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The Effect of Parental Consanguinity and Inbreeding on The Anthropometric Measurements of the Newborn Babies Revisited

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ABSTRACT The present paper deals with the effects of parental consanguinity and inbreeding on the anthropometric measurements of 4,941 newborn babies studied in 1978-79 and 1445 newborn babies studied in 1998-99, i.e. after a gap of 20 years, at Visakhapatnam, Andhra Pradesh. Inbreeding caused significant diminution of all anthropometric measurements recorded (weight, height, chest girth, calf girth, head girth, head length) except head breadth in the earlier study, but in the present study, there is no inbreeding depression on any of the anthropometric measurements. Plausible reasons for the presence and absence of inbreeding depression in the earlier and present studies are discussed.

INTRODUCTION

There are only a few studies available on the effects of parental consanguinity and inbreeding on anthropometric measurements. Slatis and Hoene (1961) in a small Caucasian sample found that the mean birth weight of the children of first cousins was less than the mean birth weight of outbred children although the difference was not statistically significant. Data from Japan, (Shiriyama 1953; Ichiba 1953b, 1954; Neel and Schull 1965) suggest that inbreeding diminishes body size, as judged by a variety of anthropometric measurements. Morton (1958) reported small but significant effects of consanguinity on weight, height and chest girth at the age of nine months. Barrai et al. (1964) studied the effects of consanguinity on stature and chest girth in Italian military conscripts aged approximately 20 years and found a diminution in chest girth due to inbreeding . Krishan (1975) in a study on Sunni Muslims of Delhi aged 10-19 years found that the children of consanguineous parents were small in all the measurements than the children of non consanguineous control group. In another study on Sheikh Sunni Muslim boys of old Delhi, between the ages of 11 and 16 years, Krishan (1986) observed slight inbreeding depression for all the eight anthropometric measurements i.e. stature, sitting height, head length, head circumference, chest girth, and calf girth. Paddaiah and Reddy (1980), which is the outcome of our earlier study, found that inbreeding caused diminution of all anthropometric measurements recorded (weight, height, chest girth, calf girth, head girth, head length) except head breadth. But, when the data were analysed according to the socio-economic groups, significant differences in the anthropometric measurements between inbred and non-inbred were seen only in the lower socio-economic class. Similarly, when the anthropometric measurements of the newborns were analysed according to the age groups of their mothers, Paddaiah (1985) did not, however, consistently observe significant differences between the inbred and non-inbred, in any of the age groups. Saedi-wong and al-Frayh (1989) in their Saudi newborn infants found no significant effects of inbreeding either on gestational age or on anthropometric measurements.

On the other hand, Mukherjee (1982), Mukherjee and Lakshmanadu (1990) found that the mean values of the physical measurements of the offspring of consanguineous marriages are lower than that of the non-consanguineous marriages. The inbreeding depression is more marked in the case of stature and also there is a decreasing trend in the mean values of stature with the increase in the degree in inbreeding. Findings from the previous studies on the presumed effects of inbreeding seem quite inconsistent from one another and very often the inferences drawn are diametrically opposite. Keeping this in mind, an attempt has been made to reevaluate the effect of consanguinity and inbreeding on the anthropometric measurements in the same populations adopting the same methodology after a gap of 20 years.

MATERIAL AND METHODS

The previous study consisted of 4,941 newborns, out of which 3,081 newborns were born to non-consanguineous parents (NC) and 1,860 to consanguineous parents (C). Out of the latter, 525 newborns were born not only to consanguineous parents, but also one or the other parent was again the product of a consanguineous marriage and termed as Inbred (IB). Out of the 525 newborns, 289 newborns were born to the mothers who not only married blood relatives but also they were themselves the products of consanguineous marriages and termed as Maternal Inbred (MIB). The present study consisted of 1,445 newborns, out of which 1013 belong to NC and 432 belong to C, 58 to IB and 36 to MIB parents.

The anthropometric measurements included are weight, height, chest girth, calf girth, head girth, head length and head breadth. The anthropometric measurements were taken within 48 hours of birth. Methodology adopted for taking the anthropometric measurements of the newborn babies was given in detail in Paddaiah and Reddy (1980).

The information regarding consanguinity status was elicited by the authors through personal interviews of the mother, the maternal grandmother (who was generally present as an attendant) and from the relatives of the patient. The data were collected from the two Government Hospitals, 1. The King George Hospital (KGH), the biggest hospital in South Eastern India and 2. The Victoria Hospital for women and children in Visakhapatnam city, Andhra Pradesh, India. As is mentioned, both the previous and present studies were divided into four groups like NC, C, IB and MIB and comparisons were made between NC and C; NC and IB and between NC and MIB groups.

RESULTS

The means and standard deviations of the seven anthropometric measurements of the newborn babies by consanguinity are depicted in tables 1 and 2, respectively, for the earlier and present studies. It is observed from table 1, that the mean values of the five anthropometric measurements like weight, height (crown-heel length), chest girth, calf girth and head girth of NC group are significantly higher than the mean values of the C, IB and MIB groups. With regard to weight and crown-heel length, there is a decreasing trend in the mean values from NC to

Table 1: The means and standard deviations of the seven anthropometric measurements of the newborn babies by consanguinity of the previous study

Anthropometric Measurements	*Parental Relationship*			
	NC	*C*	*IB*	*MIB*
No. of Newborns	*3081*	*1860*	*525*	*289*
Weight	2854.94	2796.11	2771.81	2.2754.36
(in gm)	±451.51	±458.26	±443.61	±368.98
		t = 4.39*	t = 5.22*	t = 4.34*
Height	48.61	48.17	48.15	48.13
(Crowin-Heel Length)	±2.53	±2.75	±2.85	2.31
(in cm)		t = 6.11*	t = 3.63*	t = 3.52*
Chest Girth	29.44	29.33	29.98	29.05
(in cm)	2.33	±2.42	±2.27	±2.45
		t = 3.28*	t = 4.84*	t = 2.68*
Calf Girth	9.82	9.70	9.63	9.64
(in cm)	±0.81	±0.79	±0.75	±1.70
		t = 5.36*	t = 4.61*	t = 3.18*
Head Girth	32.87	32.69	32.70	32.57
(in cm)	±2.75	2.65	±2.28	32
		t = 2.5*	t = 1.57	t = 2.11*
Head Length	11.20	11.13	11.15	11.04
(in cm)	2.10	±2.25	±2.11	±1.95
		t = 1.20	t = 0.52	t = 1.40
Head Breadth	9.05	9.01	9.08	9.21
(in cm)	±2.28	2.30	±2.50	±2.48
		t = 0.62	t = 0.25	t = 1.05

Table 2: The means and standard deviations of the seven anthropometric measurements of the newborn babies by consanguinity of the present study

	Parental Relationship			
Anthropometric Measurements	*NC*	*C*	*IB*	*MIB*
No. of Newborns	*1013*	*432*	*58*	*36*
Weight	2746.94	2736.78	2721.55	2751.38
(in gm)	±370.74	±385.51	±297.52	±312.93
		t = 0.47	t = 0.51	t = 0.71
Height	48.08	47.79	47.75	47.63
(Crowin-Heel Length)	±2.08	±1.99	±2.03	±2.18
(in cm)		t =2.41*	t = 1.17	t = 1.26
Chest Girth	32.04	31.95	31.95	32.02
(in cm)	±3.47	±2.15	±2.13	2.07
		t = 0.66	t = 0.19	t = 0.03*
Calf Girth	11.11	10.88	10.96	11.01
(in cm)	±5.24	±0.98	±0.95	±0.91
		t = 0.91	t = 0.22	t = 0.12
Head Girth	33.88	34.19	34.72	35.36
(in cm)	±2.12	±3.70	±6.77	±8.52
		t = 2.02*	t = 2.39*	t = 3.34*
Head Length	11.60	11.37	11.30	11.20
(in cm)	±3.84	±1.02	±0.98	±1.01
		t = 1.23	t = 0.60	t = 0.62
Head Breadth	8.92	8.82	8.94	8.84
(in cm)	±0.95	±0.98	±0.01	±1.01
		t = 1.80	t = 0.98	t = 0.52

MIB groups through C and IB groups. The mean head length of NC group, although higher than that for different inbred groups, the differences failed to attain statistical significance. The mean head breadth of IB and MIB groups, contrary to the expectations, are higher than the mean for NC group. However, the differences are not statistically significant.

The mean values of the seven anthropometric measurements of the NC group of the present study are although higher than the mean values of the C, IB and MIB groups the differences are not statistically significant (Table 2). With regard to the crown-heel length and head length, there is a decreasing trend in the mean values from NC to MIB groups, through C and IB groups. However, contrary to the theoretical expectations, the mean head girths of the C, IB and MIB groups are significantly ($p<0.05$) higher than that of the NC group. There is, therefore, a qualitative and quantitative difference in the nature of inbreeding effects between the present and previous studies. However, with the exception of weight of NC and C, and chest girth of MIB, there are no statistically significant mean differences in different anthropometric measurements of the present and the previous studies.

DISCUSSION

Based on the present study, it cannot be inferred that inbreeding has any effect on the anthropometric measurements. Nevertheless, based on the findings of our earlier study (Paddaiah and Reddy 1980) and of others, it may be surmised that the populations in this region have been practicing inbreeding for the last several centuries, and therefore their physique has been gradually decreased on account of the inbreeding depression. Observations on plants and animals lend support to this generalization. But, if the continuous inbreeding by the consanguineous groups was strictly practiced, the magnitude of the diminution in measurements of the consanguineous, inbred and maternal inbred groups should have been much larger than what has presently been observed. This may be most probably because of the confounding nature of inbreeding effects on different categories of the sample, including the non-consanguineous one. The ancestors of the non-consanguineous group, though are not blood relatives in the past

few generations, might have practiced consanguinity, hence undergone the process of inbreeding in the earlier generations. Similarly, the ancestors of the inbred subjects of the present study might not have been inbred in the earlier generations. Because of the very high average intensities of inbreeding and the small size of the breeding unit of these populations, even the non-consanguineous sample might not truly be non-consanguineous in the absolute sense. In these regions, marriage contacts normally are restricted to a small area with a tendency of forming smaller breeding units within apparently a caste or a sub-caste or an endogamous unit. Therefore, the non-consanguineous, consanguineous, inbred and maternal inbred groups, considered as distinct, may not be truly reflecting the degree of consanguinity generally assigned to such marriages because of the continued practice of inbreeding over several generations. Hence the degree of relationships must be much closer than that indicated by the terms used.

How can one account for the qualitative and quantitative difference in the nature of inbreeding effects between the present and previous studies? With the exception of weight of NC and C, and chest girth of MIB, there are no statistically significant mean differences in different anthropometric measurements of the present and the previous studies. One plausible explanation could be the perceptible difference in sample sizes. The mean differences between non-inbred and different categories of inbred samples in our earlier study probably attained statistical significance because of the much larger samples in comparison to the present study. This explanation appears more plausible because the mean differences between the non-consanguineous and various consanguineous groups of the previous and present studies are almost of equal magnitude, but attained statistical significance in the previous study, not in the present.

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