

Genetics of Gotra System

Unraveling the Genetic Wisdom Behind the Gotra System: Understanding Its Role in Preserving Male Lineage and Preventing Genetic Disorders.

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This article is the outcome of a series of lectures that Dr. Pramod B. Gai and Dr. Suyamindra Kulkarni delivered at various places in the Uttara Kannada District under the auspices of Swaranavalli Math, Sirsi.

It is an attempt to unravel the scientific reasoning behind the ‘Gotra’ system which is being followed by many of the communities in India since thousands of years. This article aims to create awareness among the people, following the Gotra system in marriage alliances, about the genetic implications & health consequences on the progeny.

Etymologically the word 'Gotra' is derived from two Sanskrit words “Gou” meaning cow and “Trahi” meaning Shed. Translated Gotra means "Cow Shed" or "Cowpen", throughout the Vedic literature the word Gotra has several connotations. For example, in the ‘Atharva Veda’ around 1000 BCE the word Gotra denotes Paternal Lineage, which refers to clans or groups descended from a common paternal ancestor. Then later in the Chandogya Upanishad written in 7th Century BCE, the term Gotra is defined as a mechanism through which the paternal lineage of an individual could be traced and identified. We then find the reference of this word in Panini's Astadhyayi where the term is equated with the word ‘progeny.’



The Gotra system associates a person with his most ancient or root ancestor in an unbroken male lineage. For example, if a person says that, he belongs to Vishwamitra Gotra, then it means that, he traces back his ancestry to the ancient Rishi Vishwamitra. Therefore 'Gotra' refers to the root person in a person's male lineage. Since Gotra means cowshed, where ancient Hindus reared, protected and worshipped many best breed cows, the name Gotra referring to the system of maintaining individual male Lineage seems more appropriate.

According to Brahadanyakopanishat 8 original or root persons are called Gotrakarins' meaning roots of gotras. The original Gotrakarins are:

- 1) Kashyap
- 2) Goutam
- 3) Bharadwaja
- 4) Vishwamitra
- 5) Jamadagni
- 6) Vasistha
- 7) Atri
- 8) Shandilya.

All other gotras are said to be evolved from one of the above gotras. There are about 49 gotras which have evolved from these original gotrakarins.

The male lineage of an individual is identified through the gotra to which he belongs. This is passed down automatically from father to son. But the gotra system is not automatically passed down from father to daughter. For example, a person with Bharadwaja gotra has a son. His gotra will be Bharadwaja. Suppose he marries a girl whose father belongs to Kashyap gotra. Now after marriage, the gotra of the girl

automatically is said to become Bharadwaja though her father belonged to Kashyapa Gotra. Therefore, the rule of gotra system is that the gotra of man remains the same while the gotra of woman becomes the gotra of her husband after marriage. But suppose a person has only daughters and no sons, then this gotra will end with him in that lineage because his daughters will carry the gotras of their husbands after their marriage. Probably this might have been the reason for preferring to have at least one son so that the gotra of the father could continue.

The most important rule in the gotra system is that a bride and a bridegroom belonging to the same gotra should not marry because they are considered siblings even though they belong to distant families.

Pravaras

Every gotra is further sub-divided into several divisions known as Pravaras. The term Pravara translated from Sanskrit means “most excellent.” A Pravara represents a lineage of male individual from a particular gotra who had achieved greatness. These individuals are usually descendants of the eight gotrakarins who may be saints or sages or sometimes kings and princes. It is believed that these individuals are said to have achieved greatness by performing noble deeds, great virtues consistently throughout their lifetime and upheld the reputation of their gotrakarins. The number of Pravaras vary from gotra to gotra depending on the number of individuals who have achieved greatness. The reason behind the Pravara system is to ensure that the derived gotras still maintain track of their gotrakarins or root gotra, where the bride and the bridegroom from no two pravaras coming from the same gotra marry each other. Therefore, every derived gotra maintains a list of Pravaras attached to it, so that the individuals follow not only gotra exogamy but also pravara exogamy.

In this backdrop, we are confronted with several questions: Why should only sons carry the gotra of their father why can't daughters carry? How does the gotra of a daughter change just because she marries a person from different gotra? What is the need for maintaining only man's ancestry, why not females? How can a boy and a girl belonging to different families who have not met for centuries be considered siblings. For all these questions, there are evidence-based answers in the science of Genetics.



Chromosomes and Genes

Human body is composed of trillions of cells. Each Cell contains a central organelle called Nucleus; every human cell nucleus contains thread-like structures called chromosomes. There are 46 chromosomes in normal human cell nucleus. We receive 23 chromosomes from father and 23 from mother. Each chromosome comprises thousands of genes responsible for normal and abnormal characters in humans.

Out of these 23 pairs of chromosomes, there is one pair which is called as the sex chromosomes, which decides the gender of a person. After conception, if the zygote has XX chromosomes, then the child will be female, and if the zygote has XY chromosomes then the child will be male. Therefore, it is clear that the Y chromosomes is responsible for the birth of male child.

Since, only males have Y chromosome, son always gets his Y chromosome from his father and transmits the Y chromosome to his son. Thus, the Y chromosome is transmitted from generation to generation through male line. So, the Y chromosome is always preserved through male lineage (Grandfather – Father- Son - Grandson) On the other hand daughters always get their X chromosomes, - one each from father and mother. Hence the X chromosome is not preserved in the female lineage (Grand Mother - Mother – Daughter- Grand Daughter)

During transmission of X chromosome from one generation to another, we find that mother will pass on either her mother's X Chromosome to her children or her father's X Chromosome to her children or a combination of both because both her X chromosomes get mixed up during crossing over. On the other hand, a son always gets his father's X chromosome almost intact without any changes because there is no corresponding another Y chromosome for crossing over to happen. But in females since there are two XX chromosomes there is mixing of both these X chromosomes during crossing over.



It has been observed that Y chromosome is the only Chromosome passed on from one generation to the next, through male line Women never get Y chromosome in their body. Therefore, Y chromosome plays a significant role, in identifying the genealogy especially the male ancestry of a person, and as such the gotra system has been designed to track down the root Y chromosome of a person very easily. Suppose a person belongs to Vishwamitra Gotra, it means that his Y chromosome came all the way down over thousands of years from Rishi Vishwamitra. The ancient Vedic rishis understood the existence of the paternal genetic material that was passed on almost intact from generation to generation through male line. Therefore, they created the Gotra system to identify their male lineage & to protect the male genetic material.

When we look into the structure of the Y chromosome, we observe that, it is the smallest chromosome in the complete set of 46 chromosomes. Secondly, it does not have a similar pair in the human body. The corresponding pair of the Y chromosome in the human body is the X chromosome which is significantly different from Y chromosome. The size of the Y chromosome is almost one third of the size of the X chromosome. It has also been observed that throughout the course of human evolution, the size of the Y chromosome is decreasing by way of losing some of its genes and has attained the current size. The scientists are wondering whether the Y chromosome will be able to survive for many more million years or will it disappear gradually which may cause the male species to become extinct Under such circumstances the scientists are not sure whether any other chromosome will be able to take over the function of Y chromosome.

This is primarily because, unlike other chromosomes, there is no way for Y chromosome to repair itself by doing crossover with its chromosomal pair in case of DNA damage. But, since other chromosomes come in pairs, in case of DNA damage that occurs in one chromosome, it gets repaired by copying the DNA from the other chromosome in its pair as both are similar. The Y chromosome on the other hand, must depend on itself to repair any of its damages and for that it has created duplicate copies of its genes within itself. However, this does not stop the DNA damages in the Y chromosome which will lead to accumulation of DNA damage over a prolonged



period of time in the course of evolution. Scientists believe that this causes Y chromosome to decrease in size.

Under these circumstances, the creation of the Gotra System and the strict exogamy associated with it was an attempt by our ancient learned Rishis to protect the Y chromosome becoming extinct. The Vedic Rishis who had the knowledge of degeneration of the Y chromosome wanted to maintain as many individual healthy Y chromosome lineages as possible. That would continue male lineage because Y chromosome is passed on from generation to generation with almost negligible change in its genetic combination as it does not take part in mix with other chromosomes.

Therefore, the Rishis devised a wonderful system called the Gotra system where the given Y chromosome had little chance of adding more genetic defects. Then they could become successful, not only in slowing down further degeneration of Y chromosome but also in completely stopping the Y chromosome's degeneration process.

Now, the only way to stop this was to see that the 5% of the Y chromosome, which is usually mixed and crossed over with its pair of X chromosome, be protected so that the remaining 95% that does not participate in the mixing process stays healthy.

In modern Genetics, we know that consanguineous marriages i.e., marriages between close relatives especially uncle- niece marriages, first cousin marriages result in the birth of children with genetic disorders and congenital malformations. It is also observed that, majority of the genetic disorders are controlled by recessive genes which do not express in single dose (heterozygous condition) but express only in double dose (homozygous condition). When an individual marries outside his gene pool, the probability of homozygosity of the recessive gene responsible for a genetic disorder appearing in the offspring is rare. But if he marries within his close relation, then the probability of the couples, though apparently normal, carrying the defective gene, they might have received from their common ancestor, which may express in offspring in homozygous condition leading to a genetic disorder is very high.

Because of this reason, our Rishis i.e. our gotrakarins banned the marriages of individual belonging to same gotra. If they had allowed such marriages within the



same gotra, the chances of resulting male to be born with a genetic disorder would be very high and expression of such genes which might take place in the 5% of the exposed area of the Y chromosome would be fatal to the continuity of the Y chromosome. Even after hundreds of generations these defective genes would be carried to their offsprings and marriages within the same gotra would provide higher opportunity for these defective genes to express themselves in the offspring. Hence the ancient Rishis created the Gotra System where they barred marriages of individuals belonging to the same gotra no matter how deep the lineage tree was to prevent inbreeding and eliminate all the defective recessive genes from the human gene pool.

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