Does size matter in cancer?

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Introduction

To be able to explain whether there is a relationship between size, lifespan and cancer risk we must first know what cancer is, how is thought that was its origin and finally see the relationship between these parameters in the Peto’s paradox. That arose from Peto’s studies in the 1970s. One possible answer to his paradox is that large animals (for example elephants) are less likely to develop cancer than short animals.

What is cancer?

Cancer is a disease caused because some cells in the body multiply uncontrollably and spread to other parts of the body (can lead to metastasis).

When a cell has an error it can follow two pathways:

- It goes into APOPTOSIS, therefore, it dies, and does not harm to other healthy cells.
- It becomes cancerous:
  - Detected by the immune system and eliminated.
  - Not detected → proliferation → metástasis

2 Origin hipotesis

- Atavism
- Somatic selection process

Peto’s Paradox

In the seventies, after doing several studies, Peto proved that the risk of a human developing cancer isn’t higher than a mouse, even though humans have 1000 times more cells than mice. Therefore, it must be some Tumor Suppressor mechanism (TSM) that ensures that animals with very large sizes (and a greater number of cells) do not develop more cancer than small animals.
Fig 1. An illustration of Peto’s Paradox. The expected cancer rate for large and/or long-lived species is higher than for smaller short-lived ones. The solid orange line indicates a linear relationship between cancer rate and \((\text{body mass}) \times \text{lifespan}\) and the dashed orange line represents an approximation of the expected cancer rate assuming a model describing the probability of an individual developing colorectal cancer after a given number of cell divisions. The solid blue line represents the observation that there is no relationship between cancer risk and \((\text{body mass}) \times \text{lifespan}\).

Conclusions

- There is no correlation between size and not having cancer. It’s all about lifespan.
- Animals with more lifespan have developed some tumor suppressor mechanisms, such as increasing TP53.
- Long-lived and large animals have developed TSM or eliminating proto-oncogenes.
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