INFERTILITY: A WEIGHTY MATTER

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The prevalence of infertility among couples in industrialized countries is between 10% and 20% and increasing [1]. Infertility is commonly defined as the inability of a couple to conceive after trying for one year or an inability to carry to term. Its prevalence is equal in males and females. Infertility is not a recent condition; but dates back to the times of the Bible and apparently was prevalent among women, especially in the Biblical matriarchs. The first couple experiencing infertility was Abraham and Sarah, followed by Rebecca and Isaac, and then Rachel and Jacob. A later couple, living in the time after the conquest of Israel, was Elkanah and Hannah. Bereishis Rabbah (45:4) explains that their infertility was “Because the Holy One, blessed be He, yearns for their prayers and supplications.” The prayers of our patriarchs and matriarchs for offspring further developed their relationship with God, praying intensely that He grant them their request of progeny. However, as God works through nature, scholars try to discern physiological reasons for infertility in these Biblical women.

In the cases of Sarah and Abraham and of Rachel and Jacob, infertility was explicitly directed to the wife. In Genesis (16:2), Sarah explained to Abraham, “See, now, God has restrained me from bearing.” With Rachel the verse states, “but Rachel remained barren” (Genesis, 29:31). Later, when Rachel finally conceived and bore a child, the Bible says, “And He opened her womb” (Gen. 30:23) implying that she was the cause for their infertility. With both matriarchs, the wives requested that their husbands have children for them through their maidservants. A 13th century Bible commentator and physician, Rabbi Levi ben Gershom, termed the Ralbag, associated these matriarchal infertilities with obesity. (Commentary on Gen. 16:1) The Ralbag stipulated that Sarah and Rachel were obese, which triggered an inability to conceive, possibly linked to their development of polycystic ovary syndrome, or PCOS. He supported this speculation by first stating that obesity is a known cause of infertility. He then added that both Sarah and Rachel had their maidservants replace them, to intentionally induce jealousy and depression, causing the matriarchs to lose weight and reverse their infertility[2]. They chose this means because this is the worst anguish that can be brought upon a wife in a polygamous marriage.

The disease pathology of polycystic ovary syndrome supports the Ralbag's stipulation. PCOS is an anovulation, or failure of the ovaries to release an oocyte, due to an excess of androgen hormone, which interferes with the ability of the ovary to release eggs during ovulation and thus leads to female infertility. As a result, fluid filled sacs and cysts appear on the ovaries. In normal ovulation, the ovarian follicles retain the egg until it matures and then releases it into the fallopian tubes. In a woman with PCOS, however, the egg matures in bunches of immature follicles that lump together, creating cysts, which prevent the release of the egg when maturation is complete. As a result, the female has menstrual irregularities, including loss of her period and irregular periods. If the egg is not released from the ovary, she may become infertile.

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PCOS is seen frequently in obese women. Obesity, characterized by a body mass index, BMI, of 30 or above, results from the body storing more energy than it expends. A study done to test infertility in women with normal ovulation, found that severely obese women were 43% less likely to become pregnant [3]. When body mass increases, it cuts off the oxygen supply from the adipocytes, which are the cells that make up the tissue that store energy as fat. The lack of oxygen leads to the release of adipokines, cytokines released from the adipose tissue, each with respective effects on the
female reproductive system.

One type of adipokine that is released is leptin. Leptin, the body's anti-obesity hormone, inhibits feeding at the level of the hypothalamus by creating a feeling of satiation and by increasing energy expenditure. The levels of leptin are usually proportional to body fat. Regarding the female reproductive system, the level of leptin regulates menstruation. As a person achieves a certain body weight and the fat cells release more leptin, their rising levels aid in initiating puberty. Amenorrhea, or the loss of the period, is associated with decreases in body fat in individuals with eating disorders or who perform strenuous exercise, thereby secreting less leptin. Leptin also binds to receptors on follicular cells, causing an inhibitory effect on ovulation. Such binding reduces steroidogenesis, a process in which steroids, such as androgen and estrogen, are produced. In obesity, levels of leptin may be very high, leading to a major inhibition of steroidogenesis in the granulosa and theca cells, both very closely related to the reproductive system and to the developing gamete. This, in turn, can lead to poor fertility in obese women.

Adiponectin, resistin and ghrelin are three other adipose hormones that may play a role in reproduction. Ghrelin receptors and ligands were identified within the ovary, but no direct correlation to ovarian regulation has been found, as yet.

Another major side effect of obesity is its association to insulin resistance. Increased energy stores create increased levels of insulin. Such hyperinsulinemia stimulates the production of excess androgen, which may cause anovulation, similar to the pathology of PCOS. As a side note, because type 2 diabetes (insulin resistance) and PCOS have similar symptoms, they both can be treated using similar medications. In addition, sex hormone binding globulin production, SHBG, is inhibited in obese individuals, again leading to higher levels of androgen, causing anovulation.

Obesity is also linked to miscarriages. Having a BMI of over 30 can have negative effects both on the endometrium and the developing embryo. Assisted reproductive technologies are more challenging in obese women. Once pregnant, a woman's obesity can lead to many complications, including gestational diabetes, an increased risk of complicated operative delivery, birth defects, and intrauterine fetal death. Normal hormone levels and lower risk pregnancies can be achieved through weight loss. Most of the problems caused by obesity are reversible with weight loss and the accompanying reduction in BMI. The matriarchs, who may have been infertile due to PCOS, tried to motivate themselves to diet and lose weight, thereby to reverse their infertility. In both instances, this solution solved their problem [4].

With Sarah and Rachel it may seem clear that the couples’ infertility was due to the wife’s inability to conceive, with Rebecca and Isaac the situation it is not as clear. While scripture states that Rebecca was barren, it does not say that God closed her womb or, conversely, opened it when she became pregnant, as in the other cases. Additionally, both Isaac and Rebecca prayed for children, God preferentially positively responded only to Isaac, “God allowed Himself to be entreated by him (Isaac)” (Genesis 25:21). This response implies that, perhaps, Isaac was the cause for the couple’s infertility. Another difference between Isaac and Rebecca and the others, was that while the other husbands successfully conceived with other wives, Isaac did not attempt to conceive with any other woman. Perhaps, one could assume that Isaac was sterile. The Talmud (Yevamos 64a) stated that Isaac was akur, or sterile, but later made note that both Isaac and Rebecca were sterile (Yevamos 64a).

In contrast to Sarah and Rachel’s infertility which may have been caused by obesity, is the infertility of Hannah which may have been caused by another extreme. Hannah’s story is related in the beginning of Samuel 1. She was one of Elkanah’s two wives and was tormented, because of her infertility by Peninah, the other wife. According to Scripture, “Peninah had children, but Hannah had no children…for God had closed her womb” (Samuel 1 1:2-6), implying again that the infertility was due to the wife’s inability to conceive. Peninah tormented Hannah leading her into a depression that caused her to stop eating, as it says, “Why do you cry and why do you not eat? Why is your heart broken?” (Samuel 1, 1:8). Drs. I. and M. Schiff [5] postulate that malnutrition was the possible cause for Hannah’s infertility. Although not explaining her initial inability to conceive, Hannah’s cessation of eating, which would fall under the current clinical description of anorexia, may have caused further damage and complications. This is substantiated a few verses later when Eli, the priest, said that God would grant Hannah her request for children. After hearing this, the verse says, “The woman went on her way and she ate” (Samuel 1, 1:18), and shortly thereafter she conceived, thereby linking the return to normal eating with conception.

While obesity can cause infertility, being extremely thin is not beneficial either. It is well known that anorexia and
severe malnutrition can cause cessation of the menstrual cycle. A study done tracking the menstrual cycles of athletes who were involved in strenuous exercise and activity shows many cases of amenorrhea. Intense training, 30-50 miles per week, building up over two months can lead to menstrual disturbances and abnormalities. This was mostly noted in ballet dancers and long distance runners. The study notes that menstruation may cease when there is a less than 12% body fat content [6]. Fat cells are responsible for estrogen production and without estrogen a woman cannot ovulate. A study on concentration camp inmates states similar results. According to a study done on Polish migrants, “almost all of the women in German concentration camps developed amenorrhea and following the war there was a significant reduction in their fertility” [7]. The severe weight loss in inmates, in women suffering anorexia nervosa, and in athletes causes them to lose their period, because of the inability to produce the hormones necessary to ovulate. If pregnant, there is an increased risk of miscarriage. Disturbed menstrual cycles of an anorexic woman or of a female athlete can also lead to PCOS. With a return to normal eating, however, these conditions can be reversed.

As mentioned, the prevalence of infertility is between 10-20% and is increasing. Perhaps, this is due, in part, to the increasing obesity in America today. While the matriarchs and patriarchs had to resort to various strategies to conceive, today there are more choices, such as in vitro fertilization and other infertility treatments. However, the best cure, when applicable, is to have a stable, healthy, and nutritious diet, coupled with an exercise regime.

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REFERENCES