9.1.4.2 Smoking

Cigarette smoking is known to be a predominant killer in many countries and is gradually taking center stage in the remaining countries. It is generally measured in terms of number of cigarettes smoked per day. However, the duration of smoking is also important. A person's intensity of smoking may also vary from time to time. A measure could be the total number of cigarettes smoked so far in life. This number is given by

$$S_1 = n_1x_1 + n_2x_2 + \cdots + n_Kx_K, \tag{9.5}$$

where n_k ($k = 1, 2, \ldots, K$) cigarettes per day (intensity) are smoked for x_k years (duration). This is more exact than pack-years generally used for smoking. S_1 suffers from the same demerit as the pack-years: smoking 10 cigarettes a day for 25 years is the same as smoking 25 cigarettes per day for 10 years. This obviously is not always true. For lung cancer, duration may be more important, whereas for coronary disease, intensity of smoking may be more important. Despite this deficiency, pack-years continues to be the most accepted measure, so should S_1.

Now consider a multiplier p_k to indicate further variation in the intensity of smoking. Evidence suggests that p_k could be 0.15 for passive smoking (i.e., effect of passive smoking is 15% of the effect of active smoking), 0.67 for filter cigarettes, 5.0 for cigar, and 2.5 for pipe. Similar equivalence can be possibly postulated for smokeless tobacco such as snuff, chewing tobacco, and betel quid. With this adjustment, an elementary index of smoking is

$$S_2 = \Sigma p_k n_k x_k (p_k = 1 \text{ for regular cigarette}). \tag{9.6}$$

S_2 measures modified cigarette-years of smoking and can range from 0 to 2000 or more. For many diseases, the cumulative burden of smoking is not linear but progressively declines as the amount of smoking increases. That is, the first 1000 cigarette-years are more harmful than the next 1000 cigarette-years. Logarithm is generally considered a good moderation in such situations, but this would be too severe for smoking as it would reduce 100 cigarette-years to 2 and 1000 cigarette-years to 3. I looked for a simple function of S_2 that may take a value of nearly 5 for $S_2 = 100$ and nearly 15 for $S_2 = 1000$. The values 5 and 15 are my subjective assessment of the years that must elapse after quitting for the burden of such smoking to disappear in many cases. The function with this feature is $\frac{1}{2}\sqrt{S_2}$. When the benefit of the time elapsed since quitting is also allowed,

$$S_3 = 1/2\sqrt{\Sigma p_k n_k x_k} - y; \quad y \le S_2; \tag{9.7}$$

where y is the number of years elapsed since quitting.

S_3 can be adjusted for the age at start of smoking. Not much evidence is available, but assume that the burden is twice as much when the age at start is 15 years as when the age at start is 30 years or more. Epistemic uncertainties are prominent for this aspect but the postulation seems plausible. Under these assumptions, the final index of smoking is

$$S = (3 - a/15)(1/2\sqrt{\Sigma p_k n_k x_k} - y). \tag{9.8}$$

A value less than zero is interpreted as zero. This is a comprehensive index of the present burden of smoking as it incorporates (a) the duration of smoking, (b) the quantity of smoking, (c) smoking of filter cigarettes and other forms of tobacco consumption that can be factored to cigarette smoking, (d) progressively less burden from smoking additional pack-years in life, (e) benefit of the time elapsed since quitting, and (f) deleterious effect of starting smoking early in life. The index has an inbuilt feature to consider current smokers and ex-smokers and obviates the need to divide ever smokers into such dichotomy. The index models the entire history of smoking into a single metric. The modification of the cigarette-years in some typical conditions is shown in Figure 9.2. This index does incorporate a large number of aspects of smoking but fails to capture occasional smoking or the beneficial effect of interruption.


Example 9.2 Calculation of smoking index
The following is the smoking history of three persons:

Person A: Started smoking at age 12 years. Initially smoked 10 regular cigarettes for $3\frac{1}{2}$ years. Since then has been smoking 20 filter cigarettes a day for the last $17\frac{1}{2}$ years.

Person B: Started smoking at age 21 years. Smoked 12 cigarettes a day for 1 year, 15 cigarettes a day for $2\frac{1}{2}$ years, 20 cigarettes a day for $1\frac{1}{2}$ years, no smoking for 6 months, and 2 cigars a day for 1 year. He has not smoked for the past 4 years.
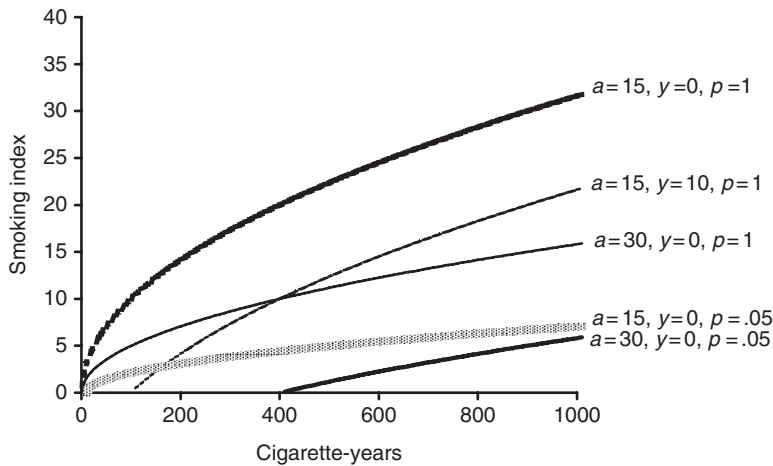
FIGURE 9.2: Smoking index for some typical values.

Person C: Never smoked but spouse smoked. When both were together an average of 5 cigarettes a day were smoked. This started at age 27 years and went on for 6 years. There has been no exposure to cigarette smoke for the past 3 years.

Smoking index

Person A: $S = (3 - 12/15)\left(\frac{1}{2}\sqrt{10 \times 3.5 + 0.67 \times 20 \times 17.50}\right) = 2.2 \times 8.21$

$= 18.1.$

An index of 8.21 increases to 18.1 because smoking started at an early age of 12 years.

Person B: $S = (3 - 21/15)\left(\frac{1}{2}\sqrt{12 \times 1 + 15 \times 2.5 + 20 \times 1.5 + 5 \times 2 \times 1} - 4\right)$

$= 1.64 \times (4.73 - 4) = 1.2.$

The present burden of smoking is small because of quitting 4 years ago.

Person C: $S = (3 - 27/15)\left(\frac{1}{2}\sqrt{0.15 \times 5 \times 6} - 3\right)$

$= 1.2 \times (-1.9) = 0$ (negative value is to be taken as zero).

The burden was small because of passive smoking and that too vanished because of no exposure for the past 3 years.