Probability of foetal gender based on time of conception

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Abstract

Due to differences in physical size and measured motility, X and Y chromosome-bearing spermatoza do not have an equal probability of fertilising the ovum on any random day. An argument based purely on the statistics and measured ratios is put forth, along with a proposal to falsify this argument.

The probability of intercourse occurring is highest during the mid-follicular phase of the menstrual cycle[1], with a gentle rise in value and a sharp drop-off after ovulation[8] peaking at the day of ovulation when conception is most viable. Spermatozoa have a limited lifespan, and are generally viable for between 3 and 5 days in utero.

As gender ratios at birth are close to 1:1, Fishers argument[3] predicts that each ejaculation must contain a ratio of X:Y spermatozoa that must result in a 1:1 ratio of male:female infants born,[1] i.e. the biological pressures must stabilise the birth ratio of male:female at 1:1, resulting in a bell curve[3, p117]. Thus the implication is that there is no need to compensate for issues such as the higher in utero mortality rate of Y spermatozoa - only actual births are counted.

All spermatozoa derive their energy for survival and motility from the base of the flagellum (midpiece)[2], and X spermatozoa are statistically significantly larger than Y spermatozoa[4] in all of the sections, including the midpiece of the spermatozoa. Therefore, the X sperm cell has a greater amount of initial energy and either:

1. Has a longer lifespan than the Y spermatozoa,

or

1. Has better (faster) mobility than the Y spermatozoa.

If the above two statements are both true at the same time, then the X spermatozoa would have vastly better ability to reach the ovum first, and we would see evidence of this in the form of a ratio at birth of male:female being highly favourable to female births. Since the ratio is still close to 1:1, we can safely assume that the above two statements are mutually exclusive.

So, which of the statements above is true? Due to the measured zeta potentials of the cells[5], the motility of the X spermatozoa should be higher, but it was found in bovine spermatozoa that the X spermatozoa has a longer lifespan[6], hence the Y spermatozoa move faster but die quicker *in bovines*. A search for a study on the lifespan and motility differences in human X and Y spermatozoa was unsuccessful. A reasonable assumption is that statement #1 above has a larger chance of being true for humans, as it is already true for bovines.[2]

The longer lifespan of X spermatozoa results in a higher probability of a female conception if intercourse was significantly prior to ovulation, as there would be a larger percentage of X spermatozoa left alive at time of ovulation. To maintain the observed birth ratio of 1:1, this means that the Y spermatozoa has to move significantly faster than the X cells while

[1] This ratio need not be 1:1.

[2] The discrepancy in motility between X and Y chromosome bearing spermatozoa seems to be widely acknowledged, even in the popular press - as an example see *http://news.bbc.co.uk/2/hi/health/4529152.stm*.

they are still alive, and that their probability of fertilisation is actually the inverse of the probability of the Y fertilisation.

In simpler terms, the advantage that the X cell has at the end of the viability of the ejaculation has to be offset by an equal advantage to the Y cell at the beginning, else the birth ratio would not be close to 1:1. The probabilities can both be considered a continuous function, so at a particular point prior to ovulation, the probability of an X cell fertilisation would be exactly equal to a Y cell fertilisation.

Hence, immediately after intercourse, the Y cells have an advantage that decreases with time, therefore intercourse earlier in the cycle (and none until after ovulation) would result in a higher chance of a female birth, while intercourse close to or on the day of ovulation would result in a higher chance of a male birth.

A proposed test of the above hypothesis can be performed in a reasonably non-invasive manner by simply asking subjects (who are attempting to conceive) to track their menstrual cycle, and record whether they attempted to conceive a male or a female using the above method, and whether it was successful or not.

An application has been developed to aid in this process, but due to privacy and ethical concerns, it does not record the information. It is hoped that a more fully funded study would be able to address the privacy and ethical concerns, and thus record anonymised data for each subject.

The test proposed (together with the application developed) would no doubt be foundational in further research into this hypothesis.

All of the above studies were done on cytometric flow-sorting of spermatozoa, which is currently thought to have no effect on the fertilisation capacity of the spermatozoa.[7]

References

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