

Genetic and Environment Analysis for General Intelligence of Twins during Early Childhood

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ABSTRACT

The classical twin study provided robust information regarding the contribution of genetics and environment propensities on the general intelligence of twins. The twin study has been planned to assess the impact of genetics and environment on general intelligence. This investigation was performed in the Bhiwani and Hisar districts of state of Haryana. A sample of 150 pairs of twins in the age groups of 3-6 years was attained from 55 villages of two districts. Results of heritability estimates showed that the contribution of genetics for general intelligence ranged from 45 to 63% for 3-6 years of twins. The conclusion of heritability estimates indicated that the impact of genetic factors on the general intelligence of twins was greater than the environmental factors.

Keywords- Genetic, Environment, General Intelligence, Monozygotic Twins, Dizygotic Twins.

Introduction

The intelligence of an individual consist of the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly, and learn from experiences [13]. Intelligence is significant scientifically as well as socially. Intelligence is the ability to learn from experience and to adapt to, shape, and select environments [18]. Intelligence symbolizes those individual differences in brain processes working in concert to solve problems, it is central to systems approaches to brain structure and function, and to the conceptualization of how diverse cognitive abilities decline with age [6].

Intelligence is one of the most heritable behavioral, and best predictors of important life outcomes such as education, occupation, mental and physical health and illness, and mortality [14]. Genetic studies have shown that intellectual abilities are heritable, and highly polygenic, and that shared genetic factors account for part of their observed co-variation [5]. The genetic influences are an important component of variation for almost all human traits. The intellectual abilities are heritable, genetic differences between individuals account for between approximately 20 per cent and 70 per cent of the variance in intellectual abilities [10].

The heritability of intelligence increases linearly from early childhood to young [11]. The findings of the study on the connection between the brain and intelligence quotient came up with evidence that common genes influence change in brain structure and intelligence quotient [4]. The level of intellectual functioning has been positively associated with the whole brain system [17].

Heritability is a statistic that describes the amount of variance in a trait that can be attributed to genetic differences in a given population [12]. It is not a constant value and varies for a trait depending on developmental processes like neonate, child and adult [8]. Twin study design estimates the relative contribution of heritability in shaping the intelligence of twins.

The twin study designs determine causal interrelationships between brain structure and function, and neuropsychological performance [3]. Twin studies suggested that the variance in IQ is linked to the genetics frame work because genetics may play a larger role environmental factor in determining individual IQ [20].

Twin study is one of the major methods used in quantitative genetics to estimate both genetic and environmental parameters of individual differences. The twin method requires both identical twins (monozygotic [MZ]) and non-identical twins (dizygotic [DZ]) because the comparison between these twins indicated that differences were due to genetic and environmental influences at a particular time [9].

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Methodology

Study Design: The descriptive research design was used to conduct the twin investigation. The study has been planned with aim of analyzing the role of genetics and environment on general intelligence of twins. 150 pairs of twins with age group 3-6 years were selected from two districts i.e. Bhiwani (N = 174) and Hisar (N = 126) of state Haryana.

Data collection: For data collection, various methods of data collection were used like questionnaires, interviews and observation methods to collect appropriate information from twins.

Tool: General intelligence of twins was assessed by Stanford Binet Intelligence Scale [19].

Statistical Analysis: The data was analyzed and inferences were drawn through SPSS software. The correlation coefficient and Heritability estimate (h^2) were calculated to come across the aim of the study. Heritability estimates (h^2) were calculated by the formula of [7] $h^2 = 2(R_{MZ} - R_{DZ})$.

Results

Heritability estimate for general intelligence of twins with age over the district

The heritability estimate for the general intelligence of twins with the age group 3-4 years in the Bhiwani district was 49% and the remaining 51% variance in the general intelligence of twins in the Bhiwani district was attributed to environmental factors (Table 1). Further, the data in this table showed that the heritability estimate for the general intelligence of twins in the Hisar district was (45 %) and the remaining 55% variance in general intelligence was due to environmental circumstances in the group aged 3-4 years. Results showed that the genetic influence on the general intelligence of twins for the Bhiwani district was more than the environment. Further, the heritability estimate for general intelligence was 55% in the age group 4-5 years that indicated that a 45% variance in general intelligence of twins was attributed to environmental situations in the Bhiwani district. In the Hisar district, the heritability estimates for the general intelligence of twins was 52% in the age group 4-5 years and the remaining 48% variance in the general intelligence of twins was due to environmental situations. Further, heritability estimates for the general intelligence of twins was 63% in the age group 5-6 years in the Bhiwani district and the remaining 37% variance in general intelligence of twins in the same age group was due to environmental situations, while in Hisar district the heritability estimate was 53% in the same age group and remaining 47% influence of environmental factors on general intelligence of twins in the same the age group. The conclusion of heritability estimates showed that the genetic influence on the general intelligence of twins as increases scores on heritability estimates with increasing age of twins.

Table 1: Heritability estimate for general intelligence of twins with age over the district

District	Heritability (%)		
	3-4 years	4-5 years	5-6 years
Bhiwani	49	55	63
Hisar	45	52	53

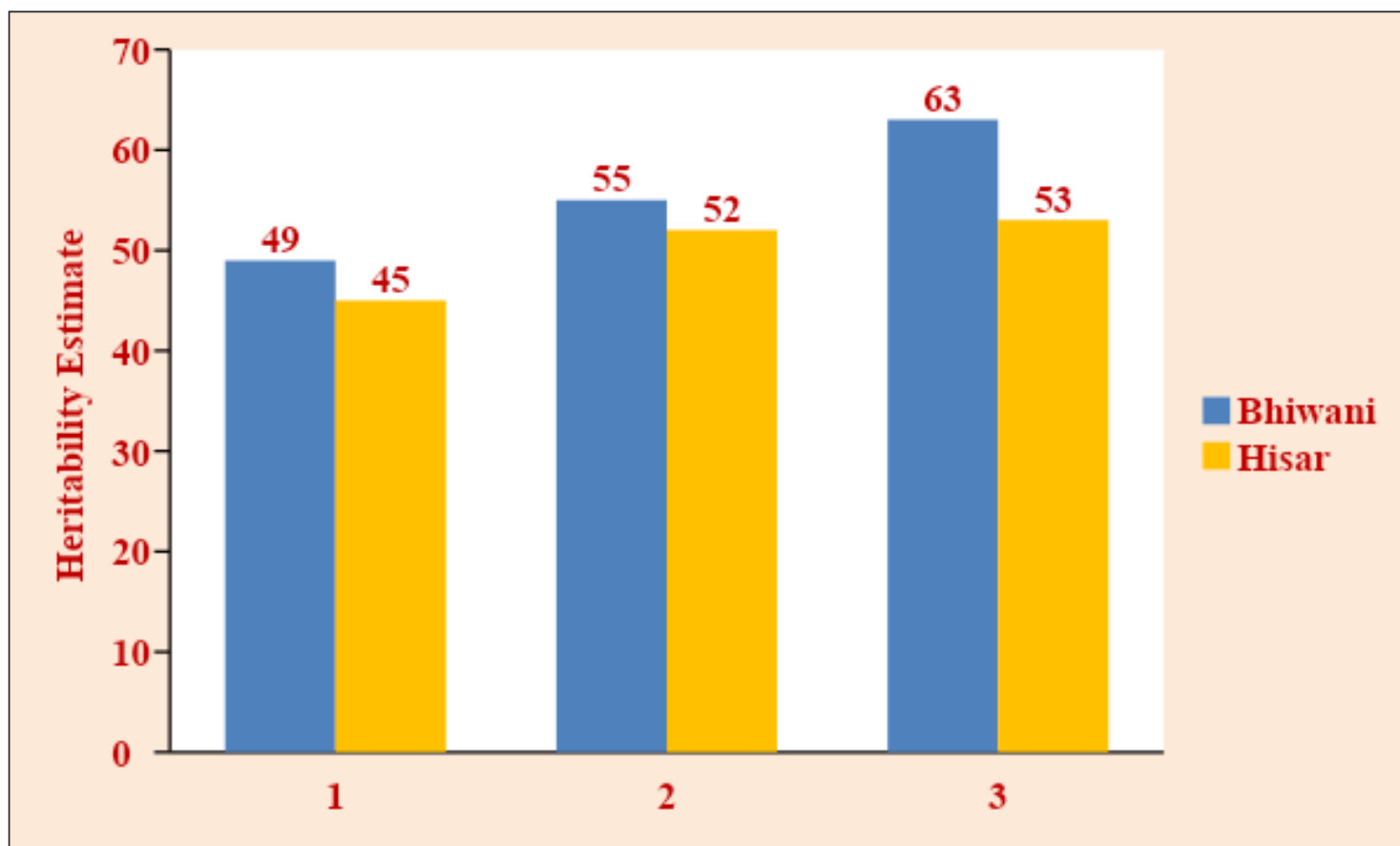


Fig.1: Heritability Estimate for General Intelligence of Twins in both Districts

The correlation coefficient among monozygotic and dizygotic twins for general intelligence of twins from 3-6 years in both districts

The correlation coefficient among monozygotic twins for general intelligence at age 3-4 years was $r=0.76$ in the Bhiwani district and $r=0.73$ in the Hisar district (Table 2). Among dizygotic twins, the correlation coefficient for general intelligence at age 3-4 years ($r=0.52$) and ($r=0.51$) in Hisar district. Further the correlation coefficient among monozygotic and dizygotic twins for general intelligence at age 4-5 years was $r=0.66$ and $r=0.39$ respectively in Bhiwani district and Hisar district, the correlation coefficient among monozygotic and dizygotic twins for general intelligence at age 4-5 years was $r=0.71$ and $r=0.45$ respectively. At age 5-6 years, the correlation coefficient among monozygotic and dizygotic twins for general intelligence was $r=0.89$ and $r=0.58$ in Bhiwani. In Hisar, the correlation among monozygotic and dizygotic twins for general intelligence was $r=0.80$ and $r=0.54$ respectively. The data indicated that the correlation coefficient of identical twins was more than that of non-identical twins for general intelligence.

Table 2 Correlation coefficient among monozygotic and dizygotic twins for general intelligence of twins from 3-6 years in both districts

Age (in years)	Correlation Coefficient (r) for General Intelligence			
	Bhiwani		Hisar	
	Monozygotic	Dizygotic	Monozygotic	Dizygotic
3-4	0.76	0.52	0.73	0.51
4-5	0.66	0.39	0.71	0.45
5-6	0.89	0.58	0.80	0.54

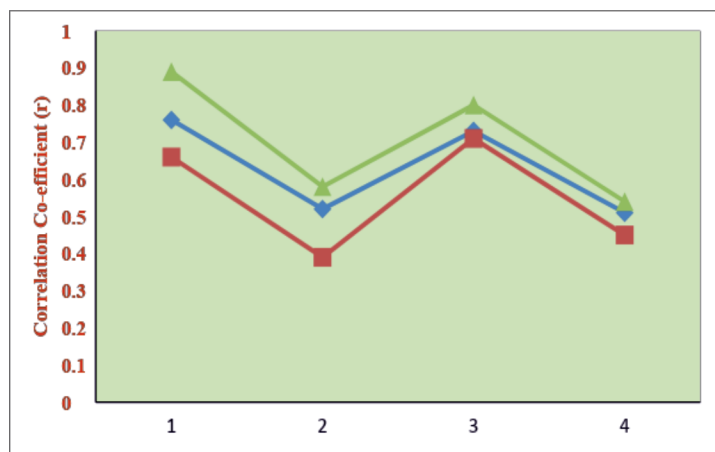


Fig.2: Correlation coefficient among monozygotic and dizygotic twins for general intelligence of twins from 3-6 years in both districts

Discussion

The result of the heritability estimate stated that the contribution of genetics on the general intelligence of twins ranges from 45-63 percent from 3-6 years. The general intelligence of twins was more influenced by genetic factors as compared to environmental factors. A similar study indicated that both genetics and the environment play a role in determining intelligence [16]. [1] Investigated the genetic architecture of environmental sensitivity by estimating its heritability and suggested that the heritability of sensitivity was 0.47 and that individual differences in susceptibility to environmental influences have a genetic basis. [2] Assessed intelligence and academic performance and revealed that intelligence and academic performances both are highly heritable. Moreover, verbal performances in early and middle childhood are early manifestations of genetic effects on later intellectual performance.

The findings of the correlation coefficient indicated that identical twins were more correlated with each other for general intelligence in both the Bhiwani and Hisar districts. [15] Examined correlations of intelligence heritability in identical and fraternal twins, and in adopted children as well and observed that the correlation is relatively higher in MZ twins than in DZ twins.

Conclusion

The variations in general intelligence of twins were due to genetics ranging from 45 to 63 per cent. General intelligence was more influenced by genetic material than the environmental situation in both districts. The stability of genetics for general intelligence increased with an increase in the age of twins. A significant difference was found in the general intelligence of twins from 3-6 years. The monozygotic twins had similar general intelligence to dizygotic twins.

Recommendations

It is recommended that twin studies should be based on the cross-culture approach to get more knowledge about the influence of genetics and environment on particular traits.

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