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Genetic Analysis of Blood Pressure and Anthropometric Measures Among North Indian Twins

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INTRODUCTION

Higher blood pressure constitutes a major risk factor for coronary heart disease. The genetic contribution to blood pressure with reference to metrical variables based on the classical twin method has been reported by the several authors (Bodurtha et al., 1990; Hall, 1996; Martin et al., 1997; Rose et al., 1979 and Schieken et al., 1989). Twin and family studies have also revealed a significant familial aggregation of blood pressure with their concordance and heritability estimates (Brook et al., 1975 and Ewell et al., 1978). Heritability studies investigate the relative importance of heredity and environment on the expression of a given metrical traits. Heritability may be defined as proportion of phenotypic variance due to additive genetic variance. We report here the relative contribution of genetic environmental factors to the variation of blood pressure and eight anthropometric measurements among North Indian twins of both sexes aged 7-67 years.

MATERIALS AND METHODS

Population: We identified 50 pairs of twin (male-male pair 23, female-female pair 15 and male-female pair 12) in which 8 pairs are monozygotic and 42 pairs are dizygotic twins living in the district Amritsar in Punjab. The data were collected during months of December 2001 to August 2002.

Zygosity Determination: Zygosity was assessed initially by a questionnaire, similarity method and confirmed by blood group testing on the twins and their parents. The probability of dizygosity for concordant pairs typically is <.001 (King et al., 1980).

Measurements

Blood Pressure: Blood pressure was measured in the sitting position using a mercury sphygmomanometer with the appropriate compression cuff. The BP was recorded 3 times after rest period of 15 minutes. The mean of three measurements was used in the analysis. While pulse pressure was calculated as difference of systolic and diastolic blood pressure.

Anthropometrics: Skinfold thickness were measured in the standard manner using a Harpenden Skinfold caliper over the mid-point of the triceps muscle on the left arm and of the left scapula. Standing height was measured using a wall mounted vertical metal meter and body weight was recorded to the nearest kilogram using a balance scale. Body mass index (BMI) was also calculated as weight in Kg divided by height in m^2. Height and weight were obtained from the subjects dressed in light weight clothes with their shoes removed. Waist circumference was measured midway between the lower rib and iliac crest. Hip circumference was measured at the level of the trochanters. Age and gender were determined by self –reported information during screenings.

Statistical Analysis

Heritability: Heritability, defined as the proportion of total variance of a characteristic in a particular population due to genetic cause, was calculated by three different methods from the intraclass correlation coefficients. If the variation of a trait is entirely genetic controlled, the correlation coefficient in monozygotic twins would be 1.00 whereas, the expected correlation coefficients in dizygotic twins would be 0.5. Therefore, estimates a heritability (h^2) are: (i) $h^2 = rMZ$; (ii) $h^2 = 2(rMZ - rDZ)$ (Falconer, 1989) (iii) $h^2 = (rMZ - rDZ)/ 1\text{-}rDZ$ (Susane et al., 1980).

Heritability may also be calculated from within pair variances of MZ and DZ twins: $h^2 = (\delta^2D - \delta^2M)/\delta^2D$. Where δ^2D and δ^2M are the within pair variance for dizygotic and monozygotic twins respectively. Clark (1956) suggested that this method is the best method for interpretation of heritability, because it is insensitive to sex and other between pair differences in the composition of monozygous and dizygous samples.

Mean differences of zygosity were evaluated by pooled 't' test. Pearson correlation coefficients

were calculated by twin type.

RESULTS

Table 1 represents the distribution of means, standard deviation and within pair differences for all the measurements in MZ and DZ twins. All the means values of HT, WT, SBP, DBP, WC, HC, UAC, BMI and PP are larger in DZ twins, but the differences are not statistically significant (P<.05). Whereas, the mean values of all skinfold thicknesses (TSF, SSSF and SISF) are larger in MZ twins, but only tricep skinfold (TSF) has statistically significant differences (P<.001). The average intra pair differences are larger in non-identical than in identical twins for each traits except subscapular skinfold. Identical twins also showed differences within pairs in all traits.

Table 2 shows the distribution of intraclass correlation coefficients with 't' values for MZ and DZ twins. All the intraclass correlation coefficients among MZ as well as DZ for all the traits are highly statistically significant (P<.01) except triceps skinfold and pulse pressure in DZ twins.

Table 3 shows the estimates of heritability calculated by different methods using intraclass correlation coefficients and within pair variances.

DISCUSSION

In the present study, the MZ twin pairs

Table 1: Means; standard deviations and within pair differences on the 12 quantitative variables among 50 pair of twins by zygosity

Variables[a]	*MZ Twins*	*DZ Twins*	*t-value*	*Within pair difference*	
	Mean ± SD	*Mean ± SD*		*MZ twins*	*DZ twins*
Height (HT)	147.00 ±17.00	153.50 ± 28.00	0.878	0.06	0.18
Weight (WT)[b]	46.93 ±15.81	55.05 ± 17.06	1.310	1.00	8.00
Systolic blood pressure (SBP)[c]	115.75 ±20.44	120.68 ± 14.32	0.652	10.00	12.00
Diastolic Blood Pressure (DBP)	75.00 ±13.30	74.47 ± 14.12	0.102	8.00	11.50
Triceps Skinfold (TSF)	18.75 ± 3.53	11.80 ± 5.34	4.660	11.00	8.10
Subscapular Skinfold (SSSF)	9.68 ± 3.87	7.62 ± 3.32	1.110	1.00	4.70
Suprailiac Skinfold (SISF)	8.50 ± 3.58	7.82 ± 4.15	0.440	4.00	5.90
Waist Circumference (WC)	66.37 ±11.20	70.68 ± 16.31	0.860	7.25	9.50
HIP circumference (HC)	76.88 ±11.75	77.38 ± 16.54	0.100	8.00	11.50
Upper Arm circumferences (UAC)	21.54 ± 4.43	23.48 ± 5.56	1.080	4.55	5.75
Body Mass Index (BMI)	20.96 ± 4.51	22.35 ± 4.69	0.790	0.63	2.40
Pulse pressure (PP)	39.62 ±12.51	45.38 ± 12.82	1.260	18.0	19.20

*Significant at p<.05; a. All anthropometric measurement in cm. except where indicated; b. Kg; c. mm Hg.

Table 2: Distribution of intraclass correlation coefficients of the 12 quantitative variables among 50 pairs of twins by zygosity

Variables	*Intraclass Correlation Coefficient between M.Z. twins (rMZ)*	*t-value*	*Intraclass Correlation Coefficient between D.Z. twins (rDZ)*	*t-value*
Height (HT)	0.99	2.42*	0.93	15.89*
Weight (WT)	0.95	2.32*	0.89	13.70*
Systolic Blood Pressure (SBP)	0.95	2.32*	0.56	4.20*
Diastolic Blood Pressure (DBP)	0.93	2.27*	0.70	6.22*
Triceps Skinfold (TSF)	0.86	2.10*	0.22	1.43
Subscapular Skinfold (SSSF)	0.79	1.93*	0.54	4.05*
Suprailiac Skinfold (SISF)	0.95	2.32*	0.41	2.84*
Waist Circumference (WC)	0.97	2.37*	0.87	11.00*
Hip Circumference (HC)	0.98	2.40*	0.97	25.54*
Upper Arm Circumference (UAC)	0.95	2.32*	0.85	10.32*
Body Mass Index (BMI)	0.99	2.42*	0.97	25.54*
Pulse Pressure (PP)	0.75	1.83*	0.22	1.43

* Significant at p<0.01 level

Table 3: Estimates of heritabilities of 12 quantitative variables using intraclass correlation coefficients and within pair variances among twins

Variables	*Heritability (h^2)*			
	$h^2 = rMZ$	$h^2 = 2(rMZ - rDZ)$	$h^2 = \frac{rMZ - rDZ}{I - rDZ}$	$h^2 = \frac{\delta^2 D - \delta^2 M}{\delta^2 D}$
Height (HT)	0.99	0.12	0.85	0.99
Weight (WT)	0.95	0.12	0.54	0.97
Systolic Blood Pressure (SBP)	0.95	0.78	0.88	0.79
Diastolic Blood Pressure (DBP)	0.93	0.46	0.76	0.66
Triceps Skinfold (TSF)	0.86	1.00	0.82	1.00
Subscapular Skinfold (SSSF)	0.79	0.24	0.43	0.16
Suprailiac Skinfold (SISF)	0.95	1.00	0.91	0.37
Waist Circumference (WC)	0.97	0.20	0.76	0.87
Hip Circumference (HC)	0.98	0.02	0.33	0.98
Upper Arm Circumference (UAC)	0.95	0.20	0.66	0.65
Body Mass Index (BMI)	0.99	0.02	0.66	0.95
Pulse Pressure (PP)	0.75	1.00	0.83	0.59

showed differences within pairs in all the traits. This is an effect of non-genetic agents, which prenatally or postnatally gives rise to phenotypic differences in spite of identical genotypes. It is also apparent from the present sample that the correlation coefficient for HT, WT, WC, HC, UAC and BMI are maximum 0.93, 0.89, 0.87, 0.97, 0.85 and 0.97 respectively. This shows that DZ twin pairs are also quite similar for all the phenotypes. The high correlation is probably due to high pair variance among DZ twins (Grim et al., 1990).

When correlation of monozygotic twins is taken as heritability estimate then all the traits have shown very high estimates of heritability like for height is 99% showing no environmental stress. The second method [2(rMZ-rDZ)] is proposed by Falconer (1989). The advantage of this formula is that it do not ignore familial environment but minimize it. After using this formula the heritability of all the traits except TSF, SISF and PP have lowered down. The heritability estimates of SBP (0.78) and DBP (0.42) are more likeli-hood to other previous studies (Grim et al., 1990; Hong et al., 1994 and Schieken et al.,1989).

As a result at high correlation coefficients for dizygotic twins, the environmental correlation increased and heritability estimates has decreased. The heritability has also estimated with Holizonger index (Susane et al., 1980): (rMZ-rDZ)/(1-rDZ). Many authors used this formula because the common family environment is marked but is not totally eliminated. This formula gives us good estimates for heritability for different traits.

KEYWORDS Twins. Blood Pressure. Anthropometry. North India

ABSTRACT Twin investigation has played a major role in the history of human genetics. The present cross-sectional study was undertaken on 50 pairs of monozygotic and dizygotic (8 monozygotic and 42 dizygotic) aged 7-67 years in Amritsar district in Punjab. Results from twin studies indicate that all the means of height, weight, systolic blood pressure, diastolic blood pressure, waist circumference, hip circumference, upper arm circumference, pulse pressure and body mass index are higher in dizygotic twins than in monozygotic twins. But the differences are statistically not significant in any trait (P<. 05) whereas, the means for all skin thickness measurements are large in monozygotic twins. It have also been seen that all dizygotic twins were significantly taller and heavier than monozygotic twins. The intra class correlation coefficients among monozygotic twins for all studied traits are highly significant (P<.01). The genetic fraction heritability (h^2) was estimated using interclass correlation coefficients and within pair variances for all anthropometric and physiometric characters.

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