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Original Research Article

Effect of Genetic / Environmental Influence on Growth of Newborn in Himachal Pradesh

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ABSTRACT

Introduction: The effects of altitudinal variation on child growth and development have long been a center of attention for researcher. We believe that hereditary factor primarily affects on child growth and development however environment has secondary effect on it. The available literature on newborns in Himachal Pradesh establishes the fact that as altitude increases the crown heel length decreases. A comprehensive significant finding was also available in both the regions of Himachal Pradesh in terms of head length, foot length, nasal height etc. the comparison between the neonates of the two zones of Himachal Pradesh explains the difference in physical appearance of people of both zones. These features may be biological or behavioral in nature, genetic or developmental in origin. Most instances, a combination of factors are involved.

Methods: The present study included 185 parents and their newborns from two zones (Lower zone and Middle zone) of Himachal Pradesh and separated as per the criteria. Measurement of newborn parameters was taken in 12-24 hours after birth by using digital vernier caliper. Ethical clearance from university and permission from Himachal Pradesh government was taken. All the newborns were separated as per criteria

1. Mother / Father from Lower Zone. **(Zone category 1)**
2. Mother / Father from Middle Zone. **(Zone category 2)**
3. Mother from Lower Zone / Father from Middle Zone. **(Zone category 3)**
4. Mother from Middle Zone / Father from Lower Zone. **(Zone category 4)**

Results: Statistically significant difference was obtained in all the four categories. Different parameters were compared across different parent- zone categories by one way ANOVA. The results showed that four parameters shows significantly across groups, viz, Weight, Facial Length, Nasal Height and Philtrum width in all the Zone categories.

Conclusions: The early historical studies mention that people living in Himachal Pradesh have migrated from different geographical locations hence their genetics, as well as culture is different from each other. This study clearly demonstrates the effects of environmental factors on child growth and development in Himachal Pradesh.

KEY WORD: Anthropometry, Newborn, Himachal, Environment, Genetics.

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INTRODUCTION

The primary involvement of high altitude studies to anthropology has been to demonstrate the ways in which humans respond biologically to environmental stress and how biological responses, alone and together with cultural factors, affects the process of adaptation. In this manner high altitude studies serve

as a useful complement to other areas of anthropology concerned with the products and processes of evolution.

Genetic and environmental influences may affect an embryo and fetus at any time during development, the fetal genome itself has a significant role in development and fetal survival. Different patterns of intrauterine weight gain are probably primarily caused by environmental factors, which somehow affect the immediate intrauterine environment of the fetus.

It must be remembered that the reaction to a given environment represents the interaction of the genotype of the population being studied with the environment in respect to the variation of shape in various races and geographical zones; we believe that hereditary factor primarily affects on the shape however environment has secondary effect on it [1].

The geographical location, racial and environmental factors are responsible for the differences in growth and body composition in individuals. Adaptations refer to a feature of structure, function, and behavior that authorize an organism to live and reproduce in a given environment. These features may be biological or behavioral in nature, genetic or developmental in origin. Most instances, a combination of factors is involved [2].

Genetic adaptation means heritable characteristic whose presence reflects the operation of natural selection or other evolutionary forces (genetic drift, gene flow, operation) over time. We use developmental responses to refer to those occurring after prolonged exposure to stress during the period of growth and development. While developmental processes are considered distinct from genetic ones, it is important to recognize that the capacity to acquire the trait may be genetically based [3]

Species of Homo-sapiens lived an isolated life for centuries; they exhibited variations from the nearby population with respect to their social, cultural, linguistic and morphological behavior. These variations between the human groups are the result of complex mixture of biological, geographical and cultural determinants. Since time immemorial, there has been the uniqueness of genetics that humans evolved which got dissolved or diluted because many isolates of these races lost their reproductive barrier [4].

Anthropometry is a series of systematized measuring techniques that expresses quantitatively the dimensions of the human body and skeleton. Newborn anthropometry is the most important as there is no such measurement for universal use because it is dependent on racial, ethnic, environmental, age factors, biological, ecological and geographic factors [5-6].

AIM: The aim of the study is to find out any maternal/paternal/environmental/genetics and geographical influence on growth of newborns.

MATERIALS AND METHODS

The present study included 185 parents and their newborns from two zones [Lower zone (Elevation 350-1500 meters from sea level) and Middle zone (Elevation 1500-4500 meters from sea level)] of Himachal Pradesh and separated as per the criteria. Measurement of newborn parameters was taken in 12-24 hours after birth by using digital vernier caliper. All the newborns were separated as per criteria shown in **Table -1 and Figure -1.**

Fig. 1: Measurements on a newborn's different parameters.

Table 1: Distribution of subject.

Zone	Category criteria	Total
Zone cat- 1	Mother / Father from Lower Zone.	60
Zone cat- 2	Mother / Father from Middle Zone	40
Zone cat- 3	Mother from Lower Zone / Father from Middle Zone.	43
Zone cat- 4	Mother from Middle Zone / Father from Lower Zone.	42
	Total	185

Table 2: Descriptive summary of parameters.

Parameter	Zone	N	Mean	Std. Deviation		Zone	N	Mean	Std. Deviation
Weight	zonecat 1	60	2.8857	0.33429	**NH**	zonecat 1	60	21.1862	1.90387
	zonecat 2	40	2.8525	0.26384		zonecat 2	40	23.318	2.82196
	zonecat 3	43	3.0733	0.28833		zonecat 3	43	23.3014	2.87754
	zonecat4	42	2.9967	0.4274		zonecat4	42	23.0862	2.4084
	Total	185	2.9473	0.34311		Total	185	22.5701	2.63906
HC	zonecat 1	60	33.4367	1.1495	**NW**	zonecat 1	60	20.646	1.58971
	zonecat 2	40	33.8425	1.40199		zonecat 2	40	21.3602	1.88725
	zonecat 3	43	33.8814	1.18206		zonecat 3	43	21.2607	1.5432
	zonecat4	42	33.6548	1.35001		zonecat4	42	21.5312	2.10119
	Total	185	33.6773	1.26492		Total	185	21.1443	1.79474
HL	zonecat 1	60	1.13E+02	6.47977	**PW**	zonecat 1	60	6.9963	1.17787
	zonecat 2	40	1.12E+02	6.28134		zonecat 2	40	6.3695	1.16423
	zonecat 3	43	1.12E+02	6.07212		zonecat 3	43	6.3656	0.71833
	zonecat4	42	1.12E+02	5.79868		zonecat4	42	6.54	1.29595
	Total	185	1.12E+02	6.15658		Total	185	6.6106	1.14039
HW	zonecat 1	60	89.2147	5.33797	**PL**	zonecat 1	60	8.3035	1.30771
	zonecat 2	40	89.9785	4.30694		zonecat 2	40	8.5412	1.33771
	zonecat 3	43	90.3298	5.41879		zonecat 3	43	8.3612	1.20744
	zonecat4	42	89.444	4.78153		zonecat4	42	8.565	1.46202
	Total	185	89.6911	5.00666		Total	185	8.4277	1.32283
FL	zonecat 1	60	53.0115	4.42213	**CC**	zonecat 1	60	31.54	2.00264
	zonecat 2	40	56.537	5.23902		zonecat 2	40	31.425	1.9187
	zonecat 3	43	57.4128	3.73335		zonecat 3	43	31.3419	1.58629
	zonecat4	42	56.4807	4.82474		zonecat4	42	31.0333	2.17117
	Total	185	55.5844	4.87617		Total	185	31.3541	1.93053
FW	zonecat 1	60	78.8778	8.08766	**AC**	zonecat 1	60	30.1067	2.33919
	zonecat 2	40	79.676	6.78991		zonecat 2	40	29.68	2.20549
	zonecat 2	43	79.4672	4.41008		zonecat 3	43	29.3953	1.61554
	zonecat4	42	79.2895	6.08511		zonecat4	42	29.119	2.37889
	Total	185	79.2809	6.59781		Total	185	29.6249	2.18846
ICD	zonecat 1	60	19.3922	1.65167	**CHL**	zonecat 1	60	49.7383	1.73607
	zonecat 2	40	21.599	8.5867		zonecat 2	40	49.22	2.24445
	zonecat 3	43	19.9077	2.03478		zonecat 3	43	48.7649	5.04033
	zonecat4	42	19.8	2.12857		zonecat4	42	49.3445	1.96108
	Total	185	20.0817	4.3747		Total	185	49.3106	2.97008

RESULTS

For this study, 185 parents were selected who have delivered a newborn. The parents were divided according to their birth place, mother and father from lower zone, mother and father from middle zone, mother lower zone father middle zone and father lower zone mother middle zone. The birth places of newborns have not given any importance. It may be delivered in lower zone or middle zone. The distribution of subject based on his / her birth place shown in table-1.

The present study was conducted to obtain a baseline standard criterion (Mean±SD) of different zone category's newborns and their correlation. One way ANOVA test was applied

Table 3: One Way ANOVA Results.

Dependent Variable	Groups	Sum of Squares	Df	Mean Square	F	Sig.
Weight	Between Groups	1.372	3	0.457	4.08	0.008
	Within Groups	20.289	181	0.112		
	Total	21.661	184			
HC	Between Groups	6.378	3	2.126	1.336	0.264
	Within Groups	288.026	181	1.591		
	Total	294.405	184			
HL	Between Groups	31.041	3	10.347	0.27	0.847
	Within Groups	6943.194	181	38.36		
	Total	6974.235	184			
HW	Between Groups	37.026	3	12.342	0.488	0.691
	Within Groups	4575.227	181	25.277		
	Total	4612.253	184			
FL	Between Groups	610.978	3	203.659	9.793	0
	Within Groups	3764.002	181	20.796		
	Total	4374.98	184			
FW	Between Groups	17.488	3	5.829	0.132	0.941
	Within Groups	7992.242	181	44.156		
	Total	8009.73	184			
ICD	Between Groups	125.251	3	41.75	2.225	0.087
	Within Groups	3396.138	181	18.763		
	Total	3521.388	184			
NH	Between Groups	171.473	3	57.158	9.32	0
	Within Groups	1110.022	181	6.133		
	Total	1281.495	184			
NW	Between Groups	23.633	3	7.878	2.506	0.061
	Within Groups	569.047	181	3.144		
	Total	592.68	184			
PW	Between Groups	14.043	3	4.681	3.762	0.012
	Within Groups	225.249	181	1.244		
	Total	239.292	184			
PL	Between Groups	2.423	3	0.808	0.458	0.712
	Within Groups	319.555	181	1.765		
	Total	321.979	184			
CC	Between Groups	6.602	3	2.201	0.587	0.625
	Within Groups	679.157	181	3.752		
	Total	685.759	184			
AC	Between Groups	27.06	3	9.02	1.911	0.129
	Within Groups	854.185	181	4.719		
	Total	881.246	184			
CHL	Between Groups	24.16	3	8.053	0.912	0.437
	Within Groups	1598.974	181	8.834		
	Total	1623.133	184			

to find significant difference between different zones as per criteria. The significant difference was obtained in parameters weight, facial length, nasal height and philtrum width of newborns in different zone categories of Himachal Pradesh. **Table -2** shows the mean and slandered deviation in different zone categories.

Post HOC Tukey test- for multiple comparisons was done Table 3.

For weight - Zonecat-1 compared with other zone cat-2, 3, 4 and it has been found that Zonecat-1 is significant (.028) with zonecat-3. Zonecat-2 is significant (.016) with zonecat-3. Zonecat-3 is significant with zonecat-1 (.028) and zonacat-2 (.016). Zonacat-4 is having no relation with rest of zone categories.

For Facial Length - Zonecat-1 was highly significant with all the zone categories- 2, 3, 4 (.001). Zonecat-2 was highly significant with zonecat-1(.001); zoncat-3 was highly significant with zonecat-1(.000) and zonecat-4 was also

highly significant with zonecat-1(.001).

For Nasal Height - Zonecat-1 was highly significant with all the zone categories- 2, 3, 4 (.000). Zonecat-2 was highly significant with zonecat-1(.000); zoncat-3 was highly significant with zonecat-1(.000) and zonecat-4 was also highly significant with zonecat-1(.001).

For Philtrum Width - Zonecat-1 compared with other zone cat-2, 3, 4 and it has been found that zonecat-1 is significant with zonecat-2(.033) and zonecat-3 (.026). Zonecat-2 is significant with zonecat-1 (.033) and zonacat-3is significant with zonecat-1 (.026). Zonacat-4 is having no relation with rest of zone categories.

Table 4: Post Hoc Tukey test-multiple comparisons.

Dependent Variable	(I) zonecat	(J) zonecat	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Weight	zonecat 1	zonecat 2	0.03317	0.06834	0.962	-0.144	0.2104
		zonecat 3	-.18759*	0.0669	0.028	-0.3611	-0.0141
		zonecat4	-0.111	0.06736	0.355	-0.2857	0.0637
	zonecat 2	zonecat 1	-0.03317	0.06834	0.962	-0.2104	0.144
		zonecat 3	-.22076*	0.07355	0.016	-0.4115	-0.03
		zonecat4	-0.14417	0.07397	0.211	-0.336	0.0476
	zonecat 3	zonecat 1	.18759*	0.0669	0.028	0.0141	0.3611
		zonecat 2	.22076*	0.07355	0.016	0.03	0.4115
		zonecat4	0.07659	0.07263	0.718	-0.1118	0.2649
	zonecat4	zonecat 1	0.111	0.06736	0.355	-0.0637	0.2857
		zonecat 2	0.14417	0.07397	0.211	-0.0476	0.336
		zonecat 3	-0.07659	0.07263	0.718	-0.2649	0.1118
FL	zonecat 1	zonecat 2	-3.52550*	0.93085	0.001	-5.9392	-1.1118
		zonecat 3	-4.40129*	0.91116	0	-6.764	-2.0386
		zonecat4	-3.46921*	0.91746	0.001	-5.8482	-1.0902
	zonecat 2	zonecat 1	3.52550*	0.93085	0.001	1.1118	5.9392
		zonecat 3	-0.87579	1.00175	0.818	-3.4734	1.7218
		zonecat4	0.05629	1.00748	1	-2.5562	2.6687
	zonecat 3	zonecat 1	4.40129*	0.91116	0	2.0386	6.764
		zonecat 2	0.87579	1.00175	0.818	-1.7218	3.4734
		zonecat4	0.93208	0.98932	0.782	-1.6333	3.4974
	zonecat4	zonecat 1	3.46921*	0.91746	0.001	1.0902	5.8482
		zonecat 2	-0.05629	1.00748	1	-2.6687	2.5562
		zonecat 3	-0.93208	0.98932	0.782	-3.4974	1.6333
NH	zonecat 1	zonecat 2	-2.13183*	0.5055	0	-3.4426	-0.821
		zonecat 3	-2.11523*	0.49481	0	-3.3983	-0.8322
		zonecat4	-1.90002*	0.49823	0.001	-3.192	-0.6081
	zonecat 2	zonecat 1	2.13183*	0.5055	0	0.821	3.4426
		zonecat 3	0.0166	0.544	1	-1.394	1.4272
		zonecat4	0.23181	0.54712	0.974	-1.1869	1.6505
	zonecat 3	zonecat 1	2.11523*		0	0.8322	3.3983
		zonecat 2			1	-1.4272	1.394
		zonecat4	0.2152	0.53725	0.978	-1.1779	1.6083
	zonecat4	zonecat 1	1.90002*	0.49823	0.001	0.6081	3.192
		zonecat 2	-0.23181	0.54712	0.974	-1.6505	1.1869
		zonecat 3	-0.2152	0.53725	0.978	-1.6083	1.1779
PW	zonecat 1	zonecat 2	.62683*	0.22771	0.033	0.0364	1.2173
		zonecat 3	.63075*	0.2229	0.026	0.0528	1.2087
		zonecat4	0.45633	0.22444	0.18	-0.1256	1.0383
	zonecat 2	zonecat 1	-.62683*	0.22771	0.033	-1.2173	-0.0364
		zonecat 3	0.00392	0.24506	1	-0.6315	0.6394
		zonecat4	-0.1705	0.24646	0.9	-0.8096	0.4686
	zonecat 3	zonecat 1	-.63075*	0.2229	0.026	-1.2087	-0.0528
		zonecat 2	-0.00392	0.24506	1	-0.6394	0.6315
		zonecat4	-0.17442	0.24202	0.889	-0.802	0.4531
	zonecat4	zonecat 1	-0.45633	0.22444	0.18	-1.0383	0.1256
		zonecat 2	0.1705	0.24646	0.9	-0.4686	0.8096
		zonecat 3	0.17442	0.24202	0.889	-0.4531	0.802

*. The mean difference is significant at the 0.05 level.

DISCUSSION

It must be remembered that the reaction to a given environment represents the interaction of the genotype of the population being studied with the environment in respect to the variation of shape in various races and geographical zones; we believe that hereditary factor primarily affects on the shape however environment has secondary effect on it [7].

Genetic and environmental influences may affect an embryo and fetus at any time during development, the fetal genome itself has a significant role in development and fetal survival. Different patterns of intrauterine weight gain are probably primarily caused by environmental factors, which somehow affect the immediate intrauterine environment of the fetus.

The previous study on newborn establishes the fact that as altitude increases, there is some statistically significant difference in body parameters i.e. weight, facial length, nasal height, philtrum width in males and female newborns and additionally crown heel length in female newborns which explains the difference in physical appearance of people in Himachal Pradesh.

In present study all the parameters of newborns subject in four different zone categories were compared. Significant differences were found in weight, facial length, nasal height and philtrum width which are similar to the study conducted by Soni and Kapoor [2].

The present observations are compared with literature available in India as well as in other countries.

Lu et al [8] Another study by Inter-population difference in growth rate of P. vlangalii may primarily result from developmental plasticity in response to the difference in environmental resources, rather than genetic differentiation. The higher growth rate of high-elevation is likely associated with higher potential food availability and higher active body temperatures. Various authors Ray yip [9], Haas JD [10] and Waldhoer T [11] compared neonate' sparameters in different altitude and suggested that there may be a relationship between the neonate's parameters and environmental factors.

The above literatures indicated the role of different genetic, geographical, nutritional and environmental factors in the variation of different neonate bodily parameters.

CONCLUSION

The early historical studies mention that people living in Himachal Pradesh have migrated from different geographical locations hence their genetics, as well as culture is different from each other. The present study demonstrates that the geographical, nutritional and environmental factors are responsible for child growth and development in Himachal Pradesh.

Conflicts of Interests: **None**

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