The Effect of Smoking in Midlife on Health-Related Quality of Life in Old Age

A 26-Year Prospective Study

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Background: Smoking shortens life expectancy by 7 to 10 years. However, it is unclear whether the enhanced longevity of nonsmokers produces increased disability and decreased quality of life during these extra final years. This study evaluates the long-term effect of smoking in midlife on health-related quality of life (HRQoL) in old age.

Methods: Prospective cohort study with a 26-year follow-up of 1658 white men (born 1919-1934) of similar socioeconomic status who were participating in the Helsinki Businessmen Study. All men were healthy at baseline in 1974, when cardiovascular risk factors and smoking habits were assessed. The participants were reevaluated with the use of mailed questionnaires in 2000; HRQoL was measured with the use of the RAND 36-Item Health Survey (similar to the Medical Outcomes Study Short-Form Health Survey) and related to the baseline smoking status. Total mortality through 2000 was determined from Finnish national registers.

Results: Participants who had never smoked (n=614) lived a mean of 10 years longer than heavy smokers (>20 cigarettes daily; n=188). Among survivors in 2000 (n=1131), the never-smokers had the highest (ie, best) scores on all RAND 36-Item Health Survey scales. The differences were greatest between never-smokers and heavy smokers, ranging from 4 points on the scale of social functioning to 14 points on the physical functioning scale. The physical component summary score showed a graded deterioration of HRQoL with an increasing number of cigarettes smoked daily (P=.01).

Conclusions: During the 26-year follow-up of this socioeconomically homogeneous male cohort, HRQoL deteriorated with an increase in daily cigarettes smoked in a dose-dependent manner. Never-smokers lived longer than heavy smokers, and their extra years were of better quality.


Numerous studies have demonstrated the various ill effects that the use of tobacco has on health, particularly by causing vascular, neoplastic, and respiratory tract diseases. Among men, smoking has been shown to shorten life by 7 to 10 years. In addition to increased morbidity, smoking is also linked to factors that may affect quality of life, such as poorer nutrition or lower socioeconomic status.

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Methods

Baseline Examination

In a longitudinal study, a cohort of originally healthy Finnish men was prospectively observed from 1964 through the 2000s and as-
essed for cardiovascular risk factors, mortality, morbidity, and quality of life. All participants were white businessmen or executives with similar socioeconomic and job status. Mean (SD) age in 1974 was 47.8 (4.1) years. The study population and methods have been described in detail elsewhere.10 This study was approved by the local ethics committee.

For this study, we analyzed the effect of smoking status in 1974 on mortality and HRQoL in 2000. In 1974, detailed smoking status was available for 2464 men. Of these, we excluded 581 men with any chronic disease or who were taking regular prescription medication and 160 men who reported smoking cigars or pipes. Therefore, all 1658 men included in this study were healthy, professionally active in positions of responsibility, and did not take regular medication or have signs of chronic diseases, including diabetes mellitus, cardiovascular disease, malignant neoplasms, psychiatric disorders, or alcoholism.

During baseline examinations, weight and height were measured, and body mass index was calculated as weight in kilograms divided by height in meters squared. Participants also reported their weight at age 25 years, which was used to calculate midlife weight gain (weight in 1974 − reported weight at age 25 years). Blood pressure and lipid levels were measured, and blood glucose level was measured 1 hour after a glucose load (1 g of oral glucose per kilogram of body weight). Alcohol consumption was assessed. One unit of alcohol (ie, a bottle of beer, a glass of wine, or 1 drink) was calculated to contain 14 g of alcohol. Participants also indicated quality of life in 1974 by rating their health and physical fitness on a 5-point scale (very good, good, fair, poor, or very poor).

Smoking status was assessed with a questionnaire. Participants were classified into 3 groups according to their reported smoking status in 1974: (1) never-smokers (n=614), defined as men who had never smoked regularly and were not currently smoking; (2) ex-smokers (n=650), defined as those who had been smokers before but had quit smoking by 1974; and participants who smoked (3) 1 to 10 cigarettes per day (n=87), (4) 11-20 cigarettes per day (n=119), or (5) more than 20 cigarettes per day (n=188). The duration of the smoking habit or the time before 1974 when ex-smokers quit smoking was not available.

THE 2000 SURVEY
In 2000, a questionnaire was mailed to all 1286 survivors, and 1131 (87.9%) responded. The questionnaire included items on demographic variables and lifestyle (such as alcohol consumption, physical activity, weight, and the latest measured blood pressure value), including current smoking status. In addition, the Finnish version of the RAND 36-Item Health Survey 1.011 (similar to the Medical Outcomes Study Short-Form Survey [SF-36]) was embedded in the questionnaire. The RAND-36/SF-36 is perhaps the most widely used instrument to measure health-related quality of life (HRQoL).12 It has been shown to be a reliable, valid, and responsive instrument in measuring HRQoL of older people.13 and it has been validated as a mailed questionnaire in the Finnish general population.14 The RAND-36 comprises 36 items that assess 8 domains of HRQoL: physical functioning, role limitations caused by physical health problems, role limitations caused by emotional problems, social functioning, emotional well-being, energy/fatigue, pain, and general health perception. All scale scores range from 0 to 100, with 100 representing the most favorable functioning or wellbeing. A difference of at least 3 points is considered to be clinically significant.15 The physical functioning scale has been shown to be comparable to other instruments measuring disability in the elderly.16 The 8 domains of RAND-36 are further aggregated into 2 summary measures: the physical and mental health component summary scores. These summary scores are standardized so that the mean (−SD) for the validated population is 50 (−10).

MORTALITY FOLLOW-UP
Total mortality of the study population through December 31, 2000, was retrieved from the National Population Information System of the Finnish Population Register Centre, which includes data from all Finnish citizens. Mortality information was available for all participants. The total follow-up time was as long as 26 years, generating 40 261 person-years of follow-up.

STATISTICAL METHODS
We used NCSS statistical software for the analyses (NCSS, Kaysville, Utah). In statistical analyses, 2-tailed tests were used and P <.05 was considered significant. Analyses of covariance were used to compare continuous variables. Logarithmic transformations were used for variables with skewed distributions. Trend and χ² tests were used to compare proportions, and Spearman rank coefficients were used to assess correlations. Differences in survival were analyzed using Kaplan-Meier curves and log-rank tests. Other risk factors were adjusted for in respective models.

BASELINE CHARACTERISTICS
Of 1658 men, 614 (37.0%) were never-smokers at baseline in 1974, and 650 (39.2%) had quit smoking earlier. There were 87 (5.3%), 119 (7.2%), and 188 (11.3%) participants who smoked 1 to 10, 11 to 20, and more than 20 cigarettes daily, respectively. The characteristics and cardiovascular risk factors for the different groups at baseline are presented in the Table. There were significant differences in several baseline variables among groups.

SMOKING, MORTALITY, AND HRQoL DURING FOLLOW-UP
In 2000, current smoking status was gathered from 1131 men. The median age of responders was 73 years (interquartile range, 70-76 years). The mean response rate was 87.9%. During follow-up, the cessation rate among smokers was substantial: 68.9% of those smoking more than 20 cigarettes to 82.1% of those smoking 1 to 10 cigarettes per day. The never-smokers had the highest (best) scores on all 8 RAND-36 scales, although the differences were not statistically significant for the scales expressing the mental...
The unadjusted association of smoking status and the number of cigarettes smoked daily at baseline in 1974 and mortality during the 26-year follow-up period. Arrows indicate the difference of survival in years between never-smokers and participants who smoked more than 20 cigarettes daily; vertical dotted line, survival to 73 years, the mean age at follow-up.

The physical component summary score showed a graded deterioration of HRQoL with an increasing number of cigarettes smoked daily (global P=.01) (Figure 3). However, in multiple comparisons, only the difference between never-smokers and smokers of more than 20 cigarettes daily reached statistical significance.

The differences in RAND-36 scale scores remained similar among the smoking groups, adjusting for age and perceived health status in 1974. Differences in physical functioning (P<.001) and bodily pain (P=.04) scores remained statistically significant. The difference in physical component summary scores did not quite reach statistical significance (P=.09).

In a more extensive model adjusted for age and several variables in 1974 (perceived health, body mass index, 1-hour–postload glucose level, and alcohol consumption), the 8.5-point difference in the RAND-36 scale of physical functioning between never-smokers and those smoking more than 20 cigarettes daily remained statistically significant (P=.01).

Ex-smokers did not generally seem to reach the RAND-36 points of never-smokers during the 26-year follow-up.

CROSS-SECTIONAL ANALYSIS OF HRQoL AND SMOKING STATUS IN 2000

To compare our longitudinal findings with a cross-sectional setting in this cohort, we also carried out an analysis of RAND-36 among survivors according to their smoking status (smoking/not smoking) in 2000. In this analysis, the nonsmoking group also includes ex-smokers. It must be noted that between 1974 and 2000

Table. Baseline Characteristics of 1658 Participants According to Smoking Status in 1974a

<table>
<thead>
<tr>
<th>Variable</th>
<th>Never-smokers (n=614)</th>
<th>Ex-smokers (n=650)</th>
<th>Current Smokers, Cigarettes/d</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-10 (n=87)</td>
<td>11-20 (n=119)</td>
<td>&gt;20 (n=188)</td>
</tr>
<tr>
<td>Age in 1974, y</td>
<td>47.2 (0.2)</td>
<td>48.1 (0.2)</td>
<td>47.7 (0.4)</td>
</tr>
<tr>
<td>Body mass indexc</td>
<td>25.5 (0.1)</td>
<td>26.2 (0.1)</td>
<td>26.1 (0.3)</td>
</tr>
<tr>
<td>Weight gain from age 25 y to baseline, kg</td>
<td>8.5 (0.3)</td>
<td>11.0 (0.3)</td>
<td>10.3 (0.9)</td>
</tr>
<tr>
<td>Blood pressure, mm Hg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systolic</td>
<td>141 (1)</td>
<td>143 (1)</td>
<td>142 (2)</td>
</tr>
<tr>
<td>Diastolic</td>
<td>91 (1)</td>
<td>93 (1)</td>
<td>90 (1)</td>
</tr>
<tr>
<td>Cholesterol level, mg/dL</td>
<td>236 (2)</td>
<td>239 (2)</td>
<td>239 (4)</td>
</tr>
<tr>
<td>Triglyceride level, median (interquartile range), mg/dL</td>
<td>115 (80-150)</td>
<td>124 (97-168)</td>
<td>132 (97-212)</td>
</tr>
<tr>
<td>Blood glucose level, median (interquartile range), mmol/L</td>
<td>115 (97-137)</td>
<td>123 (101-153)</td>
<td>123 (95-146)</td>
</tr>
<tr>
<td>Alcohol consumption, median (interquartile range), g/wk</td>
<td>84 (28-140)</td>
<td>136 (56-238)</td>
<td>140 (81-266)</td>
</tr>
<tr>
<td>Perceived physical fitness as good or very good, %</td>
<td>61.7</td>
<td>58.0</td>
<td>49.5</td>
</tr>
<tr>
<td>Perceived physical health as good or very good, %</td>
<td>44.1</td>
<td>38.6</td>
<td>33.0</td>
</tr>
</tbody>
</table>

SI conversion factors: To convert cholesterol to millimoles per liter, multiply by 0.0259; glucose to millimoles per liter, multiply by 0.0555; triglycerides to millimoles per liter, multiply by 0.0113.

a Data are given as mean (SE) unless otherwise indicated. Data, except age in 1974, are adjusted for age. In comparisons, log-transformed values were used for triglyceride level, glucose level, and alcohol consumption.

b Calculated by analysis of covariance.

c Calculated as weight in kilograms divided by height in meters squared.

d Measured (in whole blood, not serum samples) 1 hour after administration of 1 g of oral glucose per kilogram of body weight.

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In a more extensive model adjusted for age and several variables in 1974 (perceived health, body mass index, 1-hour–postload glucose level, and alcohol consumption), the 8.5-point difference in the RAND-36 scale of physical functioning between never-smokers and those smoking more than 20 cigarettes daily remained statistically significant (P=.01).

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To compare our longitudinal findings with a cross-sectional setting in this cohort, we also carried out an analysis of RAND-36 among survivors according to their smoking status (smoking/not smoking) in 2000. In this analysis, the nonsmoking group also includes ex-smokers. It must be noted that between 1974 and 2000

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many smokers had died and the ex-smokers in 2000 may have quit smoking owing to illness. Only 78 of 1131 men (6.9%) were still smokers in 2000, but they represent a cohort of truly long-term smokers. Hence, the cross-sectional viewpoint is quite different from the original longitudinal perspective.

The smokers in 2000 reported poorer scores on all 8 RAND-36 scales, and scores on 5 scales (physical functioning, energy/vitality, social functioning, role limitations owing to mental problems; RP, role limitations owing to physical health; SF, social functioning; and VT, energy/vitality) were significantly worse when adjusted for age and perceived health in 1974. Role limitations owing to physical health did not quite reach statistical significance ($P = .07$). Also, the 2.7-point difference in the mental health component summary score was significantly better for nonsmokers ($P = .03$), whereas the 1.8-point difference in physical component summary score was not statistically significant ($P = .10$). Therefore, although the differences in the physical domains of quality of life were more substantial in the longitudinal results according to smoking status in 1974, the worsening of the mental and social domains of HRQoL in smokers became statistically significant in this cross-sectional analysis.

Figure 2. The age-adjusted association of smoking status at baseline in 1974 and health-related quality of life as RAND 36-Item Health Survey (RAND-36) scores in 2000. BP indicates bodily pain; GH, general health; MH, mental health/emotional well-being; PF, physical functioning; RE, role limitations owing to mental problems; RP, role limitations owing to physical health; SF, social functioning; and VT, energy/vitality.

Our study prospectively followed up a cohort of initially healthy men of similar socioeconomic status for whom smoking and risk factor data in midlife and qual-
ity of life and mortality data from 26 years later were available. Although many smokers had quit smoking between the baseline investigation in 1974 and the follow-up examination in 2000, the effect of baseline smoking status on mortality and the quality of life in old age remained strong. Cigarette smoking had a dose-dependent effect on mortality and RAND-36 scale scores, with heavy smokers having the worst results for both endpoints. In all, the results presented here are troubling for those who were smoking more than 20 cigarettes daily 26 years earlier; in spite of the 68.9% cessation rate during follow-up, 44.1% of the originally heavy smokers had died, and those who survived to the mean age of 73 years had a significantly lower physical HRQoL than never-smokers.

**SMOKING AND HRQoL**

In the present cohort, as well as in previous studies, a low cardiovascular risk factor profile in middle-age indicates better HRQoL later in life. But how lifetime smoking by itself affects HRQoL has not been clearly demonstrated. The effect of smoking on HRQoL has been investigated in cross-sectional studies of the general population, and shorter follow-up studies have been conducted for multiple diseases, showing the benefits of nonsmoking in these subgroups. However, few prospective studies have examined the effect of long-term smoking on HRQoL in old age. Likewise, few follow-up studies have investigated the HRQoL of ex-smokers. The evaluation of the association between smoking and HRQoL is complex because smoking is linked to many confounding factors, such as sex, sedentary lifestyle, educational level, and social class. Furthermore, the reasons for cessation range from psychosocial factors to ill health. Therefore, confounding may be difficult to control for in studies of the general population.

In our cohort, the exceptionally long follow-up time provides a unique opportunity to observe the effect of smoking in midlife on HRQoL in old age. The results are based on a large cohort of men with similar socioeconomic and job status. At baseline, participants were all healthy and had no chronic diseases and took no medications. The availability of data on several risk factors at baseline allowed us to perform multivariate adjustment for potential confounding factors, including alcohol consumption. Mortality follow-up with national registers was reliable. The HRQoL was measured with a widely used and validated instrument (RAND-36/SF-36), and there was an overall response rate of 88%. In addition, a particular strength of our study is that, although there were several conservative biases that could dilute the results, our data remained statistically significant. Consequently, our findings may better reflect the loss of HRQoL owing to smoking itself instead of preexisting disease.

The following factors possibly diluting the differences deserve consideration. First, because our cohort was healthy at baseline, we may have excluded men with tobacco-related diseases, producing a “healthy participant” bias. We did not investigate at which age each smoker began smoking, but because most smokers begin during adolescence, we can speculate that, in our cohort, many had been smoking for as long as 30 years in 1974. This probably explains the differences in perceived health at baseline. Second, the high rate of cessation of smoking during follow-up is likely to have diluted some of the harmful effects of smoking in our cohort, because quitting smoking has been shown to be beneficial for HRQoL. Cessation of smoking after baseline owing to illness may, in turn, negatively affect HRQoL and produce relatively better scores for smokers than quitters in 2000. The longitudinal design in the present study helps to investigate this possible bias. In fact, the physical functioning of the 78 men who were still smoking in 2000 was, on average, better than that of participants who were heavy smokers in 1974.

Similarly, there is a “healthier user” bias to be expected in the analysis of the HRQoL of surviving smokers in 2000. This cross-sectional analysis compares current nonsmokers, many of whom may have quit smoking because of illness, disability, or worse quality of life, with surviving smokers who were healthy enough to continue decades of smoking. Yet, the HRQoL of those 78 men still smoking in 2000, most of whom were likely lifetime smokers, was significantly worse compared with current nonsmokers. And the worse status of smokers extended to the mental and social components of the RAND-36 as well.

Finally, because only survivors were assessed, and participants with poorer health are less likely to provide information, important data may be lost in late-life studies such as this one, which favors the group with the most deaths and missing data. Our 2000 questionnaire was conducted when mortality among the cohort was already considerable and significantly different among groups. It is therefore possible that there were more nonrespondents owing to ill health in the smokers’ groups, again tending to weaken the negative effect of smoking on HRQoL in our study.

**LIMITATIONS**

The high cessation rate during follow-up may be regarded as a limitation, but it reflects the real-life change in the smoking habits of educated men from 1974 to 2000 in Finland and elsewhere. Another limitation is that we did not have any update of the changes in participants’ smoking habits between 1974 and 2000. However, the aim of the present study was to investigate the baseline smoking status in relation to the end points in 2000. Furthermore, there were only 3 men who took up smoking between 1974 and 2000.

Another limitation is that we could not measure the baseline HRQoL with RAND-36/SF-36 in 1974 because this instrument was not used at that time. Assessed with the 5-point health measure, smokers already reported their perceived health status to be inferior to never-smokers at baseline. There are data demonstrating that the HRQoL of healthy young smokers already differs from nonsmokers in the first years of smoking. This indicates that those who are apt to take up smoking may have intrinsic psychological features, which are mirrored in their quality of life before the specific effects of smoking are evident. This may also partly explain the baseline differences be-
between the groups in our study. However, the differences in HRQoL between the smoking groups in 2000 remained essentially similar when adjusted for age and subjective health in 1974.

Low socioeconomic status is associated with lower HRQoL. Although the socioeconomic similarity of our cohort has important advantages when evaluating the mechanistic association between smoking, mortality, and quality of life, extrapolation of the results to the general population and to women must be done cautiously.

CLINICAL AND PUBLIC HEALTH IMPLICATIONS

Compared with heavy smokers, never-smokers had a mean life expectancy that was 10 years longer. They also enjoyed significantly better physical health status (assessed by the physical functioning scale of RAND-36) in late life, which was equal to an age difference of 10 years in the general population. This postmenopause of physical disability among never-smokers could implicate a similar lifetime burden of care among smokers and never-smokers, despite the longer lifespan of the latter. However, whether there is true compression of morbidity in the never-smokers' group, ie, a net reduction of disability, can only be assessed later as the cohort ages.

From a prevention point of view, our findings of the smoking/HRQoL relationship add to the view of the burden of smoking on society, and might at an individual level encourage smoking cessation. The argument of better quality of life may be especially meaningful for the aging smoker but, as our results show, for the best HRQoL, the habit should not be started at all. The highly addictive nature of nicotine is revealed by the persistence of the smoking habit in spite of the declining HRQoL among older heavy smokers. For those not able to quit smoking, reduction may also be beneficial because mortality and HRQoL showed a dose-dependent trend according to the number of cigarettes smoked daily.

CONCLUSION

Our longitudinal study shows that smoking status in middle age predicted HRQoL in old age, 26 years later, as well as mortality in a cohort of men who were healthy and socioeconomically homogeneous at baseline. Compared with never-smokers, heavy smokers lost about 10 years of their life-expectancy, and those who survived experienced a significant decline in their quality of life.

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