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RESEARCH ARTICLE

COMPARATIVE STUDY OF SEROLOGICAL PARAMETERS: ABO AND RH(\pm D) BLOOD GROUPS AMONG THE SCHEDULED CASTES (Pasis AND CHAMARS) OF LUCKNOW (INDIA)

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Key words:-

Blood Group, Gene Frequencies, Pasi and Chamar Caste groups, Lucknow, India and Sanghvi.

Abstract

The present study deals with the distribution of ABO and Rh(\pm D) parameters to study the **genetical variation of Pasis and Chamar population as well as to analysis the coefficient of genetic variability present in Indian subcontinent in relation to scheduled caste populations**. The distribution of ABO blood groups and Rh (\pm D) factor has been studied traits from rural part of Lucknow like: Telibagh, Kalli Paschim and Mohanlalganj area. The frequencies of **B** blood group percentage are recorded as 31.63 percent and 37.17 percent respectively. **The frequency of (Rh+) gene is higher in both populations as compared to (Rh-) gene**. A comparative inference shows that both are heterogeneous population but in terms of Rh(\pm D) blood groups they hold biological similarity to some extent due to sharing similar eco-zones. When the data are compared on the basis of ABO and Rh(\pm D) gene frequencies as well as Genetic Distance variability G^2 with Religious and Caste, Tribal and World population groups, some of them show significant differences. The analysis also shows that on the basis of four varna system, the gene flow of ABO and Rh blood group gene indicate upward mobility, that means Pasis and Chamar shared to some extent similar ecozones due to occupations, marital status or they to achieve advantage of upper caste system.

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Introduction:-

Serological markers have been served as important indicators for the understanding of genetic variation between and within populations. ABO and Rh blood groups have been extensively studied all over the world, providing valuable insight into the dynamics of population structure. The present study reports the distribution of ABO and Rh blood group traits as well as to analysis the coefficient of genetic variability test (Sanghvi, 1953) present in Indian subcontinent in relation to scheduled caste populations.

Material and method:-

In order to identify and type the blood correctly, blood samples were collected from 308 individuals representing the two caste groups equally. The details of which may be presented as below:-

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Collection of blood samples:-

After obtaining their prior consent, blood samples (2-3 ml by vein puncture) were collected randomly using sterile EDTA as anticoagulant vials by disposable syringes and needles, from each individual for Electrophoresis and Blood Typing. Blood samples were collected to the laboratory at Department of Genetics of Sanjay Gandhi Post Graduate Institute of Medical Science (SGPGIMS), Lucknow under the medicool facility within 24 hours of collection.

Sample processing:-

The blood samples so collected were soon processed for typing the blood within the next 5-8 hours of their collection. While processing, the cells were duly washed after centrifuging at about 1200 r.p.m. for about two minutes. Then the plasma (supernatant part) was separated from the Blood cells and it was stored in a medicool for further processing.

Typing of the blood:-

The blood sample were tested with help of the Antisera (anti-A and anti-B) produced by Span Diagnostics Ltd., Surat, India. For the observation of blood groups (A, B, O and AB) the classical tube technique has been employed and the tests were performed according to the standard procedure as suggested by Dunsford and Bowley (1956). Positive and Negative controls have been included in each series of tests. Weak positive and negative reactions have been retested, wherever necessary. Since anti-D serum is a complete serum, it does not require any incubation at 37°C, the Rh-D typing has been made through the simple micro slide technique as the instructions given by the serum manufacturer.

The standard statistical analysis has been carried out to estimate the ABO blood group gene frequencies (Bernstein's, 1930 as quoted by Race and Sanger, 1958), Goodness of fit and degree of freedom (Bernstein's, 1930), Chi-square Test for caste group comparison (Tylor and Priors, 1933) and Coefficient of Genetic Variability (Sanghvi, 1953)

Results and discussion:-

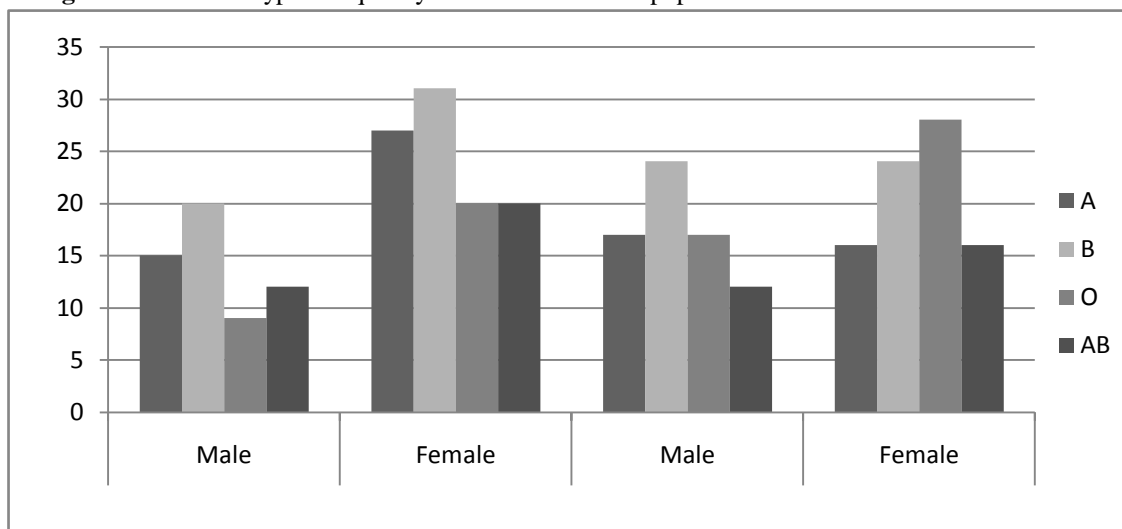
The results of the genetical analysis based on the Pasi and Chamar individuals of 6 villages, which consist of 1597 souls of Pasi and Chamar households (i.e. 766 Pasi individuals and 831 Chamar individuals). In all total, the data were collected from 323 households (158 Pasi and 165 Chamar) belonging to the both sexes, who were selected randomly, formed the representative group. The sampled groups are presented in accordance with the following headings:-

Frequency of abo blood groups:-

The genetic traits reveal that the frequency of blood group B has been found highest (33.12 percent and 33.17 percent) respectively in the both population.

Table 1:- ABO Blood Groups among Pasis and Chamars of Rural Lucknow.

Blood Group	Pasis						Chamars						Total M+F	%
	M	%	F	%	M+F	%	M	%	F	%	M+F	%		
A	15	26.79	27	27.55	42	27.27	17	24.29	16	19.05	33	21.43	75	24.35
B	20	35.71	31	31.63	51	33.12	24	34.29	24	28.57	48	31.17	99	32.14
O	9	16.07	20	20.41	29	18.83	17	24.29	28	33.33	45	29.22	74	24.03
AB	12	21.43	20	20.41	32	20.78	12	17.14	16	19.05	28	18.18	60	19.48
Total	56	100.00	98	100.00	154	100.00	70	100.00	84	100.00	154	100.00	308	100.00

Fig. 1:- ABO Phenotypic Frequency in Pasi and Chamar population of Rural Lucknow.**Table 2:-** Rh (+D) Phenotypes and Gene Frequencies among Pasis and Chamars of Rural Lucknow.

Population		No. Tested	Phenotype				Total	%	Gene Frequencies	
			Rh+	%	Rh-	%			D	d
Pasis	M	56	54	35.06	2	1.30	56.00	91.06	0.81102	0.18898
	F	98	97	62.99	1	0.65	98.00	63.64	0.89846	0.10153
	M+F	154	151	98.05	3	1.95	154.00	100.00	0.85905	0.14095
Chamars	M	70	68	44.16	2	1.30	70.00	45.46	0.83097	0.16903
	F	84	80	51.95	4	2.60	84.00	54.55	0.78179	0.21821
	M+F	154	148	96.10	6	3.90	154.00	100.00	0.80262	0.19738

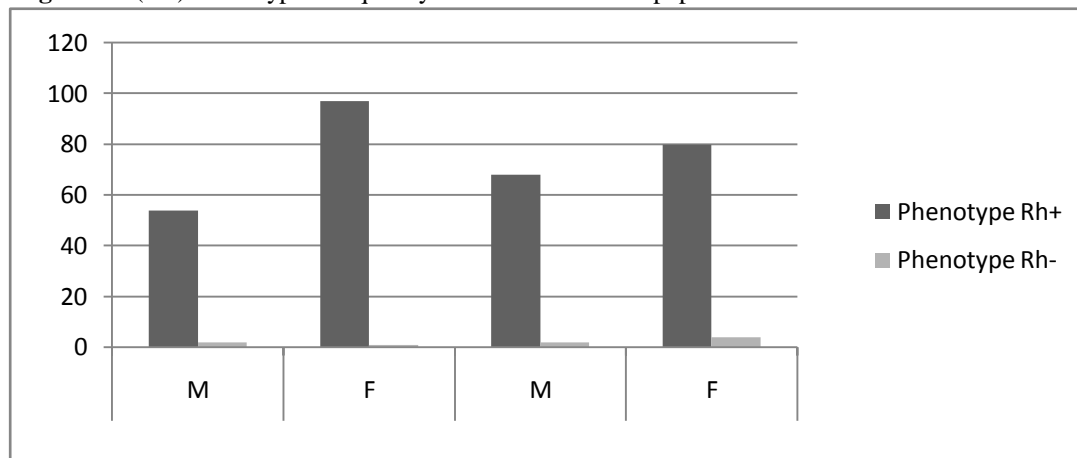
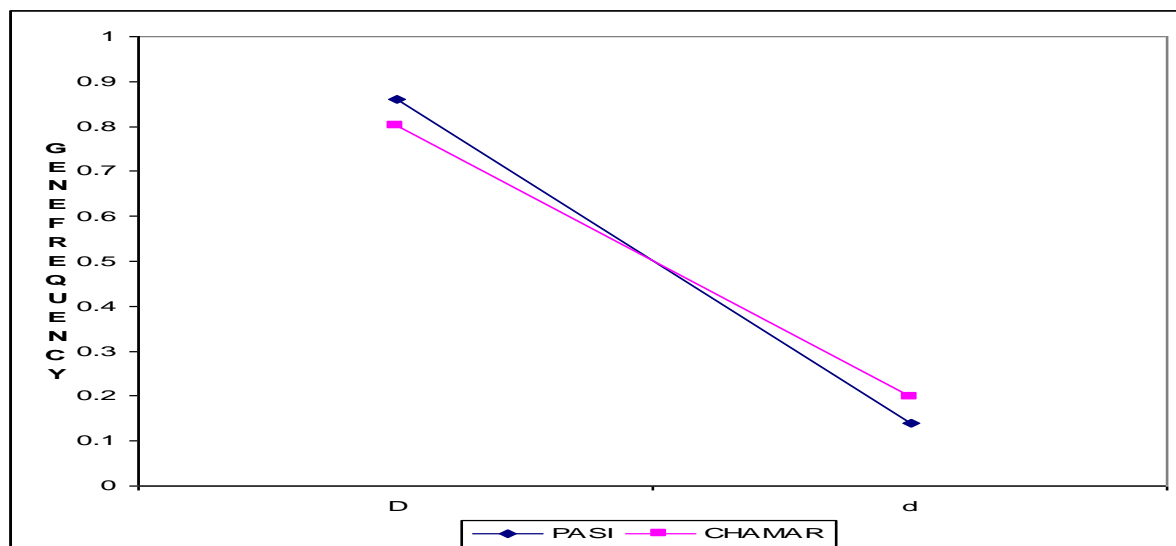
Fig 2:- Rh (\pm D) Phenotypic Frequency in Pasi and Chamar population of Rural Lucknow.

Fig 3:- 'D' and 'd' Gene Frequency.**Comparative evaluation of pasi and chamar population:-**

While the group homogeneity worked out by evaluating the significance of the observed differences it is noted that they held biological dissimilarity in terms of ABO blood groups, whereas they do have similarity in terms of Rh(\pm D) blood groups.

Variables		Statistical Techniques	Pasi \times Chamar	Inference
Genetical	ABO blood Group	chi-square test	Statistically significant	Hold Biological Dissimilarity
	Rh (\pm D) Blood Group	chi-square test	Statistically Insignificant	Hold Biological Similarity

Comparative evaluation of pasi and chamar with other caste and religious groups, tribal groups in india and world population groups:-

In order to understand the comparative evaluation of the scheduled caste population (Pasi and Chamar) with the other caste and religious groups, Tribal groups, and World populations at 5 percent level it might be inferred that:

Abo blood groups:-**Religious and caste groups:-**

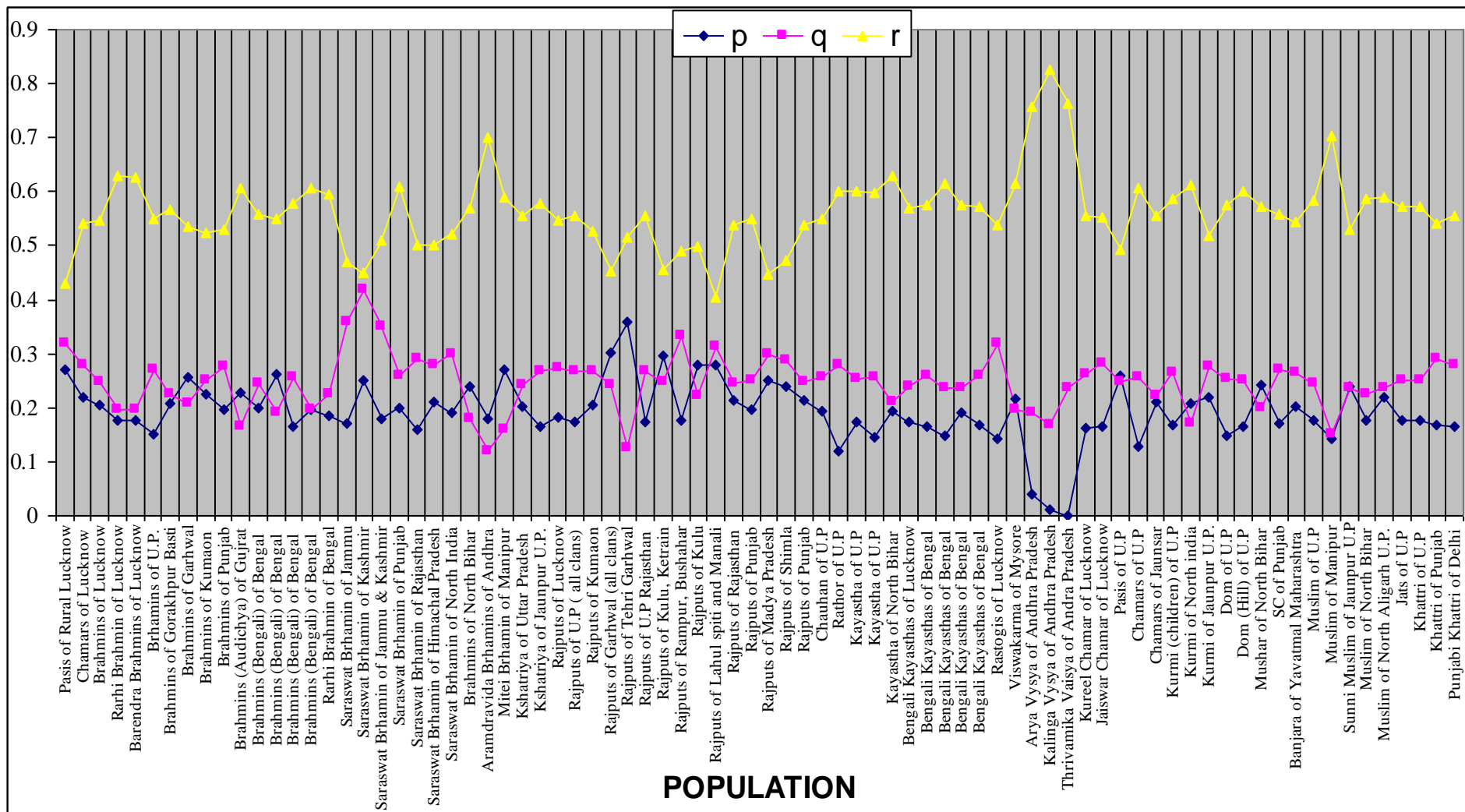
- The pattern type exhibit the highest frequency of 'B' followed by A>AB>O in Pasis and O>A>AB in Chamars, Most of other caste and religious groups under comparison, exhibit the highest frequency of B followed by O, A and AB groups.
- Rajputs of Rampur, Bushahar, Rajputs of Lahul spiti and Manali, Pasis of U.P hold similarity to Pasis Phenotypic pattern and rest population hold similarity to Chamar Phenotypic pattern.
- On the basis of the 'p', 'q' and 'r' frequencies, 'r' has been found highest as compared to 'p' and 'q' and it is found similar to Pasis and Chamar population. In respect of 'p' highest (0.36) position is occupied by the Rajputs of Garhwal (all clans), 'q' highest (0.42) position is occupied by the Saraswat Brahmin of Kashmir and However in the respect of 'r', the Kalinga Vysya of Andhra Pradesh occupies the highest position (0.82).
- (d)The observations made on the basis of the X^2 test, Brahmins of Garhwal and Kumaon, Kurmi of Jaunpur U.P hold similarity with Pasi and Chamar population.

Table 3:- Comparison of Pasi and Chamar with other caste groups and Religious groups with Respect to ABO Blood Groups in India.

Population Area	Number Tested	Percentile Frequency				Gene Frequency			X ² Pasis df=2	Probability	X ² Chamars df=2	Probability	Investigator
		O	A	B	AB	p	q	r					
Pasis of Rural Lucknow	154	18.83	27.27	33.12	20.78	0.27	0.32	0.43	*4.90	.10<P<.05	(Pasi x Chamar)		Present Study
Chamars of Lucknow	154	24.03	24.35	32.14	19.48	0.22	0.28	0.54					Present Study
Brahmins of Lucknow	186	27.80	29.40	35.80	7.00	0.21	0.25	0.55	*16.34	.001<P	*6.2931	.005<P<.01	Majumdar (1947)
Rarhi Brahmin of Lucknow	150	39.33	25.33	28.67	6.67	0.18	0.20	0.63	*23.66	.001<P	*11.66	.01<P.001	Deb Mili (1980)
Barendra Brahmins of Lucknow	150	38.67	26.00	29.33	6.00	0.18	0.20	0.63	*22.59	.001<P	*11.39	.001<P	Deb Mili (1980)
Brhamins of U.P.	200	30.50	23.50	42.00	4.00	0.15	0.27	0.55	*29.88	.001<P	*18.94	.001<P	Rai Vandana and Kumar Pradeep
Brahmins of Gorakhpur Basti	203	31.30	29.10	31.60	8.00	0.21	0.22	0.57	*15.35	.001<P	*9.66	.001<P	Majumdar (1947)
Brahmins of Garhwal	105	20.60	22.80	25.60	12.00	0.26	0.21	0.54	2.33	.50<P<.30	1.83	.50<P<.30	Tewari et al (1968)
Brahmins of Kumaon	108	25.92	27.78	31.48	14.81	0.23	0.25	0.52	3.24	.20<P<.10	1.65	.50<P<.30	Tewari (1954)
Brahmins of Punjab	402	27.11	25.63	37.81	9.45	0.20	0.28	0.53	*15.90	.001<P	*9.91	.001<P	Bhalla (1963)
Brahmins (Audichya) of Gujrat	200	37.00	32.50	22.50	8.00	0.23	0.17	0.61	*24.5	.001<P	*15.7	.001<P	Vyas et al (1958)
Brahmins (Bengali) of Bengal	235	31.49	25.53	32.77	10.21	0.20	0.24	0.56	*13.4	.001<P	*4.86	.10<P<.05	Chaudhury et al (1969)
Brahmins (Bengali) of Bengal	100	28.00	38.00	27.00	7.00	0.26	0.19	0.55	*12.57	.01<P<.001	*12.17	.01<P<.001	Sen (1954)
Brahmins (Bengali) of Bengal	237	34.18	21.10	35.44	9.28	0.17	0.26	0.58	*18.68	.001<P	*6.67	.05<P<.01	Majumdar (1952)
Brahmins (Bengali) of Bengal	125	35.20	29.60	29.60	5.60	0.20	0.20	0.61	*17.63	.001<P	*12.18	.01<P<.001	Macfarlane (1938)
Rarhi Brahmin of Bengal	372	36.02	24.46	30.38	9.04	0.18	0.22	0.59	*23.47	.001<P	*9.70	.001<P	Battacharjee (1956)
Saraswat Brhamin of Jammu	63	22.22	19.04	46.03	12.69	0.17	0.36	0.47	*5.98	.10<P<.05	4.52	.20<P<.10	Yadav Bhuvnesh et.al (2011)
Saraswat Brhamin of Kashmir	65	20.00	13.84	36.92	29.23	0.25	0.42	0.45	*5.28	.10<P<.05	*6.01	.05<P<.01	Yadav Bhuvnesh et.al (2011)
Saraswat Brhamin of Jammu &	128	25.78	16.40	41.40	16.40	0.18	0.35	0.51	*7.8	.05<P<.01	3.18	.30<P<.20	Yadav Bhuvnesh et.al (2011)
Saraswat Brhamin of Punjab	60	36.66	18.33	26.66	18.33	0.20	0.26	0.61	*8.45	.05<P<.01	1.11	.95<p<.90	Yadav Bhuvnesh et.al (2011)
Saraswat Brhamin of Rajasthan	67	25.37	25.37	44.77	4.47	0.16	0.29	0.50	*13.76	.001<P	*8.49	.05<P<.01	Yadav Bhuvnesh et.al (2011)
Saraswat Brhamin of Himachal	65	24.61	27.69	38.46	92.30	0.21	0.28	0.50	*26.90	.001<P	*34.46	.001<P	Yadav Bhuvnesh et.al (2011)
Saraswat Brhamin of North India	320	27.50	20.93	38.75	12.81	0.19	0.30	0.52	*10.13	.001<P	4.25	.20<P<.10	Yadav Bhuvnesh et.al (2011)
Brahmins of North Bihar	208	32.21	34.62	25.96	7.21	0.24	0.18	0.57	*21.61	.001<P	*16.49	.001<P	Pandey B.N et.al (1995)
Aramdravida Brhamins of Andhra	120	49.17	27.50	17.50	5.83	0.18	0.12	0.70	*35.07	.001<P	*19.82	.001<P	Prasad B V Ravi (1988)
Mitei Brhamin of Manipur	302	34.77	35.10	18.54	11.29	0.27	0.16	0.59	*26.69	.001<P	*17.50	.001<P	Metei Sanjenbam Yaiphaba et.al
Kshatriya of Uttar Pradesh	415	30.84	26.75	32.77	9.64	0.20	0.24	0.56	*17.62	.001<P	*9.04	.05<P<.01	Majumdar (1947)
Kshatriya of Jaunpur U.P.	20	33.50	20.00	36.00	10.50	0.17	0.27	0.58	*14.24	.001<P	*5.26	.05<P<.01	Kumar Pradeep et.al (2010)

Rajputs of Lucknow	300	30.30	22.50	36.60	10.60	0.18	0.27	0.55	*13.71	.001<P	*5.96	.10>P>.05	Shukla (1973)
Rajputs of U.P (all clans)	769	30.95	22.50	37.19	9.36	0.17	0.27	0.56	*24.40	.001<P	*10.09	.01<P<.001	Negi and Das (1963)
Rajputs of Kumaon	124	29.03	24.19	33.87	12.90	0.21	0.27	0.53	*5.41	.10>P>.05	1.9	.50<P<.30	Tewari (1954)
Rajputs of Garhwal (all clans)	175	20.57	36.57	28.00	14.86	0.30	0.24	0.45	*4.86	.10>P>.05	*9.44	.01<P<.001	Tewari and Bhasin (1968)
Rajputs of Tehri Garhwal	50	30.00	46.00	10.00	14.00	0.36	0.13	0.51	*14.92	.001<P	*14.83	.001<P	Kaul (1953)
Rajputs of U.P Rajasthan	769	30.95	22.50	37.19	9.36	0.17	0.27	0.56	*24.40	.001<P	*10	.001<P	Majumdar (1947)
Rajputs of Kulu, Ketrain	268	21.64	34.70	27.61	16.04	0.30	0.25	0.46	4.32	.20<P<.10	*8.47	.05<P<.01	Mourant et al (1976)
Rajputs of Rampur, Bushahar	126	29.36	13.49	37.30	19.84	0.18	0.33	0.49	*9.59	.001<P	3.21	.30<P<.20	Mourant et al (1976)
Rajputs of Kulu	98	17.35	44.90	36.73	11.22	0.28	0.22	0.50	*27.0	.001<P	*15.7	.001<P	Bagai (1975)
Rajputs of Lahul spiti and Manali	185	17.84	28.65	33.51	20.00	0.28	0.31	0.41	0.16	.95<p<.90	*7.26	.05<P<.01	Mourant (1976)
Rajputs of Rajasthan	118	28.80	28.00	33.00	10.20	0.21	0.25	0.54	*7.7	.05<P<.01	3.57	.20<P<.10	Mahalanobis (1941)
Rajputs of Punjab	118	28.80	28.00	33.00	10.20	0.2	0.3	0.6	*7.7	.05<P<.01	3.57	.20<P<.10	Seth and Seth (1973)
Rajputs of Madhya Pradesh	100	20	29	36	15	0.3	0.3	0.4	1.75	.50<P<.30	*4.84	.10>P>.05	Kumar (1963)
Rajputs of Shimla	196	20.9	30.6	37.3	11.3	0.2	0.3	0.5	*5.78	.10>P>.05	*8.84	.05<P<.01	Delhi Univ. Exp (1957)
Rajputs of Punjab	118	28.80	28.00	33.00	10.20	0.2	0.2	0.5	*7.7	.05<P<.01	3.57	.20<P<.10	Malone and Lahiri (1928)
Chauhan of U.P	216	30.6	25.5	35.2	8.8	0.2	0.3	0.5	*15.27	.001<P	*6.87	.05<P<.01	Negi and Das (1963)
Rathor of U.P	211	35.6	15.6	40.8	8.06	0.1	0.3	0.6	*25.86	.001<P	*12.23	.01<P<.001	Negi and Das (1963)
Kayastha of U.P	111	36	19.8	32.4	11.7	0.17	0.25	0.60	*12.08	.01<P<.001	2.5	.30<P<.20	Majumdar (1947)
Kayastha of U.P	112	35.7	19.6	37.5	7.14	0.1	0.3	0.6	*17.4	.001<P	*7.18	.05<P<.01	Kurup and Verma (1971)
Kayastha of North Bihar	228	39.47	22.81	25.44	12.28	0.19	0.21	0.63	*19.61	.001<P	*5.64	.10>P>.05	Pandey B.N et.al (1995)
Bengali Kayasthas of Lucknow	300	34.67	23.00	34.00	8.33	0.17	0.24	0.57	*22.61	.001<P	*9.93	.01<P<.001	Deb Mili (1980)
Bengali Kayasthas of Bengal	229	31.8	23.1	38	6.97	0.2	0.3	0.6	*21.09	.001<P	*51.28	.001<P	Chaudhury et al (1969)
Bengali Kayasthas of Bengal	139	38.1	20.1	34.5	7.19	0.1	0.2	0.6	*20.61	.001<P	*9.09	.01<P<.001	Sen (1954)
Bengali Kayasthas of Bengal	364	32.4	26.1	33.2	8.24	0.2	0.2	0.6	*22.68	.001<P	*11.38	.01<P<.001	Majumdar (1952)
Bengali Kayasthas of Bengal	200	32	23	37.5	7.5	0.2	0.3	0.6	*19.09	.001<P	*8.86	.05<P<.01	Macfarlane (1938)
Rastogis of Lucknow	150	27.4	19.3	46.7	6.66	0.1	0.3	0.5	*18.95	.001<P	*13.71	.001<P	Rastogi (1972)
Viswakarma of Mysore	143	37.76	26.57	23.78	11.89	0.22	0.20	0.61	*15.78	.001<P	*6.05	.05<P<.01	M.I.Dore Raj et al (2010)
Arya Vysya of Andhra Pradesh	101	57.43	7.92	34.65	0.00	0.04	0.19	0.76	*61.75	.001<P	*36.58	.001<P	Laxmi N., Veerraju P et.al (2002)
Kalinga Vysya of Andhra Pradesh	100	68.00	1.00	30.00	1.00	0.01	0.17	0.82	*82.32	.001<P	*54.07	.001<P	Laxmi N., Veerraju P et.al (2002)
Thrivamika Vaisya of Andhra	101	58.42	0.00	41.58	0.00	0.00	0.24	0.76	*78.9	.001<P	*54.27	.001<P	Laxmi N., Veerraju P et.al (2002)
Kureel Chamar of Lucknow	320	29.4	22.5	41.3	6.85	0.2	0.3	0.6	*14.46	.001<P	*16.20	.001<P	Tandon (1978)
Jaiswar Chamar of Lucknow	314	30.89	20.70	38.55	9.87	0.17	0.28	0.55	*16.88	.001<P	*8.18	.05<P<.01	Tandon (1978)

Pasis of U.P	601	24.62	37.62	37.95	29.95	0.26	0.25	0.49	1.06	.70<p<.50	*10.63	.01<P<.001	Bhatnagar (1973)
Chamars of U.P	158	36.67	18.67	39.33	5.33	0.13	0.26	0.61	*26.36	.001<P	*13.57	.001<P	Majumdar et al (1941)
Chamars of Jaunsar	207	30.90	29.50	31.40	8.20	0.21	0.22	0.56	*15.58	.001<P	*9.62	.01.P>.001	Rai Vand Patel Ram Pal et.al (2009)
Kurmi (children) of U.P	107	34.58	19.63	34.58	11.21	0.17	0.26	0.59	*11.33	.01.P>.001	2.39	.30<P<.20	Majumdar (1947)
Kurmi of North india	150	37.40	31.30	25.30	6.00	0.21	0.17	0.61	*23.13	.001<P	*14.14	.001<P	Prabakar Jai et.al (2009)
Kurmi of Jaunpur U.P.	212	26.89	25.47	33.96	13.68	0.22	0.28	0.52	4.96	.10<p<.05	2.29	.30<P<.20	Rai Vandana et.al (2009)
Dom of U.P	179	33	22.9	39.7	4.47	0.15	0.25	0.57	*27.97	.001<P	*15.54	.001<P	Majumdar et al (1941)
Dom (Hill) of U.P	125	36	20	33.6	10.4	0.17	0.25	0.60	*13.79	.001<P	3.85	.20<P<.10	Majumdar et al (1941)
Mushar of North Bihar	325	32.62	31.69	24.92	10.77	0.24	0.20	0.57	*17.41	.001<P	*10.65	.01.P>.001	.Pandey B.N.et.al (1995)
SC of Punjab	1150	31.22	21.91	37.57	9.30	0.17	0.27	0.56	*27.53	.001<P	*12.08	.01>P>.001	Siddu Sharda (2003)
Banjara of Yavatmal Maharashtra	550	29.64	24.54	33.82	12.00	0.20	0.26	0.54	*12.80	.01>P.001	3.80	.20<P<.10	Chavhan Aravind et.al (2010)
Muslim of U.P	326	34.1	23	33.7	9.2	0.18	0.24	0.58	*19.77	.001<P	7.5	.05<P<.01	Majumdar (1947)
Muslim of Manipur	303	49.50	22.44	24.10	3.96	0.14	0.15	0.70	*57.24	.001<P	*37.58	.001<P	Metei Sanjenbam Yaiphaba et.
Sunni Muslim of Jaunpur U.P	200	28.00	30.50	30.00	11.50	0.24	0.24	0.53	*8.47	.05<P<.01	*5.72	.05<P<.01	Kumar Pradeep et.al (2010)
Muslim of North Bihar	217	34.56	25.35	33.18	6.91	0.18	0.23	0.59	*20.47	.001<P	*11.16	.01>P>.001	.Pandey B.N et.al (1995)
Muslim of North Aligarh U.P.	607	34.76	23.72	26.02	15.48	0.22	0.24	0.59	*15.53	.001<P	3.03	.20<P<.10	Ara Gulsan et.al (2008)
Jats of U.P	113	31	25.7	37.2	6.2	0.2	0.3	0.6	*14.97	.001<P	*8.83	.05<P<.01	Chattopadhyaya (1963)
Khatti of U.P	125	32	24	33.6	10.4	0.2	0.3	0.6	*9.37	.01>P>.001	3.51	.20<P<.10	Majumdar (1947)
Khatti of Punjab	1708	30	21.4	40.6	7.96	0.2	0.3	0.5	*35.63	.001<P	*18.35	.001<P	Anand (1957)
Punjabi Khatti of Delhi	540	30	22	39.6	8.33	0.2	0.3	0.6	*24.83	.001<P	*13.81	.001<P	Bhalla (1963)

Fig 4:- Comparative Evaluation of p q r Gene Frequencies with other Castes and Religious Groups in India.

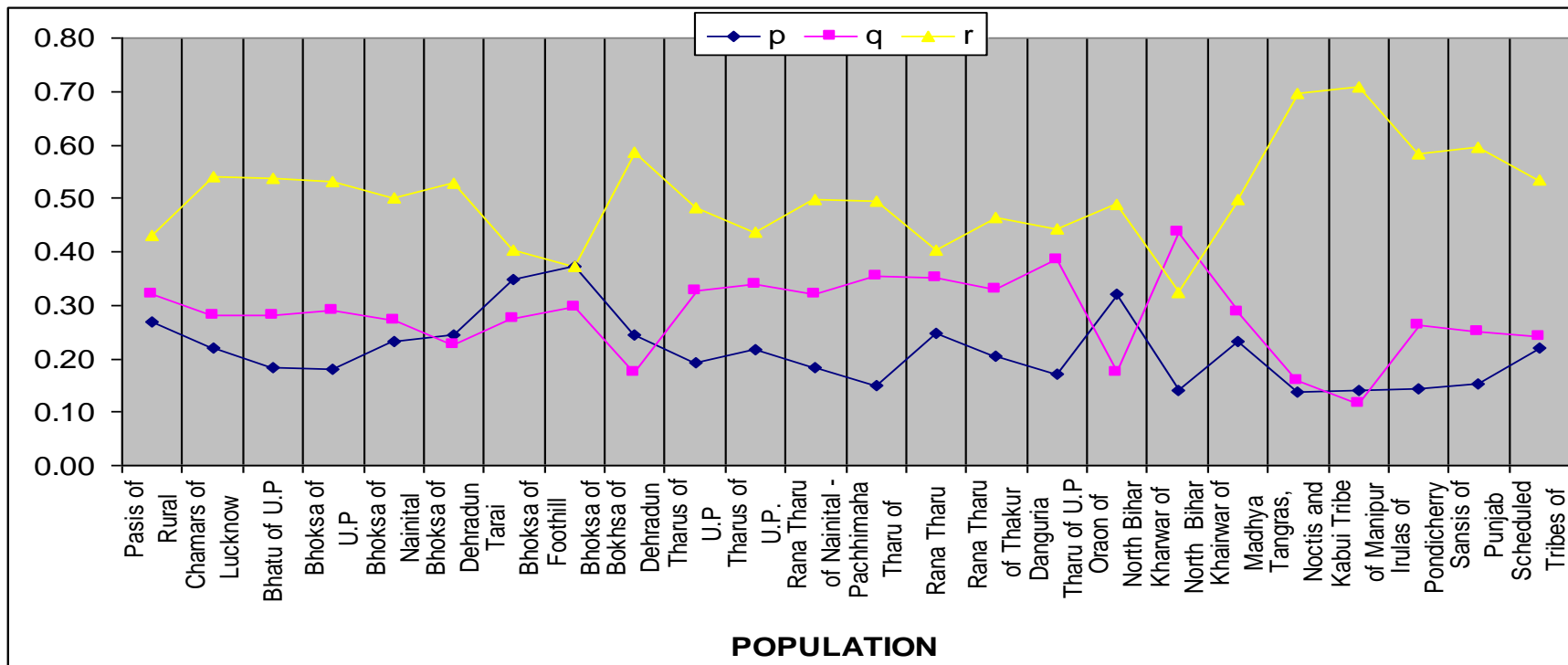
Tribal groups:-

- (a) It is observed that different Tribal populations exhibit similar pattern of highest frequency of B followed by A, O and AB. This pattern have been found in Bhatu of U.P., Bhoksa of U.P., Rana Tharu of Nainital-Tarai, Pachhimaha Tharu of Gorakhpur, Khairwar of Madhya Pradesh and Scheduled Tribes of Orissa as similar to phenotypic frequency of Chamar population.
- (b) In respect of 'p' highest (0.37) position is occupied by the Foothill Bhoksa of Dehradun, U.P., 'q' exhibit highest (0.44) position by the Kharwar of North Bihar and 'r' occupy the highest position (0.71) by Kabui Tribe of Manipur.
- (c) The observations made on the basis of the X^2 test, only Bhoksa of Nainital holds similarity with Pasi and Chamar population.

Table 4:- Comparison of Pasi and Chamar with Different Tribal Population with Respect to ABO Blood Groups in India.

Population Area	Number Tested	Percentile Frequency				Gene Frequency			X ² Pasis df=2	Probability	X ² Chamar s df=2	Probability	Investigator
		O	A	B	AB	p	q	r					
Pasis of Rural Lucknow	154	18.83	27.27	33.12	20.78	0.27	0.32	0.43	*4.90	.10<P<.05	(Pasi X Chamar)		Present Study
Chamars of Lucknow	154	24.03	24.35	32.14	19.48	0.22	0.28	0.54					Present Study
Bhatu of U.P	113	27.43	24.78	39.82	7.96	0.18	0.28	0.54	*9.81	.01<P.001	*7.31	.05<P<.01	Majumdar (1942)
Bhoksa of U.P	144	30.56	19.44	36.11	13.89	0.18	0.29	0.53	*8.59	.05<P<.01	1.60	.50<P<.30	Majumdar (1941)
Bhoksa of Nainital	195	25.13	27.69	33.85	13.33	0.23	0.27	0.50	3.85	.20<P<.10	3.20	.20<P<.10	Bhargava et al (1973)
Bhoksa of Dehradun	201	26.87	33.33	30.35	9.45	0.25	0.23	0.53	*11.48	.01<P.001	*9.85	.01<P.001	Garg et al (1981)
Tarai Bhoksa of Nainital	200	17.00	38.50	25.50	19.00	0.35	0.28	0.40	*5.86	.05<P<.01	*16.55	.001<P	Singh U.P (1993)
Foothill Bhoksa of Dehradun	200	14.00	36.00	25.50	24.50	0.37	0.30	0.37	*5.83	.05<P<.01	*18.29	.001<P	Singh U.P (1993)
Bokhsa of Dehradun Uttarakhand	213	34.21	33.80	23.00	7.89	0.24	0.18	0.58	*22.67	.001<P	*15.16	.001<P	Patni Swati and Yadav Ankur (2003)
Tharus of U.P	240	27.08	17.08	37.50	18.33	0.19	0.33	0.48	*8.63	.05<P<.01	2.15	.30<P<.20	Mourant et al (1976)
Tharus of U.P.	300	19.00	24.67	42.33	14.00	0.22	0.34	0.44	*5.34	.05<P<.01	*8.83	.05<P<.01	Sharma T.P. and Shukla B.R.K. (2004)
Rana Tharu of Nainital - Tarai	255	24.31	21.96	42.35	11.37	0.18	0.32	0.50	*10.08	.01<P.001	*8.02	.05<P<.01	Kumar P (1968)
Pachhimaha Tharu of Gorakhpur	69	23.19	18.84	49.27	8.69	0.15	0.35	0.50	*9.71	.01<P.001	*8.81	.05<P<.01	Mouant et al (1976)

Rana Tharu	158	15.8 2	26.5 8	41.1 4	16.4 5	0.2 5	0.3 5	0.4 0	2.18	.30<P<.20	*8.91	.05<P<.01	Mouant et al (1976)
Rana Tharu of Thakur Kheri & Nainital	203	21.6 7	23.1 5	41.3 8	13.7 9	0.2 1	0.3 3	0.4 6	*4.88	.10<P<.05	*6.05	.05<P<.01	Mouant et al (1976)
Danguria Tharu of U.P	185	17.8 4	20.5 4	51.3 5	10.2 7	0.1 7	0.3 9	0.4 4	*14.2 8	.001<P	*17.6	.001<P	Mouant et al (1976)
Oraon of North Bihar	117	23.9 3	44.4 4	22.2 2	9.40	0.3 2	0.1 7	0.4 9	*14.5 0	.001<P	*17.39	.001<P	Pandey B.N et.al (1995)
Kharwar of North Bihar	171	10.5 3	21.0 5	63.1 6	5.26	0.1 4	0.4 4	0.3 2	*36.5 9	.001<P	*42.51	.001<P	Pandey B.N et.al (1995)
Khairwar of Madhya Pradesh	329	24.6 2	26.1 4	34.2 6	13.6 8	0.2 3	0.2 9	0.5 0	*4.54	.10<P<.05	*3.79	.20<P<.10	Sharma K.K.N (1989)
Tangras, Noctis and Singhpos of Arunachal Pradesh	157	48.4 0	22.2 9	26.1 1	3.18	0.1 4	0.1 6	0.7 0	*43.2 8	.001<P	*25.69	.001<P	Pavate Prabhakar et.al (1988)
Kabui Tribe of Manipur	127	50.0 3	28.3 5	23.6 2	7.87	0.1 4	0.1 1	0.7 1	*30	.001<P	*14.89	.001<P	Metei Sanjenbam Yaiphaba et.al (2010)
Irulas of Pondicherry	200	34.0 0	20.5 0	39.5 0	3.50	0.1 4	0.2 6	0.5 8	*33.9 9	.001<P	*22.65	.001<P	Subhashini A.B.(2007)
Sansis of Punjab	200	35.5 0	20.5 0	36.5 0	7.30	0.1 5	0.2 5	0.6 0	*23.3 9	.001<P	*10.09	.01<P.001	.Sidhu S and Sidhu L.S.(1980)
Scheduled Tribes of Orissa	1959	28.5 0	29.1 0	32.2 0	10.2 0	0.2 2	0.2 4	0.5 3	*19.4 2	.001<P	*10.78	.001<P	.Balgir R.S et.al (2004)

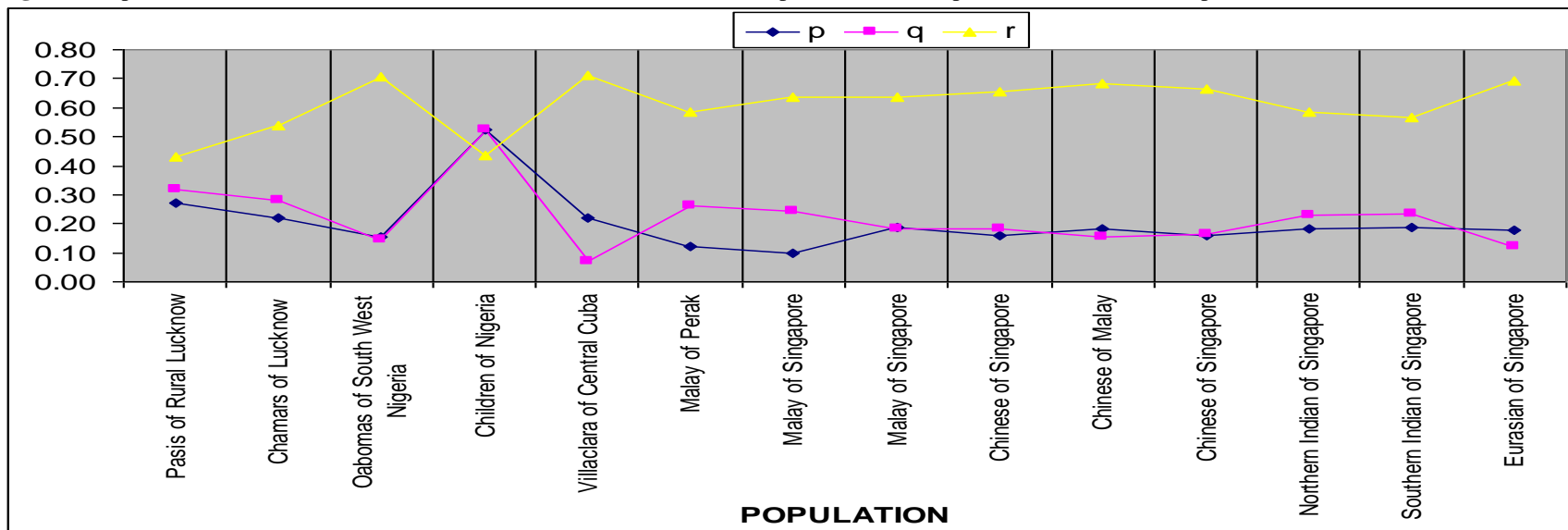
Fig 5:- Comparative Evaluation of Pasis and Chamars with Different Tribal Population with Respect to ABO Blood Groups

World population groups:-

- (a) When considering the Pasi and Chamar population with different World population the Malay of Perak and South Indian of Singapore shown a similar trend of highest frequency of B followed by O, A and AB except rest population.
- (b) However in respect of 'p', 'q' and 'r' similarity in these population, it shows that the 'p' occupy the highest position (0.52) in Children of Nigeria, the 'q' exhibit highest (0.52) position by the Children of Nigeria and 'r' occupy the highest position (0.71) by Oabomas of South West Nigeria .
- (c) The observations made on the basis of the X^2 test, Only Malay of Perak holds similarity with Pasi and Chamar population.

Table 5:- Comparison of Pasi and Chamar with Different World Population with Respect to ABO Blood Groups.

Population Area	Number Tested	Percentile Frequency				Gene Frequency			X ² Pasis df=2	Probability	X ² Chamars df=2	Probability	Investigator
		O	A	B	AB	p	q	r					
Pasis of Rural Lucknow	154	18.83	27.27	33.12	20.78	0.27	0.32	0.43	*4.90	.10<P<.05	(Pasi X Chamar)		Present Study
Chamars of Lucknow	154	24.03	24.35	32.14	19.48	0.22	0.28	0.54					Present Study
Oabomas of South West Nigeria	7653	50.00	22.90	21.30	5.90	0.16	0.15	0.71	*154.75	.001<P	*60.85	.001<P	.akare A.J et.al (2006)
Children of Nigeria	240	18.80	3.80	3.80	1.30	0.52	0.52	0.43	*50.33	.001<P	*29.92	.001<P	Jeremiah Z.A.et.al (2010)
Villaclara of Central Cuba	6004	50.51	36.32	10.49	2.66	0.22	0.07	0.71	*253.72	.001<P	*189.33	.001<P	Hidalgo Pedro.C .et.al (1995)
Malay of Perak	44	34.09	20.45	43.18	2.27	0.12	0.26	0.58	3.67	.20>P>.10	1.03	.70>P>.50	Schebesta (1952)
Malay of Singapore	42	40.47	16.66	40.47	2.38	0.10	0.24	0.64	*14.26	.001<P	*8.2037	.10>P>.05	Mourant et al (1953)
Malay of Singapore	1963	40.44	26.54	25.67	7.33	0.19	0.18	0.64	50.55	.001<P	*26.47	.001<P	Allen &MacGregor(1947)
Chinese of Singapore	624	43.10	24.03	27.72	5.12	0.16	0.18	0.66	*55.77	.001<P	*33.24	.001<P	Allen &MacGregor(1947)
Chinese of Malay	250	46.40	25.20	20.80	7.60	0.18	0.15	0.68	*40.08	.001<P	*20.42	.001<P	Simmons et al(1950)
Chinese of Singapore	1000	44.30	25.50	26.50	3.70	0.16	0.16	0.67	*91.10	.001<P	*55.40	.001<P	Yeoh (1960)
Northern Indian of Singapore	1478	34.30	24.96	32.61	8.11	0.18	0.23	0.59	*36.25	.001<P	*17.31	.001<P	Allen & MacGregor(1947)
Southern Indian of Singapore	389	31.87	26.73	34.44	6.94	0.19	0.23	0.56	*24.98	.001<P	*14.67	.001<P	Allen & MacGregor(1947)
Eurasian of Singapore	209	47.84	29.66	20.09	2.39	0.18	0.12	0.69	*56.13	.001<P	*39.12	.001<P	Allen & MacGregor(1947)

Fig 6:- Comparative Evaluation of Pasis and Chamars with Different World Population with Respect to ABO Blood Groups.**Rh(±d) blood group:-**

In terms of the 'D' and 'd' gene frequencies it is observed that all the populations such as religious, Tribal and World population groups exhibit comparatively higher frequency of 'D' gene.

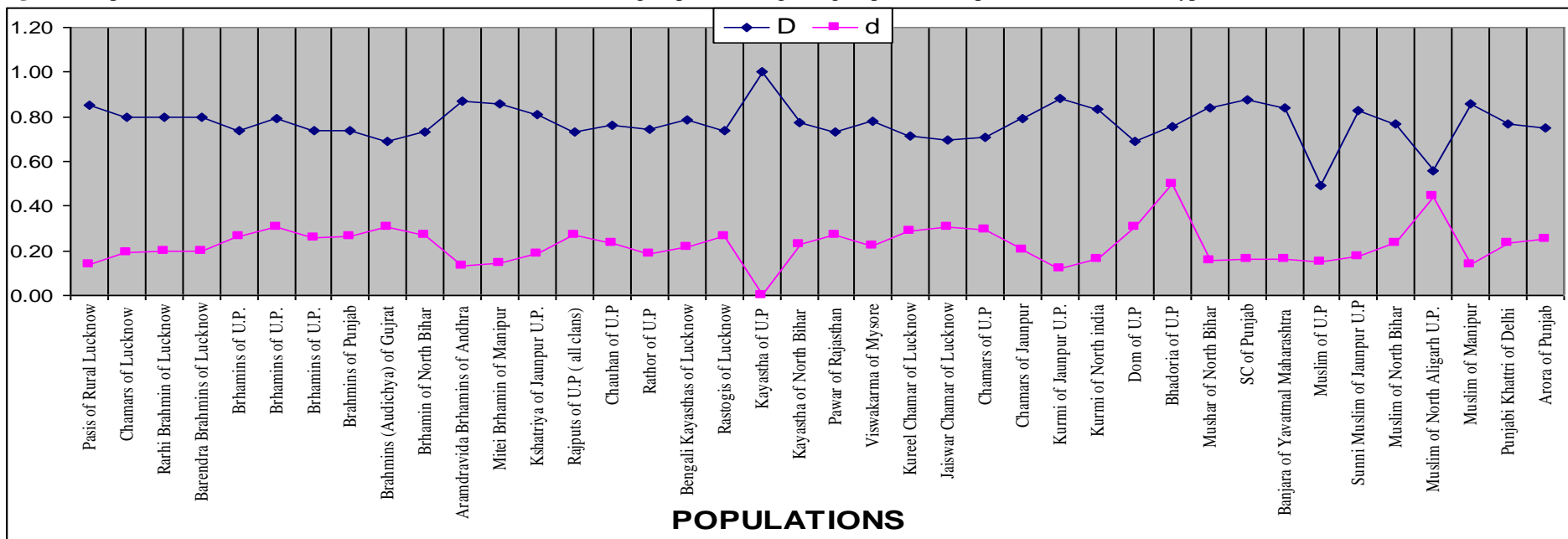
Religious and caste groups:-

The observations made on the basis of the X^2 test, it is noted that some populations such as Brahmin (Punjab, Gujrat and North Bihar), Rajputs (U.P.), Chauhan (U.P.), Rathor (U.P.), Kureel and Jaiswar Chamar of Lucknow exhibit great similarity with Chamar population only.

Table 6:- Comparison of Pasis and Chamars with other caste groups and Religious groups with Respect to Rh(+D) Phenotypes in India.

Population Area	Number Tested	Phenotype Percentage		Gene Freq.		X ² Pasis df=1	Probability	X ² Chamars df=1	Probability	Investigator
		Rh+	Rh-	D	d					
Pasis of Rural Lucknow	154	98.05	1.95	0.85	0.14	1.033	.50<P<.30	(Pasi X Chamar)		Present Study
Chamars of Lucknow	154	96.10	3.90	0.80	0.19					Present Study
Rarhi Brahmin of Lucknow	150	96.00	4.00	0.80	0.20	1.85	.20<P<.10	0.00	P<.95	Deb Mili (1980)
Barendra Brahmins of Lucknow	150	96.00	4.00	0.80	0.20	1.85	.20<P<.10	0.00	P<.95	Deb Mili (1980)
Brhamins of U.P.	200	93.00	7.00	0.74	0.27	*4.078	.05>P>.01	1.92	.20>P>.10	Rai Vandana and Kumar Pradeep (2011)
Brhamins of U.P.	23	95.65	4.35	0.79	0.31	0.00	p>.95	0.00	p>.95	Majumdar (1948)
Brhamins of U.P.	311	93.25	6.75	0.74	0.26	*4.93	.10<P<.05	1.59	.50<P<.30	Bhalla (1963)

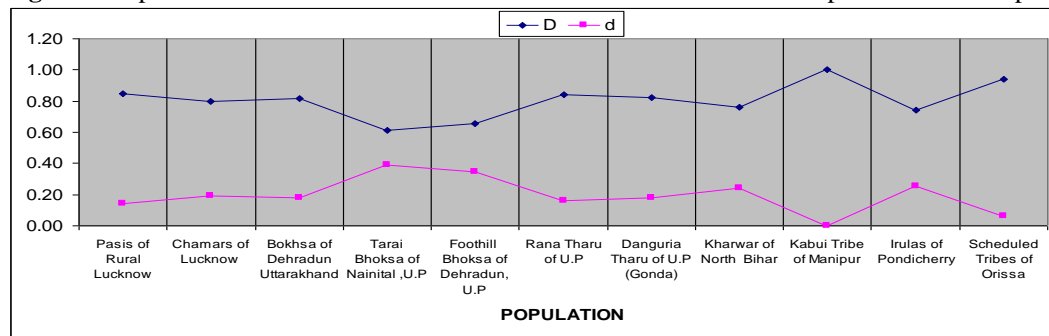
Brhamins of Varanasi	108	58.80	41.94			*66.57	.001<P	*58.77	.001<P	Sirsat (1956)
Brahmins of Punjab	311	92.29	7.71	0.74	0.26	*6.35	.05<P<.01	2.55	.30<P<.20	Bhalla (1963)
Brahmins (Audichya) of Gujrat	200	90.50	9.50	0.69	0.31	*9.58	.01<P.001	4.36	.10<P<.05	Vyas et al (1958)
Brhamin of North Bihar	208	92.79	7.21	0.73	0.27	*5.91	.05<P<.01	1.85	.50<P<.30	Pandey B.N et.al (1995)
Aramdravida Brhamins of Andhra	120	98.33	1.67	0.87	0.13	0.00	p>.95	2.05	.30<P<.20	Prasad B V Ravi (1988)
Mitei Brhamin of Manipur	302	98.01	1.99	0.86	0.14	0.00	p>.95	1.53	.50<P<.30	Metei Sanjenbam Yaiphaba et.al (2010)
Kshatriya of Jaunpur U.P.	200	96.50	3.50	0.81	0.19	0.42	.90>P>.80	0.00	p>.95	Kumar Pradeep et.al (2010)
Rajputs of U.P (all clans)	469	92.72	7.82	0.73	0.27	*6.84	.05<P<.01	3.16	.30<P<.20	Negi and Das (1963)
Chauhan of U.P	216	92.89	7.11	0.76	0.24	*5.11	.05<P<.01	2.05	.50<P<.30	Negi and Das (1963)
Rathor of U.P	216	92.13	7.87	0.75	0.18	*5.5	.10<P<.05	3.02	.30<P<.20	Negi and Das (1963)
Bengali Kayasthas of Lucknow	300	95.33	4.67	0.78	0.22	2.41	.30<P<.20	0.23	.20>P>.10	Deb Mili (1980)
Rastogis of Lucknow	200	93.00	7.00	0.74	0.26	4.07	.20>P>.10	1.92	.50<P<.30	Rastogi (1972)
Kayastha of U.P	22	100.00	0.00	1.00	0.00	0.00	p>.95	1.25	.50<P<.30	Majumdar (1947)
Kayastha of North Bihar	228	94.74	5.26	0.77	0.23	2.59	.30<P<.20	0.24	.90>P>.80	.Pandey B.N et.al (1995)
Pawar of Rajasthan	98	92.84	7.16	0.73	0.27	3.93	.20>P>.10	1.68	.50<P<.30	Negi and Das (1963)
Viswakarma of Mysore	143	95.10	4.90	0.78	0.22	1.66	.20>P>.10	0.32	.70>P>.50	Raj M.I.Dore et al (2010)
Kureel Chamar of Lucknow	320	91.88	8.12	0.71	0.29	*6.15	.05<P<.01	2.48	.30<P<.20	Tandon (1976)
Jaiswar Chamar of Lucknow	314	90.77	9.23	0.70	0.30	*9.51	.01<P.001	4.93	.10<P<.05	Tandon (1976)
Chamars of U.P	23	91.31	8.69	0.71	0.29	1.29	.50>P>.30	1.19	.50>P>.30	Majumdar et al (1941)
Chamars of Jaunpur	207	95.85	4.15	0.79	0.21	1.20	.50>P>.30	0.04	p>.95	Rai V and Patel Ram Pal et.al (2009)
Kurmi of Jaunpur U.P.	212	98.58	1.42	0.88	0.12	0.02	.95>P>.90	1.85	.20>P>.10	Rai Vandana et.al (2009)
Kurmi of North india	150	97.33	2.67	0.84	0.16	0.60	.50>P>.30	0.41	.70>P>.50	Prabakar Jai et.al (2009)
Dom of U.P	21	90.47	9.53	0.69	0.31	1.30	.50>P>.30	1.20	.50>P>.30	Majumdar et al (1941)
Bhadoria of U.P	244	93.44	6.53	0.76	0.50	3.25	.20>P>.10	1.20	.50>P>.30	Negi and Das (1963)
Mushar of North Bihar	325	97.54	2.46	0.84	0.16	0.40	.80<P<.70	0.20	.70>P>.50	.Pandey B.Net.al (1995)
SC of Punjab	1150	97.30	1.67	0.87	0.16	0.29	.70>P>.50	1.15	.30>P>.20	Siddu Sharda (2003)
Banjara of Yavatmal Maharashtra	550	97.45	2.55	0.84	0.16	0.33	.90<P<.80	1.28	.30>P>.20	Chavhan Aravind et.al (2010)
Muslim of U.P	615	97.72	2.28	0.49	0.15	0.00	p>.95	1.27	.70>P>.50	Jolly (1976)
Sunni Muslim of Jaunpur U.P	200	97.00	3.00	0.83	0.17	0.46	.70>P>.50	0.35	.70>P>.50	Kumar Pradeep et.al (2010)
Muslim of North Bihar	217	94.47	5.53	0.77	0.24	2.60	.30>P>.20	0.24	.90<P<.80	.Pandey B.N et.al (1995)
Muslim of North Aligarh U.P.	607	79.73	20.26	0.56	0.44	*29.35	.001<P	*23.18	.001<P	Ara Gulsan et.al (2008)
Muslim of Manipur	303	98.02	1.98	0.86	0.14	0.01	.95>P>.90	1.54	.50>P>.30	Metei Sanjenbam Yaiphaba et. al(2010)
Punjabi Khattri of Delhi	417	94.48	5.52	0.765	0.23	3.28	.20>P>.10	0.73	.70>P>.50	Bhalla (1963)
Arora of Punjab	252	93.65	6.35	0.748	0.25	3.79	.20>P>.10	0.83	.70>P>.50	Bhalla (1963)

Fig 7:- Comparative Evaluation of Pasis and Chamars with other caste groups and Religious groups with Respect to Rh(±D) Phenotypes in India.**Tribal groups:-**

The observations made on the basis of the X^2 test, Hookahs of Dehradun, Tharu, Rana Tharu and Dhanguria Tharu of U.P. hold similarity with Pasi and Chamar population. Kabui Tribe of Manipur holds similarity with Pasi population whereas Irulas of Pondicherry hold similarity with Chamar population only.

Table 7:- Comparison of Pasi and Chamar with Different Tribal Population with Respect to Rh(+)D) Phenotypes in India.

Population Area	Number Tested	Phenotype Percentage		Gene Frequency		X ² Pasis df=1	Probability	X ² Chamars df=1	Probability	Investigator
		Rh+	Rh-	D	d					
Pasis of Rural Lucknow	154	98.05	1.95	0.85	0.14	1.033	.50<P<.30	(Pasi X Chamar)		Present Study
Chamars of Lucknow	154	96.10	3.90	0.80	0.19					Present Study
Bokhsa of Dehradun Uttarakhand	213	96.71	3.28	0.82	0.18	0.43	.70>P>.50	0.34	.70>P>.50	Patni Swati and Yadav Ankur (2003)
Tarai Bhoksa of Nainital ,U.P	200	85	15	0.6127	0.3873	*16.54	.001<P	*12.53	.01<P.001	Singh U.P (1993)
Foothill Bhoksa of Dehradun, U.P	200	88	12	0.65359	0.3464	*13.15	.001<P	*7.26	.05>P>.01	Singh U.P (1993)
Rana Tharu of U.P	156	97.44	2.56	0.84	0.16	0	p>.95	0.41	.90<P<.80	Srivastava (1963)
Danguria Tharu of U.P (Gonda)	185	96.76	3.24	0.82	0.18	0.45	.80<P<.70	0.35	.90<P<.80	Srivastava (1963)
Tharu of U.P (Gonda)	69	100	-	-	-	1.52	.50<P<.30	3.08	.30.>P>.20	Srivastava (1963)
Kharwar of North Bihar	171	0.00	5.85	0.76	0.24	*97.38	.001<P	*96.04	.001<P	Pandey B.N.et.al (1995)
Kabui Tribe of Manipur	127	100.00	0.00	1.00	0.00	1.51	.30.>P>.20	*6.13	.05>P>.01	Metei Sanjenbam Yaiphabaet.al (2010)
Irulas of Pondicherry	200	93.50	6.50	0.75	0.26	*4.25	.05>P>.01	0.91	.50>P>.30	.Subhashini A.B (2007)
Scheduled Tribes of Orissa	1959	99.60	0.40	0.94	0.06	*4.49	.20>P>.10	*27.22	.001<P	.Balgir R.S et.al (2004)

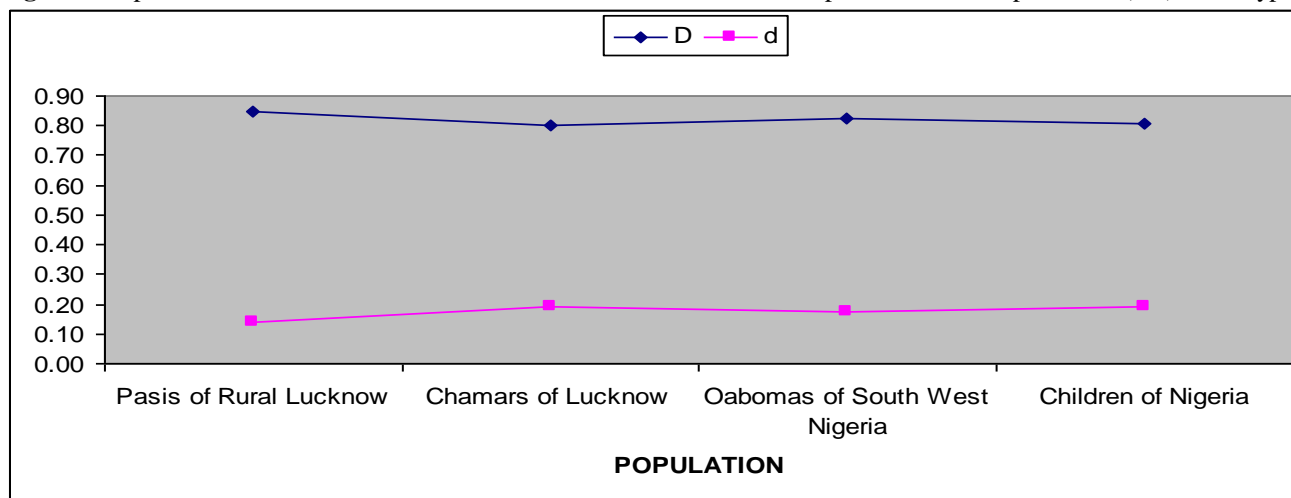
Fig 8:- Comparative Evaluation of Pasi and Chamar with Different Tribal Population with Respect to Rh(+)D) Phenotypes.

World population groups:-

The observations made on the basis of the χ^2 test, Only Oabomas of South West Nigeria holds similarity with Pasi and Chamar population.

Table 8:- Comparison of Pasi and Chamar with Different World Population with Respect to Rh(+D) Phenotypes.

Population Area	Number Tested	Phenotype Percentage		Gene Frequency		χ^2 Pasis df=2	Probability	χ^2 Chamars df=2	Probability	Investigator
		Rh+	Rh-	D	d					
Pasis of Rural Lucknow	154	98.05	1.95	0.85	0.14	1.033	.50<P<.30	(Pasi X Chamar)		Present Study
Chamars of Lucknow	154	96.10	3.90	0.80	0.19					Present Study
Oabomas of South West Nigeria	7653	96.70	3.30	0.83	0.17	0.85	.50>P>.30	0.21	.70>P>..50	akare A.J et.al (2006)
Children of Nigeria	240	23.80	3.80	0.81	0.19	*7.6245	.01>P>.001	*6.811	.01>P>.001	Jeremiah Z.A et.al (2010)

Fig 9:- Comparative Evaluation of Pasi and Chamar with Different World Population with Respect to Rh(+D) Phenotypes.

Genetic distance estimation:-

The degree of overall genetic distance between Pasis and Chamar with the Religious, Tribal and World population groups assessed by the formula given by Sanghvi (1953), which gives an idea of the degree of genetic similarity or dissimilarity between these populations. The interpretations of genetic distance estimation are presented in accordance with the following headings:

Table 9:- Value of overall genetic distance (G^2) of Pasi and Chamar with other caste groups and Religious groups with Respect to ABO Blood groups in India.

Pairs of populations	Pasis ABO system (df=2)	Chamar ABO system (df=2)	Pasis Rh system (df=1)	Chamar Rh system (df=1)	Total no. of degree of freedom (df)	Genetic Distance (G^2)
Pasis × Chamar	4.9		1.03		6	0.98
Rarhi Brahmin of Lucknow	23.66	11.66	1.85	0	6	0.99
Barendra Brahmins of Lucknow	22.59	11.39	1.85	0	6	0.92
Brhamins of U.P	29.88	18.94	4.078	1.92	6	0.54
Brahmins of Punjab	15.9	9.91	6.35	2.55	6	0.50
Brahmins (Audichya) of Gujrat	24.5	15.7	9.58	4.36	6	0.65
Brahmins of North Bihar	21.61	16.49	5.91	1.85	6	0.47
Aramdravida Brhamins of Andhra	35.07	19.82	0	2.05	6	1.05
Mitei Brhamin of Manipur	26.69	17.5	0	1.53	6	0.57
Kshatriya of Jaunpur U.P.	14.24	5.26	0.42	0	6	0.76
Rajputs of U.P (all clans)	24.4	10.09	6.84	3.16	6	1.22
Chauhan of U.P	15.27	6.87	5.11	2.05	6	0.75
Rathor of U.P	25.86	12.23	5.5	3.02	6	0.93
Kayastha of U.P	12.08	2.5	0	1.25	6	1.26
Kayastha of North Bihar	19.61	5.64	2.59	0.24	6	1.61
Bengali Kayasthas of Lucknow	22.61	9.93	2.41	0.23	6	1.12
Rastogis of Lucknow	18.95	13.71	4.07	1.92	6	0.27
Viswakarma of Mysore	15.78	6.05	1.66	0.32	6	0.87
Kureel Chamar of Lucknow	14.46	16.2	6.15	2.48	6	0.28
Jaiswar Chamar of Lucknow	16.88	8.18	9.51	4.93	6	0.75
Chamars of U.P	26.36	13.57	1.29	1.19	6	0.68
Chamars of Jaunsar	15.58	9.62	1.2	0.04	6	0.42
Kurmi of North India	23.13	14.14	0.6	0.41	6	0.37
Kurmi of Jaunpur U.P	4.96	2.29	0.02	1.85	6	0.46
Dom of U.P	27.97	15.54	1.3	1.2	6	0.59
Mushar of North Bihar	17.41	10.65	0.4	0.2	6	0.28
SC of Punjab	27.53	12.08	0.29	1.15	6	1.09
Banjara of Yavatmal Maharashtra	12.8	3.8	0.33	1.28	6	0.91
Muslim of U.P	19.77	7.5	0	1.27	6	1.13
Muslim of Manipur	57.24	37.58	0.01	1.54	6	0.93
Sunni Muslim of Jaunpur U.P	8.47	5.72	0.46	0.35	6	0.09
Muslim of North Bihar	20.47	11.16	2.6	0.24	6	0.78
Muslim of North Aligarh U.P.	15.53	3.03	29.35	23.18	6	1.52
Punjabi Khattri of Delhi	24.83	13.81	3.28	0.73	6	0.79

The result of G^2 test indicate a smaller genetic distance of Pasis and Chamar (0.98) between Rarhi Brahmin of Lucknow (0.99), Barendra Brahmin of Lucknow (0.92), Rathor of U.P. (0.93), Banjara of Yavatmal Maharashtra (0.91) and Muslim of Manipur (0.93). This suggests a strong similarity between these populations. The genetic distance between Aramdravida Brhamins of Andhra (1.05), Rajputs of U.P. (1.22), Kayastha of U.P. (1.26), Kayastha of North Bihar (1.61), Bengali Kayasthas of Lucknow (1.12), SC of Punjab (1.09) and Muslim of North

Aligarh U.P. (1.52) are comparatively higher, suggesting greater dissimilarity between Pasis and Chamar with these populations.

Fig 10:- Comparative evaluation of Pasi and Chamar in following Scattering diagram with other caste groups and Religious groups with Respect to ABO Blood groups in India.

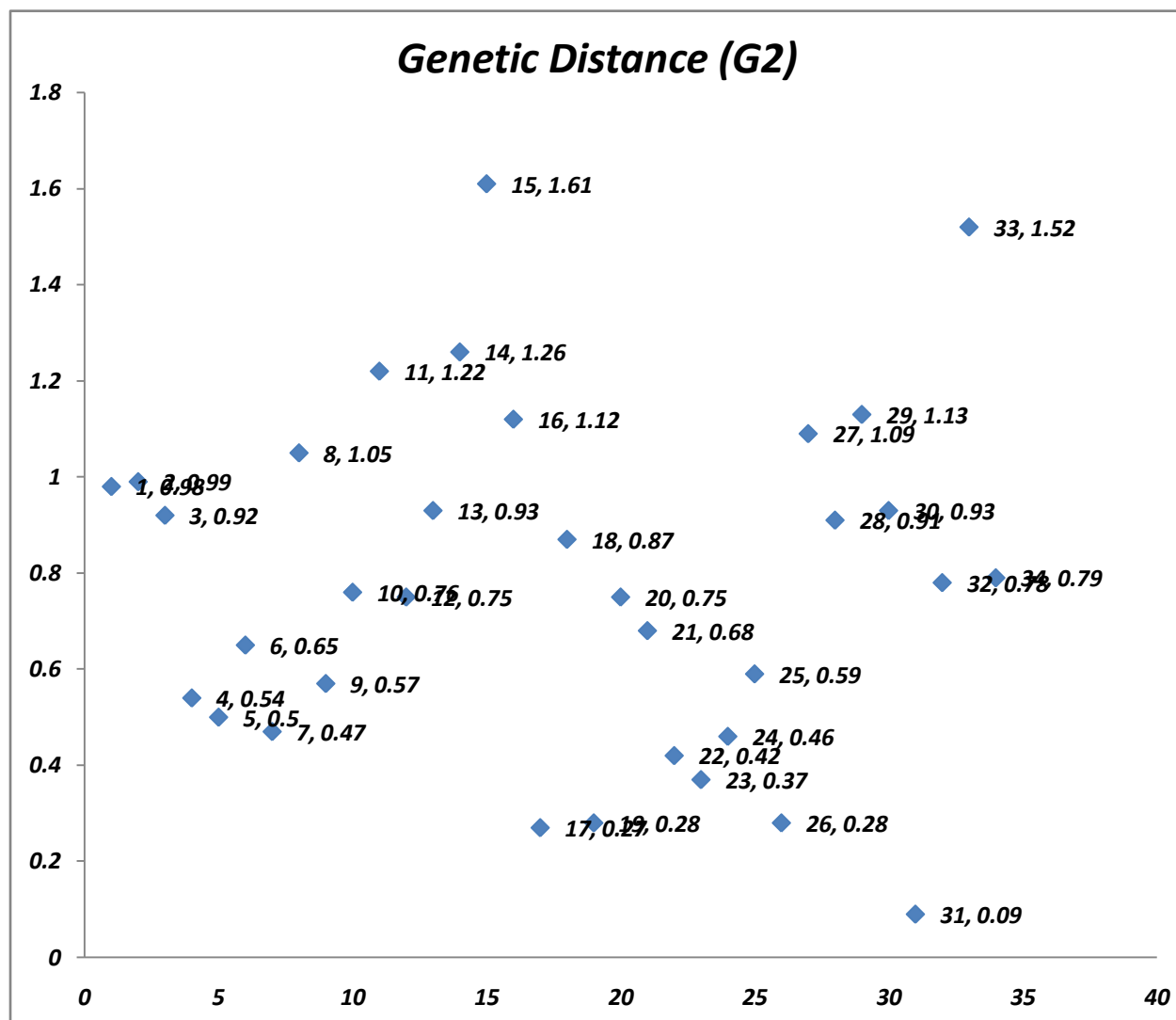


Table 10:- Value of overall genetic distance (G^2) of Pasis and Chamar with Different Tribal Population with Respect to ABO Blood groups in India.

Pairs of populations	Pasis	Chamar	Pasis	Chamar	Total no. of degree of freedom (df)	Genetic Distance (G^2)
	ABO system (df=2)	ABO system (df=2)	Rh system (df=1)	Rh system (df=1)		
Pasis × Chamar	4.9		1.033		6	
Tarai Bhoksa of Nainital	5.86	16.55	16.54	12.53	6	0.94
Foothill Bhoksa of Dehradun	5.83	18.29	13.15	7.26	6	1.36
Bokhsa of Dehradun Uttarakhand	22.67	15.16	0.43	0.34	6	0.25
Kharwar of North Bihar	36.59	42.51	97.38	96.04	6	0.08
Kabui Tribe of Manipur	30	14.89	1.51	6.13	6	1.31
Irulas of Pondicherry	33.99	22.65	4.25	0.91	6	0.74
Scheduled Tribes of Orissa	19.42	10.78	4.49	27.22	6	3.13

The result of G^2 test indicates a smaller genetic distance of Pasis and Chamar (0.98) between Tarai Bhoksa of Nainital (0.94) and Irulas of Pondicherry (0.74). This suggests a strong similarity between these populations. The genetic distance between Foothill Bhoksa of Dehradun (1.36), Kabui Tribe of Manipur (1.31) and Scheduled Tribes of Orissa (3.13) is comparatively higher, suggesting greater dissimilarity between Pasis and Chamar with these populations.

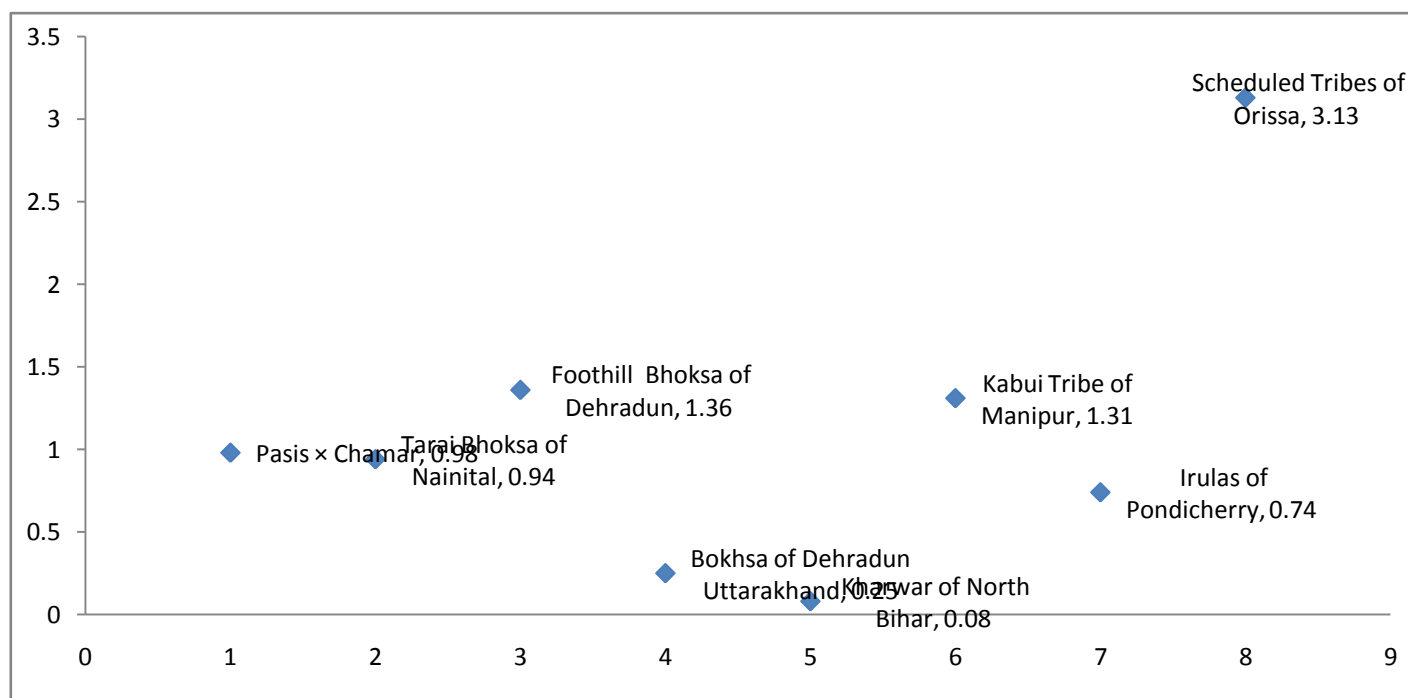
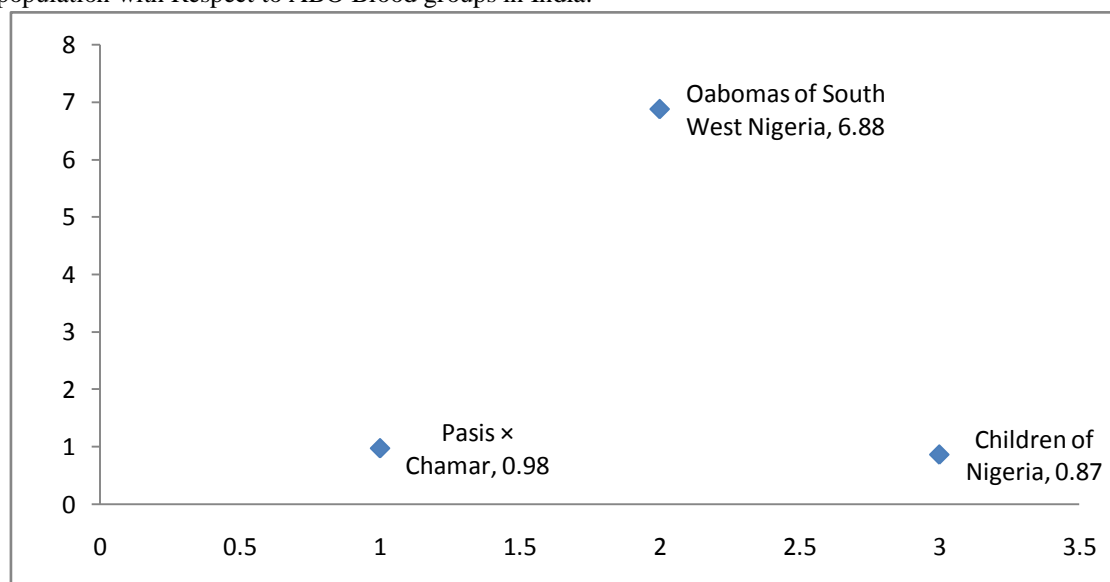
Fig 11:- Comparative evaluation of Pasi and Chamar in following Scattering diagram with different Tribal population with Respect to ABO Blood groups in India.

Table 11:- Value of overall genetic distance (G^2) of Pasi and Chamar with Different World Population with Respect to ABO Blood groups in India.

Pairs of Populations	Pasis	Chamar	Pasis	Chamar	Total num. of degree of freedom (df)	Genetic Distance (G^2)
	ABO system (df=2)	ABO system (df=2)	Rh system (df=1)	Rh system (df=1)		
Pasis × Chamar	4.9		1.033		6	
Oabomas of South West Nigeria	154.75	60.85	0.85	0.21	6	6.88
Children of Nigeria	50.33	29.92	7.6245	6.811	6	0.87

Fig 12:- Comparative evaluation of Pasi and Chamar in following Scattering diagram with different World population with Respect to ABO Blood groups in India.

The result of G^2 test indicates a smaller genetic distance of Pasis and Chamar (0.98) with Children of Nigeria (0.87). This suggests a strong similarity between these populations. The genetic distance with Oabomas of South West Nigeria (6.88) is comparatively higher, suggesting greater dissimilarity with Pasis and Chamar populations.

Conclusion:-

Thus, it may be concluded that on the basis of Genetical Inferences, that the two scheduled caste populations (i.e. Pasi and Chamar) of rural Lucknow are heterogeneous. Their entire data analysis shows that they differ to a large extent in terms of ABO gene frequencies. But in terms of Rh gene frequencies they exhibit to some extent, biological similarity due to sharing similar eco-zones. The uniqueness of gene pool in terms of ABO blood group in India as well as Uttar Pradesh and Lucknow in their pattern type of ABO alleles (i.e. B, O, A, AB) it has been found that these pattern have been followed by only Chamar population whereas in Rh(D) Phenotype (D and d alleles) has been found similar in both Pasi and Chamar population. The comparative inferences of Pasi and Chamars in terms of ABO and Rh gene frequencies and Genetic Distance G^2 with other caste and religious groups, Tribal groups in India and World population groups, show that they hold to some extent, biological similarity.

References:-

1. Anand, S. (1957); A genetic Survey of the ABO blood groups among the Punjabis, *The Anthropologist* 4(1&2): 28-33.
2. Ara, Gulsan (2008A); Maternal age and Ethnicity in determining Demography and Selection Intensity parameters among North Indian Muslims, *The Internet Journal of Biological Anthropology* Vol 2, No. 1.
3. Bagai (1975); A1 A2 BO Blood Groups, Rhesus Factor and ABH Secretion among the Rajputs & Brahmins of North-West Kulu (H.P), *Man in India* 55: 137-148.
4. Bakare, A.A., Azeez, M.A. and Agbolade, J.O. (2006); Gene frequencies of ABO and Rhesus blood groups and hemoglobin variants in Ogbomoso, South-west Nigeria, *African J. of Biotechnology* Vol 5(3): 224-229.
5. Balgir, R.S, Dash, B. P. and Murmu, B. (2004); Blood Groups, Hemoglobinopathy and G-6-PD Deficiency Investigations among Fifteen Major Scheduled Tribes of Orissa, India, *Anthropologist* 6(1): 69-75.
6. Bhalla, V. (1963), PhD Thesis Department of Anthropology, University of Delhi.
7. Bhatnagar, B.R. (1973); ABO blood group among Pasis. *Journal of the Indian Anthropological Society* 8: 41-49.
8. Bhattacharjee, P.N. (1956); A genetic survey of the Rarhi Brahmin and the Muslims of West Bengal, *Bull. Department of Anthropology, Govt of India*. 5(1): 18-28.
9. Chaudhury, S., Mukherjee, B., Ghosh, J. and Roy, A.K. (1969), Study of blood groups, ABH Secretor and Haemoglobin variants in the three upper castes of West Bengal, India, *American. J. Phys. Anthropol* 30.
10. Chavhan, Aravind, Pawar, Santosh and Baig, M.M. (2010), Allelic frequency of ABO and Rh(D) Blood group among the Banjara Backward Caste of Yavatmal Maharashtra, India, *Nature Proceedings: nal 1010/npre 54821*, Dec.
11. Deb. Mili (1980); Morphological, genetical and Demographic study of the Bengalis in Lucknow, Ph.D. Thesis, University of Lucknow.
12. Delhi University Exp (Dissertation) 1957; Brahmins, Kanets and Scheduled Castes of Simla Hills (Quoted from Tandon, 1976).
13. Dunsford, I. and Bowley, C.C. (1955, 1956); *Techniques in Blood Grouping*, Oliver and Povd. London.
14. Garg, S.K., Negi, R.S. and Sankhyan, A.K. (1981); A Serological analysis of the Bhoksa: A Scheduled Tribe of Uttar Pradesh, *Acta Anthropogenet* 5(3):157-68.
15. Hidalgo, Pedro C. (1995); Distribution of ABO, Rh, Mn and Kell blood groups in central Cuba, *Brazilian J of Genet* (18)3:475-478.
16. Jeremiah, Z.A., Jeremiah, T.A. & Emelike, F.O. (2010); Frequencies of Some human genetic markers and their association with Plasmodium falciparum malaria in the Niger Delta, Nigeria, *J. Vector Borne Dis* 47 March:11-16.
17. Jolly (1976), cited from Singh, U.P. (1993); PhD Thesis, University of Lucknow.
18. Kaul (1953), cited from Singh, U.P. (1993); PhD Thesis, University of Lucknow.
19. Kumar (1963); Rajput of Madhya Pradesh, cited from Singh, U.P. (1993); PhD Thesis, University of Lucknow.
20. Kumar, P. (1968); A genetic survey among the Rana Tharus of Nainital district in Uttar Pradesh. *Journal of the Indian Anthropological Society* 3:39-55.
21. Kumar, Pradeep, Saima and Rai, Vandana (2010); Study of ABO and Rh(D) blood groups in Sunni Muslim of Jaunpur District, Uttar Pradesh, India, *Anthropologist*, 12(3):225-226.
22. Kurup, A.M. and Verma, D.K. (1971); A note on ABO, MN & Secretor factors of Kayasthas of U.P, *The Eastern Anthropologist* 24(1), Jan - April.
23. Laxmi, N., Demarchi, D., Veeraju, P., Rao V.T. (2002); Population structure and genetic differentiation among the sub-structured Vysya Caste population in comparison to the other populations of Andhra Pradesh. *India Annals Human Biology* 29:538-549.
24. Levine, P., Katzin, E.M. and Burnham, L. (1941); Isoimmunization in pregnancy, its possible bearing on the etiology of erythroblastosis fetalis, *J. Am. Med. Ass.*:116: 825.
25. Macfarlane (1938); cited from Deb, Mili (1990); PhD Thesis, University of Lucknow.
26. Mahalanobis, P.C., Majumdar, D.N. and Rao, C.R. (1941); Anthropometric Survey of the United Provinces: A Statistical Study, *Sankhya* 9:89-324.
27. Majumdar (1952), cited from Deb, Mili (1990); PhD Thesis, University of Lucknow.
28. Majumdar, D.N. (1942); The blood groups of Doms. *Current Science* 11(4):153-154.
29. Majumdar, D.N., Rao, C.R. and Mahalanobis, P.C. (1941-1949); Dom (C), Uttar Pradesh, Anthropometric survey of the United Provinces, A statistical study, *Sankhya* 9:89-324.

30. Majumdar, D.N., and Krishan, Kumar (1947); Report on the serological survey of U.P, Census operations 1941. *The Eastern Anthropologist*, 1(1): 8-15.
31. Malone, R.R. and Lahiri, M.N. (1928); The Distribution of the blood groups in certain races and castes of India, *Ind. J. Med. Res.* 16:963-968.
32. Meitei, Sanjenbam Yaiphaba, Asghar, Mohammad, Achoubi, Nongthombam Devi, Murry, Benrithung and Saraswathy, Kallur Nava, Sachdeva, Mohinder Pal (2010: A); Distribution of ABO and Rh(D) blood groups among four populations in Manipur, North East India, *Anthropological Notebooks* 16(2):19-28.
33. Mete, Sanjenbam Yaiphaba and Kshatriya, G.K. (2009 B); Distribution of A1A2BO and Rh blood group among the Rajputs and Warlis of Naroli village Panchayat, Dadra and Nagar Haveli; *Anthropologist* 11(1): 65-66.
34. Mourant, A.E., Kopec, A.C. and Domaniewska, Sobezak (1976); The distribution of human blood groups and other polymorphisms, Oxford Blackwell Scientific Publications.
35. Mourant, A.E., Kopec, A.D.A. and Domanieswska-Sobezek, K. (1976); The ABO Blood Groups-Comprehensive Tables and Maps of World Distribution. Oxford, London: Blackwell Scientific Publication.
36. Negi, R.S. and Das, A. (1963); The Blood Groups (ABO, MN and Rh) ABH Secretor in Saliva and Colour-Blindness in the Rajput of Western Uttar Pradesh and Dholpur, *Bull. Anthropol. S.I, Govt of India*, 11(3 &4):221-231.
37. Pandey, B.N., Das, P.K.L. and Jha, A.K. and Sinha, M.K. (1995); Genetic Variation in some Endogamous Population Groups of North Bihar, *J. Hum. Ecol* 6(2):119-122.
38. Patni, Swati and Yadav, Ankur (2003); Blood groups among the Bhoksa of Vikasnagar Block of Dehradun, Uttaranchal, *Anthropologist*, 5(2):137-138.
39. Pavate, Prabhakar & Pavate, Priya (1988); ABO blood groups among the Tansas, Noctes and Singphos of Arunachal Pradesh, *Ind. J. Phys. Anthropol & Hum. Gen.* Vol. 14 No 3:41-47.
40. Prabhakar, S.C. Jai and Gangadhar, M.R. (2009); Study of ABO and Rh(D) blood groups among Gangadikara Vokkaligas of Mysore, Karnatka, *Anthropologist* 11(1):63-64.
41. Prasad, B.V. Ravi and Busi, B.R. (1988); Distribution of A1A2B0 and Rh(D) Blood Groups among Aramadravida Brahmins of Andra Pradesh, *Ind. J. Phys. Anthropol & Hum. Gen.* Vol. 14, No 3:57-63.
42. Race and Sanger, R. (1958); Blood groups in Man. Black well Scientific Publication, Oxford:108-169.
43. Rai, V., Patel, Ram Pal, Kumar, Pradeep (2009); Study of ABO and Rh (D) blood groups in Scheduled Caste of Jaunpur District, *Anthropologist*, 11(2):151-152.
44. Rai, Vandana and Kumar, Pradeep (2011); Genetic Analysis of ABO and Rh Blood Groups in Brahmin population in Uttar Pradesh, India, *proceeding nature.com*.
45. Rai, Vandana, Verma, Akhilesh Kumar and Kumar, Pradeep (2009 B); A study of ABO and Rh(D) Blood Groups among Kurmi (Backward Caste) of Jaunpur District, *Anthropologist* 11(4):305-306.
46. Raj Dore, M.L., and Reddy, Rajsekhar K. (2010); The study of ABO and Rh(D) blood groups among the Vishwakarma Population of Mysore District in Karnatka, India, *Anthropologist*, 12(3):227-228.
47. Rao, V.V. and Murthy, J.S. (1984); Selection intensities and inbreeding among some caste groups of Andhra Pradesh, *Indian Social Biology* 31:114-119.
48. Rapley, S., Robson, E.B., and Smith, S.M. (1967); Data on the incidence, segregation and linkage relations of the adenylate kinase (AK) polymorphism, *Ann. Hum. Gene.* 31: 237
49. Rastogi, S. (1972); Morphogenetic study of the Rastogies of Lucknow, PhD Thesis, Department of Anthropology Lucknow, University.
50. Sanghvi, L.D. (1953). Comparison of genetic and morphological methods for a study of biological differences. *Ani.l.Phvs. /snthropol.* II: 385-404.
51. Schebesta (1952), Mourant (1953), Allen & MacGregon (1947), Simmons (1950) and Yeoh (1960) cited from Chan, K.T. (1962); The ABO blood group frequency Distribution of Singapore based on a blood donor sample, *Singapore Med. J*, Vol.3, No.1, March.
52. Sen, D.K. (1954); Blood group investigation in 24 Parganas District, West Bengal, *Man in India* 34:50-60.
53. Seth, P.K. and Seth, S. (1973); Genetical study of Angami Nagas (Nagaland, India) : A1A2BO, MN, Rh blood groups, ABO(H) secretion, P.T.C. taste sensitivity and colour blindness. *Hum. Biol.* 45:457-468.
54. Sharma, K.K.N. (1989); Distribution of ABO Blood Groups of the Khairwars of Madhya Pradesh, *Ind. Journal of Phy. Anthropol. and Hum. Genet.* 15(182):9-12.
55. Sharma, Tej P. and Shukla B.R.K. (2004); ABO blood groups and Autosomal DNA Polymorphism as the Indicators of Genetic Diversity among the Tharus of Uttar Pradesh, *Indian. J. Phys Anthropol & Hum. Genet*, Vol. 23 No.2:171-184.
56. Shukla B.R.K., and Tyagi, D. (1973); Rajputs and their ABO Blood groups, *Z Morph, Anthropol* 65:237-244.

57. Shukla, B.R.K., and Tyagi, Deepak (1973); Rajputs and their ABO blood groups, paper presented in 59th Indian science congress, Calcutta.
58. Sidhu, S. and Sidhu, L.S. (1980); ABO blood group frequencies among the Sansis of Punjab, coll, Anthropol, 4(1):55-57.
59. Sidhu, Sharda, (2003); Distribution of the ABO Blood Groups and Rh(D) Factor among the Scheduled Caste Population of Punjab, Anthropologist 5(3):203-204.
60. Singh, Udai Pratap (1993); Biological Microdifferentiation and population structure among Bhoksa Tribals of U.P, PhD Thesis, University of Lucknow.
61. Sirsat (1956); cited from Singh, U.P. (1993); PhD Thesis, University of Lucknow.
62. Srivastava, R.P.; Physical Anthropology of Tharus of Uttar Pradesh, Lucknow University, (Unpublished).
63. Subhashini, A.B. (2007); Distribution of ABO and Rh(d) blood groups among Irulas, A tribal population of Pondicherry, India, Anthropologist 9(2):163-164.
64. Tandon, V.K., Pandey, Nisha and Shukla, B.R.K. (1978); Blood and Secretion: A genetic survey among Kureel and Jaiswar Chamars, Indian J. of Phys. Anthropology and human Genetics, Vol.4, No.1:47.
65. Tewari and Bhasin, M.K. (1968); The Blood Groups of the Brahmins and Rajputs of Garhwal, Human Biology, 40 (3):386-395.
66. Tewari, S.C. (1954); Blood Groups of the Kumaons, The Anthropologist 1:50-52.
67. Tylor, B. Arnold and Prior (1933); cited from Singh, U.P. (1993); PhD Thesis, University of Lucknow.
68. Vyas, G.N., Bhatia, H.M., Banker, D.D. and Purandare, N.M. (1958); A study of Blood Groups and other genetical characters in Six Gujrati endogamous groups in Western India, Ann.Eugen, 22:185-199.
69. Yadav, Bhuvnesh, Raina, Anupuma and Abdullaha, Tasadud (2011); Serological Polymorphisms of ABO and Rh(D) blood groups among Saraswat Brahmin Inhabiting four states of North India, Anthropologist 13(1):17-20.