Heritability of Ambulatory Blood Pressure in Population of Western Region of Iraq

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Abstract

Heritability of ambulatory blood pressure parameters in western population has been well described, there is no information on Iraqi population. Therefore, the aim of the present study is to investigate genetic influences on intra-individual variation, by performing heritability analysis on an Iraqi population (Anbar province).

A total of 389 individuals, constituting 93 families were ascertained. Most of the parents included in the study were in their 5th and 6th decade of life, and the siblings included in the study were in their 2nd and 3rd decade of life.

To define the portion of difference of variables that is due to genetic and non-genetic influences, full sib analysis was used to estimate heritabilities of blood pressure parameters systolic, diastolic, mean and pulse pressure were estimated during the morning and evening. Heritabilities were estimated in narrow sense which were ranged from 28 % for morning systolic blood pressure to 84% for morning systemic pulse pressure.

The finding of modest narrow sense heritability indicates the significant role of non-genetic factors affecting morning systolic, evening systolic and diastolic, and mean blood pressure, whereas the high estimate of heritability for morning diastolic and pulse pressure indicate the significant effect of genetic.

Key words: *Heritability, Blood pressure, systolic, diastolic*

Introduction

Hypertension, which has an impact on about 1/3 of the old age people of the population in Western countries, is currently becoming a considerable problem in Middle Eastern region too, with incidence ranging from 16% to 32% amongst adults[1-3]. Globally, by 2025, it is expected that there will be 1.5 billion people with systemic arterial hypertension[4]. An elevated blood pressure measurement is an important risk factors in 49% of coronary artery disease and 69% of stroke, and lead to half of all cardiovascular mortality[5,6].

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A increasing number of studies exhibit the presence of significant genetic difference in natural populations. The amount of genetic difference for phenotypic characters that is exist in a population is the key element of their potential for reacting to different aspects. The impact of genetic difference on a character might be very subtle to diverse contributions an individual receives from its environment. It is very inspiring to reveal genetic variations that require this things. In human being population genetics studies, there is no opportunity to governor the environmental exposures. These can be examined by intensive subject profiling. Though, it might be essential to study populations having individuals with significantly diverse environmental exposures to detect the major effects, and the price and complication shaped by this kind of researches is an obstacle[1,7,8].

The first step in unscrambling the genetic sources of an illness or character is the heritability estimate which is usually reflected the first pace in revealing the genetic bases of a disease or trait and numerous studies existing or heritability estimates for different characters or diseases. Following step is publishing the finding results later these results to assist in determining the necessary sample size in order for the study to have a positive influence to recognize the vulnerable gene[1]. Highly heritable traits could be correlated with important or complex traits, and these interactions very important in any program to understand the effects of genetic and environment factors that effect on blood pressure parameters[9]. Although heritability of ambulatory blood pressure in many populations such western population and east African population have been well described[10,11], there is no information in Iraqi population. Therefore, the purpose of the present study is to investigate genetic influences on intra-individual variation of ambulatory blood pressure parameters, by performing full-sib heritability analysis on a sample of Iraqi population reside in the western region of Iraq.

Materials and Methods

Subjects

Ninety three families were included in this study. The total number of studied population was 389 individuals, consisting of 18- to 61-year-old healthy subjects. All subjects provided informed consent.

Measurements of Anthropometric

Sex, waist circumference, height and weight were measured at home using standard methods. Body mass index (BMI) was measured as weight/height^2 (Kg/m^2).

Blood pressure

Measurements of ambulatory blood pressure were documented throughout the period of the study. Blood pressure was documented by the average of two measurements taken at specified times in the morning and afternoon. The blood pressure was measured after the subjects have been seated for 5 min, using a standard mercury sphygmomanometer. The subjects were in a supine position. A first reading was taken followed by a second reading after a 2 min delay. The mean of two consecutive measurements which were less than 10 mmHg apart was used. Siblings included in the study were in their 2nd and 3rd decade of life, most of them were having a normal body mass index (BMI), and a waist circumference (WC) below 80 cm. The measured phenotypes of blood parameters were morning systolic blood pressure(MSBP), morning diastolic blood pressure (MDBP), evening systolic blood pressure (ESBP), evening diastolic blood pressure (EDBP) , mean of morning systolic blood pressure (MMSBP), mean of morning diastolic blood pressure (MDBP), mean of evening systolic blood pressure (MESBP), mean of evening diastolic blood pressure (MEDBP) , morning pulse pressure (MPP), evening pulse pressure (EPP)

Mean BP(MBP) was estimated as :

$$MBP = DBP+[(SBP-DBP) / 3] \quad \text{..... (1).}$$

The difference between the systolic and diastolic pressure define as pulse pressure. It is reading in millimeters of mercury (mmHg). It shows the force that the heart produces each time it contracts. was calculated by the following formula.

$$\text{Systemic pulse pressure} = P_{systolic} - P_{diastolic} \quad \text{.....(2)}$$

Also, Uric acid (UR), cholesterol (CH), and triglycerides (TRI) were measured for each individual under investigation.

Statistics

Descriptive statistics were accomplished by SPSS software package (IBM Corporation New York, USA) [12].

Heritability

Heritabilities estimate accomplished by utilizing the maximum-likelihood-grounded on variance breakdown technique executed by the SAS program [13].

To define the portion of variance of the variables that is due to genetic influences, the full-sib method was used to estimate the heritability for different characters under investigation. In order to reduce the inflation of genetic variation estimate that may arise from similarity of a number of environmental effects, therefore the potential effect of all main effects that were included in this analysis were statistically factored out. Those factors were age, body mass index and waist circumference.

A P-value less than 0.05 were considered statistically significant. Estimated heritability near (0) imply that there are no genetic variation whereas values close to (1) imply strong genetic variation under the assumption of an underlying multifactorial model [9] . All analyses were performed using SAS[13].

Results and Discussion

Blood pressure is a complex genetic character with heritability estimation between 30 to 70% of the character difference which is due to genetic difference. The advancement of genetic exploration to recognize the genes that cover this difference and thus has impact on blood pressure regulation and effect the risk of hypertension has gotten a new level with large number of publication of wide scale of population genetic researches. Those have studied very large numbers of genetic markers in an effort to link single markers with blood pressure and hypertension [1,3,14,15].

Heritability values are helpful in predicting the expected genetic and environmental variations for any traits under investigation for specific population. Estimates of heritability in narrow sense ranged from 28 % for MSBP to 84% for morning systemic pulse pressure (Table 1). The estimate of heritability in table (1) of MSBP, EDBP , ESBP, MMBP, MEBP, Cholesterol, Uric acid were low category and other traits were moderately to very high. This study was conducted to estimate heritability by full-sib method. Whereas, greatest heritability researches on ambulatory BP were conducted in twins and have stated big value of heritability estimates. Researches in diverse cohorts of twins of Caucasian and African backgrounds stated heritability value for systolic BP (SBP) and diastolic BP (DBP) throughout day and night (sleep) time reaching 0.44 to 0.75 [11,14,16].

Table (1) Heritabilities and means for different characters under investigation with their corresponding standard errors

Characters	No.	h2 ± S.E	Mean ± S.E
Morning DBP	389	0.70 ± 0.24	78.14 ±7.16
Morning SBP	389	0.28 ± 0.22	120.22 ± 9.650
Evening DBP	389	0.36 ± 0.23	77.47 ± 7.72
Evening SBP	389	0.34 ± 0.23	119.49 ± 9.53
Mean Morning BP	389	0.39 ± 0.21	91.74 ± 6.94
Mean Evening BP	389	0.39 ± 0.20	91.01 ± 7.40
Morning Systemic pulse pressure	389	0.84 ± 0.22	42.08 ± 8.35
Evening Systemic pulse pressure	389	0.28 ± 0.21	41.69 ± 7.97
Cholesterol	389	0.31 ± 0.22	180.88 ± 25.56

Cont... **Table (1) Heritabilities and means for different characters under investigation with their corresponding standard errors**

Triglyceride	389	0.53 ± 0.21	196.22 ± 100.02
Uric acid	389	0.39 ± 0.19	6.86 ± 16.914
Age	389		28.13 ± 9.93
BMI	389		24.05 ± 6.65
WC	389		85.10 ± 16.39

The characters having low heritability indicated relative small contribution of the genetic factors and large contribution of environmental factors to the phenotype and such characters could be fairly easy manipulate by modifying environmental factors like medicine , smoking and diet due to low additive effect and large environment effects. In addition to that, heritability could be altered over time since the difference in genetic variance can change, the difference due to environmental elements alteration, or the association between genetic factor and environment can altered. Genetic variation can modified if allele occurrences altered might be due to consanguinity, novel variations obtained by the population by mutation or immigration which will add to the genetic difference resulting from the change in genetic bases or the environment. Similar character estimated throughout an individual's lifespan might have diverse environmental and genetic influencing it, like the differences turn out to be a role of age. The results are in conformity with heritability estimation of blood pressure in people descended from east African [10, 17,18].

Table 2 The correlation between different characters under investigation.

	MSBP	**MDBP**	**ESBP**	**EDBP**	**CH.**	**UR**	**TG**	**MMBP**	**MEBP**	**MPP**	**EPP**	**WC**	**Age**
MSBP	1												
MDBP	.54**	1											
ESBP	.62**	.43**	1										
EDBP	.36**	.67**	.62**	1									
CH	.13	.03	.09	.06	1								
UR	.00	.031	.02	.04	.03	1							
TG	.18	.08	.15	.04	.24*	-.06	1						
MMBP	.80**	.92**	.54**	.62**	.07	.02	.14	1					
MEBP	.50**	.62**	.83**	.93**	.07	.04	.10	.65**	1				
MPP	.69**	-.23*	.39**	-.16	.12	-.01	.14	.13	.05	1			
EPP	.37**	-.17	.61**	-.24*	.03	-.01	.15	.04	.09	.58**	1		
WC	.37**	.04	.34**	-.05	.19	-.02	.04	.19	.10	.40**	.47**	1	
Age	.35**	.28**	.42**	.28**	-.02	-.07	.04	.34**	.33**	.16	.16	.38**	1
BMI	.55**	.13	.44**	.15	-.23*	.002	.18	.32**	-.29**	.53**	.35**	.59**	.44**

** P≤0.01

* P≤0.05

The degree of association among the characters is an significant factor particularly in vital and complex character as blood pressure. Steel and Torrie [19] showed that correlations are measures of the intensity of association between traits. The positively correlated characters resulted in progress all characters and retrogress for characters that are adversely correlated.

The result of correlation investigation as presented by their coefficients (Table 2) showed that MSBP, displays significantly positive correlation with the MDBP, ESBP, EDBP,MMBP, MEBP, MPP and EPP which were 0.54** ,0 .62**,0.36**,0 .80**,0.50**, 0.69** and 0.37** respectively.

Throughout the day, BP had no significant differences in SBP and DBP between morning and evening measurements. There is significant correlation between MSBP and ESBP which was 0.54** . Age was significantly correlated with MSBP , MDBP, ESBP, EDBP, MMBP, MEBP,MPP and EPP which was 0.35** , 0.28**, 0.42** , 0.28**, 0.34**, 0.33**, 0.16, and 0.16 respectively. Sex, age, BMI and waist circumference were kept as covariates in all model-fitting analyses. Body mass index correlated significantly with MSBP (0.55**) but not with MDBP (0.13). The correlation between blood pressure characters and cholesterol, triglycerides and uric acid showed no significant correlation. While, the correlation between cholesterol and BMI was significantly negative -0.23** [20].

These results confirm that the assortative mating and environmental influences have shown to be an effective factors which effect heritability estimation, in addition to the familial aggregation of cardiovascular risk factors happens and that much of this aggregation has a genetic background. Since the study was carried out in very much consanguineous marriages, and multigenerational Arab individuals, with an average age of 28.13 years, 90% of whom were younger than 30 years. Those people were more similar environmental exposure with alike social and economic status and similar in habits related health like habitual physical activity; diet, smoking and the strict religious abstinence from alcohol [7,21,22,23].

Conclusion

The results showed that there is sufficient genetic variation existing in the material studied. The narrow sense heritability analysis of the study revealed that the morning diastolic blood pressure and morning systemic pulse pressure were the most traits with genetic variation components. The other characters also showed moderate to low heritability and genetic variation. Therefore, the results suggest that morning diastolic blood pressure and morning systemic pulse pressure are important characters contributing in the phenotype of blood pressure and based on these traits would be most effective in any program to control blood pressure.

Ethical Clearance: The Research Ethical Committee at scientific research by ethical approval of both MOH and MOHSER in Iraq

Conflict of Interest: Non

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