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Relative Risks of Saccharin and Calorie Ingestion

Abstract. *The risk of a person getting cancer from ingesting saccharin is compared with the risk of ingesting additional calories which cause excess body weight. It is found that, for a person who is 10 percent overweight, the risk of ingesting one diet soft drink, which would cause a decrease in life expectancy of 9 seconds, is approximately equal to the risk of ingesting one additional kilocalorie; that is, if ingesting a diet drink inhibits ingestion of more than 1 kilocalorie, its benefits exceed its risks.*

The reason for the use of saccharin is to avert the ingestion of calories. Therefore, to make a risk-benefit analysis of this process one must know the relative risks of saccharin and calorie intake. It is the purpose of this report to develop a comparison between the two.

In the recent Canadian study of patients with bladder cancer (*1*), a link was established between that disease and use of saccharin such that if the U.S. population (2×10^8) were to ingest one 12-ounce diet soft drink (*2*) per day throughout their lives, there would be an extra 1200 bladder cancers per year. This implies a risk of 1200 cancers per 7.3×10^{10} drinks, or one cancer per 6×10^7 drinks. There is ordinarily a time delay of 10 to 50 years between ingestion of a carcinogen and development of a cancer, so an average case would result in no more than a 20-year loss of life expectancy; thus an average diet drink would reduce life expectancy by 20 years per 6×10^7, or about 9 seconds. To put this number into perspective, let us consider that smoking a single cigarette reduces life expectancy by 12 minutes (*3*), so a diet soft drink is about 80 times less dangerous than a cigarette. From the above result (or from the original finding) it is straightforward to calculate that one diet drink per day throughout life causes a reduction in life expectancy, ΔL, of 2 days; or

$$\Delta L = 2 \text{ days} \left(\frac{\text{diet drinks}}{\text{day}} \right) \quad (1)$$

The benefits of diet soft drinks result from their use in weight control by reducing caloric intake. Being overweight is well known to reduce life expectancy. In a somewhat earlier study, Pauling (*4*) analyzed the data in a 1952 report (*5*) to obtain best fits to both linear and quadratic relations between loss of life expectancy, L, and overweight, $(W - W_0)$, where W is the weight and W_0 is the optimal weight. These were

$$L = 17 \text{ years } [(W - W_0)/W_0] \quad (2)$$

$$L = 36 \text{ years } [(W - W_0)/W_0]^2 \quad (3)$$

If one differentiates Eq. 3 and assumes that an average saccharin user is at least 10 percent overweight and weighs perhaps 160 pounds (73 kg), one obtains

$$\Delta L = (0.05 \text{ year/pound}) \Delta W \quad (4)$$

If one applies the same assumptions to Eq. 2 one obtains

$$\Delta L = (0.11 \text{ year/pound}) \Delta W \quad (5)$$

independent of the percentage of overweight. There are more recent data on this subject (*6*). To quote typical figures, for a 45-year-old male with an optimal weight of 150 pounds, an increase in weight to 170 pounds reduces his life expectancy by 1.5 years; an increase to 200 pounds reduces it by 4 years. This gives an approximately linear relation with

$$\Delta L = (0.08 \text{ year/pound}) \Delta W = (29 \text{ day/pound}) \Delta W \quad (6)$$

Since this is intermediate between Eqs. 4 and 5 and is based on better data, I use Eq. 6.

An average person's body weight is related to his average daily caloric intake at about 1 pound per 14 kcal/day (*7*). If one multiplies this by Eq. 6 one obtains a change in life expectancy

$$\Delta L = 2 \text{ day/kcal-per-day-intake} \quad (7)$$

By comparing Eqs. 1 and 7 one can see that diet soft drinks give a net benefit if one such drink reduces caloric intake by more than 1 kcal.

There seems to be no firm evidence on the amount by which diet drinks reduce caloric intake (or body weight). A nondiet drink contains about 100 kcal, so if all other things were unchanged, the substitution of diet for nondiet drinks would increase life expectancy by 100 times more than the cancer risk reduced it. This is perhaps an extreme assumption, but it seems most unlikely and it would be very difficult to prove that it overestimates the reduction in caloric intake from diet drinks by a factor of 100. Unless this is done, there is no evidence that the risk of diet drinks is greater than their benefits.

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References and Notes

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