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Effects of Microgravity on Sexual Organs

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ABSTRACT
This review introduces microgravity environment; the escape velocity which is independent of the mass of the object escaping; and the effects of microgravity on bones, muscles, blood flow, proprioceptive system and re-distribution of fluid in relation to the impact of the affected parts to the reproductive organs. Since the human reproductive organs components include bones, muscles, blood and fluids tissues. From previous work, it was discovered that penis, virginal, and uterus activities are negatively affected.

KEYWORDS: *Bones, muscles, blood, brain*

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1. INTRODUCTION

Attainment of escape velocity is attainment of microgravity. Escape velocity can be said to be velocity at which an object escapes the gravitational pull of the Earth. In physics, the escape velocity is:

- The minimum speed needed for an object to "break free" from the gravitational attraction of a massive body.
- The speed at which the sum of an object's Kinetic Energy and its Gravitational Potential is equal to zero.

Let:
m be the mass of the object,
M be the mass of the Earth,
υ_e be the escape velocity,
r be the distance of the object from the centre of the Earth

$$\upsilon_e = \sqrt{\frac{2GM}{r}} \quad \text{.....(1)}$$

The escape velocity is independent of the mass of the object escaping.
The escape velocity from the Earth is about 40, 270km/h $(11.2 \times 10^3 \frac{m}{s^2})$.

The escape velocity is $2.94 \times 10^{-5}\, c$ where c is velocity of light

Two things learned from equation (1).

- Object will Attain Floating Stage as Distance from the Earth Increases.

As the distance r increases, the escape velocity decreases $(\upsilon_e \propto \frac{1}{\sqrt{r}})$ at a great distance from the earth or at infinite distance r, the velocity tend to zero. The object will be floating (Weightlessness).

- The Weight is no more Applicable

Since the weight of an object is a function of its mass and gravitational acceleration, the object weight $(W = mg)$ is not applicable in the equation above. At great or infinite distance from the Earth, the weight of the object is not felt or it become infinitesimal or turns to zero. That is floating at microgravity environment.

Microgravity $(\mu g)$is an experience in the outer space where the gravitational pull is very low and it is a state of being weightlessness (Oluwafemi, 2014).Methods for simulating microgravity on Earth have been investigated as alternative to expensive space flight. A microgravity condition can be produced by a space flight or by a free fall. The parachute method (drop from a tower or balloon) and parabolic flight have beenused to stimulate microgravity on Earth. By these

methods a gravity of 1×10^{-3} G can be produced (Takahito*et al.,* 2005).

According to Oluwafemi (2014), National Space Research and Development Agency (NASRDA), she stated that all experiments in all fields can be done under microgravity to compare the result/see the changes gotten under microgravity with that done/gotten under gravity, and that experiments are continually going on in the International Space Station (ISS) to see the effect of microgravity on such experiment. But we can't all go to the ISS for our experiments as this will limit the number of experiments to be done per time. This led to the development of an instrument called "Clinostat": An instrument used to eliminate the effect of gravity. Many efforts have been made to establish alternative methods for simulating microgravity on Earth, and one of these, is the clinostat- considered to be a suitable device. Clinostat is used to understand how organisms and matter react in the absence of gravity and basically used to observe the germination and early growth of small plant seeds. The seedlings grown under rotation are compared to germinated seeds under normal gravity (Oluwafemi, 2014). Oluwafemi, further explained that due to limitations in number of experiments to be performed and cost implication of carrying experiment to the ISS, these led to development of this instrument called clinostat. Takahito*et al*, stated that clinostat, water submersion and suspended methods have been used to simulate a μG environment where the G level on the individual is unchanged.

Microgravity environments generally affect human body in the following manners: The reductions in bones mass-density, demineralization of bones and loss of muscles mass, strength and endurance is one of the effects of microgravity on human body; calcium in the bones been lost through urine secretions; the rate at which bones are been broken down to minerals is more than the rate at which bones are formed, this causes bones diminishing constantly with no recovery; the decrease in bone density can increase the risk of kidney stones and bone fractures; exposure to microgravity also alters the ability of bones to heal after fractures; the rate at which the heart muscles contract is affected due to loss of muscles mass, strength and endurance, this results into inadequacy of blood flow to the heart muscles and reducing the amount of blood that flow into the heart chamber, eventually, reducing the amount of the blood that the heart will pump to the body; and the heart rhythm (beating of the heart) is disturbed due to abnormal contraction of the heart muscles.

Another effect is that the blood tends to collect in the upper part of the body (chest and head) and even it can accumulate in the brain because no gravity to pull the blood from upper to the lower part of the body. On the earth, the gravitational pull assists the flow of the blood from upper to the lower part of the body (Maya, 2016). It is known that, once pumping machine is used to pump water from the well or bore-hole to the upper chamber or tank on the roof of the house, the pump is no more needed to get the water to the house from the tank. The rate of the running of the water from the tank to the house is the function of the potential energy which solely depends on the quantity of the water in the tank, the height of the tanks above the earth surface and gravity. $\text{Potential Energy} = mgh$.

The heart is below the chest and head, so it needs the assistance of the gravitational pull force to get blood to the lower part from the chest and head. The implication is that the amount of blood in the lower part will be inadequate for proper utilization of the body components at the lower parts of the body. Generally, in the microgravity environment, fluid or water is easily re-distributed to the upper body and because gravity is not available to pull the fluid (blood and water) down to the lower body for proper circulations, concentration of much water pressure is stored in the upper body. This water pressure results into bulging of neck veins, puffy face, nasal congestion, sinus headache, and triggers the body to excrete fluids, and leading to dehydration. In microgravity environment, proprioceptive system is disrupted. The ability to sense the position, location, orientation and movement of the body and its part is difficult. The orientations of arms, legs and other parts of the body relative to each other cannot be signal by the proprioceptive system. Astronauts lost track of their arms and legs. Due to change from gravity environment to microgravity environment, there is conflict between what the body expects and what the body actually perceives. These conflicts will result to motion sickness or space sickness. This Space Adaption Syndrome (SAS) has the following symptoms: nausea, vomiting, vertigo, headaches, lethargy and overall malaise.

This paper therefore reviews and discusses previous work on gravitational force; acceleration due to gravity; and microgravity effects on human reproductive system.

2. CONCEPTUAL FRAME WORK

Scientist are searching for possibilities of: getting life in the space (microgravity environment); and performing the Earth activities there with an extension to other celestial bodies such as Mars and Moon. Robert*et al*stated that, the myotonia, the increase in muscles tension is a characteristic of sexual excitement and plateau phases and that it is likely to be experienced by astronauts as being less intense during spaceflight than they normally experience on Earth, particularly in the voluntary muscles groups over which there is conscious control.

Lori *et al*., 2014 in comparing the effect of microgravity on male and female muscles stated that "there is considerable individual variability with respect to loss of muscles size and function as a result of unloading. The precise extent to which gender (male and female) differences contribute to this is unknown. There is limited evidence in the literature that gender differences related to muscle atrophy might exist. In the first 2 weeks of unloading, minimal gender influence was apparent in the whole muscle atrophy (2%-4%) in side-by-side comparisons. If unloading extends beyond 2 weeks, women may experience greater reductions in whole muscle volume. Both men and women exhibit preferential atrophy with unloading".

Lori *et al.*, 2014 also stated that "there is one study suggesting that recovery of muscle strength after unloading may be slower for women than men. Taken together these data suggest that the time course of unloading-induced muscle loss may be gender specific". Lori*et al*'s view on joint injuries on musculoskeletal, is that because articular cartilage health is impacted by the quality of the underlying bone as well as the strength of muscles around the joint,

assessment of the potential risk for articular cartilage injury imposed by unloading needs to include evaluation of all three tissues: bone, muscle, and cartilage. There is some evidence to suggest that osteopenia of subchondral bone underlying articular cartilage contributes to cartilage degeneration. Conversely, damaged cartilage releases receptor activator of nuclear factor kappa-B ligand (RANKL) and other inflammatory components, which can lead to the loss of adjacent bone. Since muscles serve to stabilize and dampen forces across joints, loss of muscle mass and strength after a prolonged unloading can contribute to joint injury risk and early degenerative joint changes, especially in the knee. However, gender-based differences in the relative impact of bone and muscle loss on joint health have not been defined. Specific interventions to increase load-bearing or strengthening activities in space will be indicated. They may also identify the need for progressive strengthening and joint loading upon arrival on a planetary surface after extended microgravity exposure (real or simulated weightlessness) andreturn from space.

Musculoskeletal injuries have been reported in-flight at a rate of 0.021 per flight day for men and 0.015 per flight day for women; hand injuries are the most common, with abrasions and small lacerations the most common manifestations. There are few data on the recovery of the musculoskeletal system following spaceflight and even less data on gender differences in recovery rates. Generally, international space station crew have substantial recovery of muscle strength within a month following flight. The time course of recovery of bone mineral density has been evaluated but not specifically for gender differences. In general, half-lives for recovery of bone mineral density are ~150–200 days depending on site.

Roiz explained that the brain is the most powerful sex organ. It is the brain that sends out the signals that radiate through the central nervous system, triggering changes in blood flow in the penis that cause an erection. He said, most cases of erectile dysfunction (ED) are caused by physical problems not mental ones. The mind may be willing, but if the cardiovascular system is not quite as healthy as it could be, the blood just does not get where it needs to be and stays there. The hypothalamus is the most important part of the brain for sexual functioning. This is a small area at the base of the brain consisting of several groups of nerve cell bodies that receives input from the limbic system. Studies have shown that within lab animals, destruction of certain area of hypothalamus causes the elimination of sexual behaviors. The hypothalamus is important because of its relationship to the pituitary gland, which lies beneath it. The pituitary gland secretes hormones that are produced in the hypothalamus and itself.

In this review, how the above-mentioned effects of microgravity environment can affect human's sexual organs will be discussed. This discussion will be limited to the following areas:

- The erection of penis and orgasm
- Microgravity and romance

Biological detail of reproduction will not be considered in this work, discussions will only be made on how microgravity affects the above-mentioned processes without which no reproduction can take place.

3. FINDINGS

3.1. Penis Erection and Sexual Stamina Need Strong Bones

The penis system has connection with the pelvic bone, limp bone, hip bone and spinal cord.

Table3.1 Average Bone Mineral Density Loss on Mir Space Mission/Flight

Variable	Number of Crewmembers	Mean Loss (Percent/Month)	Standard Deviation
Spine	18	1.07	0.63
Neck of femur	18	1.16	0.85
Trochanter	18	1.58	0.98
Total body	17	0.35	0.25
Pelvis	17	1.35	0.54
Arm	17	0.04	0.88
Leg	16	0.34	0.33
Source: LeBlanc *et al.*, 1996.			

The table above can be used to analyze the effects of microgravity on sexual stability and stamina. In human skeleton, the penis is situated in the position such that it has link with:

Spine: Backbone or Spinal Cord

Femur: Limb Bone or Thighbone - extends from the pelvis to the knee

Trochanter: Bony: Upper extreme of the Femur to which muscles are attached

Pelvis: Hipbone forming half of the pelvis: Hip is found below the waist and above the thigh. Hip and thigh support the waist.

Generally, pelvis bone, can be referred to as pelvic girdle, pelvic arch or hip. The is the structure of vertebrate skeleton supporting the lower limb and hind limbs. All these can be regarded as pendulum clock components where the pendulum rod is suspended vertically downward. The components were so constructed so that accurate time can be marked. But if any of the components is impaired or affected the time indicated will be abnormal. The penis seems to be suspended and supported by the above-mentioned bones. If those bones are affected negatively, the penis will suffer erectile dysfunction. When penis shut forth, the bone holds it firm to the body, reacting to the forward force of the penis. When the action and reaction balances each other the penis remains rigidly strengthening, gain

toughness and turgidity. It is the penis muscle called the sex muscles that will shut the penis forward and the bones hold the penis firmly to the body while it remains erect. The above-mentioned bones are called weight-bearing bones.

Table 4.1 indicates mean loss percent per month, from each species of bones. The main weight-bearing bones lost bone minerals density during space missions in Earth orbit at an average greater than one percent per month. Spine (1.07), Femur (1.16), Trochanter (1.58), and Pelvis (1.35).Bones mass, density and strength decreases because of demineralization of the bones. Bones are constantly losing calcium and phosphorus which are needed to build bones because the activity of the osteoclasts greatly exceeds that of the osteoblasts. The demineralization affects all bones. These bones in the pelvic, hips, limps and spinal cord been weak due to demineralization could make erection and spinning difficult.

Although the bone density mass reduction cannot be generalized and that it may not be applicable to all astronauts due to the fact that phenotype varies from organisms to organisms sharing the same genetic constitutions. This shows that microgravity-induced bone mineral loss are not of the same rate for all astronauts because of difference in the genotype and bone mass differences among the selected astronauts, although high bone masses may not prevent bone mineral density loss, it may prevent the consequence of decreased bone mineral density; that is, bones with higher mineral densities may be at a decreased risk of fracture.

Vico*et al.*, 2000 says that because of unknown genetic component and variability among astronauts with regard to the rate of bone mineral density loss, it might be increasingly important to identify individuals whose bodies are able to resist bone mineral density loss on prolong space mission

3.2. Active Muscles are Needed for Erections

Pelvic floor muscles are important for sexual function in both men and women. In men, it is important for erectile function and ejaculation. In women, voluntary contractions (squeezing) of the pelvic floor contribute to sexual sensation and arousal. The muscles of the pelvic floor work with the abdominal and back muscles to stabilise and support the spine.

The important of muscles are that muscles help to:

- Get much harder erections
- Prevent erectile dysfunction
- Maintain harder erections much longer naturally (without the use of expensive viagra)
- Improves ejaculatory control
- Get ability to shoot instead of dribble i.e. gives stronger ejaculations.
- Contribute to sexual sensation and arousal in women through voluntary contractions (squeezing) of the pelvic floor
- The pelvic floor muscles in women also provide support for the baby during pregnancy and assist in the baby delivery process.

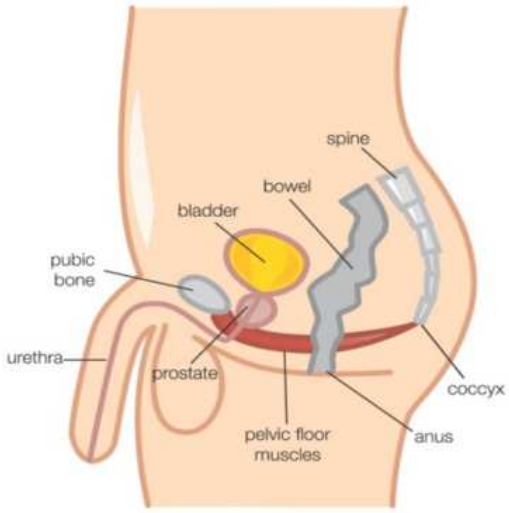

Figure 1 ……

This effect may increase as the time in space increases because of the progressive de-conditioning of the muscles. Thus, there is the distinct possibility that any of the sexual dysfunction experience by men and women on Earth may increase or be aggravated in the space environment.

Physiotherapist and muscle anatomy expert Mike Aunger, who has worked with the Chelsea Academy, stated that "We require every muscle to fire on all cylinders," he says. "In the bedroom, every muscle matter. All your skeletal muscles are essential for movement, no matter how vigorous; all your autonomous (involuntary) smooth muscles play a ceaseless role in digestion, respiration, circulation and bodily function; and of course, your cardiac muscles are needed for pumping blood into all the right places." Also, according to data, the bulbospongiosus – also known as 'the sex hero muscle' – plays the starring role between the sheets for both sexes. Found in the perineum, it contributes to erection and ejaculation in men, clitoral erection in women, and the contractions of orgasm in both. It is an equal opportunity employer. Regular activity with the lights off (or on) will, with the rest of the sex muscles, keep the bulbospongiosus trained.

The microgravity environment enhances muscles weakness, decrease in muscles mass and shrinking the muscles tissue. So, there is likelihood that pelvic muscles may as well be affected by microgravity environment causing reduction in the pelvic muscles mass and shrinking the pelvic tissue. Since the pelvic muscles may be affected, then erectile may be weak, instead of complete angle 90 degree to the two thighs, it can form complete parallel line to the two thighs, or forming $0^0 > \theta < 90^0$ where θ is erectile angle to waist or to the anus. The pelvic floor muscle makes the penis erect to nearly form a straight line with the pelvic muscle.

3.3. Joint Injuries

From the foregone discussion, the bone, the muscle and the cartilage are the factors behind the health of the joint (e.g. the knee), since prolonged flight in microgravity environment can affect bone and muscle which can be seen in the decrease of the mass-density analysis. So, if microgravity affects the quality of the underlying bone as well as the strength of muscles around the joint negatively, this suggested that cartilage will undergo degeneration and this can also lead to loss of adjacent bone.

3.4. Erection of Penis Needs Adequate Blood Flow

The penis becomes hard when a male is sexually excited. Tissues in the penis will be filled with blood and it becomes stiff and erect. When the erect penis is stimulated, muscles around the reproductive organs contract and force the semen through the duct system and urethra, this is referred to as ejaculation. The rigidity of the erect penis makes it easier to insert into the female's vagina during sexual intercourse.

In the microgravity environment, the loss of muscle mass, strength and endurance reduces the amount of blood that flows into the heart's chamber due to deteriorations rate of muscles contractions. This will reduce the amount of the blood that the heart will pump to the body. The blood will accumulate in the upper part of body because no gravity to pull it down to the lower part of the body. The erections will be difficult because enough blood will not flow to fill the penis' tissue to cause stiffness and erection. No gravity to pull the blood down to the lower part to fill the penis' tissue. Biblically, blood is life, when blood flow to the penis' tissue, the penis receives life and limps-up, strengthen, elongates, stiffs and erects. Gravity would have pull blood from upper part (chest and head), send life (blood) to the tissues - muscle and bones (pelvic, hips, limp and spinal cord bones) to make them strong and active for enhancement of erection and sexual performance.

Some women like to feel the hardness of the rigidity and the roughness of the turgidity of the penis and longer period, which can be easily achieved under Earth's gravity, but not in the microgravity environment because of the following reasons:

- Penis' tissue not receiving inflow of blood
- Sex muscles been weak and shrink
- Bones of the pelvic, hips, limp and spinal cord are weak in strength and constantly reducing in mass density.

3.5. Erection Needs Proper Brain's Signal

The male brain devotes twice as much to sex than the female brain. The brain controls the body. Many regions in the brain contribute to male sexual response, regions such as hindbrain regulates breathing, while the cerebral cortex controls higher thought and intellect. Research demonstrates that no single area of the brain controls sexual function. Rather, control is distributed throughout multiple areas of the brain and spinal cord. Should injury or disease destroy one or more of these regions, the ability to have erections often becomes a challenge (Goldstein, 2003). High brain functions such as memory and learning help to control erections.

In microgravity environment hypothalamus may be negatively affected such that oxytocin (love hormone) may not be active. The accumulations of water and blood in the body's chest and head can affect proper relationship between the hypothalamus and the brain. The brain will not be able to coordinate the sexual hormone secreted from hypothalamus for effectiveness. The following can affect brain in microgravity environment:

- The accumulations of blood in the head can raise intracranial (hollow within the skull) pressure, which can compress and damage delicate brain tissue.
- This pressure can damage the cranial bone because microgravity has caused bone to weaken and to undergo mass loss.
- Microgravity also can affect any of the 12 pairs of nerve that emerge from or enter the brain. The nerves will not efficiently network or conduct information throughout the body. Mostly between the brain and other part of nervous system, the eyes, glands, muscles and other parts of the body.

The flow of the sexual hormone secreted by hypothalamus to the brain for sexual engagement can be disrupted by accumulation of this blood in the head, damage in cranial bone and dysfunction of some nerves. Generally, the testosterone receptors that live on the nerve cells in a man's spinal cord, testicles, penis, and brain are the object that activates his entire sexual network. Once the spinal cord, penis's muscle and brain are affected by microgravity, the sexual affection will be disrupted.

3.6. How Do Microgravity Environment Deprive Women of Sexual Pleasure

The following muscles can be affected by microgravity environment in female:

- Pelvic Muscle near the vagina
- Anal sphincter muscles
- Uterus muscles

The above muscles contract and this muscles contraction in the vagina areas create a high level of pleasure for women. In the microgravity environment, it was learned that Heart's muscles contraction rate reduces and this causes scarcity of blood flowing into the Heart's chamber. This muscles contraction rate can be dysfunction in women. If the pelvic, anal sphincter and uterus muscles contractions rate are reduced, then thehigh level of pleasure created by these muscles contractions may not be possible for women in the microgravity environment.

The sphincter muscles called the bulbocavernosus muscles, underneath the muscles and opposite the sides of the vaginal opening are the vestibular bulbs, which grip the penis by swelling with blood during arousal.The reduction in the muscles contraction rate will not allow the blood to flow into the vestibular bulbs and there will be no life for the vestibular bulbs to grip the penis. These will result in sexual dysfunction in a woman. The above-mentioned bones (pelvic, hips, limbs and spinal cord) may be affected due to demineralization of bones under microgravity environment. These bones being weak under microgravity environment will be greatly affected to the extent that the acrobatic display normally featured when women are sexually excited under Earth gravity will not feature under microgravity. Those bones are weak because of loss of mass density due to reduction of calcium and phosphorous (Jessica, 2017; Benjamin, 2001).

Also, the concentration of fluid at the upper part of the body, limits the amount of alkaline fluid that can drop by the Bartholin's gland to neutralize acidity of the vaginal and to lubricate it. Penis penetration will be hard; because the vaginal is not lubricated therefore frictional force will be developed. The development of frictional force will result to heat generation both in the penis and vaginal. Lack of lubrication can cause pain in women and wound in the vaginal.

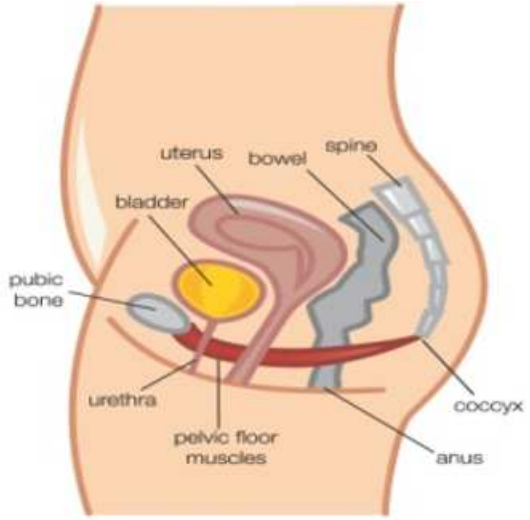

Figure 3.6 the Female Reproductive System

3.7. Microgravity Environment Does Not Allow Sexual Romance

The following can be stated as the reasons why microgravity environment does not allow sexual romance:

- Microgravity environment can induce nausea.
- Microgravity environment make astronauts to perspire, meaning sex without gravity would likely be hot, wet and surrounded by small droplets of sweat.
- Astronauts' sense of up and down gets confused, because the vestibular system no longer can figure out where the ground and ceiling are.
- Astronauts sometimes lose sense of where their legs, arms and limbs are located, and when they struggle to figure out where they have put your hands, the usage of those elements of the body for romantic activities will not function effectively and efficiently. It is not going to be much fun struggling to put your hands all over someone else and your partner will also be equally confused about what is happening with his/her own hands or limbs.
- Astronauts have their weights as weightless. No matter how light or skinning couples might be they will still want to feel that they are holding each other. Couples will like to feel the sense of action and reaction. The self-exerted opposing force that results from attraction isonly is found with Earth's gravity.
- No proper/convenient room for romantic activities in the space station. Outside the space station there is possibility of couple floating and eventually separated and burnt in the outer space, if there is no way of bringing them to the space station. Even in the attempt to strip naked outside the space station, they can be bombarded (to death) by energetic electrons ejected from corona mass ejections

4. Summary

In the microgravity environment the muscles and bones do not have to work so hard so they are weakened. Therefore, the muscle shrinks and bones mass or density decreases. The shrinking and weakness of muscles also affect sex muscles, therefore making erections difficult in microgravity environment. Bones mass, density and strength decreases because of demineralization of the bones (bones are constantly losing calcium and phosphorus which are needed to build bones because the activity of the osteoclasts greatly exceeds that of the osteoblasts). The demineralization affects all bones in the body including the pelvic, hips, limb bones and spinal cord, which are necessary in sexual activities for proper movement. These bones in the pelvic, hips, limps and spinal cordare been weak due to demineralization, therefore making erection and spinning difficult.

In the microgravity environment the loss of muscle mass, strength and endurance reduces the amount of blood that flow into the heart's chamber due to reduction rate of muscles contractions. This will reduce the amount of the blood that the heart will pump to the body. The blood will accumulate in the upper part of the body because there is no gravity to pull it down to the lower part of the body. Erections will be difficult because enough blood will not flow to fill the penis' tissue to cause stiffness and erection. Biblically, blood is life, when blood flow to the penis' tissue, the penis receives life and limps-up, strengthens, elongates, stiffen and erects. Gravity would have pulled blood from upper part (chest and head), send life (blood) to the tissue, muscle, bones (pelvic, hips, limp and spinal cord bones) to make them strong and active for enhancement of erection and sexual performance.

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- Penis'tissue not receiving inflow of blood
- Sex muscles been weak and shrinking
- Bones of the pelvic, hips, limp and spinal cord are weak in strength and constantly reducing in mass density

5. CONCLUSION

Under normal Earth gravity, the bones, muscles, blood flow, body fluid, heart rhythm and proprioceptive system are very active under Earth gravity and this gravity enhances sexual reproductive organ effectiveness and efficiency on the Earth because bones and muscles actively exercise against gravity making them well compacted and strong for effective performance; also heart pumps blood normally and blood flow normally with the influence of gravitational pull.

Since in the microgravity environment there is mass-density reduction/loss of bones; loss of muscles mass; strength; endurance and abnormality in heart muscle contractions; inadequacies of blood flowing to penis tissues; redistribution of fluid and de-orientations of proprioceptive system; and lack of vaginal lubrication will impair sex activities. Therefore, microgravity environment is not a conducive environment for romantic and sexual experience and in turns not effective for reproduction since all the components of organ connected to reproduction will be impaired. The penis, virginal, and uterus activities will be negatively affected.

6. RECOMMENDATION

The Heaven is of the Lord God and the Earth is as given unto the children of men. On the Earth, there are land and sea. In the other planets there are lands but they differ in compositions, having difference: in mineral nutrients of the lands, and atmospheric compositions, but no water has been found so far in abundance like Earth. Therefore, if microgravity can sustain lives and better reproduction mechanisms can be deduced for longer period under microgravity; similar to how it's done on the Earth, then human long-term existence is possible in space.

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