Excess injury mortality among smokers: a neglected tobacco hazard

C P Wen, S P Tsai, T Y Cheng, H T Chan, W S I Chung, C J Chen

Objective: To assess the mortality risks from injuries for smokers and ex-smokers and to quantify the mortality burden of smoking from injury in Taiwan.

Methods: Smoking and ex-smokers’ mortality risks from injuries were compared with that of non-smokers in a merged cohort from Taiwan. A total of 64,319 male subjects were followed up for 12–18 years. Relative risks (RR) (adjusted for age and alcohol use) and 95% confidence intervals (CI) for cause specific injury deaths were calculated using the Cox proportional hazard model. Relative risks of injury mortality were also calculated to assess the presence of dose–response relations with daily smoking quantity.

Results: Alcohol use adjusted relative mortality risks for all injuries (RR 1.69, 95% CI 1.39 to 2.05) including those from motor vehicle accidents (RR 1.88, 95% CI 1.44 to 2.45) and non-motor vehicle accidents (RR 1.48, 95% CI 1.11 to 1.99) were significantly higher for smokers than non-smokers. Mortality was also increased for most subtypes of non-motor vehicle injuries including falls, fires, and job related injuries. Furthermore, these increases were dose dependent, with the heaviest smokers having the highest risk and the lightest smokers the lowest risk, and ex-smokers, no increase. In 2001, over one fifth (23%) of all male injury deaths in Taiwan was associated with smoking.

Conclusion: This study demonstrated the significant association between fatal injuries and smoking. This relation adds further weight to smoking cessation campaigns.

METHODS

This study was based on an analysis of a large cohort comprised of two subcohorts: one consisting of 71,361 individuals, mostly civil servants and teachers, who took the government sponsored annual physical examination programme initiated in 1989; and the other consisting of 66,161 individuals residing in both rural and urban towns from a community based follow up study, started in 1982. Each of the cohorts consisted of both sexes, but the analysis was limited to males 18 years of age and older (n = 64,319), as extremely low smoking rates among females yielded too few deaths for analysis. Vital status as of 31 December 2001 and causes of death information were ascertained through matches between the cohort members and a computerised national causes of death database. Causes of death were classified according to the ninth revision of the International classification of diseases (ICD-9). The increased mortality risk for smokers in this cohort has been reported elsewhere. We categorised all injury deaths (ICD-9 E800–E949) as MVA (motor vehicle accidents) (E 810–E829) and N-MVA (non-motor vehicle accidents) (E 839–E929). Within N-MVA, job related injuries were defined as those in ICD codes E916–E925, as many of those injuries were more likely to be associated with occupational than non-occupational activities.

Smoking and drinking histories of the studied subjects were obtained at the time of recruitment, among other lifestyle risk factors, from a written self administered questionnaire. Current smokers were those who stated they...
smoked daily. Virtually all (99.8%) current smokers in this study had smoked 100 or more cigarettes in their lifetime. Ex-smokers were those who smoked daily in the past but had quit. Never-smokers were primarily those who never smoked with only few (0.2%) who smoked less than 100 cigarettes in their lifetime. Drinkers were those who used alcohol (that is, wine, beer, or hard liquor) on a regular basis. Those who indicated they were occasional or party drinkers were not counted as drinkers in this study. As quantitative drinking data were only available for a portion of the cohort, the risks associated with different intensities of alcohol use were not analysed. Typical drinking patterns in Taiwan are different from those in Western countries. Relatively few Taiwanese are chronic alcoholics, and drinking problems stem more from binge drinking during social occasions.21

Relative risks (RR) and 95% confidence intervals (CI) for cause specific mortality were estimated using the Cox proportional hazard model, comparing smokers with non-smokers and adjusting for age and alcohol use. A similar analysis was also conducted adjusting for education (junior high school or lower, senior high school, and college and above), as a proxy for socioeconomic status or occupational group, as well as age and alcohol use. This analysis was conducted to assess the extent of the smoking–injury association that may be confounded by socioeconomic status differences between smokers and non-smokers. Smoking attributable fraction (SAF), as developed by the US Centers for Disease Control and Prevention (CDC),22 was applied, which was based on the following formula: $SAF = P \times \frac{RR - 1}{[P \times (RR - 1) + 1]}$, where $P$ = prevalence of adult smoking rate, and $RR$ = relative risks of specific causes of injury deaths among adult smokers compared with non-smokers.

SAM from injury is the product of SAF and mortality—that is, SAF times the national number of adult deaths from a specific cause of injury. It is to be noted that SAM from injury presented in this study represents only the estimated number of fatal injuries that could be associated with smoking.

RESULTS

Characteristics of the cohort are presented in table 1. The study cohort consisted of 64 319 males, with 40.2% identified as current smokers and 10.1% as ex-smokers. The average age of the cohort at recruitment was 46.5 years. A total of 687 681 person years were observed. The proportion of the cohort who had smoked 100 or more cigarettes in their lifetime. Never-smokers were primarily those who never smoked with only few (0.2%) who smoked less than 100 cigarettes in their lifetime. Drinkers were those who used alcohol (that is, wine, beer, or hard liquor) on a regular basis. Those who indicated they were occasional or party drinkers were not counted as drinkers in this study. As quantitative drinking data were only available for a portion of the cohort, the risks associated with different intensities of alcohol use were not analysed. Typical drinking patterns in Taiwan are different from those in Western countries. Relatively few Taiwanese are chronic alcoholics, and drinking problems stem more from binge drinking during social occasions.21

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| Table 1 Demographic summary of the cohort by smoking status |
|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|                             | Total                       | Smoker                     | Ex-smoker                   | Non-smoker                  |
| Number of subjects (%)      | 64319 (100.0)               | 25848 (40.2)               | 6515 (10.1)                 | 31956 (49.7)                |
| Person years                | 687681                      | 290076                     | 62785                       | 334821                      |
| Mean (SD) age (years)       | 46.5 (11.8)                 | 47.8 (12.0)                | 49.0 (11.9)                 | 45.0 (11.3)                 |
| Drinking                    |                             |                            |                            |                             |
| Number                      | 9604                        | 6212                       | 1173                        | 2219                        |
| Prevalence (%)              | 14.9                        | 24.0                       | 18.0                        | 6.9                         |
| Number of death             |                             |                            |                            |                             |
| All causes                  | 5346                        | 3393                       | 348                         | 1605                        |
| Non-intentional injuries    | 523                         | 333                        | 24                          | 166                         |
between smoking and drinking is well established. Our study found that a smoker’s risk for injury remained elevated even after adjusting for alcohol use. However, injury mortality risks were lower after additional adjustments were made for education, a proxy for socioeconomic status.

One suggested mechanism for the strong association is that smokers suffer from “nicotine withdrawal” symptoms, such as irritation and listlessness, most of the time when not smoking. In UK, increased workplace accidents were recorded on the “No smoking day” every year between 1987 and 1996, when large numbers of smokers attempted to abstain from smoking on those days.

Some have described smokers as having “performance decrements” while abstaining, as their mood and cognitive performance deteriorates within a few hours of beginning to abstain. Smoking while driving a car has been shown to increase the number of accidents and mortality risk. Distractions, lapses of manual dexterity, or blurred vision from smoke have all been suggested as responsible mechanisms of increased injury. In Taiwan, the smoker’s injury risks could further be exacerbated by riding motorcycles, since more than half of the male adult population in Taiwan owns motorcycles and is in sharp contrast to the much slower reduction of ex-smoker’s risks from other causes, such as coronary heart diseases or lung cancer. In a number of randomised trials in which smokers were randomised to smoking cessation programmes, the association between smoking and injury emerged. Thus, it is particularly encouraging for promoting smoking cessation to reduce fatal injuries.

Historically, smokers have claimed their right to smoke as long as smoking does not affect others. In this regard, societal concern has been mainly limited to the risk of non-smokers from exposure to second hand smoke, particularly when young children were affected. However, the fact that non-smokers may be at increased risk for various injuries (for example, fire, MVA, and job related accidents) caused by smokers has not been widely recognised. The right of

### Table 2

<table>
<thead>
<tr>
<th>Cause of deaths (ICD 9 codes)</th>
<th>Non-smokers</th>
<th>Current smokers</th>
<th>Ex-smokers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n RR</td>
<td>n RR 95% CI</td>
<td>n RR 95% CI</td>
</tr>
<tr>
<td>All non-intentional injuries (E800-E949)</td>
<td>166 1.00</td>
<td>333 1.69</td>
<td>1.39 to 2.05</td>
</tr>
<tr>
<td>MVA (E810-E829)</td>
<td>85 1.00</td>
<td>197 1.88</td>
<td>1.44 to 2.45</td>
</tr>
<tr>
<td>NIMVA (E850-E859)</td>
<td>78 1.00</td>
<td>29 1.45</td>
<td>1.11 to 1.99</td>
</tr>
<tr>
<td>Fall (E880-E888)</td>
<td>18 1.00</td>
<td>38 1.95</td>
<td>1.09 to 3.48</td>
</tr>
<tr>
<td>Fire (E890-E899)</td>
<td>2 1.00</td>
<td>5 1.78</td>
<td>0.32 to 9.77</td>
</tr>
<tr>
<td>Drowning (E910-E915)</td>
<td>16 1.00</td>
<td>19 1.00</td>
<td>0.50 to 2.01</td>
</tr>
<tr>
<td>Job related accidents (E916-E929)</td>
<td>5 1.00</td>
<td>13 2.91</td>
<td>1.004 to 8.42</td>
</tr>
<tr>
<td>Suicide (E950-E959)</td>
<td>15 1.00</td>
<td>26 1.37</td>
<td>0.70 to 2.68</td>
</tr>
</tbody>
</table>

RR not shown for causes of death <2.
CI, confidence interval.

#### Table 3

<table>
<thead>
<tr>
<th>Cause of deaths (ICD 9 codes)</th>
<th>&lt;10 cigs/day</th>
<th>11–20 cigs/day</th>
<th>&gt;20 cigs/day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n RR 95% CI</td>
<td>n RR 95% CI</td>
<td>n RR 95% CI</td>
</tr>
<tr>
<td>All non-intentional injuries (E800-E949)</td>
<td>166 1.00</td>
<td>189 1.76 1.41 to 2.20</td>
<td>38 2.27</td>
</tr>
<tr>
<td>MVA (E810-E829)</td>
<td>85 1.00</td>
<td>115 2.01 1.49 to 2.72</td>
<td>20 1.95</td>
</tr>
<tr>
<td>NIMVA (E850-E859)</td>
<td>78 1.00</td>
<td>72 1.52 1.09 to 2.14</td>
<td>17 2.58</td>
</tr>
<tr>
<td>Fall (E880-E888)</td>
<td>18 1.00</td>
<td>20 1.83 0.93 to 3.60</td>
<td>5 4.20</td>
</tr>
<tr>
<td>Fire (E890-E899)</td>
<td>2 1.00</td>
<td>3 1.47 0.22 to 9.84</td>
<td>1 –</td>
</tr>
<tr>
<td>Drowning (E910-E915)</td>
<td>16 1.00</td>
<td>6 0.58 0.21 to 1.55</td>
<td>4 2.23</td>
</tr>
<tr>
<td>Job related accidents (E916-E929)</td>
<td>5 1.00</td>
<td>8 3.36 1.03 to 10.97</td>
<td>2 5.72</td>
</tr>
<tr>
<td>Suicide (E950-E959)</td>
<td>15 1.00</td>
<td>16 1.64 0.77 to 3.50</td>
<td>2 1.77</td>
</tr>
</tbody>
</table>

*p Value for trend test.
RR not shown for causes of death <2.
smokers to smoke should be qualified accordingly, as we begin to realise the potential effect on others' lives and property. Currently like drinking, smoking remains a private pursuit unless others are hurt or killed. When more of this is understood and communicated widely about the association between smoking and injuries, society may view smoking differently.

Suicide was increased among smokers in Taiwan, but the small sample size may have limited its significance. Mechanisms to explain the increased suicide risks in smokers are complex, as situations differ. The relation between smoking and suicide could be a direct one when smokers became inflected with morbidity, but it could also be an indirect one, through the mechanism of depression, as smoking is associated with depression and depression is associated with suicide. This conclusion has been questioned.

Smoking in Taiwan is mainly a male behaviour and the increased injury risk has been limited to males in this study. The smoking or drinking status was self reported at the time of recruitment and may introduce recall/reporting bias. This potential bias cannot be quantified based on data collected for this study. Drinkers in this study were defined as those who admitted in the questionnaire to be a regular alcohol user, in contrast to an occasional or party drinker. Due to the lack of detailed drinking data (for example, number of drinks per week) among some cohort members, a more precise quantitative analysis of alcohol use cannot be made. We conducted only one to two surveys at the intake and not afterwards, so smoking and drinking behaviours may have changed over time. This may lead to a non-differential misclassification of smoking and drinking status. However, it is important to note that most of the cohort members were adults over 25 years of age, when non-smokers becoming new smokers are rare, accounting for only 1.2%. As a result, there would be more smokers who quit afterwards than non-smokers who became smokers. The fact that we included these ex-smokers in our cohort as smokers would probably underestimate the mortality risk. However, the quit rate among smokers in Taiwan has been relatively small, with the cumulative lifetime ex-smoker amounting to one seventh of all male injury deaths in Taiwan were associated with smoking. Smokers have more motor vehicle accidents in Taiwan, partly because many smoke while riding motorcycles.

What this paper adds

Smokers have higher injury rates than non-smokers, even when alcohol and social class are considered. In Taiwan there are significant relations between dose (daily smoking amount) and response (injury death). Over one fifth (23%) of all male injury deaths in Taiwan were associated with smoking. Smokers have more motor vehicle accidents in Taiwan, partly because many smoke while riding motorcycles.

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