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Effects of Prolonged Fasting on Sperm Count

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ABSTRACT

Background and Aim: In Nigeria, like in many other parts of the Africa and the world, people embark on fasting for various reasons; medical, spiritual, experimental, etc. Some even engage in prolonged fasting for a period of 30 days, 40 days, 50 days, or even longer. Prolonged fasting, as it were, has been observed to have various effects on some physiological parameters of the body. The current study reports on the effects such prolonged fasting has on semen profiling in mice, with particular emphasis on sperm count, and how it consequently affects fertility in the male. **Method:** Twenty (20) male mice used for the research were grouped into two. While mice in Group 1 were fasted for 12 hours per day for 30 days during which they were denied access to feeds and water, mice in Group 2 (control) were allowed free access to feeds and water throughout the period of the 30 days. At the end of the period, the semen from both groups were separately collected and analyzed, with emphasis on the sperm count. **Results:** The results showed that sperm count in the fasted group significantly ($p<0.05$) dropped compared to the fed group. There was also a significant ($p<0.05$) weight lost in the fasted group due caloric restriction. Morphology and motility of the sperm cell were also affected. **Conclusion:** Results suggest that the 30 days fasting adversely affected the sperm cells. Some of the sperm cells may have died due to lack of nutrients to sustain it during the period of the fasting. The normal process of spermatogenesis may also have been distorted by the fasting resulting in the drop in the sperm count.

KEY WORDS: Fasting, sperm count, spermatogenesis, sertoli cell, caloric restriction

INTRODUCTION

Fasting is a deliberate abstinence from normal meal(s) ie food and drinks, or failure to eat/drink for an unusual length of time. It is a common practice in Nigeria and other parts of the world by various groups and for various reasons ranging from spiritual, health, to experimental purposes.

Fasting could take different forms and length. For instance, it could be total; where the subject abstains from all kinds of foods/drinks, it may also be partial, where the subject may only abstain from some kind of foods/drinks. On the length, fasting may take 12hrs, 24hrs, and as long as 72hrs. In human, when fasting lasts longer than 72hrs the individual becomes hypoglycaemic and could collapse as nearly all the glucose in his body may have been used up, causing the kidney and the liver to, by the process of gluconeogenesis, convert the non-carbohydrate food substances in the body, like fat and protein, to glucose to sustain the body.

Fasting has various physiological effects on the body and as such has been used to determine some important parameters like, lung mechanics, shivering activity during progressive hypothermia, neuroendocrine function and follicle development in lean women [1] [2].

Fasting may also have some effects on the gonadotropic hormone level [3] and the testosterone level in fertile males, either via the hypothalamus pituitary-testicular axis or by direct effect on the testis, and could therefore affect spermatogenesis. The quality of spermatozoa is a significant determinant of male fertility. It is therefore important to determine what effect fasting has on the general quality of the semen [4].

Generally, food has been considered to be one of the most important environmental variables controlling reproduction in animals. It has long been known that starvation adversely affect reproductive functions [5] [6]. This is evident in countries where famine had prevailed where some links have been seen between prenatal famine and birth weight, reproductive performance, and age of menopause of the conceived child [7].

Earlier researches have determined that individuals with insufficient nutrition during development often experience poorer later-life health and evolutionary fitness. The Predictive Adaptive Response (PAR) hypothesis proposed that poor early-life nutrition induces physiological changes that maximize fitness in similar environments in adulthood, and that metabolic diseases result when individuals experiencing poor nutrition during development subsequently encounter good nutrition in adulthood [8].

Although earlier studies have shown that famine exposure during developmental ages reduces health in favourable later-life conditions, no study on humans has demonstrated the predicted fitness benefit under low later-life nutrition, leaving the evolutionary origins of such plasticity unexplored, [8]. But it is established that famine exposure and childhood caloric restriction may lead to permanent changes in the hypothalamo–pituitary–gonadal axis, which could lead to impaired female reproductive ability [7].

But in Africa, and indeed some other parts of the world, many persons, and indeed male folks, faced with problems of infertility embark on prolonged fasting to seek spiritual solutions to their problems. The current study seeks to get

clearer understanding of what specific effect this prolonged fasting has on the sperm count of the male.

MATERIAL

Domestic Mice (Mus domesticus), cages, Neubauer haemocytometer, microscope, sample bottles, cover slip, Normal saline, 5ml volumetric pipette, warm and cold waters, water bath, pestle & mortar, counter, beakers, dissecting kit, dropping pipette, measuring cylinder, electric weighing scale, and thermometer.

METHOD

Twenty mice were grouped into two of 10 each, and kept in separate labelled cages. The mice were weighed before and after the 30 days fasting, using electronic weighing balance, and they had an average weight of 19g.

Group 1 was fasted for 12hrs daily for 30 days, while Group 2 was well fed with mice feeds and also given unhindered access to water for 24 hours and through the period of 30days. The two groups were kept under standard laboratory environment.

At the end of the fasting period, mice from both groups were sacrificed using chloroform, and the caudal portion of their left epididymis removed, crushed and prepared for sperm count. The semen is diluted with normal saline solution and observed at 40x, 100x and 400x using a light microscope. The caudal portion of the epididymis was preferred because it has a higher concentration of sperm cells than other parts [9].

The approval of ethical committee on experimental animals was of Bingham University was got before the experiment was carried out.

A 30-day duration was chosen for the fasting because the entire process of spermatogenesis takes about 35 days in the mouse, with mitotic, meiotic, and post-meiotic phases lasting 11, 10 and 14 days, respectively [10].

Using Haemocytometer

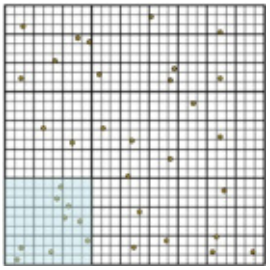

Fig 1. Haemocytometer

Procedure for the Sperm Count

A special cover-slip provided with the counting chamber of the haemocytometer was properly positioned on the surface of the chamber. Usually, when the two glass surfaces are in proper contact, Newton's rings can be observed. Then the semen suspension is applied to the edge of the cover-slip to be sucked into the void by capillary action which completely fills the chamber with the sample. The number of cells in the chamber can be determined by direct counting using the light microscope, and visually distinguishable cells can be differentially counted. The number of cells in a chamber is used to calculate the concentration or density of the cells in the mixture the sample was drawn from. It is the number of cells in the chamber divided by the chamber's volume, which must have been taken at the commencement of the experiment, taking into account of any dilution and counting shortcuts [11].

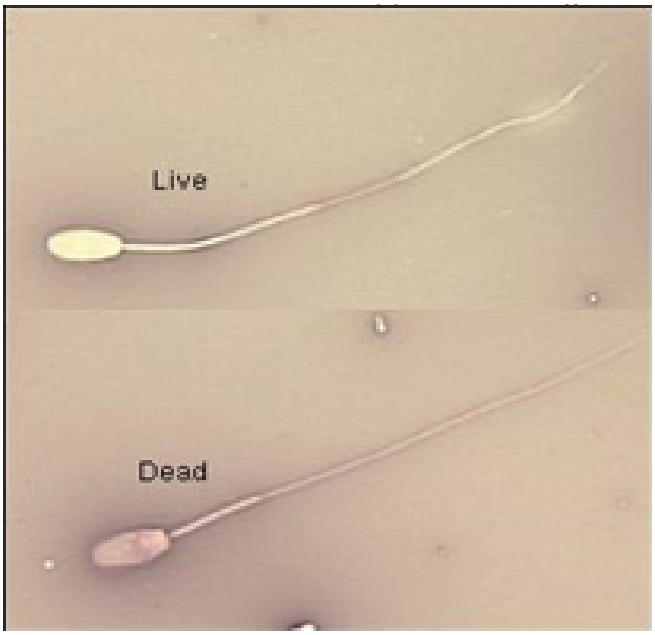

Fig 2. The nigrosin-stain produces a dark background on which the sperm stands out as lightly coloured objects. Normal live sperm exclude the eosin stain and appear white in colour, whereas 'dead' sperm (i.e. those with loss of membrane integrity) take up eosin and appear pinkish in colour, as shown above. (courtesy of J. K. Graham).

$$\text{concentration of cells in original mixture} = \left(\frac{\text{number of cells counted}}{(\text{proportion of chamber counted})(\text{volume of chamber})}\right)\left(\frac{\text{volume of sample dilution}}{\text{volume of original mixture in sample}}\right)$$

RESULTS

Table 1. Shows significant average body weight loss

Group	No	Total wt(g)	Means(g)	Variance	Std Dev.	Std Error
Fasted	10	172	17.2	0.23	0.48	0.15
Fed	10	211	21.1	0,26	0.51	0.16

P< 0.05 (significant)

Table 2. Shows significant drop in the sperm count of the mice in the fasted group

Group	No	Total	Mean	Variance	Std Dev
Fasted	10	26,988,056	2.69×10^6	7.65×10^{11}	8.7×10^5
Fed	10	50,333,333	5.03×10^6	4.08×10^{12}	2.0×10^6

P< 0.05 (significant)

Motility & Morphology of the sperm cells

Though these were not the main focus, it was however observed that about 40% of the sperm cells of the fasted group were deformed (while some were decapitated, others had their flagella coiled around their heads). This is against the 5% of deformation noticed in the fed group, showing that the prolonged fasting may have affected the morphology of the sperm cells. The motility of the sperm cells from the mice in the fasted group was also affected as the cells were either dull/slow, stagnant, or even showing reverse motility (this will however require further and specific study for confirmation).

DISCUSSION

Results show that there was a significant weight loss in the fasted group possibly resulting from hypoglycaemia [12] [13]. The average weight of the mice before the fast for both groups was 19g. But after the 30days of fasting, average weight for the fasted group dropped significantly to 17.2g, while for the fed group, the average weight rose by 2g from 19g to 21g.

There was also a significant drop in the value of sperm count in the fasted mice, showing that the process of spermatogenesis, which normally lasts through about 35 days in mice, may have been affected by the 30-day fasting [14].

Results show also that even though moderate calorie restriction (CR) with a short period has minimal impact on testicular gene expression with no significant negative impact on semen quality or plasma testosterone levels, a prolonged/severe caloric restriction (fasting) in male adults may have impacted circulating testosterone levels, testicular gene expression, and testicular morphology.

The prolonged fasting may also have caused negative effects on the histological profile of the testis which may have resulted from the impact on testicular morphology (decrease in seminiferous tubule diameter and epithelium height), with a concomitant increase in the number of depleted germ cell lines, which may have comprised the sperm count and of course fertility.

Also, it is thought that Sertoli cells may have been compromised by the prolonged fasting (nutrient deprivation), thereby resulting in decreased sperm count, impaired motility, and deformation in sperm cells.

Sertoli cell is a highly specialized cell found in the testes. It plays an important role in the development and maturation of sperm cells, or spermatozoa, within the testes (spermatogenesis). Because a Sertoli cell functions largely to assist the developing sperm cells through their maturation process, it is sometimes referred to as a nurse cell. In addition to secreting numerous important hormones and other substances to trigger proper development, a Sertoli cell also consumes excess material left behind after the sperm cells have completed development [15]

Another function of a Sertoli cell is to control the movement of hormones, nutrients and chemicals into the seminiferous tubules. During the course of the development of the spermatozoa, the Sertoli cell also triggers several phases of growth by excreting certain substances. For instance, spermatogenesis begins when Sertoli cells secrete a protein to increase the concentration of testosterone in the somniferous tubules, [16]. Compromise of the sertoli may have left such grave consequence on spermatogenesis.

CONCLUSION

Prolonged fasting generally reduces sperm count, impact negatively on sperm cells viability in males owing to poor nourishment of mature sperm cell, and also by interfering with the process of spermatogenesis. Prolonged fasting also causes deformation on the sperm cells and impair the motility of sperm cells. All these would affect fertility. Therefore males facing fertility problems are advised to abstain from prolonged fasting; they are advised to eat balanced diet regularly, especially during the period of the fertility problems. If they must embark on fasting at all, it should not be a prolonged one.

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