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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 thas was it's 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 → metàstasis

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.

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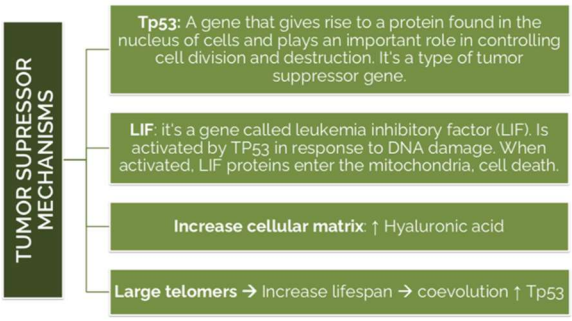

ANIMAL	WEIGHT	LIFE SPAN	TSM
Elephant	2700-6000 Kg	60-70 years	Tp53 + LIF*
Duck-billed dinosaur	4000-5000 Kg	30-50 years	-
Naked mole-rat	25-35 g	30 years	↑↑ Cellular matrix
Rat	140-500g	2 years	-
Bat	6,0-13,5 g	16 years	Large telomers + TP53

*Table 1 Proves that there is **no correlation** between size and not having cancer. Elephant and Duck-billed dinossaur are big and heavy animals. Elephant have developed TSM throughout the evolution and Duck-billed dinosaur haven't, they desappeared many years ago and hadn't yet depeloped any TSM. The same applies to the rat and the naked mole rat. Is all about evolution.*

*LIF: Leukemia Inhibitory Factor

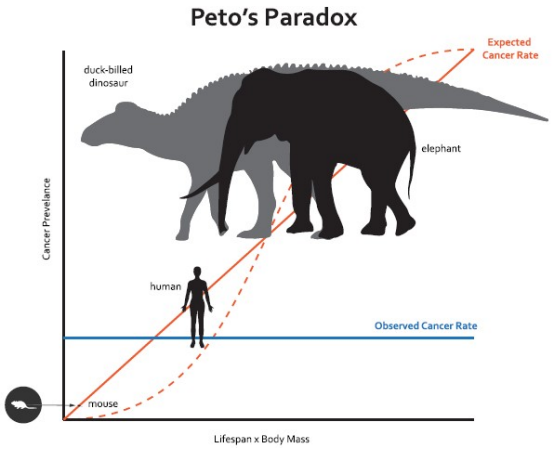

Fig 1. An illustration of Peto's Paradox. The expectedcancer rate for large and/or long-lived species ishigher than for smaller short-lived ones. The solidorange line indicates a linear relationship betweencancer rate and (body mass)*(lifespan) and the dashedorange line represents an approximation of theexpected cancer rate assuming a model describing theprobability of an individual developing colorectalcàncer after a given number of cell divisions . The solidblue line represents the observation that there is no relationship between cancer risk and (body mass)*(lifespan).

Conclusions

- There is no correlation between size and not having cancer. It'sallabout **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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