Ind. J. Phys. Anthrop & Hum. Genet. Vol. 38, No. 1, (2019) : 77-82

GLUCOSE-6-PHOSPHATE DEHYDROGENASE DEFICIENCY AMONG MUSLIMS OF LUCKNOW DISTRICT, UTTAR PRADESH, INDIA.

SUSHMITA KANT, IMNAMEREN LONGKUMER, PRATIBHA AND KALLUR NAVA SARASWATHY

ABSTRACT

Glucose-6-Phosphate dehydrogenase (G6PD) deficiency is the most common enzyme deficiency of human red blood cell that affects more than 400 million people worldwide. Though clinically asymptomatic, this deficiency can pose severe complications if exposed to certain chemicals in food and medicines or infections. Therefore early recognition of G6PD deficiency can help prevent those complications. In Indian scenario, the distribution of G6PD deficiency is population specific. Thus, the present study attempts to estimate the prevalence of G6PD deficiency among Muslim community residing in Lucknow District of Uttar Pradesh, India. A total of 128 males were recruited and screened for G6PD deficiency using Fluorescent Spot Test. Altogether 5 individuals were tested G6PD deficient, which accounted for 3.9% prevalence. The frequency of G6PD deficiency in the studied population was found to be towards the lower range of the national prevalence as well as among Muslim populations in India.

Keywords: Glucose-6-Phosphate dehydrogenase deficiency, Muslim community, population-specific, prevalence

INTRODUCTION

The study of red blood cells has been at the forefront of anthropology. Glucose-6-phosphate dehydrogenase (G6PD) deficiency is a biochemical marker that is most extensively studied by anthropologists. It is an X-linked, hereditary genetic disorder caused by mutations in the *G6PD* gene. The mutation results in protein variants with different levels of enzyme activity that are associated with a wide range of biochemical and clinical phenotypes (Cappellini and Fiorelli, 2008: 64-74). The most common clinical manifestations include neonatal jaundice and

Ms. Sushmita Kant, Department of Anthropology, University of Delhi, New Delhi-110007(India); **Mr. Imnameren Longkumer,** Research Scholar, Department of Anthropology, University of Delhi, New Delhi-110007(India); **Ms. Pratibha,** Department of Anthropology, Lucknow University, Lucknow, Uttar Pradesh-226007(India); **Dr. Kallur Nava Saraswathy (Corresponding Author),** Assistant Professor, Department of Anthropology, University of Delhi, New Delhi-110007 (India), Email: knsaraswathy@yahoo.com

acute haemolysis, which in most cases arises when red blood cells undergo oxidative stress triggered by agents such as drugs, infection, or the ingestion of fava beans (Hoiberg et al., 1981: 1485-1488; Luzzatto et al., 2001: 4517-4554; Padilla and Therrell, 2007: 16-17).

In India investigations on G6PD deficiency has gained its momentum after it was first reported by Baxi et al. (1961: 493-500). Since then, numerous studies regarding its prevalence have been conducted that ranges from 0% to 27% among various caste, ethnic, religious and linguistic groups (Shah et al., 2018: 481). However, among Muslim communities it is found to range from 0% to 21.3% (Achoubi et al., 2010: 201-204; Pathak et al., 2013: 170-176). It is necessary to document the frequency of G6PD deficiency from time to time for safe administration of anti-malarial drugs. Therefore, the present study attempts to estimate the prevalence of G6PD deficiency among Muslim community residing in Lucknow District of Uttar Pradesh, India.

MATERIALS AND METHODS

Muslims constitute the second largest religious community in Lucknow District of Uttar Pradesh, India with an estimate of 26.4% of the total population of the district (Census India, 2011). For the present study, a total of 128 males, ranging in age from 10 to 66 years, were recruited after obtaining informed and written consent from each participant. Ethical clearance was obtained from the Ethics Committee, Department of Anthropology, University of Delhi, prior to commencement of the study.

Blood samples were drawn in EDTA (0.5M)-coated Eppendorf tubes following finger-prick method. Blood relatives upto first cousin were avoided in the present study. Screening for red blood cell G6PD deficiency was performed by employing Fluorescent Spot Test (Beutler and Mitchell, 1968: 816–818).

RESULTS AND DISCUSSION

Globally, more than 400 million individuals are G6PD deficient. India is the second largest populated country in the world and also a malaria endemic region where the incidence of G6PD deficiency is high. In the present study, an attempt is made to investigate the prevalence of G6PD deficiency among Muslim community residing in Lucknow, Uttar Pradesh. The study found that 3.9% of the population are G6PD deficient (Table 1) which was towards the lower range of the national prevalence, i.e. 0% to 27% as reported by Shah et al., (2018: 481).

Table -1: Prevalence of G6PD deficiency among Muslims of Lucknow District, Uttar Pradesh, India

Total, N (%)	G6PD Status	
	G6PD Normal, N (%)	G6PD deficient, N (%)
128 (100.0%)	123 (96.1%)	5 (3.9%)

Muslims are the second largest religious community in India, however, there are scanty reports of G6PD deficiency among this community, especially in Uttar Pradesh. A comparative analysis of the prevalence of G6PD deficiency among various population groups in India (Table 2) revealed that deficiency is highest among tribal population (30.7%), followed by caste population (26.92%) and least among religious community (21.32%). In regards to Muslim population, G6PD deficiency ranges from 0% (Pathak et al., 2013: 170-176) to 21.3% (Achoubi et al., 2010: 201-204). A study by Rai and Kumar (2014: 96-97) among Muslims of Uttar Pradesh reported the prevalence of G6PD deficiency as 13%. This indicates that G6PD deficiency reported in the present study among Muslims is much less as compared to other studies and falls towards the lower range of prevalence among Muslims in India.

Table 2: Prevalence of G6PD deficiency among different population groups in India

Author (Year)	Area	Population type	No. of tested	No. of G6PD deficient	Prevalence (%)	Range of prevalence
Religious communities	0.00-21.32					
Pathak et al., (2013)	Gujarat	Muslims	14	0	0.00	
Present study	Lucknow	Muslims	128	5	3.9	
Chatterjea, J.B. (1966)	West Bengal	Muslims	17	1	5.88	
Verma et al., (1986)	Jammu	Christians	86	5	6.87	
Verma et al., (1986)	Jammu	Muslims	342	26	6.83	
Verma et al., (1986)	Jammu	Sikh	322	22	7.6	
Rai & Kumar, (2014)	Uttar Pradesh	Muslims	200	26	13.00	
Kate et al., (1978)	Maharashtra	Parsis	133	23	17.30	
Achoubi et al., (2010)	Manipur	Muslims	136	29	21.32	
Caste populations						
Sidhu et al., (2001)	Punjab	Aggarwal	47	0	0.00	0.00-26.92
Kabita et al., (2011)	Himachal Pradesh	Rajput	65	1	1.54	
Kabita et al., (2011)	Himachal Pradesh	Brahmins	47	1	2.12	
Chatterjea, J.B. (1966)	West Bengal	Bengali	103	4	3.88	
Achoubi et al., (2010)	Manipur	Brahmins	115	12	9.44	
Pathak et al., (2013)	Gujarat	Harijan	26	7	26.92	
Tribal populations						
Pathak et al., (2013)	Gujarat	Bharwad	16	0	0.00	0.00-30.7
Achoubi et al., (2010)	Manipur	Kabui	51	4	7.84	
Saraswathy&Sachdeva, (2008)	Andhra Pradesh	Koyadora	71	6	8.45	
Saraswathy&Sachdeva, (2008)	Andhra Pradesh	Nayakpod	20	20	10.00	
Saraswathy&Sachdeva, (2008)	Andhra Pradesh	Kolam	226	26	11.50	
Nishank et al., (2008)	Orissa	Santal	106	13	12.30	
Sivaraj et al., (2015)	Tamil Nadu	Badagas	970	170	18.00	
Seth & Seth, (1971)	Nagaland	Angami Naga	150	33	22.00	
Balgir, R.S. (2010)	Orissa	DhelkiKharia	345	106	30.7	

Furthermore, the age-wise distribution of G6PD deficiency in the present study revealed that among younger age group (<30 years) the prevalence is much lower (20%) as compared to higher age group (≥30 years), i.e., 80% (Figure 1). One plausible explanation can be that with the advancement in pharmacology

the younger generations are exposed to an array of drugs since birth. Nevertheless, the usually asymptomatic and clinically silent G6PD deficient individuals have higher risk of complications with exposure to various drugs (Cappellini and Fiorelli, 2008: 64-74). Thus, unbeknown to this deficiency, the younger age groups are exposed to various drugs which might be life-threatening for G6PD deficient individual.

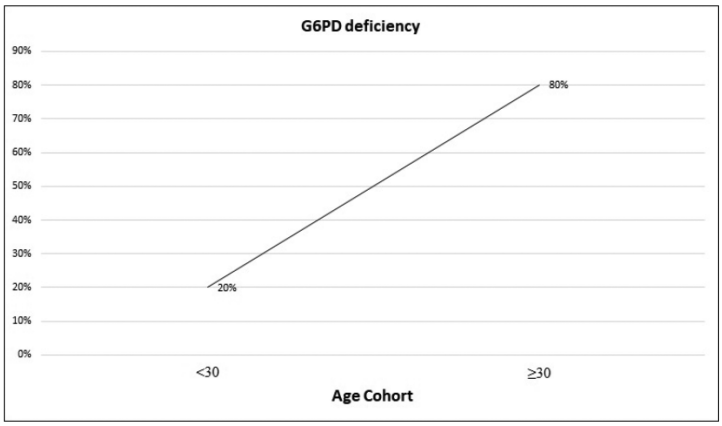

Figure-1: Age-wise distribution of G6PD deficient individuals among Muslims of Lucknow District, Uttar Pradesh, India.

CONCLUSIONS

The low frequency of G6PD deficient individuals observed in the present study may not be viewed as a good trend because the lowered frequency could be due to the disadvantageous effects of the phenotype in early age, specifically when exposed to various drugs unknowingly. Thus, inclusion of neonatal screening programmes for G6PD deficiency should be encouraged. Further, understanding the distribution and prevalence of this disorder may substantially inform risk and thus better equip policy makers and practitioners alike in designing and implementing treatment practices.

ACKNOWLEDGEMENTS

We are thankful to Dr. Shivani Chandel for her assistance during data collection. We are also grateful to all the individuals who volunteered to participate in this study.

REFERENCES

Achoubi, N., Asghar, M., Meitei, S.Y., Sachdeva, M.P., Sarawathy, K.N. and B., Murry, 2010. Haemoglobinopathies and glucose-6-phosphate dehydrogenase deficiency in a malaria endemic region of Manipur, northeast India. *Anthropological Science*, 118(3): 201-204.

Balgir, R.S., 2010. Genetic Diversity of Hemoglobinopathies, G6PD Deficiency, and ABO and Rhesus Blood Groups in Two Isolates of a Primitive Kharia Tribe in Sundargarh District of Northwestern Orissa, India. *Journal of Community Genetics* , 1: 117-123.

Beutler E. and M. Mitchell, 1968. Special modification of the fluorescent screening method for glucose-6-phosphate dehydrogenase deficiency. *Blood,* 32: 816–818.

Baxi A.J., Balakrishnan, V., Undevia, J.V. and L.D. Sanghvi, 1963. Glucose-6-phosphate dehydrogenase deficiency in the Parsee community, Bombay. *Indian Journal of Medical Science*; 17:493-500.

Cappellini, M.D. and G.E.M.I.N.O. Fiorelli, 2008. Glucose-6-phosphate dehydrogenase deficiency. *The lancet*, 371(9606): 64-74.

Census of India, 2001. Registrar General and Census commissioner, Government of India. http://www.censusindia.net/ [Access date 30th January, 2019]

Chatterjea, J.B., 1966. Haemoglobinopathies, Glucose-6-Phosphate Dehydrogenase Deficiency and Allied Problems in the Indian Subcontinent. *Bulletin of the World Health Organization*, 35:837-856.

Hoiberg, A., Ernst, J. and D.E. Uddin, 1981. Sickle cell trait and glucose-6-phosphate dehydrogenase deficiency: effects on health and military performance in black navy enlistees. *Archives of internal medicine*, 141(11). 1485-1488.

Kabita, S., Khurana, P., Saraswathy, K.N. and M.P. Sachdeva, 2011. Glucose-6- Phosphate Dehydrogenase Deficiency among the Rajputs and Brahmins of Solan District, Himachal Pradesh. *Anthropologist* , 13:39-41.

Kate, S.L., Mukherjee, B.N., Malhotra, K.C., Phadke, M.A., Mutalik, G.S. and G.S. Sainani, 1978. Red Cell Glucose-6-Phosphate Dehydrogenase Deficiency and Haemoglobin Variants among Ten Endogamous Groups of Maharashtra and West Bengal. *Human Genetics* , 4: 339-343.

Luzzatto, L., Mehta, A.B. and T. Vulliamy, 2001. Glucose-6-phosphate Dehydrogenase Deficiency. *Metabolic and Molecular Basics of Inherited Disease*.4517-4554

Nishank, S.S., Chhotray, G.P., Kar, S.K. and M.R. Ranjit, 2008. Molecular Variants of G6PD Deficiency among Certain Tribal Communities of Orissa, India. *Annals of Human Biology*, 35:355-361.

Padilla, C.D. and B.L. Therrell, 2007. Newborn screening in the Asia Pacific region. *Journal of inherited metabolic disease*, 30(4):490-506.

Baxi, A.J., Balakrishnan, V. and Sanghvi, Baxi, A.J., Balakrishnan, V. and L.D. Sanghvi, 1961. Deficiency of glucose-6-phosphate dehydrogenase—observations on a sample from Bombay. *Current Science*, 30(1):16-17.

Pathak, R.R., Chhaiya, S.B. and D.S. Mehta, 2017. Prevalence of G6PD deficiency versus oxidizing drugs: a survey in the tertiary care hospital. *International Journal of Basic & Clinical Pharmacology*, 2(2):170-176.

Rai, V. and P. Kumar, 2014. Glucose 6-Phosphate Dehydrogenase Deficiency in Muslim Community Settled in Jaunpur District. *Indian Journal of Human Genetics*, 20:96-97.

Saraswathy, K.N. and M.P. Sachdeva, 2008. G6PD Deficiency, Sickle Cell Trait, Haptoglobin and Transferrin Polymorphisms among Koyadoras and Nayakpods of Andhra Pradesh. *Anthropologist* , 10:163-165.

Seth, P. and S. Seth, 1971. Biogenetical Studies of Nagas: Glucose-6-Phosphate Dehydrogenase Deficienc in AngamiNagas. *Human Biology*, 43: 557-561.

Shah, I.I., Jarullah, J. and B. Jarullah, 2018. Prevalence of Glucose-6-Phosphate Dehydrogenase (G6PD) Deficiency in India: A Systematic Review. *Advances in Bioscience and Biotechnology*, 9(09):481.

Sidhu, P.K., Kaur, K., Kumar, I. and S. Lata, 2001. Glucose-6-Phosphate Dehydrogenase Deficiency in Blood Donors: Screening by Micromethaemoglobin Reduction Test. *Indian*

Journal of Pathology and Microbiology, 44: 23-25.

Sivaraj, B., Radha, R., Vidya, C. and R. Sanil, 2015. Prevalence of Glucose 6 Phosphate Dehydrogenase (G6PD) Deficiency among the Badagas of the Nilgiris. *Asian Journal of Biochemical and Pharmaceutical Research* , 5: 295-299.

Verma, V., Saini, R.K., Arya, R.K. and B. Kaul, 1986. Incidence of G6PD Deficiency in the Various Ethnic Groups of Jammu Region (Jammu and Kashmir State). *Current Science* , 55:1075-1076.