Original Article

Mitotic Studies in Children with Learning Disability

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ABSTRACT

Objectives: *This study was conducted to assess the various mitotic chromosome features and karyotype of different age groups of children having learning disability.*

Methos: *In the present study 86 learning disabled children from South India were selected. For mitotic analysis, peripheral blood samples were used and for estimating the size of chromosome, micrometry was employed.*

Results: *Most of the chromosome showed significant difference in measurements. In the present investigation X chromosome showed least variability in arm lengths comparing with that of Y chromosome.*

Conclusion: *Chromosome size has a great role in detecting the character of an organism. In the present investigation all the chromosomes showed variation from the normal, but X chromosome showed least variation in chromosome measurements.*

Key words*: Learning disability, mitotic studies, children.*

INTRODUCTION

The term 'learning disability' (LD) was introduced by two British physicians Martin and Bell in 1943.[1] The term LD is defined as 'the unexplained difficulty of a person of at least average intelligence has in acquiring basic academic skills which are essential for achieving success at school, workplace and for coping with life'. LD is a neuro developmental disorder that affects people's ability to interpret what they see, hear or link information from different parts of their brain. A learning disabled child is one who has at least average intelligence whose academic performance is impaired by developmental lags in the ability to sustain selective attention and such a child is required specialized instruction in order to permit the use of his or her full intellectual potential. Learning disability is not a single disorder, but it is composed of disabilities in seven areas. They are receptive and expressive languages, basic reading skill and comprehension, written expression, mathematical calculation and reasoning. The term does not include the children who have learning problems which are primarily the result of visual, hearing and motor handicaps. It has been observed in several studies that, LD is over expressed in males than females.[2] Approximately one half of all children receiving special education services nationally or about 5% of the total public school population are

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identified as having LD.

Variations in the human karyotype is associated with sexual and congenital anomalies.[3] Variations that have no association with developmental abnormalities or genetic diseases have been described less frequently, despite the fact that several areas of research demand accurate knowledge of the normal human karyotype. The means of the normal chromosome arm lengths and centromere indices for mitotic chromosomes were reported by Penrose, Bender and Kastenbaum.[4, 5] The objective of this study was to assess the mitotic chromosome and karyotype features of LD children of different age group of South Indian population.

MATERIALS AND METHODS

In the present investigation, eighty six samples of children having LD in the age group of 7 to 15, who were attending various therapies in Institute of Communicative and Cognitive Neurosciences (ICCONS), Trivandrum were selected. Children were screened by conducting standardized intelligence test. For mitotic analysis, 5 ml of peripheral blood samples were collected. The chromosome preparations were made from peripheral blood lymphocytes using the standard method modified by Manjunatha.[6] For estimating the size of chromosome, ocular micrometry was employed, for this the ocular micrometer was placed on the metal diaphragm in the eye piece of the microscope. Throughout the study, objective lens of 20 x and 50 x were used. The chromosomes were micro photographed to study the chromosome number, length of short and long arm, position of centromere, S/L ratio and total chromosome length. Photomicrographs were taken for all the observations, Jetner Biolux research microscope was used for micro photographing. All measurements were taken from an average of twenty readings. The slides were GTG banded using Seabright's method of chromosome banding. Karyotypes were made according to the classification adopted by the Paris conference.[7, 8]

OBSERVATION AND RESULTS

Chromosome measurements of different age groups were made and their averages were taken. In the case of Group A chromosomes, the mean of short and long arm lengths were 3.29 and 4.78 μm, S/L ratio was noticed as 0.70 and total arm length was reported as 8.07 μm. The short, long and the total arm length of Group B chromosomes were recorded as 1.54, 4.27 and 5.8 μm respectively and the S/L ratio of this group was 0.37.For Group C S/L ratio was as 0.53, the mean arm measurements were reported as 1.77, 3.42 and 5.19 μm corresponding to short, long and the total arm length respectively.

The average short and long arm measurement of Group D chromosome was measured as 0.74 and 3.06 μm, the S/L ratio was 0.24 and the total arm length was 3.78μm. In the case of Group E chromosomes, the average short arm, long arm and the total arm lengths were recorded as 0.82, 1.94 and 2.77μm and S/L ratio was 0.42. The arm measurements of Group F chromosome were 0.99, 1.22 and 2.21 μm corresponding to the short, long and the total arm lengths, the S/L ratio was 0.81. In the case of Group G, short and long length was recorded as

0.53, 1.41 and 1.93 µm and S/L ratio was 0.38 (Table: 1 and Figure 1- 6).

In the present investigation X chromosome showed the least variability in arm lengths. Among most of the age groups the values are almost same. The short arm lengths was measured and ranged from 2.00 - 2.03 µm. The long arm length was between 3.55 - 3.58 µm. S/L ratio was in between 0.55 - 0.57, minimum and a maximum arm length was recorded as 5.55 µm

Table 1: Mitotic chromosome measurements of children with LD

Chromosome number	Short arm length (Mean)	Long arm length (Mean)	S/L ratio (Mean)	Total arm length (Mean)
1	3.56	4.86	0.73	8.42
2	2.97	5.46	0.54	8.43
3	3.35	4.00	0.84	7.35
4	1.64	4.87	0.34	6.51
5	1.43	3.66	0.39	5.09
6	1.96	3.49	0.56	5.45
7	1.75	3.19	0.55	4.94
8	1.79	3.60	0.50	5.39
9	1.71	3.23	0.53	4.94
10	1.50	3.43	0.54	4.93
11	1.86	3.54	0.53	5.4
12	1.84	3.45	0.53	5.29
13	0.85	3.15	0.27	3.95
14	0.62	3.04	0.20	3.66
15	0.75	2.99	0.25	3.74
16	1.00	1.98	0.50	2.98
17	0.77	1.94	0.37	2.71
18	0.70	1.92	0.36	2.62
19	0.97	1.26	0.77	2.23
20	1.00	1.19	0.84	2.19
21	0.58	1.42	0.41	2
22	0.47	1.39	0.34	1.86
X	2.03	3.50	0.58	5.53
Y	0.51	1.81	0.28	2.32

PLATE: 1



Fig:-1



Fig:-2



Fig:-3



Fig:-4



Fig:-5

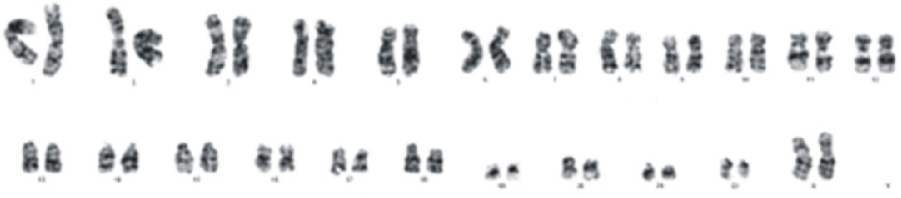


Fig:-6

Fig:-1-3, Mitosis and 4-6 Karyotype of children with Learning Disability

and 5.61 µm respectively. It was interesting that majority of the age groups showed the total arm length as 5.59 µm. The average short arm length of Y chromosome in all the age group selected for the present investigation ranged from 0.43 - 0.56 µm and long arm length ranges between 1.63 - 1.87 µm, S/L was between 0.23- 0.33 and total arm length measured at a minimum of 2.15 µm and a maximum of 2.32 µm.

DISCUSSION

LD is one of the disorders affecting the X chromosome; it is commonly known form of inherited intellectual disability, affecting one in 4,000 individuals worldwide.[9,10] During childhood and before puberty-hyperactivity, attention deficiency and learning disabilities are common, especially in LD boys, and a delay in learning language is often the first sign which prompts suspicion of the syndrome.[11, 12] People with LD experience a slow development, emotional problems and hyperactivity. Noticeable signs of a child with LD include, hand flapping, hand biting, poor eye contact, chewing on their clothes, repetitive speech patterns, rocking and preservation.[13] LD is an X-linked recessive disorder, which affects more males than females. A delay in learning language is often the first sign, which prompts suspicious of the syndrome .[14]

Penrose Bender and Kastenbaum reported the measurements of normal chromosome arm lengths and centromere indices for mitotic chromosomes. Penrose presented the statistical descriptions of somatic chromosomes, pooled the male and female samples.[15] The present investigation analyzed the various mitotic chromosome features like the short and long arm length, S/L ratio and total arm length of all the chromosomes of the children with LD. This study highlighted the differences in short and long arm lengths of 23 chromosome pairs of age groups 7-15. The short and long arm lengths of all the chromosomes studied showed remarkable differences from the normal. Bender and Kastenbaum compared male and female samples for the relative lengths of the short and long chromosome arms of each of the autosomes and found significant differences. Females had significantly higher arm ratios and the short arms of the female chromosomes are longer relative to their long arms than in the male cells. The present study also noticed that in most of the age groups the average short arm lengths of the chromosomes in females were longer than that of the male chromosome. Chen and Falek found out that variations in the human karyotype associated with sexual abnormalities, congenital anomalies and mental retardation have received much attention in the literature. Variations that have no association with developmental abnormalities or genetic diseases have been described less frequently, despite the fact that several areas of research demand accurate knowledge of the normal human karyotype.

In the present investigation X chromosome, showed least variability in arm lengths. In most of the age groups short and long arm lengths, S/L ratio and the total arm length were measured, which showed almost same values. For all LD children lengths was measured and it ranged between 2.01 - 2.03 µm. The long arm length was in between 3.55 - 3.58 µm. Majority of the age groups showed long arm length as 3.57 µm. Total arm length also showed least variation from the normal in most of the age

groups. It is concluded the fact that in LD children, greater attention should be given to the study of X chromosome.

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