ALLOMETRY

Setareh Sabeti, Farzanegan 2 high School, Tehran, Iran

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Advisor: Dr. Mohammad Qorbani

Accepted by Ariaian Young Innovative Minds Institute , AYIMI

http://www.ayimi.org ,info@ayimi.org

ABSTRACT

If we want to create a new creature (by stimulation of new stem cells), we should apply allometric scaling and equations in designing processes. For example, if the target be the creation of a human, her/his skull should become approximately twofold after the puberty period. Allometry helps us to guess the size of different parts of the body in different ages that is how the doctors find out how much our stature will grow. Here, we show the allometric scaling of different kind of animals which shows a logarithmic behaviors.

Keywords : *Stem Cell, Allometry, animals, logarithmic*

1. Introduction

It is clear that the body of animals and humans is made of different parts and organs. These parts and organs grow during time gradually and everything about the biology of an animal is influenced by its body size, including its physiology (e.g., heartrate, respiratory rate, total metabolic rate, mass specific metabolic rate, growth rate), anatomy (e.g., organ mass, blood volume, surface area, cross-sectional area of limbs), and ecology (e.g., diet, home range size, reproductive strategy, life span, population density) [1]. But the question is that "what happens to these different parts when an animal grows?" and to answer this question many tries have been done [2]. There are many researches which show when the body becomes more massive, different parts become larger. These studies are the subjects of allometry science. Hence, Allometry is the study of how these processes scale with size of the body. In its broadest sense, it describes how the characteristics of living creatures change with size. The term originally referred to the scaling relationship between the size of a body part and the size of the body as a whole, as both grow during development. However, more recently the meaning of the term allometry has been modified and expanded to refer to biological scaling relationships in general. In this research, we searched to find the charts that shows how much the different important parts of the human body (such as bones, brain and heart) or body of animals (such as legs, antennae or horns) relate to each other [1]. One of the most general concepts that you are likely to find in biology is that of the relationship between body size and the rest of an organism's biology, a relationship that is often referred to as allometry. Therefore, an exploration of this topic is important if we are to understand the relationship between form and function in vertebrates. The purpose of learning allometry study is to explore for ourselves the relationship between two important biological traits: volume (a function of mass) and surface area, and how this relationship influences other aspects of an animal's biology. Allometry literally means "of other or different measures" (allo = other or different; metry =measure). The goal of its study with respect to biology is to describe the differences in magnitude in form or function that are correlated with changes in form or function of another variable [3].

2. Experiment

Allometry does not have any direct experiment. Therefore, the only thing that we should do is: search and read the gathered data in the libraries, websites and published papers. We've also investigated the documents about the dinosaurs in museums and national parks and got information about allometry equation. We've also investigated allometric scaling in different parts of different animals bodies. We realized that allometry is not always additive for example Our heads are almost a quarter of our body size when we are born, but when we grow to become adults our heads are only 1/8 or so (or heads grow slower than the rest of our body) and it is negative allometry (Fig. 1).

We found it ourselves by investigating the table of height, weight and height and weight of head growing during gestational period.

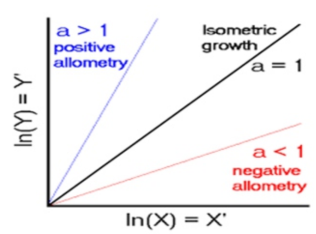

Fig. 1: The chart which shows negative and positive allometry[5].

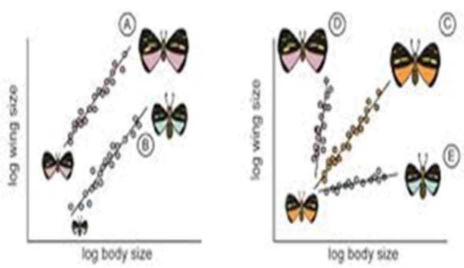

Fig. 2 : Allometric scaling of butterfly wings [1]

We also found many charts about allometric scaling of different parts of the body of different animals (Figs. 2 to 5) and Table (1).

Table. 1: Mass and length of a baby inside the mothers [3]

getational age	length(us) (crown to rump)	weigt(us) (crown to rump)	length(cm)	mass(g)
8weeks	0.63inch	0.04 ounce	1.6	1
9weeks	0.90inch	0.07 ounce	2.3	2
10weeks	1.22 inch	0.14 ounce	3.1	4
11weeks	1.61inch	0.25 ounce	4.1	7
12weeks	2.13inches	0.49 ounce	5.4	14
13weeks	2.91 inches	0.81 ounce	7.4	23
14weeks	3.42 inches	1.52 ounce	8.7	43
15weeks	3.98 inches	2.47 ounces	10.1	70
16weeks	4.57 inches	3.53 ounces	11.6	100
17weeks	5.12 inches	4.94 ounces	13	140
18weeks	5.59 inches	6.70ounces	14.2	190
19weeks	6.02 inches	8.47ounces	15.3	240
20weeks	6.46 inches	10.58ounces	16.4	300
21weeks	10.08 inches	10.58ounces	25.6	300
22weeks	10.51 inches	12.70ounces	26.7	360
23weeks	10.94 inches	15.17ounces	27.8	430
24weeks	11.38 inches	1.10 pound	28.9	501
25weeks	11.81 inches	1.32 pound	30	600
26weeks	13.62 inches	1.46 pound	34.6	660
26weeks	14.02 inches	1.68 pound	35.6	760
27weeks	14.41 inches	1.93 pound	36.6	875
28weeks	14.80 inches	2.22pounds	37.6	1005
29weeks	15.2 inches	2.54pounds	38.6	1153
30weeks	15.71 inches	2.91pounds	39.9	1319
31weeks	16.18 inches	3.31pounds	41.1	1502
32weeks	16.69 inches	3.75pounds	42.4	1702
33weeks	17.20 inches	4.23pounds	43.7	1918
34weeks	17.72 inches	4.73pounds	45	2146
35weeks	18.19 inches	5.25pounds	46.2	2383
36weeks	18.66 inches	5.78pounds	47.4	2622
37weeks	19.13 inches	6.30 pounds	48.6	2859
38weeks	19.61 inches	6.80 pounds	49.8	3083
39weeks	19.96 inches	7.25 pounds	50.7	3288
40weeks	20.16 inches	7. 63pounds	51.2	3462
41weeks	20.35 inches	7.93pounds	51.7	3597
42weeks	20.28 inches	8. 12pounds	51.5	3685

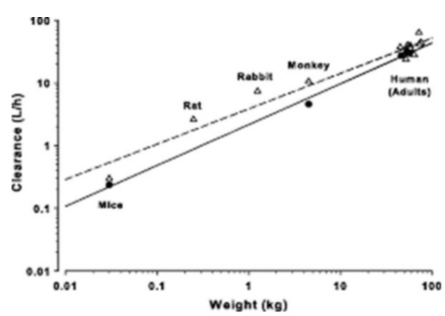

Fig. 3 : Information of different animals and human [5]

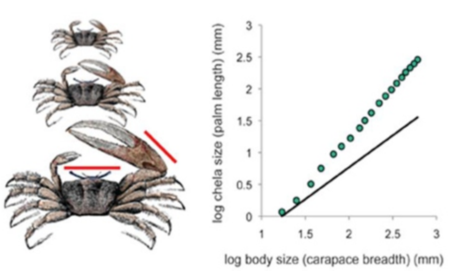

Fig. 4: Allometric scaling of chela and carapace of crab [1].

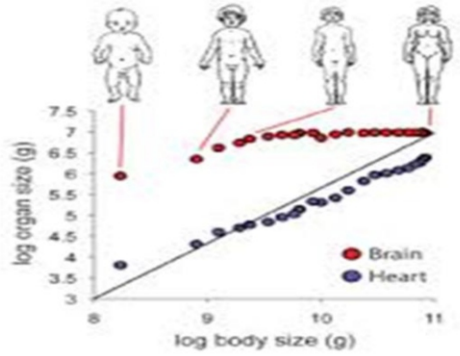

Fig. 5: Allometric scaling of brain and heart of humans [1]

3. Results

More simply, it is the study of what happens to Variable Y when you change Variable X. This is basically a qualitative description and only allows us to speak of correlated changes in qualitative ways; for example, Y gets bigger as X gets bigger, Y slows down as X speeds up, Y gets wider as X gets heavier, and so on. As biologists, however, we want to be able to describe things in a more precise way.

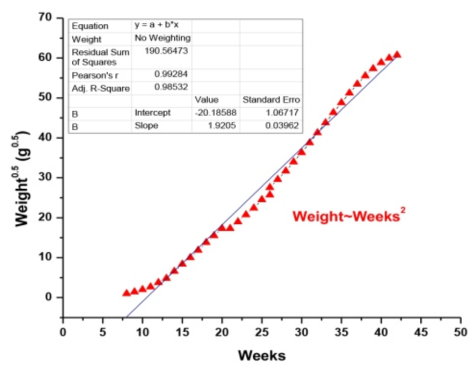

Fig. 6 : Chart of weight growing during time (OUR MODELING)

Does Y get bigger (or slow down or get wider) at the same rate as X? At a faster rate? A slower rate? To satisfy our need for quantification, we resort to mathematical equations that precisely describe the relationship between two variables. We investigated the table of humans head growing during gestational period* and found out my own equations. We've also drawn the charts of these information ourselves (Figs. 6 to 9).

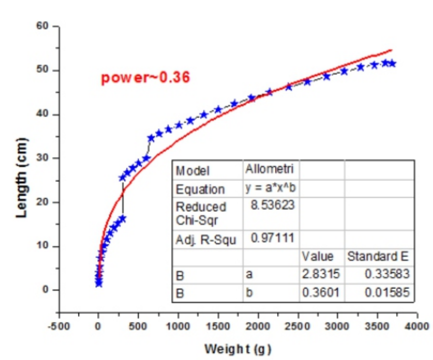

Fig. 7 : chart of length growing relating to the weight (OUR MODELING)

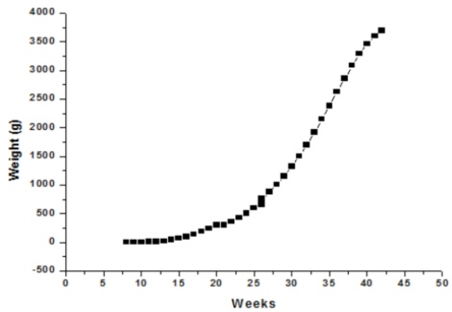

Fig. 8: Chart of weight growing during time (OUR MODELING)

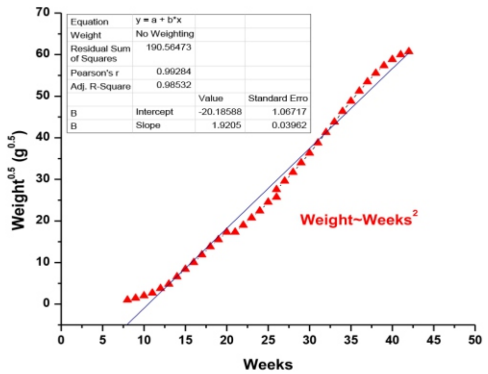

Fig. 9: Chart of (weight)^(0.5) growing during time

4. Conclusion

Allometry scaling shows that when an animal or human grows up, different parts of its body become larger and all of these parts grow relating to the whole body size. We are not always able to measure the size of different parts of the body such as inner parts like brain or heart and we can figure it out by the allometric equations that describe the relationships between two variables(like weight of the whole body and length of the crown in humans). Allometry is not always positive and it's sometimes (like humans head) negative when a particular part of the body grows slower than the rest of the parts.

References

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