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Y-Chromosome Polymorphism In Meos And Sunnni Muslims Of Haryana

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Abstract

The present investigation was planned on Meos and Sunni Muslims of Haryana as instances of close inbreeding were observed among them. Cytogenetic studies were carried out. For cytogenetic investigation, blood samples from 18 male and 10 female individuals from each endogamous group were taken and short-term lymphocyte cultures were set up. As many as, 100 well spread metaphases were selected from the slide of each individual for Y chromosome polymorphism. Four different, indices viz. Y/D, Y/E, Y/F and Y/G were calculated to study Y chromosome polymorphism. Suuni Muslims were found to have higher mean value of all the four Y indices than those of Meos. The "t-test" was also applied to find the significance of study.

Keywords: Cytogenetic studies, short-term lymphocyte culture, Y chromosome polymorphism.

Introduction

Different investigators have assessed the possibilities of distinguishing the Y-chromosome from the other acrocentrics on morphological grounds. Some consider it as the smallest chromosome in this group or as equal to chromosome 22 (Chu and Giles, 1959), for others it is longest, with the highest arm ratio, of all acrocentrics (Tjio and Puck, 1958; Levan and Hsu, 1959). The Y chromosome, however, has been found to be heteropycnotic (Sasaki and Makino, 1963) and is composed of two straight chromatids without a visible centromere (Patau, 1960). However, Van Brink et al. (1962) objected to such a definition of Y chromosome and distinguished it by its failure to take part in satellite association among the acrocentrics. These authors held that Y chromosome does not possess a satellite in contrast to other chromosomes of the group. Studies regarding the orientation of Y chromosome revealed its preferential location in the periphery as a consequence of its heterochromatic nature and delayed orientation on equatorial plate (Breg et al., 1971).

In the London Conference (1963), the Y chromosome was suggested to be the most variable chromosome in the human karyotype. An increasing number of human Y chromosome-specific polymorphism is being used as markers for human evolutionary studies. The human Y chromosome does not undergo meiotic recombination along most of its length with the exception of pseudoautosomal region. It is inherited paternally and has maintained a unique record of mutational events that have occurred in previous generations (Jobling and Tyler-smith, 1995). The polymorphisms of Y chromosome are caused by mutations. Single-nucleotide insertion,

deletion and short tandem repeat (STR) are useful markers in studying movement of males in human population history (Zerjal et al., 1997; Casalotti et al. 1999; Jimenez et al 2001; Stumpf and Goldstein 2001; Mukherjee et al., 2004; Yang et al., 2004). The inheritance of Y chromosome, at a constant length, was familiar from father to son (Bishop et al., 1962; Balicek et al., 1978). A number of studies have been conducted concerning Y chromosome heteromorphism in clinically abnormal populations (Jeske and Hubner, 1970; Meisner and Inhorn, 1972; Koulischer, 1976).

Long Y chromosome and repeated abortions have been suggested to be associated by several workers and length of Y chromosome and criminal behaviour of the individuals are also associated (Tajmirova and Ondrejeak, 1976; Patil and Lubs 1977; Nielsen 1978). Others, however, could not find a significant association (Brogger, 1977). Y chromosome polymorphism has been associated with hypertension (Cato-Garcia et al., 2003). Various types of banding have differentiated the different regions of each chromosome. The genetic loci that control the expression of histocompatibility-Y (H-Y) antigens, development of testis from undifferentiated gonad, as well as the one that control spermatogenesis have been localized on the Y chromosome (Wachtel et al., 1975).

Materials And Methods

Peripheral blood cultures of normal individuals belonging to Meos and Sunni Muslims were set up to study the presence of chromosomal aberrations. For cytogenetic studies 18 individuals from each caste were selected randomly from the Meo and Sunni Muslim population from Gurgaon, Faridabad, Kaithal, Jind and Kurukshetra districts of Haryana. About 10 ml blood was taken from each individual in heparin coated green top tube by vein puncture in the arm. Short term lymphocyte cultures were setup (Moorhead et al. 1960). For chromosomal study, the cells were cultured for 48 hours, slides were prepared and stained with 4% Giemsa solution. At least 100 cells (first division metaphases) from each subject were scored.

For studying Y chromosome polymorphism, length of the Y chromosome in relation to the four different sets of chromosomes as "Standard chromosome" namely 13-15 (Y/D Index), 16-18 (Y/E index), 19-20 (Y/F Index) and 21-22 (Y/G) index was calculated. Eighteen individuals belonging to the two ethnic groups under present investigation were selected for Y chromosome polymorphism study. Mean, Standard Deviation and Variance were calculated. ‘t’ test was also applied.

Results

Table 1and 2 show the relative values in length of Y chromosome among Meos and Sunni Muslims of Haryana.

Table 1: Relative Values in the Length of Y chromosome among Meos

Individual No.	Y/D	Y/E	Y/F	Y/G
1	0.62	0.66	0.94	1.04
2	0.56	0.60	0.65	0.98
3	0.59	0.61	0.67	1.09
4	0.54	0.58	0.88	1.15
5	0.80	0.88	0.95	1.12
6	0.46	0.56	0.78	0.88
7	0.42	0.54	0.69	0.76
8	0.34	0.49	0.54	0.68
9	0.53	0.59	0.64	0.80
10	0.33	0.37	0.47	0.59
11	0.44	0.58	0.62	0.89
12	0.42	0.57	0.72	0.88
13	0.49	0.61	0.77	0.98
14	0.36	0.49	0.64	0.88
15	0.54	0.74	0.82	0.98
16	0.33	0.49	0.57	0.84
17	0.46	0.62	0.73	0.90
18	0.39	0.53	0.80	0.92

Table 2: Relative Values in Length of Y chromosome among Sunni Muslims

Individual No.	Y/D	Y/E	Y/F	Y/G
1	0.70	0.75	1.05	1.45
2	0.36	0.49	0.68	0.88
3	0.54	0.62	0.69	0.90
4	0.44	0.57	0.73	1.01
5	0.51	0.57	0.78	0.94
6	0.55	0.61	0.81	1.14
7	0.65	0.71	0.79	1.03
8	0.62	0.69	0.78	1.09
9	0.49	0.58	0.77	0.98
10	0.56	0.61	0.69	0.93
11	0.51	0.59	0.68	0.89
12	0.37	0.49	0.64	0.83
13	0.46	0.72	0.78	0.94
14	0.58	0.68	0.84	1.21
15	0.41	0.59	0.78	0.95
16	0.64	0.72	0.82	0.99
17	0.39	0.53	0.65	0.79
18	0.44	0.61	0.74	0.96

The mean standard deviation of four different indices was calculated. The mean Y/D index value was found to be 0.4789 ± 0.1205 in Meos and 0.5122 ± 0.1031 in Sunni Muslims. The mean Y/E index value was found to be 0.5839 ± 0.1598 in Meos and 0.6183 ± 0.0782 in Sunni Muslims. The mean Y/F index value was found to be 0.7156 ± 0.1323 and 0.7611 ± 0.0816 in Meos and Sunni Muslims respectively. The mean Y/G index value was found to be 0.9089 ± 0.1463 in Meos and 0.9950 ± 0.1836 in Sunni Muslims.

Sunni Muslims exhibit more value of Y/D, Y/E, Y/F and Y/G indices than the Meos. The incidence of long Y chromosome was found to be 5.6% in Sunni Muslims (Fig 1). The 't'-test for four different Y indices indicated non-significant values in Meos and Sunni Muslims.

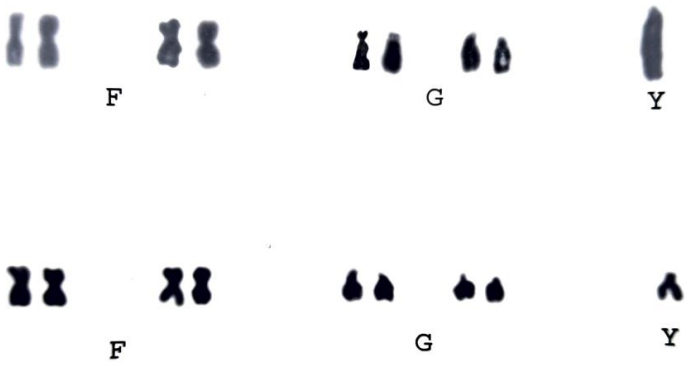

Fig 1: Long Y chromosome among Sunni Muslims (upper) as compared to Meos (lower)

Discussion

Human chromosomes show morphological variations. It occurs in about 5% of the general population. The distal part of long arm of Y chromosome is highly variable (Lubs and Ruddle, 1971). The Y chromosome is mostly heteropycnotic and carries in its longer arm a large achromatic region (Sasaki and Makino, 1963). Hetropycnosis is linked with late replication of DNA (Schmid, 1963). These phenomena are considered to be the manifestation of a genetically inert region (Klevecz and Hsu, 1964). Because of its genetically inert nature, size variability of the Y chromosome is possible since structural alterations in the inert part of Y are not reflected in phenotypical modifications.

The Y chromosome varies more in length from subject to subject than other chromosomes. The polymorphism of the Y chromosome is caused by mutation during migratory events and can be used to determine the evolutionary history of paternal ancestors (Jin and Su, 1999). Y chromosome short tandem repeats (Y-STRs) lie in the non-coding region of Y chromosome and Y-STRs have high rate of mutation (Kayser et al., 1997, Perez-Lezaun et al., 1999, Khil et al., 2001). A considerable number of cases are available in literature with unusually long Y chromosome. Jacob and Harnden (1961) observed long Y chromosome in a Down's syndrome case. Long Y has also been observed related to oligospermia (Van Wijck et al., 1962). A consistently large Y chromosome was observed in a case of hypogonadism and in his normal father, brother son and paternal uncle by Lubs and Ruddle (1971). Long Y chromosome has also been observed in a mentally retarded individual and his normal father, in a individual with testicular feminization and his normal father as well as in an azoospermic individual (Van Wijzk et al., 1962; Tonomura and Ono, 1963. Bender and Gooch (1996) observed 15% increase in length of Y chromosome in a highly intelligent person.

Cohen et al. (1966) studied Y chromosome polymorphism among the 'White and non-Jewish males of New York and observed the frequency of long Y to be 5%. Court Brown (1967) observed a frequency of 1.5% of long Y among the Scots newborn. Frequency of 13.4% of long Y was observed among Finnish (Unnerus et al., 1967). Torre et al. (1970) observed a frequency of 18.6% of the long Y carrying individuals among Spanish population. The frequency of long Y among newborns of New Haven, Caucasions of New Haven and Negro of New Haven were found to be 6.6%, 14.9% and 14.8% respectively (Lubs and Ruddle, 1971). Frequency of long Y among German children was 2.1% (Zankl and Zang, 1971); among Polish students the frequency was 2.9% (Huebner, 1971); among Swedish the frequency of was 9.4% (Lins and Sundequish, 1971); among the new borns of Danes it was 1.4% (Nielsen and Friedrich, 1972); among the Canadian newborns was 0.9% (Hamerton et al., 1972); among the newborns of Danes, it was 1.0% (Friedrich and Nielsen, 1973). The frequency of long Y among normal individuals of Ontario was 12.2 (Soudek et al., 1973); among the Estonian, it was 3.8% (Mikelsaar et al., 1973); among the Russian new borns it was 1.5% (Bochkov et al., 1974). Ghosh and Singh (1975) found a long Y chromosome in 5% of the Rajput and 3% of the Punjabi population. Long Y chromosomes were recorded in 5% population of Saini and Kamboj of Haryana (Yadav et al. 1996). In the present investigation long Y chromosome was found to be 5.6% in Sunni Mulsims.

The length of Y in proportion to the average of other small chromosomes is usually calculated. This is termed as Y index. Tonomura and Ono (1963) calculated Y/G index among the Japanese. It was found to be 1.186. Y/E index of Swedish population was found to be 0.734 (Lins and Sundequist, 1971). Y/F index was found to be 0.83 and 0.88 in Danish newborn male children and youth from Danish prison (Zeuthen and Nielsen, 1973). Yadav et al. (1996) calculated Y/D, Y/E, Y/F and Y/G indices among five different ethnic groups of Haryana and observed high values of Y indices among Saini. During the present investigation Y/D, Y/E, Y/F and Y/G indices were calculated among Meos and Sunni Muslims of Haryana and compared with Y indices in different populations. It was observed that values of Y indices were more in Sunni Muslims than Meos. The 't-test' showed that the difference for four Y indices was found to be statistically non-significant in Meos and Sunni Muslims.

Various factors have been suggested to be responsible for variation in length of Y chromosome. The variation, partly or wholly, may be simply a result of varying degree of contraction of chromosome during the cell division. Gripenberg (1964), however, considered that increase in length may be due to addition of chromosomal substance and cited the evidence that extra-long Y chromosome have two secondary constrictions. The long Y chromosome may be a result of structural changes and duplication of finite length of chromosome may be the one mean by which the long Y chromosome has evolved (Tishler, 1972).

Variation in the length of the Y chromosome has been attributed to the variation in the heterochromatic distal segment and actual variation in the DNA content as well as different polymorphic human Y chromosome (Tishler et al., 1972). It is interesting that the Y chromosome length varies considerably even in the cells derived from the same individual. However, it remains a question as to whether the length of Y chromosome is inherently

liable to vary responding to an exaggerated and non-coordinated sprialization of the Y or otherwise corresponding to structural change of chromatin as a result of deletion, duplication or translocation.

It is clear from the above discussion that wide range of variation in the human karyotype is tolerated and racial polymorphism is one of strongest factor responsible for maintaining this variation. However, much work has to be done in this area before anything conclusive can be said about the mechanism and the way such chromosome polymorphisms are maintained.

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