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Living Body Special Mass; A New Theory

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Author's contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

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ABSTRACT

In classical mechanics a mass at rest is supposed to accelerate upwards if it undergoes force greater than its gravity force or greater than its weight, F-W= positive, then the force F is greater than the weight W. In case of a lever a person can lift a mass with force less than its weight but still the force at the other arm on the mass is bigger than the mass weight. The resultant of the forces F-W acting on the mass will be a vector force upwards. In this paper I explain with experimental evidence that a human body uses force less the human body weight to accelerate upwards. The experiment measures the maximum force that a human muscle can exert and shows that this maximum force is less than the human weight and it lifts the human. I also apply this special mass concept to the human body joints including the human spine long term functionality. This theory applies to all living organisms here I focus on the human body specifically.

Keywords: Special mass; physics; force; weight; body mass; uplift.

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1. INTRODUCTION

Mass is one of the fundamental quantities in Physics and the most basic property of matter. We can define mass as the measure of the amount of matter in a body. The SI unit of mass is Kilogram (kg). The mass of a body does not change at any time. Only for certain extreme cases when a huge amount of energy is given or taken from a body. For example: in a nuclear reaction, tiny amount of matter is converted into a huge amount of energy, this reduces the mass of the substance [1,2]. Weight is the measure of the force of gravity acting on a body. The equation for weight is as follows:

$$w = mg$$

Considering that weight exerts a force, The Newton is the same SI unit for weight as it is for force (N). The expression for weight reveals a dependence on both mass and the acceleration due to gravity; while the mass itself may remain constant, the acceleration due to gravity varies depending on location. Let's use this illustration to break down the idea: Since the Earth is not perfectly spherical but rather an oblate spheroid, a person standing at the equator is physically located much further from the centre of the Earth than a person located at the North Pole. Since the acceleration due to gravity is proportional to the inverse of the square of the distance between two objects, the North Pole resident will feel a greater amount of weight than the Equator resident [3,4]. For a force to lift an object it must be greater than the object weight an example is an object hung with a rope at its center of gravity. Forces equal to or less than the object weight acting on the rope vertically will not accelerate the object. As soon as the force reaches the smallest value that is greater than the object weight the object will accelerate upwards with a non-zero acceleration [5,6].

Organisms including humans have advantage in the body motion,i.e, the human for example can move his body and lift his body and parts of the body easily without the effort he needs to lift or move another mass that have the same human body mass. This is termed as G-force. The acceleration or slowdown in speed over time is quantified by the G-force. The acceleration we experience owing to gravity is one G, and if you're sitting stationary while reading this, your body is feeling that force. The G-forces exerted on your body change your perception of weight by making you feel heavier or lighter as you rapidly accelerate or decelerate from your current position. Passengers on a commercial flight, for instance, normally feel no more than 1.3 Gs of force on their bodies and no less than 0.7 Gs during specified manoeuvres. In other words, depending on whether the plane is speeding up, slowing down, rising, descending, or turning, the average passenger can feel up to 30% heavier or 30% lighter for a few seconds. The vast majority of individuals won't even feel these forces [7,8].

Moving or lifting a rock of for instance 80 kg is not as easy as moving or lifting the human body of 80 kg mass by the human muscles. So a human runs fast, walk long distances, dance easy, with very small effort. An average human can run with average speed up to 12 km/h and walk an average distance of 20 miles in one day. An average human can climb upstairs very easy but if he holds only small mass like 15 kg make it very difficult. We only add 15 kg if the human is 60kg then the total mass is 75 kg but removing this 15 kg makes a big difference for a human to climb a ladder because a human can move or lift his body easy compared to moving or lifting any other object with the same mass [9,10].

2. HYPOTHESIS

Theory: A human or any other organism has a special mass that can interact with inanimate surfaces:

a. A human normal force that lifts or moves a human when the human pushes or lifts his body against a surface is greater than the force exerted by the muscles. So a human can lift his body up short distance with calves and feet muscles like someone tries to pick a fruit from a tree with force smaller than his weight. A human of 80 kg can lift his body with force let’s say 10 kgf like someone tries to pick a fruit from a tree with calves muscles but the normal force by the ground is 60 kgf and this is although the human exerts only 10 kgf. This does not violate the law of conservation of energy the force lifting the human is 60 kgf and the human heels returns back to the ground with the same force 60 kgf” which is the human weight” even though the human exerts force with feet and calves muscles of 10 kgf. The energy of lifting is the same which is the energy exerted by the human muscles and it is the same energy by which the human heels return to the ground. This is similar to the leverage idea as shown in the below figure.

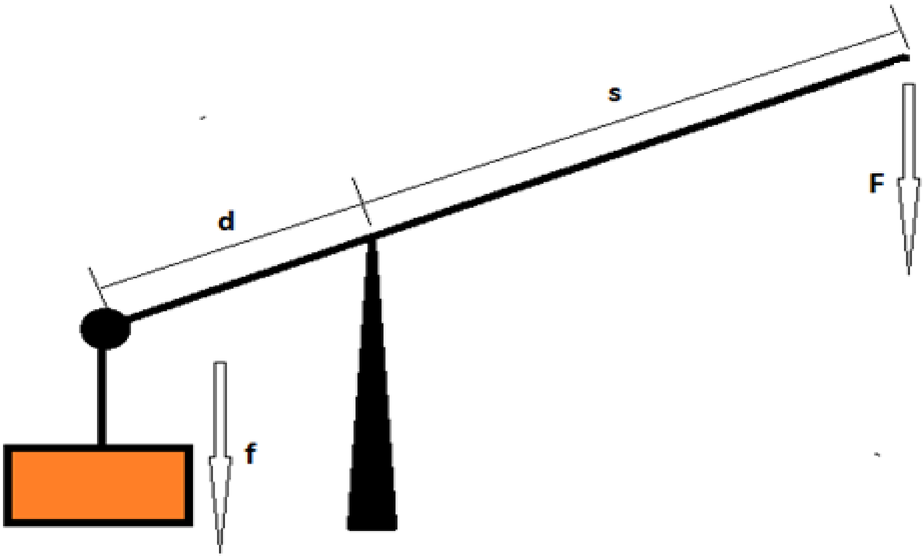

Fig. 1. d=1 m, s= 3 m, f is the weight of the block =60 kgf, F =20 kgf, F*s=f*d

The human exerts force 20 kgfless than the weight to lift the block, but still the force at the other side of the lever which lifts the block equals to the weight 60 kgfin other words the human exerts smaller force than the weight and convert it by the lever to lift the block with force equals to the weight. However, the energy done at both sides is equal. So the human can exert let's say 10 kgf to lift his body 60 kgf the work done here does not equal F*d, but it is the energy consumed from the muscles. Even though the human exerts only 10 kgf but the energy is big. The energy is bigger because the human will get tired soon after several movements of lifting his body with one foot like someone tries to pick a fruit from a tree.

b. The normal force on the human when standing on a surface will press the body with pressure less than the pressure by an equal force on the human.

3. METHODS

3.1 Experiment No. 1

3.1.1 A human lifts his body with force less than his weight

Each human muscle has a maximum force that can exert, for example a human cannot lift 10 tonne object with his arm muscles. If we measure the maximum force of calves and feet muscles for both legs to be x N we will find that this maximum force is smaller than the human weight but they lift the human body of 60 kg.I measured my own calves and feet muscles maximum force for both legs by pressing as hard as I can on a scale which turned out to be approximately 31 kgf and my weight is 57.7 kg. The force I need to lift my body with calves and feet muscles like someone tries to pick a fruit from a tree must be greater than my weight because a force to lift an object must be greater than its weight smaller forces than the weight do not accelerate an object upwards. The maximum force of feet and calves muscles by exerting as hard as I can of both legs is 31 kgf but because I lift my body with one leg and I do it easily without exerting my maximum calf muscles force then I lift my body like someone tries to pick a fruit from a tree with force very smaller than the maximum of one leg 15.5 kgf and hence very smaller than 57.7 kgf. Below figures show the accurate calculations between the minimum tension by the the Achilles tendon to lift my body and the maximum force of the Achilles tendon.

3.1.2 Measuring the maximum calves and feet muscles force

A scale is fixed to a wall. A human is lying on the ground pushing the scale with his feet. The human head is on another wall so that the body will not move when the human pushes the scale. The pushing is only with feet and calves muscles no other muscles of the legs are involved. The push movement is equivalent to the human lifting his body like someone tries to pick a fruit from a tree with feet and calves muscles movement. The human pushes as hard as he can, then the scale will measure the maximum force by the calves and feet muscles.

Assume my Achilles tendon pulls straight upwards on the heel bone while my tibia pushes straight downwards on the ankle joint.

Fig. 2. Feet muscles force

The tension on the Achilles tendon T when lifting my body can be obtained by the free- body diagram:

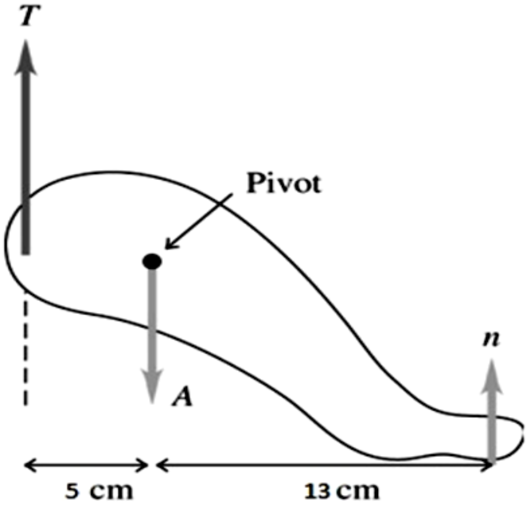

Fig. 3. Free- body diagram

By Putting the pivot at the ankle. The two upward forces have to be in rotational equilibrium, so:

T(5)=n(13)For my body mass 57.7 kgf the tension on the Achilles tendon T when I lift my body up like someone tries to pick a fruit from a tree:T(5)=(57.7)(13)=150 kgf. I need tension by the Achilles tendon equals at least 150 kgf tolift my body.Assume the force n is the maximum force measured by the scale previously which is 15.5 kgf" estimation for one leg"

T(5)=(15.5)(13)

T=40.3 kgf. One leg Achilles tendon can exert a maximum of 40.3 kgf

So my maximum Achilles tendon tension of one leg I could exert was 40.3 kgf but to lift my body 57.7 kgf I need a minimum tension of the Achilles tendon of 150 kgf. Notice also I exert force to lift my body 57.7 kgf smaller than the maximum because lifting my body is remarkably easy so I do not even exert the maximum 40.3 kgf which is below the force needed to lift my body 150 kgf. A human when he lifts his whole body with one foot does not exert his maximum force which is obvious. So I lift my body with 40.3 kgf or less by the Achilles tendon but the normal force by the scale on my body is 150 kgf so that the force upwards must be bigger than the minimum tension by the Achilles tendon so that the energy exerted to lift my body and the energy exerted by the weight when the heels return back to the ground are equal. This is the normal force but not the actual tension I exert by my Achilles tendon.

150 kgf of the Achilles tendon equals a rock of 150 kg weight so it is not possible for an average human to stand on tip toes like someone tries to pick a fruit from a tree with 150 kgf weight on his Achilles tendon for minutes. Adding that my maximum force of the Achilles tendon is far smaller than 150 kgf. The Achilles tendon is far weaker than that nor any muscle of an average human is that strong to support a 150 kg rock. Holding a 20 kg mass and standing on tip toes gives a remarkable bigger tension on the Achilles tendon even though I only added the third of the weight 20 kg mass and I cannot stand on tip toes that long periods of time nor lifting my body with one foot that easy.

3.2 Experiment No. 2

3.2.1 The pressure by the ground by the normal force of the human weight is relativity small

A human is lying on the belly on a concrete block. The concrete block does not touch any bones, just the belly, and the rest of the body is free in air. The human body weight 60 kg will not damage the belly, however, the block of 15 kg put on the belly will damage it. The block will give bigger pressure on the belly “ damage it ” than the pressure on the belly by the human mass even though the human mass is 60 kg four times the concrete block mass 15 kg. The areas of contact in both cases are equal. On the other hand if a rock of 60 kg put on the belly of an average human (the 60 kg rock touches only the belly of the human so that the areas are equal in both cases) it will damage it severely compared to the human of weight 60 kg lying on belly on the the rock which will not cause any damage to the average human. This experiment can be conducted on a dead body or an animal.

4. RESULTS

4.1 Observations of Experiment 1

a. An average human of 60 kg mass lifts his body up short distance like someone tries to pick a fruit from a tree with only one foot. The human uses foot and calf muscles of one leg which are weak and the human does not exert his maximum calves’ muscles force.
b. A human can stand on tip toes for very long time and it is supposed according to current physics concepts of biomechanics he exerts by his Achilles tendon 150 kgf force for a human of 57.7 kg as was shown, it is not possible for an average human to support a 150 kgf - a rock of 150 kg- by his Achilles tendon for that long periods.

4.2 Observations of Experiment 2

a. The pressure on the soles when an average human of weight 60 kg is standing is relatively low compared to the pressure on the soles when an object of for instance 15 kg put on bare soles. The human is lying on the ground with his feet up and the 15 kg object is put on his bare soles. This is despite the fact that the mass of the human is four times the mass of the object 15 kg.
b. An average human body mass of the trunk, the arms and the head is approximately 50 kg. Even though the human trunk, arms and the head are massive 50 kg, the human spine can bear it for years without spine cartilage damage, this is as a result of small pressure on the spine. A rock of mass smaller than 50 kg for instance 15 kg fixed on the human shoulders for one week of everyday life will damage the spine cartilage severely. We can imagine the big difference between one week vs 2400 weeks (50 years) and 50 kg vs 65 kg. Removing only approximately fourth of the weigh (the rock 15 kg) multiples the time the spine cartilage can bear by thousands.

5. DISCUSSION AND CONCLUSION

As in Experiment No.1 the human is able to lift his body with force less than his weight, the normal force on the Achilles tendon is bigger but this is because of the foot lever, still to lift a mass by a lever, the force on the mass arm is bigger than the weight although the force on the effort arm is less than the mass weight as shown by the figure previously, The tension on the Achilles tendon to lift the human with force equal to his weight must be a minimum of 150 kgf as in the previous free body diagram, but the maximum tension by the Achilles tendon of one leg was only 15.5kgf and the human actually does not even exert this maximum force to lift his body with one leg which is obvious because the lifting is easy, so the human lifts his body with force less than his weight, the human exerts force less than his weight but the actual normal force lifting the human is equal to his weight similar to the lever concept in the previous figure, and as in experiment No.2 the human can support his massive body weight on his body, so the pressure on the belly when the human lies on it on a concrete block is relatively smaller than the pressure by a same-mass concrete block put on the belly, as experiment No.2 and the observations suggest, the belly can support very big human weight and the spine cartilage as well, but the spine and the belly cannot support the same mass put on them as in experiment No.2. This leads to the fact that the Achilles tendon can also support human massive weight and the tension on it is also small just like the pressure on the belly is small, the maximum Achilles tendon’s tension of one leg was only 15.5kgf even though I needed a minimum Achilles tendon’s tension of 150 kgf to lift my body and the human does not use this maximum force 15.5kgf to lift his body, he uses force far smaller than 15.5kgf which is obvious because he lifts with one leg easily. The idea of small tension on the Achilles tendon is similar to the idea of small pressure on the belly when the human lies on the belly on a concrete block all this is proved by experiments. The difference is the human’s belly support a push force while the Achilles tendon supports a pull force, so the tension on the Achilles tendon is relatively small and my Achilles tendon overcomes this small tension to lift my body with small force which is the maximum 15.5kgf or less. This force is smaller than the force needed to lift the human 150 kgf if the human is going to lift his body with force equals to his weight but in case the force is15.5kgf or less then the human lifts his body with force less than his weight. The human has special mass, a living mass that interact with any surface that makes the surface press the body like the belly, the spine, the Achilles tendon, etc, with small pressure resulting in the human overcoming this small pressure on the Achilles tendon or any other muscle on the human and lifting his body with force less than his weight, for example a human of 80 kg can lift his body holding a bar easily, but he barely moves a rock of the same mass 80 kg. This theory applies to any other inanimate or living mass. animals undergo the same concept. So for example a bird can fly with very small force by the wings compared to its weight, and an average horse of 400 kg mass can support this mass by its belly when it lies on its belly on a concrete block but a rock of 400 kg put on its belly will damage its belly severely.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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