use among early midlife
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23 64 mothers.

24 25 26 27 28 66 **KEYWORDS**

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31 67 Purpose in life, Mother, Psychological distress, Tokyo Early Adolescence Survey (T-EAS), Tobacco
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34 68 use

35 36 37 38 39 70 **STRENGTHS AND LIMITATIONS OF THIS STUDY**

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41
42 71 • The study investigated the association between a sense of purpose in life (PIL) and tobacco use
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45 72 among community dwelling mothers in early midlife.
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48 73 • Data were collected from a large community-based sample of mothers in early-middle age,
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51 74 randomly recruited from the resident registries of three municipalities in Tokyo.
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54 75 • We demonstrated the association between PIL and tobacco use while controlling for confounders,
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3 76 including demographic variables and psychological distress.
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5 77 ▪ The study adopted a cross sectional design and was limited to determining a causal relationship
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8 78 between PIL and tobacco use.
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79 INTRODUCTION

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81 The tobacco epidemic is one of the most significant international public health threats.
82 Globally, more than one in ten adult deaths is estimated to be due to tobacco. The World Health
83 Organization is particularly concerned about the possibility that the global increase in deaths due to
84 tobacco is driven by the accelerating rate of tobacco use in women.¹ Smoking prevalence among
85 women is not decreasing, while that among men has been decreasing rapidly during the past three
86 decades in Japan.² Tobacco use among women is dramatically increasing among those between 30
87 and 50 years old,³ and tobacco cessation in early midlife is associated with a substantial decline in
88 mortality risk for women.^{4,5} In addition, maternal smoking is the major determinant of child's passive
89 smoking⁶ and smoking initiation.⁷ Smoking prevention for women, especially mothers, in early
90 midlife, is therefore a significant international public health goal.

91 We examined the association between purpose in life (PIL) and tobacco use in women in
92 early midlife. PIL is a component of psychological eudaemonic well-being, and refers to the extent to
93 which individuals regard their own life as meaningful.⁸ Previous studies, which have mainly
94 examined elderly populations, have shown that a higher sense of PIL is associated with reduced risk
95 for diseases (e.g. Alzheimer's disease,⁹ myocardial infarction,¹⁰ stroke,¹¹ cerebral infarctions¹²) and
96 with better physical function¹³ and lower mortality.¹⁴⁻¹⁹ A growing body of research indicates the
97 existence of links between PIL and health behaviours²⁰ (e.g. use of preventive health care services,²¹

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3 98 daily exercise,²²⁻²⁴ maintenance of a healthy diet,^{25 26} preventive behaviours for breast cancer.²³). In
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6 99 contrast, lower PIL is associated with detrimental health behaviours. Previous research in this area
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8 100 has mainly concentrated on the association between PIL and addiction.²⁷⁻³⁰
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11 Previous studies suggested that interventions and promotions focusing on psychological
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14 102 factors were important for smoking prevention and cessation among women. Meta-analyses have
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17 103 shown that women have more difficulty maintaining long-term smoking cessation than men,³¹ and
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20 104 nicotine replacement therapy for smoking cessation is less effective in women than in men, in
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23 105 particular for supporting long-term maintenance of smoking cessation.³² Another meta-analysis
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26 106 demonstrated that motivational interviewing, which is a psychological approach used to enhance PIL
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29 107 among people with addictive behaviours, could be effective for tobacco cessation.³³
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31 108 Purpose in life might be a significant psychological factor for promoting tobacco cessation
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34 109 among women. However, relatively little is known about the association between PIL and tobacco
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37 110 use, with no study to date examining this association in women in early midlife. A previous survey
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40 111 on 341 adults in Hungary³⁴ demonstrated that daily smokers had lower PIL than non-smokers,
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43 112 although the sample was limited to a small number and did not focus on women in early midlife. In
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46 113 the current study, we hypothesized that PIL is inversely associated with tobacco use among early
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49 114 midlife mothers, even after controlling for demographic variables and the effect of psychological
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52 115 distress. Psychological distress (depression and/or anxiety) often co-occurs with tobacco use.³⁵⁻⁴²
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54 116 Since psychological distress (ill-being) is inversely associated with PIL^{8 43 44} and is positively
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3 117 associated with substance abuse,^{28 29} it could confound associations between PIL and tobacco use.

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5 118 We also hypothesized that PIL is inversely associated with the amount of tobacco consumption.

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11 120 **METHODS**

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17 122 **Study design, sample, and survey procedure**

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22 124 This study used data from the Tokyo Early Adolescence Survey (T-EAS),[45, 46] which was
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24
25 125 originally designed as a baseline survey for the Tokyo Teen Cohort, a currently ongoing longitudinal
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28 126 cohort study (URL: <http://ttcp.umin.jp/index.html>). The T-EAS is a multidisciplinary survey of
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31 127 10-year-old adolescents and their main carers (98.5% mothers). The T-EAS contains questions about
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34 128 tobacco use, PIL, and psychological distress, as well as a variety of other potentially confounding
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37 129 variables. Participants were randomly recruited from the resident registries of three municipalities in
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40 130 Tokyo: Setagaya Ward, Mitaka City, and Chofu City. Participants were sent invitation letters on or
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43 131 around the child's tenth birthday. The survey was completed in two home visits. During the first visit,
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46 132 written informed consent from the main carer (generally the mother) was obtained; participants were
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49 133 then asked to complete the questionnaires at home before the second visit. During the second visit,
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52 134 both the adolescent and the main carer were each asked to complete the self-report questionnaires
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55 135 separately. The questionnaires were enclosed in envelopes by the respondents immediately after

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3 136 completion. In addition, the main carer responded to a semi-structured interview. All data were
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5 137 collected anonymously. The T-EAS was conducted by three research institutes: Tokyo Metropolitan
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8 138 Institute of Medical Science, The University of Tokyo, and SOKENDAI (The Graduate University
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11 139 for Advanced Studies). This survey was approved by the ethics committees of these three institutes.
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141 **Participants**

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143 A total of 4,478 children and their primary parents participated in the Tokyo Early
144 Adolescence Survey (T-EAS) (response rate 43.8%). We used the primary parent data for the
145 purposes of the current study. Of the 4,478 respondents, 68 were men, and were hence excluded to
146 focus the investigation on the association between PIL and tobacco use in women. An additional 347
147 female respondents' data were excluded due to incomplete answers to the questions on tobacco use,
148 PIL, psychological distress, or other confounding variables. The final dataset therefore contained
149 data from 4,063 respondents.
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151 **Measures**

152 153 Tobacco Use

154 Respondents were asked whether they used tobacco. Those who answered 'yes' were

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3 155 subsequently asked about the number of cigarettes they smoked per day. A binary variable was
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5 156 created ('0: non-smokers' versus '1: smokers'), based on the first question. Respondents were then
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8 157 split into: '0: non-smokers', '1: light smokers (less than half a pack per day)', and '2: moderate to
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11 158 heavy smokers (more than or equal to half a pack per day)', to assess potential dose-response effects.
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160 Purpose in Life

161 PIL was assessed using a 14-item version of the Purpose in Life scale derived from Ryff's
162 Psychological Well-Being scales.⁸ The scale included items such as 'I have a sense of direction and
163 purpose in life', and 'My daily activities often seem trivial and unimportant to me' (reverse coded).
164 Each item was rated on a 6-point Likert scale (1: strongly disagree; 6: strongly agree) and scores
165 were summed, so that continuous scores ranged from 14 to 84. Higher scores indicated a higher
166 sense of PIL.

167

168 Psychological Distress

169 Psychological distress was assessed using the K6.⁴⁷ This survey contains six items,
170 assessing how frequently during the past 30 days respondents felt: i) so depressed that nothing could
171 cheer them up, ii) hopeless, iii) restless or fidgety, iv) that everything was an effort, v) worthless, and
172 vi) nervous. Each item was scored on a 5-point Likert scale (0: never; 4: most of the time). Scores
173 were summed, with the resulting raw scores ranging from 0 to 24. Higher scores indicate more

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3 174 frequent psychological distress during the past 30 days.
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8 176 Other covariates
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11 177 The following covariates were examined for their potential confounding effects: age,
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14 178 educational attainment, marital status, annual family income, and frequency of alcohol consumption.
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17 179 High socioeconomic status (represented by educational attainment and annual family income here) is
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20 180 known to be associated with higher PIL,⁴² and socioeconomic disadvantage is a risk factor for
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23 181 tobacco use.⁴⁸⁻⁵¹ Educational attainment was coded as follows: '1: junior high school or lower', '2:
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26 182 high school', '3: technical or junior college', and '4: 4-year university or higher'. Marital status was
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29 183 dichotomized as '1: yes' or '0: no', depending on whether the respondent was in a marriage or
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32 184 marriage-like relationship. Family income over the past year was divided into four categories: '1:
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35 185 less than 4 million yen', '2: 4–6 million yen', '3: 7–9 million yen', and '4: over 10 million yen'.
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38 186 Frequency of alcohol consumption was assessed using a 5-point Likert scale (0: do not drink; 4:
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41 187 more than 4 times a week).
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46 189 Statistical analyses
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49 190 Cross tabulation and chi-square tests were conducted to test the differences between three
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52 191 groups based on the amounts of tobacco used (none, light, and moderate to heavy smokers), and
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55 192 covariates in categorical variables as well as ANOVAs were used in continuous variables. We
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3 193 conducted binomial logistic regression analyses (using a binary dependent variable: non-smokers vs.
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5 194 smokers) to test the association between PIL and tobacco use. The PIL score was standardized to
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8 195 report odds ratios per one standard deviation change of PIL scores. Logistic regression model 1 was
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11 196 unadjusted for covariates; model 2 was adjusted for socioeconomic covariates: age, education,
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14 197 marital status, and family income; model 3 was further adjusted for alcohol consumption; and finally,
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17 198 model 4 was further adjusted for psychological distress (see Table 2). In order to further examine the
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20 199 relationship between PIL and tobacco use, we conducted multinomial logistic regression analyses to
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23 200 assess the effect of PIL on the degree of tobacco use. Regression models 5 to 8 were identical to
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26 201 models 1 to 4, except that the dependent variable was multivariate: non-smokers, light smokers, and
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28 202 moderate or heavy smokers.
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34 204 **RESULTS**

35 36 37 205 38 39 206 **Prevalence of smokers and corresponding descriptive statistics**

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45 208 Of the 4,063 respondents (mean age 42.0 years, standard deviation 4.2; 95.8% married;
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48 209 40.1% achieved a degree from a 4-year university or higher; 8.8% had family income less than 4
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51 210 million yen), 324 (8.0%) were smokers. 204 (5.0%) were light smokers, 120 (3.0%) were moderate
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54 211 to heavy smokers. Chi-square tests and ANOVA indicated that inverse associations were clearly
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3 212 evident between tobacco use and PIL, age, education, marital status, and annual family income
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5 213 (Table 1). Psychological distress was higher in smokers than in non-smokers (Table 1). On the other
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8 214 hand, the highest alcohol consumption was reported by light smokers (Table 1).
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[Insert Table 1 about here]

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18 19 20 218 **The association between PIL and tobacco use**

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25 220 Table 2 shows the binominal odds ratios for tobacco use compared to no smoking. PIL was
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28 221 strongly inversely associated with tobacco use in the analysis without covariates (Model 1). The odds
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31 222 ratio was not attenuated after adjusting for socioeconomic variables (Model 2). This was also the
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34 223 case after adjusting for alcohol consumption (Model 3) and finally, for psychological distress (Model
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37 224 4). With regard to the covariates in the fully adjusted model, educational attainment, marital status,
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40 225 and family annual income were inversely associated with tobacco use. There was a positive
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43 226 association between tobacco use and frequency of alcohol consumption. Psychological distress was
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46 227 not associated with tobacco use.

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[Insert Table 2 about here]

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3 230 **The association between PIL and amount of tobacco consumption**
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8 232 Figure 1 shows the odds ratios for smoking consumption, produced by multinomial logistic

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11 233 regressions comparing light and moderate to heavy smoking against the no smoking reference

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14 234 category. Without any adjustment (Model 5), PIL was inversely associated with both light and

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17 235 moderate to heavy smoking (light smoking: OR = 0.77, 95%CI: 0.67-0.89, $p < .001$; moderate to

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20 236 heavy smoking: OR = 0.62, 95%CI: 0.52-0.74, $p < .001$). The odds ratios remained significant after

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23 237 adjusting for socioeconomic covariates (Model 6: light smoking: OR = 0.86, 95%CI: 0.74-1.00, $p =$

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26 238 0.046; moderate to heavy smoking: OR = 0.72, 95%CI: 0.59-0.87, $p < .001$) and further adjustment

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29 239 for alcohol consumption (Model 7: light smoking: OR = 0.86, 95%CI: 0.74-0.99, $p = 0.041$;

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32 240 moderate to heavy smoking: OR = 0.71, 95%CI: 0.59-0.87, $p < .001$). Adjusting further for

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35 241 psychological distress (Model 8), the association between PIL and light smoking was not significant

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38 242 (OR = 0.87, 95%CI: 0.74-1.02, $p = 0.079$). On the other hand, the odds ratio for moderate to heavy

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41 243 smoking was not attenuated after adjustment for any of the aforementioned variables (OR = 0.70,

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44 244 95%CI: 0.57-0.86, $p < .001$; See Figure 1).

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[Insert Figure 1 about here]

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3 249 **DISCUSSION**
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8 251 In a community-based sample of mothers in early-middle age, we found that PIL was
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11 252 inversely associated with tobacco use after controlling for age, education, marital status, family
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14 253 income, and alcohol use. Importantly, this was also the case even after taking psychological distress
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17 254 into account. PIL was also inversely associated with the risk of moderate to heavy tobacco
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20 255 consumption even after controlling for covariates. This result is consistent with that of a previous
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23 256 study on a community sample in Hungary.³⁴ We confirmed the association between PIL and tobacco
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26 257 use with a large population-based sample of women in early midlife in Japan.
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28 258 It is possible that individuals with higher PIL are likely to invest in healthy behaviours
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31 259 because they feel that their lives are meaningful, have a greater will to live and, therefore, are more
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34 260 proactive in taking care of their health²¹ (e.g., by the avoidance of smoking). They may also be
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37 261 motivated to acquire knowledge regarding health maintenance (i.e., the knowledge about how
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40 262 detrimental smoking is). In contrast, since those low in PIL lack a high sense of life's
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43 263 meaningfulness, it may seem pointless for them to protect their health, and they may prefer
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46 264 short-term gratification, such as that obtained through tobacco use.
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48 265 The association between PIL and tobacco use was robust even when controlling for
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51 266 psychological distress. It may suggest a relationship between a lack of eudaemonic well-being (PIL)
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54 267 and tobacco use, rather than a relationship between ill-being (psychological distress) and tobacco
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3 268 use. Mental well-being and mental illness are correlated but belong to separate continua, with
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5 269 well-being referring to the presence of positive feelings and positive functioning, rather than just the
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8 270 absence of mental illness.^{52 53}
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11 271 The present results suggest that increasing PIL may be a valuable target of intervention for
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14 272 reducing tobacco use, as well as for reducing substance abuse.²⁹ PIL is modifiable^{54 55} and increasing
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17 273 awareness of one's values or long-term goals in life could increase the sense of PIL.^{56 57} Promotion
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20 274 focusing on increasing PIL might be effective in reducing tobacco use in public settings.
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22 275 This study is limited of course, in its capacity to determine causality, since the data were
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24
25 276 cross-sectional. Longitudinal studies should be conducted in order to determine whether PIL has a
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28 277 role in tobacco use. We are currently conducting a subsequent longitudinal cohort study (Tokyo Teen
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31 278 Cohort Study), which will further clarify causality between PIL and tobacco use among mothers. The
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34 279 sample was limited only to mothers and we could not examine the association among early-middle
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37 280 aged women without children. Further studies including them would be needed. Additionally, given
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40 281 that parental smoking, especially maternal smoking, is the major determinant of passive smoking⁶
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43 282 and smoking initiation⁷ in children, follow-up studies should examine the transgenerational effects of
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46 283 mothers' tobacco use on the initiation of smoking in their children.
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48 284 In summary, in a large community-based study, we found that high PIL is associated with
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51 285 lower consumption of tobacco among mothers, after controlling for a range of potential confounds,
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54 286 including psychological distress. Our hypothesis, that PIL is independently and inversely associated
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3 287 with tobacco use, was therefore confirmed. This study may contribute to our understanding of the
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5 288 psychology of smoking behaviour and shed light on the target for intervention to reduce tobacco use
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8 289 among early midlife mothers.
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14 291 **Contributors**

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16 292 YM, SY, SA, SKoike, AN, MHH and KK involved in launching and maintaining the survey.
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19 293 SF, SKanata and KE have mainly contributed to data collection. MN, SLH and MR mainly
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21
22 294 contributed to design the study and proposing the analysis and interpretation of data. YM and SY
23
24
25 295 wrote the first draft of the manuscript and all the other authors have critically reviewed it. All authors
26
27
28 296 approved the final version of the manuscript.
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16 311 None.
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31 316 Studies). This study was approved by the ethics committees of these three institutes.
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36 318 **Data sharing statement**

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39 319 This study was planned and conducted in accordance with the ethics committee of Tokyo
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41
42 320 Metropolitan Institute of Medical Science. When applying to the research ethics committee for the
43
44
45 321 data set, the authors did not request this to be released as public data. However, the data can be made
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47
48 322 available to all interested researchers upon request to Dr. Atsushi Nishida, Ph.D.
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51 323 (nishida-at@igakuken.or.jp).
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Table 1. Descriptive statistics for T-EAS variables broken down by tobacco use

	Non-smokers	Light smokers	Moderate to heavy smokers	<i>p</i>
N (%)	3739 (92.0)	204 (5.0)	120 (3.0)	
Purpose in Life, mean (standard deviation [SD])	57.3 (9.7)	54.8 (9.8)	52.6 (9.9)	<.001
Age, mean (SD)	42.0 (4.1)	41.2 (5.0)	40.5 (4.8)	<.001
Education, n (%)				
Junior high school or lower	22 (0.6)	12 (5.9)	9 (7.5)	<.001
High school	512 (13.7)	66 (32.4)	48 (40.0)	
Technical or junior college	1626 (43.5)	89 (43.6)	51 (42.5)	
4-year university or higher	1579 (42.2)	37 (18.1)	12 (10.0)	
Marital status, n (%)				
Yes	3613 (96.6)	182 (89.2)	97 (80.8)	<.001
No	126 (3.4)	22 (10.8)	23 (19.2)	
Family annual income, n (%)				
Less than 4 million yen	285 (7.6)	42 (20.6)	31 (25.8)	<.001
4–6 million yen	1022 (27.3)	74 (36.3)	57 (47.5)	
7–9 million yen	1162 (31.1)	55 (27.0)	21 (17.5)	
More than 10 million yen	1270 (34.0)	33 (16.2)	11 (9.2)	
Alcohol use, n (%)				
Non	1160 (31.0)	44 (21.6)	43 (35.8)	<.001
Less than once a month	563 (15.1)	35 (17.2)	9 (7.5)	
2–4 times a month	689 (18.4)	24 (11.8)	15 (12.5)	
2–3 times a week	594 (15.9)	21 (10.3)	16 (13.3)	
More than 4 times a week	733 (19.6)	80 (39.2)	37 (30.8)	
K6 (Psychological Distress), mean (SD)	2.9 (3.3)	3.4 (3.4)	3.5 (3.9)	.026

Table 2. Logistic regression coefficients for odds of tobacco use, with and without potential confounding variables

	Model 1		Model 2		Model 3		Model 4	
	OR [95% CI]	<i>p</i>	OR [95% CI]	<i>p</i>	OR [95% CI]	<i>p</i>	OR [95% CI]	<i>p</i>
Purpose in Life	0.71 [0.63-0.80]	<.001	0.81 [0.71-0.91]	.001	0.80 [0.71-0.91]	<.001	0.80 [0.70-0.91]	.001
Age			0.98 [0.95-1.00]	.061	0.97 [0.95-1.00]	.043	0.97 [0.95-1.00]	.044
Education			0.44 [0.38-0.52]	<.001	0.45 [0.38-0.52]	<.001	0.45 [0.38-0.52]	<.001
Marital Status			0.41 [0.27-0.62]	<.001	0.41 [0.27-0.63]	<.001	0.41 [0.27-0.63]	<.001
Family Income			0.71 [0.62-0.82]	<.001	0.71 [0.62-0.81]	<.001	0.71 [0.62-0.81]	<.001
Alcohol Use					1.18 [1.10-1.28]	<.001	1.18 [1.10-1.28]	<.001
Psychological Distress							1.00 [0.96-1.04]	.974

464 OR: odds ratio, CI: confidence interval

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3 465 **Figure Captions**

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5 466 Figure 1

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11 468 **Figure 1. Odds ratios for purpose in life from multinomial logistic regression analysis**

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14 469 **predicting smoking consumption (reference: non-smoker) with and without potential**

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17 470 **confounding variables.**

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22 472 Model 5: without any adjustment; Model 6: adjusting for socioeconomic covariates (educational

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28 474 consumption; Model 8: adjusting for socioeconomic covariates, alcohol consumption and

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31 475 psychological distress. OR: Odds ratio.

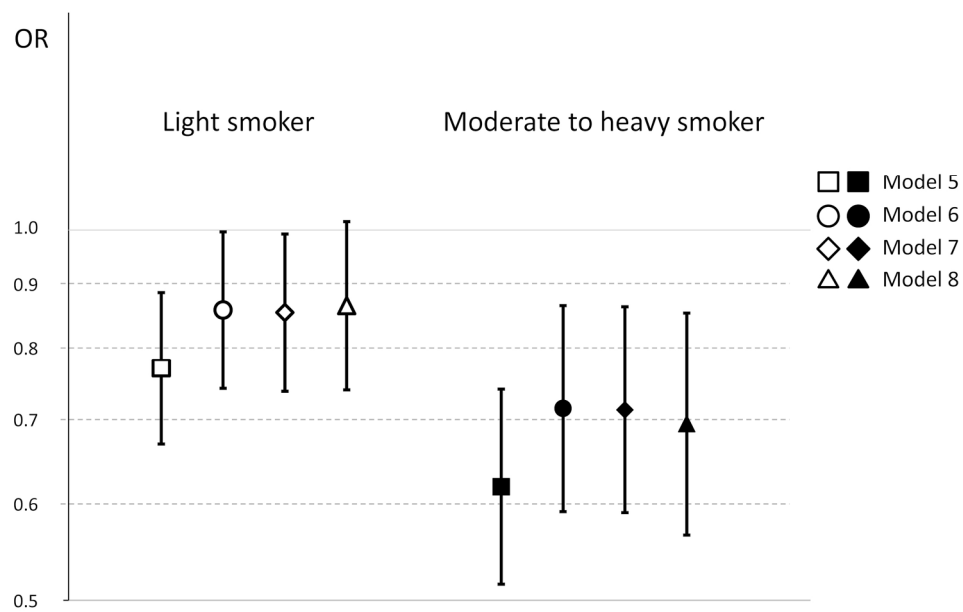


Figure 1. Odds ratios for purpose in life from multinomial logistic regression analysis predicting smoking consumption (reference: non-smoker) with and without potential confounding variables.

Model 5: without any adjustment; Model 6: adjusting for socioeconomic covariates (educational attainment and family income); Model 7: adjusting for socioeconomic covariates and alcohol consumption; Model 8: adjusting for socioeconomic covariates, alcohol consumption and psychological distress. OR: Odds ratio.

99x64mm (600 x 600 DPI)

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No.	
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,3	
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3-4	
Introduction				
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	6-8	
Objectives	3	State specific objectives, including any prespecified hypotheses	6-8	
Methods				
Study design	4	Present key elements of study design early in the paper	8-9	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8-9	
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	8-9	
		<i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls		
		<i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants		
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed		-
		<i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case		
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9-11	
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9-11	
Bias	9	Describe any efforts to address potential sources of bias	8-9	
Study size	10	Explain how the study size was arrived at	9	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9-12	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	11-12	
		(b) Describe any methods used to examine subgroups and interactions	-	
		(c) Explain how missing data were addressed	9	
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed	-	
		<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed		
		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy		
		(e) Describe any sensitivity analyses	-	

Continued on next page

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Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12-13 Table 1
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12-13 Table 1
		(b) Indicate number of participants with missing data for each variable of interest	-
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	-
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	-
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	-
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	12-13 Table 1
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13-14 Table 2 Figure 1
		(b) Report category boundaries when continuous variables were categorized	12-13 Table 1
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	16-17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17-18

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Purpose in life and tobacco use among community-dwelling mothers of early adolescents

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36 contributors, competing interests, ethical approval, data sharing statements, and strengths and

37 limitations of this study)

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2
3 38 **ABSTRACT**
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5 39 **Objectives** The rising prevalence of tobacco use and tobacco-attributable deaths among women is of
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7
8 40 worldwide concern. In particular, smoking prevention for mothers in early midlife is a significant
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11 41 international public health goal. A higher sense of purpose in life is thought to reduce detrimental
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14 42 health behaviours. However, little is known about the association between a sense of purpose in life
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17 43 (PIL) and tobacco use. This study investigates this association among community-dwelling mothers
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20 44 of early adolescents.

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22 45 **Design** This population-based cross-sectional study uses a self-reported questionnaire from the
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25 46 Tokyo Early Adolescence Survey (T-EAS), a large community-based survey conducted in Japan
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28 47 between 2012 and 2014.

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31 48 **Setting** Participants were randomly recruited from the resident registries of three municipalities in
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34 49 Tokyo, Japan.

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37 50 **Participants** A total of 4,478 children and their primary parents participated. Responses from 4,063
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40 51 mothers with no missing data were analysed (M age = 42.0 years [SD=4.2]).

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42 52 **Measures** Participants' tobacco use, including the number of cigarettes smoked per day, was
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45 53 documented using a questionnaire. PIL was assessed using a Purpose in Life scale derived from
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48 54 Ryff's Psychological Well-Being Scale.

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51 55 **Results** Greater PIL was associated with a decreased likelihood of tobacco use, even when adjusted
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54 56 for confounders (OR = 0.80, 95%CI 0.70 to 0.91). Multinomial logistic regression analyses revealed

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3 57 that PIL was inversely associated with tobacco consumption among mothers. These associations
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5 58 remained after controlling for psychological distress, socioeconomic factors, and frequency of
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8 59 alcohol consumption among moderate to heavy smokers (OR = 0.70, 95%CI 0.57 to 0.86), while
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11 60 attenuated among light smokers.

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14 61 **Conclusions** Increasing PIL may be a valuable intervention for reducing tobacco use among women
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17 62 in early midlife. This study can contribute to our understanding of the psychology of smoking
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19
20 63 behaviour, and shed light on the targeted intervention to reduce tobacco use among early midlife
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23 64 mothers.

24 25 26 27 28 66 **KEYWORDS**

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31 67 Purpose in life, Mother, Psychological distress, Tokyo Early Adolescence Survey (T-EAS), Tobacco
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34 68 use

35 36 37 38 39 70 **STRENGTHS AND LIMITATIONS OF THIS STUDY**

- 40
41
42 71 • The study investigated the association between a sense of purpose in life (PIL) and tobacco use
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45 72 among community dwelling mothers in early midlife.
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48 73 • Data were collected from a large community-based sample of mothers in early-middle age,
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51 74 randomly recruited from the resident registries of three municipalities in Tokyo.
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54 75 • We demonstrated the association between PIL and tobacco use while controlling for confounders,
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76 including demographic variables and psychological distress.

77 ▪ The study adopted a cross sectional design and was limited to determining a causal relationship

78 between PIL and tobacco use.

For peer review only

79 INTRODUCTION

80

81 The tobacco epidemic is one of the most significant international public health threats.

82 Globally, more than one in ten adult deaths is estimated to be due to tobacco. The World Health

83 Organization is particularly concerned about the possibility that the global increase in deaths due to

84 tobacco is driven by the accelerating rate of tobacco use in women.¹ Smoking prevalence among

85 women is not decreasing, while that among men has been decreasing rapidly during the past three

86 decades in Japan.² Tobacco use among women is dramatically increasing among those between 30

87 and 50 years old,³ and tobacco cessation in early midlife is associated with a substantial decline in

88 mortality risk for women.^{4,5} In addition, maternal smoking is the major determinant of child's passive

89 smoking⁶ and smoking initiation.⁷ Smoking prevention for women, especially mothers, in early

90 midlife, is therefore a significant international public health goal.

91 We examined the association between purpose in life (PIL) and tobacco use in women in

92 early midlife. PIL is a component of psychological eudaemonic well-being, and refers to the extent to

93 which individuals regard their own life as meaningful.⁸ Previous studies, which have mainly

94 examined elderly populations, have shown that a higher sense of PIL is associated with reduced risk

95 for diseases (e.g. Alzheimer's disease,⁹ myocardial infarction,¹⁰ stroke,¹¹ cerebral infarctions¹²) and

96 with better physical function¹³ and lower mortality.¹⁴⁻¹⁹ A growing body of research indicates the

97 existence of links between PIL and health behaviours²⁰ (e.g. use of preventive health care services,²¹

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2 98 daily exercise,²²⁻²⁴ maintenance of a healthy diet,^{25 26} preventive behaviours for breast cancer.²³).
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5 99 Recent systematic review showed that greater PIL is related to a range of better health outcomes for
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8 100 older adults.²⁷ The significance of PIL on better health is recently recognized cross-culturally (e.g.
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11 101 Ikigai in Japanese). Recent evidence demonstrated that PIL was associated with healthy
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14 102 glucoregulation among Japanese adults,²⁸ which had also demonstrated in Western countries.²⁹ In
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17 103 contrast, lower PIL is associated with detrimental health behaviours. Previous research in this area
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20 104 has mainly concentrated on the association between PIL and addiction.³⁰⁻³³

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22 105 Previous studies suggested that interventions and promotions focusing on psychological
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25 106 factors were important for smoking prevention and cessation among women. Meta-analyses have
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28 107 shown that women have more difficulty maintaining long-term smoking cessation than men,³⁴ and
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31 108 nicotine replacement therapy for smoking cessation is less effective in women than in men, in
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34 109 particular for supporting long-term maintenance of smoking cessation.³⁵ Another meta-analysis
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37 110 demonstrated that motivational interviewing, which is a psychological approach used to enhance PIL
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40 111 among people with addictive behaviours, could be effective for tobacco cessation.³⁶

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42 112 Purpose in life might be a significant psychological factor for promoting tobacco cessation
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45 113 among women. However, relatively little is known about the association between PIL and tobacco
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48 114 use, with no study to date examining this association in women in early midlife. A previous survey
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51 115 on 341 adults in Hungary³⁷ demonstrated that daily smokers had lower PIL than non-smokers,
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54 116 although the sample was limited to a small number and did not focus on women in early midlife. In
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3 117 the current study, we hypothesized that PIL is inversely associated with tobacco use among early
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5 118 midlife mothers, even after controlling for demographic variables and the effect of psychological
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8 119 distress. Psychological distress (depression and/or anxiety) often co-occurs with tobacco use.³⁸⁻⁴⁵
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11 120 Since psychological distress (ill-being) is inversely associated with PIL^{8 46 47} and is positively
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14 121 associated with substance abuse,^{31 32} it could confound associations between PIL and tobacco use.
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17 122 We also hypothesized that PIL is inversely associated with the amount of tobacco consumption.
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124 **METHODS**

126 **Study design, sample, and survey procedure**

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128 This study used data from the Tokyo Early Adolescence Survey (T-EAS)^{48 49} which was
129 originally designed as a baseline survey for the Tokyo Teen Cohort, a currently ongoing longitudinal
130 cohort study (URL: <http://ttcp.umin.jp/index.html>). The T-EAS is a multidisciplinary survey of
131 10-year-old adolescents and their primary caregivers (98.5% mothers). The T-EAS contains
132 questions about tobacco use, PIL, and psychological distress, as well as a variety of other potentially
133 confounding variables. Participants were randomly recruited from the resident registries of three
134 municipalities in Tokyo: Setagaya Ward, Mitaka City, and Chofu City. Participants were sent
135 invitation letters on or around the child's tenth birthday. The survey was completed in two home

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3 136 visits. During the first visit, written informed consent from the primary caregiver (generally the
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5 137 mother) was obtained; participants were then asked to complete the questionnaires at home before
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8 138 the second visit. During the second visit, both the adolescent and the primary caregiver were each
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11 139 asked to complete the self-report questionnaires separately. The questionnaires were enclosed in
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14 140 envelopes by the respondents immediately after completion. In addition, the primary caregiver
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17 141 responded to a semi-structured interview. All data were collected anonymously. The T-EAS was
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20 142 conducted by three research institutes: Tokyo Metropolitan Institute of Medical Science, The
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22 143 University of Tokyo, and SOKENDAI (The Graduate University for Advanced Studies). This survey
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25 144 was approved by the ethics committees of these three institutes.
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31 146 **Participants**

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37 148 A total of 4,478 children and their primary parents participated in the Tokyo Early
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40 149 Adolescence Survey (T-EAS) (response rate 43.8%). We used the primary parent data for the
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43 150 purposes of the current study. Of the 4,478 respondents, 68 were men, and were hence excluded to
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46 151 focus the investigation on the association between PIL and tobacco use in women. An additional 347
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49 152 female respondents' data were excluded due to incomplete answers to the questions on tobacco use,
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52 153 PIL, psychological distress, or other confounding variables. The final dataset therefore contained
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55 154 data from 4,063 respondents.
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Measures

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Tobacco Use

159 Respondents were asked whether they used tobacco. Those who answered 'yes' were
160 subsequently asked about the number of cigarettes they smoked per day. A binary variable was
161 created ('0: non-smokers' versus '1: smokers'), based on the first question. Respondents were then
162 split into: '0: non-smokers', '1: light smokers (less than half a pack [= 10 cigarettes] per day)', and
163 '2: moderate to heavy smokers (more than or equal to half a pack per day)', to assess potential
164 dose-response effects.

165

Purpose in Life

167 PIL was assessed using a 14-item version of the Purpose in Life scale derived from Ryff's
168 Psychological Well-Being scales.⁸ The scale included items such as 'I have a sense of direction and
169 purpose in life', and 'My daily activities often seem trivial and unimportant to me' (reverse coded).
170 Each item was rated on a 6-point Likert scale (1: strongly disagree; 6: strongly agree) and scores
171 were summed, so that continuous scores ranged from 14 to 84. Higher scores indicated a higher
172 sense of PIL.

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3 174 Psychological Distress
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5 175 Psychological distress was assessed using the K6.⁵⁰ This survey contains six items,
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8 176 assessing how frequently during the past 30 days respondents felt: i) so depressed that nothing could
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11 177 cheer them up, ii) hopeless, iii) restless or fidgety, iv) that everything was an effort, v) worthless, and
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14 178 vi) nervous. Each item was scored on a 5-point Likert scale (0: never; 4: most of the time). Scores
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17 179 were summed, with the resulting raw scores ranging from 0 to 24. Higher scores indicate more
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20 180 frequent psychological distress during the past 30 days.
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25 182 Other covariates
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28 183 The following covariates were examined for their potential confounding effects: age,
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31 184 educational attainment, marital status, annual family income, and frequency of alcohol consumption.
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34 185 High socioeconomic status (represented by educational attainment and annual family income here) is
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37 186 known to be associated with higher PIL,⁴⁶ and socioeconomic disadvantage is a risk factor for
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40 187 tobacco use.⁵¹⁻⁵⁴ Educational attainment was coded as follows: '1: junior high school or lower', '2:
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43 188 high school', '3: technical or junior college', and '4: 4-year university or higher'. Marital status was
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46 189 dichotomized as '1: yes' or '0: no', depending on whether the respondent was in a marriage or
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49 190 marriage-like relationship. Family income over the past year was divided into four categories: '1:
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52 191 less than 4 million yen', '2: 4–6 million yen', '3: 7–9 million yen', and '4: over 10 million yen'.
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54 192 Frequency of alcohol consumption was assessed using a 5-point Likert scale (0: do not drink; 4:
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8 195 Statistical analyses

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11 196 Cross tabulation, chi-square tests and residual analyses were conducted to test the

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14 197 differences between three groups based on the amounts of tobacco used (none, light, and moderate to

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17 198 heavy smokers), and covariates in categorical variables as well as ANOVAs were used in continuous

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20 199 variables. Correlation coefficients among all variables also examined. We conducted binomial

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23 200 logistic regression analyses (using a binary dependent variable: non-smokers vs. smokers) to test the

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26 201 association between PIL and tobacco use. The PIL score was standardized to report odds ratios per

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29 202 one standard deviation change of PIL scores. Logistic regression model 1 was unadjusted for

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32 203 covariates; model 2 was adjusted for socioeconomic covariates: age, education, marital status, and

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35 204 family income; model 3 was further adjusted for alcohol consumption; and finally, model 4 was

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38 205 further adjusted for psychological distress. In order to further examine the relationship between PIL

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41 206 and tobacco use, we conducted multinomial logistic regression analyses to assess the effect of PIL on

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44 207 the degree of tobacco use. Regression models 5 to 8 were identical to models 1 to 4, except that the

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47 208 dependent variable was multivariate: non-smokers, light smokers, and moderate or heavy smokers.

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51 210 Patient involvement

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54 211 Patients were not involved in developing the study hypothesis, recruitment, outcome measures, study

212 design, or implementation. Patients were not involved in interpretation or writing up on the results.

213 There are no plans to disseminate the results of the research to study participants or the relevant

214 patient community.

215

216 **RESULTS**

217

218 **Prevalence of smokers and corresponding descriptive statistics**

219

220 Of the 4,063 respondents (mean age 42.0 years, standard deviation 4.2; 95.8% married;

221 40.1% achieved a degree from a 4-year university or higher; 8.8% had family income less than 4

222 million yen), 324 (8.0%) were smokers. 204 (5.0%) were light smokers, 120 (3.0%) were moderate

223 to heavy smokers. Chi-square tests and ANOVA indicated that inverse associations were clearly

224 evident between tobacco use and PIL, age, education, marital status, and annual family income

225 (Table 1). Residual analyses indicated that lower educational attainment (light smokers with junior

226 high school or lower education [adjusted residuals = 6.9, $p < .01$] and those with high school

227 education [adjusted residuals = 6.9, $p < .01$]; moderate or heavy smokers with junior high school or

228 lower education [adjusted residuals = 7.0, $p < .01$] and those with high school education [adjusted

229 residuals = 7.6, $p < .01$]), not being married (light smokers without being married [adjusted residuals

230 = 4.8, $p < .01$]; moderate to heavy smokers without being married [adjusted residuals = 8.3, $p < .01$]),

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3 231 lower family income (light smokers with the lowest family income (less than 4 million yen)
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5 232 [adjusted residuals = 6.1, $p < .01$] and those with the second lowest family income (4 to 6 million
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8 233 yen) [adjusted residuals = 2.6, $p < .01$]; moderate to heavy smokers with the lowest family income
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11 234 [adjusted residuals = 6.7, $p < .01$] and those with the second lowest family income [adjusted residuals
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14 235 = 4.7, $p < .01$]), and the most frequent alcohol use (light smokers with the most frequent alcohol
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17 236 consumption (more than 4 times a week) [adjusted residuals = 6.6, $p < .01$]; moderate to heavy
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20 237 smokers with the most frequent alcohol use [adjusted residuals = 2.7, $p < .01$]) were associated with
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22 238 increasing tobacco use. Psychological distress was higher in smokers than in non-smokers (Table 1).
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25 239 On the other hand, the highest alcohol consumption was reported by light smokers (Table 1). PIL was
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28 240 positively correlated with age, educational attainment, family annual income while negatively
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31 241 correlated with tobacco consumption and psychological distress (Table 2). Tobacco consumption was
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34 242 positively correlated with alcohol consumption and psychological distress while negatively
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37 243 correlated with age, educational attainment, marital status and family annual income (Table 2). Age,
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40 244 educational attainment and family annual income were positively correlated among each other.
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43 245 Marital status was positively correlated with educational attainment and family annual income.
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46 246 Psychological distress was positively correlated with age while negatively correlated with marital
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49 247 status and family annual income (Table 2).
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51 248 *[Insert Table 1 about here]*

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53
54 249 *[Insert Table 2 about here]*

250

251 The association between PIL and tobacco use

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253 Table 3 shows the binominal odds ratios for tobacco use compared to no smoking. PIL was
254 strongly inversely associated with tobacco use in the analysis without covariates (Model 1). The odds
255 ratio was not attenuated after adjusting for socioeconomic variables (Model 2). This was also the
256 case after adjusting for alcohol consumption (Model 3) and finally, for psychological distress (Model
257 4). With regard to the covariates in the fully adjusted model, educational attainment, marital status,
258 and family annual income were inversely associated with tobacco use. There was a positive
259 association between tobacco use and frequency of alcohol consumption. Psychological distress was
260 not associated with tobacco use.

261

262

[Insert Table 3 about here]

263

264 The association between PIL and amount of tobacco consumption

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266 Figure 1 shows the odds ratios for smoking consumption, produced by multinomial logistic
267 regressions comparing light and moderate to heavy smoking against the no smoking reference
268 category. Without any adjustment (Model 5), PIL was inversely associated with both light and

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3 269 moderate to heavy smoking (light smoking: OR = 0.77, 95%CI: 0.67-0.89, $p < .001$; moderate to
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5 270 heavy smoking: OR = 0.62, 95%CI: 0.52-0.74, $p < .001$). The odds ratios remained significant after
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7
8 271 adjusting for socioeconomic covariates (Model 6: light smoking: OR = 0.86, 95%CI: 0.74-1.00, $p =$
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11 272 0.046; moderate to heavy smoking: OR = 0.72, 95%CI: 0.59-0.87, $p < .001$) and further adjustment
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14 273 for alcohol consumption (Model 7: light smoking: OR = 0.86, 95%CI: 0.74-0.99, $p = 0.041$;
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17 274 moderate to heavy smoking: OR = 0.71, 95%CI: 0.59-0.87, $p < .001$). Adjusting further for
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20 275 psychological distress (Model 8), the association between PIL and light smoking was not significant
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23 276 (OR = 0.87, 95%CI: 0.74-1.02, $p = 0.079$). On the other hand, the odds ratio for moderate to heavy
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26 277 smoking was not attenuated after adjustment for any of the aforementioned variables (OR = 0.70,
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28 278 95%CI: 0.57-0.86, $p < .001$; See Figure 1).

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34 280 *[Insert Figure 1 about here]*
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38 39 282 **DISCUSSION**

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45 284 In a community-based sample of mothers in early-middle age, we found that PIL was
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48 285 inversely associated with tobacco use after controlling for age, education, marital status, family
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51 286 income, and alcohol use. Importantly, this was also the case even after taking psychological distress
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54 287 into account. PIL was also inversely associated with the risk of moderate to heavy tobacco

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3 288 consumption even after controlling for covariates. This result is consistent with that of a previous
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5 289 study on a community sample in Hungary.³⁷ We confirmed the association between PIL and tobacco
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8 290 use with a large population-based sample of women in early midlife in Japan.
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10
11 291 It is possible that individuals with higher PIL are likely to invest in healthy behaviours
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14 292 because they feel that their lives are meaningful, have a greater will to live and, therefore, are more
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17 293 proactive in taking care of their health²¹ (e.g., by the avoidance of smoking). They may also be
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20 294 motivated to acquire knowledge regarding health maintenance (i.e., the knowledge about how
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23 295 detrimental smoking is). In contrast, since those low in PIL lack a high sense of life's
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26 296 meaningfulness, it may seem pointless for them to protect their health, and they may prefer
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28 297 short-term gratification, such as that obtained through tobacco use.
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31 298 The association between PIL and tobacco use was robust even when controlling for
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34 299 psychological distress. It may suggest a relationship between a lack of eudaemonic well-being (PIL)
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37 300 and tobacco use, rather than a relationship between ill-being (psychological distress) and tobacco
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40 301 use. Mental well-being and mental illness are correlated but belong to separate continua, with
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43 302 well-being referring to the presence of positive feelings and positive functioning, rather than just the
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45 303 absence of mental illness.^{55 56}
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48 304 The present results suggest that increasing PIL may be a valuable target of intervention for
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51 305 reducing tobacco use, as well as for reducing substance abuse.³² PIL is modifiable^{57 58} and increasing
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54 306 awareness of one's values or long-term goals in life could increase the sense of PIL.^{59 60} A systematic
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3 307 review indicated positive psychological intervention (PPI) had an impact on improving
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5 308 psychological well-being,⁶¹ as well as a meta-analysis showed behavioural intervention had a
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8 309 moderate effect on improving psychological well-being including PIL.⁶² A new community-based
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11 310 group intervention to promote psychological well-being has been developed and had a positive effect
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14 311 of improving PIL.⁶³ Promotion focusing on increasing PIL might be effective in reducing tobacco
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17 312 use in public settings.

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20 313 This study is limited of course, in its capacity to determine causality, since the data were
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23 314 cross-sectional. Longitudinal studies should be conducted in order to determine whether PIL has a
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26 315 role in tobacco use. We are currently conducting a subsequent longitudinal cohort study (Tokyo Teen
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29 316 Cohort Study), which will further clarify causality between PIL and tobacco use among mothers. The
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32 317 sample was limited only to mothers and we could not examine the association among early-middle
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35 318 aged women without children. Further studies including them would be needed. Additionally, given
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38 319 that parental smoking, especially maternal smoking, is the major determinant of passive smoking⁶
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41 320 and smoking initiation⁷ in children, follow-up studies should examine the transgenerational effects of
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44 321 mothers' tobacco use on the initiation of smoking in their children. The relatively low response rate
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47 322 (43.8%) was also a limitation of the study. A recent study indicated that response rates of national
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50 323 cross-sectional surveys in Japan have declined in the recent decade (from around 70% to 50%).⁶⁴
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53 324 One reason would be that many apartment buildings in Tokyo have recently adopted an automated
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56 325 system that enables residents talk with visitors at the locked gate through video. It allows potential

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3 326 respondents to make a decision of refusing participation without having a face-to-face encounter
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5 327 with the field worker.⁶⁴ In future study, we should consider how to overcome this obstacle to achieve
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8 328 higher response rate in general population survey in Tokyo.
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11 329 In summary, in a large community-based study, we found that high PIL is associated with
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14 330 lower consumption of tobacco among mothers, after controlling for a range of potential confounds,
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17 331 including psychological distress. Our hypothesis, that PIL is independently and inversely associated
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20 332 with tobacco use, was therefore confirmed. This study may contribute to our understanding of the
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23 333 psychology of smoking behaviour and shed light on the target for intervention to reduce tobacco use
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26 334 among early midlife mothers.
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31 336 **Contributors**

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34 337 YM, SY, SA, SKoike, AN, MHH and KK involved in launching and maintaining the survey.
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37 338 SF, SKanata and KE have mainly contributed to data collection. MN, SLH and MR mainly
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40 339 contributed to design the study and proposing the analysis and interpretation of data. YM and SY
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43 340 wrote the first draft of the manuscript and all the other authors have critically reviewed it. All authors
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46 341 approved the final version of the manuscript.
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48 342

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26 353 in the decision to submit it for publication.
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31 355 **Competing interests**

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34 356 None.
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38 39 358 **Ethics approval**

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42 359 This study was conducted by three research institutes: Tokyo Metropolitan Institute of Medical
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45 360 Science, The University of Tokyo, and SOKENDAI (The Graduate University for Advanced
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48 361 Studies). This study was approved by the ethics committees of these three institutes.
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52 53 54 363 **Data sharing statement**

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3 364 This study was planned and conducted in accordance with the ethics committee of Tokyo
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5 365 Metropolitan Institute of Medical Science. When applying to the research ethics committee for the
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8 366 data set, the authors did not request this to be released as public data. However, the data can be made
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11 367 available to all interested researchers upon request to Dr. Atsushi Nishida, Ph.D.
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14 368 (nishida-at@igakuken.or.jp).
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Table 1. Descriptive statistics for T-EAS variables broken down by tobacco use

	Non-smokers	Light smokers	Moderate to heavy smokers	<i>p</i>
N (%)	3739 (92.0)	204 (5.0)	120 (3.0)	
Purpose in Life, mean (standard deviation [SD])	57.3 (9.7)	54.8 (9.8)	52.6 (9.9)	<.001
Age, mean (SD)	42.0 (4.1)	41.2 (5.0)	40.5 (4.8)	<.001
Education, n (%)				
Junior high school or lower	22 (0.6)	12 (5.9)	9 (7.5)	<.001
High school	512 (13.7)	66 (32.4)	48 (40.0)	
Technical or junior college	1626 (43.5)	89 (43.6)	51 (42.5)	
4-year university or higher	1579 (42.2)	37 (18.1)	12 (10.0)	
Marital status, n (%)				
Yes	3613 (96.6)	182 (89.2)	97 (80.8)	<.001
No	126 (3.4)	22 (10.8)	23 (19.2)	
Family annual income, n (%)				
Less than 4 million yen	285 (7.6)	42 (20.6)	31 (25.8)	<.001
4–6 million yen	1022 (27.3)	74 (36.3)	57 (47.5)	
7–9 million yen	1162 (31.1)	55 (27.0)	21 (17.5)	
More than 10 million yen	1270 (34.0)	33 (16.2)	11 (9.2)	
Alcohol use, n (%)				
Non	1160 (31.0)	44 (21.6)	43 (35.8)	<.001
Less than once a month	563 (15.1)	35 (17.2)	9 (7.5)	
2–4 times a month	689 (18.4)	24 (11.8)	15 (12.5)	
2–3 times a week	594 (15.9)	21 (10.3)	16 (13.3)	
More than 4 times a week	733 (19.6)	80 (39.2)	37 (30.8)	
K6 (Psychological Distress), mean (SD)	2.9 (3.3)	3.4 (3.4)	3.5 (3.9)	.026

Table 2. Correlation coefficients among all variables.

	1	2	3	4	5	6	7	8
1 PIL	-	-0.092***	0.034*	0.147***	0.006	0.138***	0.013	-0.342***^a
2 Tobacco consumption		-	-0.067***	-0.203***	-0.144***	-0.172***	0.065***	0.038*
3 Age			-	0.048**	0.030	0.143***	0.020	0.055***
4 Education				-	0.076***	0.323***	-0.019	-0.023
5 Marital status					-	0.257***	-0.003	-0.054***
6 Family annual income						-	0.021	-0.048**
7 Alcohol use							-	-0.006
8 Psychological distress (K6)								-

Spearman's rank correlation coefficients except a correlation between continuous variables (PIL and K6; a: pearson correlation coefficient)

*** p < .001, ** p < .01, * p < .05

Table 3. Logistic regression coefficients for odds of tobacco use, with and without potential confounding variables

	Model 1		Model 2		Model 3		Model 4	
	OR [95% CI]	<i>p</i>	OR [95% CI]	<i>p</i>	OR [95% CI]	<i>p</i>	OR [95% CI]	<i>p</i>
Purpose in Life	0.71 [0.63-0.80]	<.001	0.81 [0.71-0.91]	.001	0.80 [0.71-0.91]	<.001	0.80 [0.70-0.91]	.001
Age			0.98 [0.95-1.00]	.061	0.97 [0.95-1.00]	.043	0.97 [0.95-1.00]	.044
Education			0.44 [0.38-0.52]	<.001	0.45 [0.38-0.52]	<.001	0.45 [0.38-0.52]	<.001
Marital Status			0.41 [0.27-0.62]	<.001	0.41 [0.27-0.63]	<.001	0.41 [0.27-0.63]	<.001
Family Income			0.71 [0.62-0.82]	<.001	0.71 [0.62-0.81]	<.001	0.71 [0.62-0.81]	<.001
Alcohol Use					1.18 [1.10-1.28]	<.001	1.18 [1.10-1.28]	<.001
Psychological Distress							1.00 [0.96-1.04]	.974

529 OR: odds ratio, CI: confidence interval

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3 530 **Figure Captions**
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5 531 Figure 1
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11 533 **Figure 1. Odds ratios for purpose in life from multinomial logistic regression analysis**

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14 534 **predicting smoking consumption (reference: non-smoker) with and without potential**

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17 535 **confounding variables.**
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20 536
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22 537 Model 5: without any adjustment; Model 6: adjusting for socioeconomic covariates (educational

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25 538 attainment and family income); Model 7: adjusting for socioeconomic covariates and alcohol

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28 539 consumption; Model 8: adjusting for socioeconomic covariates, alcohol consumption and

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31 540 psychological distress. OR: Odds ratio.
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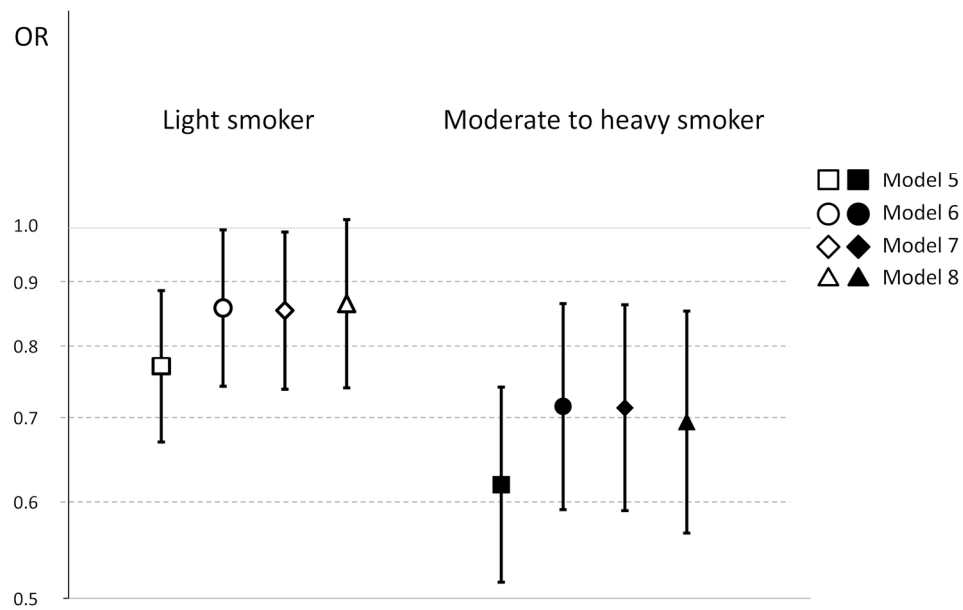


Figure 1. Odds ratios for purpose in life from multinomial logistic regression analysis predicting smoking consumption (reference: non-smoker) with and without potential confounding variables.

Model 5: without any adjustment; Model 6: adjusting for socioeconomic covariates (educational attainment and family income); Model 7: adjusting for socioeconomic covariates and alcohol consumption; Model 8: adjusting for socioeconomic covariates, alcohol consumption and psychological distress. OR: Odds ratio.

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No.	
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	1,3	
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3-4	
Introduction				
Background/ rationale	2	Explain the scientific background and rationale for the investigation being reported	6-8	
Objectives	3	State specific objectives, including any prespecified hypotheses	6-8	
Methods				
Study design	4	Present key elements of study design early in the paper	8-9	
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8-9	
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	8-9	
		<i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls		
		<i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants		
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed		-
		<i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case		
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9-11	
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9-11	
Bias	9	Describe any efforts to address potential sources of bias	8-9	
Study size	10	Explain how the study size was arrived at	9	
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	9-12	
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	11-12	
		(b) Describe any methods used to examine subgroups and interactions	-	
		(c) Explain how missing data were addressed	9	
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed	-	
		<i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed		
		<i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy		
		(e) Describe any sensitivity analyses	-	

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60**Results**

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12-13 Table 1
		(b) Give reasons for non-participation at each stage	-
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12-13 Table 1
		(b) Indicate number of participants with missing data for each variable of interest	-
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	-
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	-
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	-
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	12-13 Table 1
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13-14 Table 2 Figure 1
		(b) Report category boundaries when continuous variables were categorized	12-13 Table 1
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-

Discussion

Key results	18	Summarise key results with reference to study objectives	15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-17
Generalisability	21	Discuss the generalisability (external validity) of the study results	16-17

Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	17-18
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*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.