ISSN: 2687-8100
DOI: 10.33552/ABEB.2019.02.000526
Archives in Biomedical Engineering & Biotechnology
Iris Publishers

Mini Review

Gravitational Stress & Biological Aging

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Received Date: May 30, 2019

Published Date: June 07, 2019

Abstract

Gravitational stress is more and more considered a concern. The development of extraterrestrial travels leads to a crucial and legitimate questioning: in addition to radiative stress and anxiogenic impact, is gravity an abnormal aging threat to *spacemens*?

Keywords: *Robots*; Microgravity; Aging; spacemen

Introduction

It is observed that physiology of individuals, as well as that of bacteria, is highly sensitive to the intensity of gravity, the variations of this intensity and the frequency of these variations.

Everything and everyone are subjects to gravity. Living things are used to a constant value of gravity that is locally exerted on them. An excessive intensity, or an insufficient intensity, or inappropriate variations, can generate discomfort and even unease; the best known are car sickness, seasickness and airsickness. Gravity has an influence on physiology of living things, to the point that any variation is deleterious at long or short term, depending on the amplitude and the frequency of the variations. In some case, it leads to a critical health state. We will examine the repercussion of gravity on the clocks, then on the bacteria and finally on the man.

Clocks Subject to Gravity

Gravity results from a reciprocal action between a mass of matter, such as a planet, a star or a galaxy, and the mass of an object or a living thing. Gravity is similar to an acceleration.

On Moon surface, gravity is approximately 6 times lower than that on Earth surface. A watch is not affected, but the clock hand of a pendulum clock moves 2.45 times slower. An atomic clock is minimally affected: its precision is slightly increased [1].

On Sun surface, gravity is almost 28 times higher than that on Earth surface. Outside the fact that all clocks would be destroyed, a pendulum clock would theoretically swing 4.6 times faster, hence an advance of 4.6 years per year. An atomic clock would take an advance of about one minute per year [1].

In microgravity, the pendulum clock, the clepsydra and the hourglass, stop functioning; while precision of atomic clock is improved.

All these examples mean that gravity, and acceleration broadly speaking, affect the movements of the clocks to suit their technology; therefore, gravity does not act on a physical crypto temporality, but it acts on the specific mechanism that drives each clock, according to its technology. It leads to an obvious conclusion: gravitational experiments on clocks are not experiments on time; instead, they are experiments on their mechanism.

Bacteria in Microgravity

Bacteria reproduce by scissiparity; the population doubles at each generation, and for each primordial bacterium we have the following sequence:

$1 > 2 > 4 > 8 > 16 > 32 > \ldots > 2n$

Given that the number of bacteria doubles, the sequence can also be written relative to exponents of two:

$2^0 > 2^1 > 2^2 > 2^3 > 2^4 > 2^5 > \ldots 2^n$

At the n^{th} generation, the number "N" of bacteria is:

$N = 2^n$

In a homogeneous medium, the generations reproduce at about the same rate "μ" (Greek letter mü), therefore the number "n" of generations reads:

n # μ t

where "t" denotes the duration indicated by the laboratory chronometer after "n" duplications. The number of bacteria finally reads:

N # 2 exp (μ t)

It is to be emphasized that the effective factor of development of bacteria is "μ", and that time "t" is only what the clock of the laboratory indicates.

Dr. Valter Longo [2] has observed non-pathogenic bacteria which are deactivated after about a hundred transitions (n#100), through exhaustion of their genetic ability of scissiparity which is prescribed by the genome: this is the clinical death of the line, by completion of a genetic program, without temporal impact.

The proliferation rate "μ" has three causes:

a. The endogenous factors dependent on the genotype of the bacterium. The virulence is defined as the ability to multiply: for example, under normal conditions, Escherichia coli is able to divide every 20 minutes.

b. The exogenous factors related to the environment: hygrometry, light, temperature, presence of sugar or nitrogen, even gravity. It means that among energy, hygrometric and chemical components, the proliferation rate "μ" contains a gravitational component. For example, salmonella typhimurium is three times more virulent in microgravity.

c. The potentialization of endogenous and exogenous factors, one making the other more effective in some way.

This example proves that microgravity makes certain populations of bacteria age faster than in terrestrial gravity. In other word, microgravity shortens the lifetime of bacteria. The conclusion is that gravity accelerate biological aging, not chronological aging.

Now let's observe the action of microgravity on humans.

The Gravitational Stress

Medicine takes into account the difference between chronological age (how many years since birth, also called « civil age », given that birth is recorded in the City Register of Births) and biological age (the health condition). It is to be emphasized that, unlike an accepted opinion, an individual in water does not escape gravity: he is not subject to gravitational stress.

On the Moon, a 72 Kg individual weights only 12 Kg. A long stay potentiates the biological aging of a visitor in proportion of the gravitational stress: for example, muscle loss is quickly observed. Of course, a reduction in the gravity rate has no impact on chronological aging of the visitors.

Not only microgravity is anxiogenic, but it becomes promptly etiogenic. Indeed, all observations show that it weakens systematically the physiology of extraterrestrial travellers, so that the stress accelerates their biological aging. Here are three illustrations.

a. Ten Russian cosmonauts have spent 189 days in a space station. Nine days after their return, the thickness of their orbital and temporal frontal cortex had decreased [3] (data unspecified).

b. Donna Roberts, who is a radiologist at the Medical University of South Carolina, confirms that *Spacemen's* brain is modified in proportion of the length of stay in zero gravity [4].

c. NASA has recently developed an unprecedented experiment on twins, with one being in microgravity during 342 days. INSERM reports the « clinical expression » consecutive to the gravitational stress [5]:

- Thickening of the carotid artery wall (rate unspecified in our source).
- Bone loss of 7%.
- Decreased response to cognitive tests (results unspecified in our source).
- Effect on the eye (occurence of cataract).
- Loss of muscle mass (rate unspecified in our source).

Unfortunately, Physics does not take the concept of biological aging into account. The fictional experiment (1911) of the French physicist Paul Langevin (1872-1946) provides an interesting example: according to calculations, a twin back from an accelerated relativistic travel has become less aged than his brother who had remained at home. This paradox is caused by the confusion which is made between chronological age and biological age. The chronological age can be submitted to relativistic calculations, but not to physiological experiments; the biological age resists to calculations, but not to stressorss; less aged (number of years) does not mean younger (better health state): one can easily imagine that the relativistic stress would cause a serious additional biological aging that calculations are unable to evaluate. The myth of rejuvenation through a relativistic travel is a fantasy. Furthurmore, a fictional experiment is obviously not worth a physical experiment.

Another source of concern is radiation overexposure, which leads to development of cataract, and chromosome aberrations: the shortening of the telomere length causes a decrease in cell lifetime [5]; therefore, radiation leads to a premature biological aging, but on the other hand, nothing on chronological aging.

Spacemen Replaced by Robots?

Health of spacemen is a concern, all the more a very long stay in outer space has not been experimented yet; hence these legitimate questionings: are nowadays manned flights a necessity ? is a human presence on the Moon or on Mars necessary, for doing what else than a reliable system could do? A manless flight eliminates heavy and bulky fixtures, therefore it also saves a lot of money; hence the quick development of drones flown from the ground. Unfortunately,

this way out comes up against an inescapable difficulty caused by the speed of electromagnetic waves [6] which seems very high:

c = 299792.458 km/s

but which is in fact very low compared to long distances met in outer space. For example, the EM waves need about 1.25 second to come from the Moon, about 6 minutes to come from the Sun, and over 4 years to come from Proxima Centauri, the star closest to the Sun. Well, steering, unpredictable incident and works in situ need imediate corrections and prompt instructions that could only be done by robots on board; as soon as robots are smart.

Conclusion

Dreams about extraterrestrial travels and planetary conquests don't take into account the redoubtable threats that outer space exerts on *spacemen*. The anxiogenic components are to be added to gravitational stress and radiation stress. All these stressors lead to a drastic acceleration of biological aging, with no impact on chronological aging. In a certain way, it proves that gravitational and radiation stresses do not involve temporality. Beyond these theoretical conclusions and regardless the costly undertaking, the idea of man in outer space would it be, above all, a dangerous ambition?

Acknowledgement

None.

Conflicts of Interest

No Conflicts of Interest

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