

## FREQUENCIES OF MNS BLOOD GROUP ANTIGENS AND PHENOTYPES IN BLOOD DONORS FROM A TERTIARY CARE HOSPITAL IN SOUTH INDIA

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### Abstract

**Background:** The MN antigens are situated on glycoprotein A and the Ss antigens on glycoprotein B. Anti-S and anti-s antibodies may result in immediate and delayed hemolytic transfusion reactions, and hemolytic disease of the fetus and newborn. Anti-M and anti-N have occasionally caused mild HDFN and transfusion reactions. The present study explores the prevalence of the main antigens and phenotypes of the MNS blood group system. **Materials and Methods:** This is a prospective study, involving 200 voluntary blood donors conducted in the Department of Transfusion Medicine, Government Medical College, Thiruvananthapuram, Kerala during the period from September 2018 to August 2019 associated with the department. The serotyping was performed to investigate M, N, S, and s antigens and the various phenotypes. **Result:** The frequencies of MNS antigens were as follows: M = 85%, N = 58%, S = 49%, and s = 90%. It was observed that the M+N+ and S-s+ were found to be the most frequent phenotypes. **Conclusion:** This study may aid the transfusion services to establish an extended phenotyping of donors for the MNS and for preparing inhouse panel cells for immunohaematological tests.

## INTRODUCTION

Karl Landsteiner and Levine identified the first two antigens of the MNS blood group system, the M and N antigens.<sup>[1]</sup> There are 50 antigens in this blood group system and the M, N, S, and s antigens remain the most common. This is represented by three homologous genes, GYPA, GYPB, and GYPE.<sup>[2]</sup> The antigens of the MNS system are completely expressed at birth and are carried on two carrier molecules, glycoprotein A (GPA) and glycoprotein B (GPB). GPA carries the M and N antigens, whereas GPB carries the S and s antigens. The MNS antigens are found mainly on RBCs. There are about 1 million copies of glycoprotein A per RBC and 0.2 million copies of glycoprotein B. The MNS antigens are also expressed in the kidney (on the renal endothelium).<sup>[3]</sup> Glycoproteins A and B may serve as receptors for cytokines, bacteria, and viruses. These glycoproteins bear the MNS antigens and may act as a receptor for *Plasmodium falciparum*. Individuals who have rare blood types in which either the glycoprotein A or B is absent, e.g., phenotypes En(a-) and S-s-U-, have RBCs that are resistant to invasion by *Plasmodium*.<sup>[3]</sup>

The influenza virus and the encephalomyocarditis virus target the sialic acid attached to GPA and GPB.<sup>[4]</sup>

The anti-M and anti-N antibodies are naturally occurring IgM antibodies and are not considered to cause transfusion reactions. However there have been rare cases of delayed transfusion reactions as a result of anti-M,<sup>[5]</sup> Anti-S, anti-s, and anti-U are IgG antibodies and have been found to be involved in both immediate and delayed HTR.<sup>[6-8]</sup> Anti-S, anti-s, and anti-U are IgG antibodies and can cause HDFN.<sup>[9-11]</sup> Less common causes of HDN include anti-M, anti-N, anti-U, anti-Mia, anti-Mta, and anti-Ena.<sup>[12,13]</sup>

The prevalence of MNS antigens and phenotypes vary with race and ethnicity. There have been several studies from India which showed varied prevalence based on the region. Haemoglobinopathies are important health challenges in India especially among the tribal population.<sup>[14]</sup> In order to prevent the risk of alloimmunization, it is crucial to determine the frequency of the antigens in our population. This study aimed to investigate the prevalence of the MNS blood group system (M, N, S, and s) antigens among voluntary blood donors in South Kerala, India.

## MATERIALS AND METHODS

This prospective cross-sectional study was conducted at Government Medical College, Thiruvananthapuram, Kerala, India. The study period was from September 2018 to August 2019. The study was approved by the Institutional Research and Ethics Committee. The voluntary blood donors attending the blood centre were enrolled in the study. Informed consent was obtained from all donors. The donors were selected as per the criteria laid down by the Drugs and Cosmetics Act, 1940 and Rules, 1945 and departmental Standard Operating Procedures (SOP).

A total of 200 blood samples were collected from O blood group voluntary donors. The serological phenotyping was performed using column agglutination technique gel cards and Bio-Rad monoclonal antisera on blood samples within 24 hours of collection. The phenotyping was performed serologically as per the manufacture instructions (Bio-Rad, Switzerland).

The MNS phenotypes were determined using the ID-Antigen ID-cards (Bio-Rad, Cressier Switzerland). A 0.8% cell suspension was prepared and 50.0 µL of the cell suspension was added to each micro-tube of the phenotyping ID-cards. A 50.0 µL of ID-test sera was added to the corresponding microtubes. The gel cards were incubated for 10 minutes at room temperature and centrifuged at 1000 rpm for 10 minutes in the gel card centrifuge. Known positive and negative controls for each antigen were selected from the commercial cell panels (Dia Cell, Bio-Rad, Switzerland). The reactions were graded from 0 to 4+ for each antigen phenotyped.

The observed phenotypes for each specific antigen in the studied blood group system MNS (M, N, S, s

antigens) were prepared. Frequencies and percentages for each specific RBC antigens and the frequencies for each of the derived phenotype combinations were assessed. Frequencies of the derived phenotypes in the blood donors were compared with phenotypes published in other parts of India. The total number of donors who tested positive for a particular antigen or phenotype divided by the total number of donors tested yielded the prevalence of that particular antigen or phenotype and the results were expressed in percentage.

## RESULTS

In our study, 200 donor blood samples were tested for determining the prevalence of MNS antigens and phenotypes this blood group system. [Table 1] presents the prevalence of the MNS antigens among the voluntary blood donors in our blood centre. The M antigen was the most prevalent antigen observed among 170 (85%) samples, whereas the N antigen was the least prevalent antigen and was found only in 116 samples (58%). The frequencies of the S and s antigens were 98 (49%) and 180 (90%), respectively. [Table 2] depicts the prevalence of MNS phenotypes. The M+N+ and S-s+ were found to be the most frequent phenotypes which were similar to other Indian studies.<sup>[15,16]</sup> Nine phenotypes were observed in the population. [Table 3] The most common phenotype of the MNS blood group was M+N+S-s+ (n = 50, 25%), and the least common phenotype was M-N+S+s- (n = 3, 1.5%). Two phenotypes, M+N-S+s+ and M+N-S-s+, had prevalence of 19% and 17.5% respectively. The phenotypes M+N-S-s- and M-N+S-s- were not observed in the present study.

**Table 1: Prevalence of MNS antigen in the present study (n = 200)**

Antigen	Observation(n)	Frequency(%)
M	170	85
N	116	58
S	98	49
s	180	90

**Table 2: Prevalence of MNS antigen phenotypes in the present study (n = 200) and other studies in India.**

Phenotype	Present study (%) (n=200)	Subramaniyan et al (%) (n = 188)	Setya et al. (%) (n = 6678)	Agarwal et al. (%) (n = 508)
M+N-	42	41.49	37.96	35.83
M+N+	43	43.09	37.93	54.72
M-N+	15	15.42	24.11	9.45
S+s-	10	6.92	17.16	13.39
S+s+	39	42.55	42.5	38.98
S-s+	51	50.53	40.34	47.63
S-s-	0	0	0	0

**Table 3: Prevalence of combination of phenotypes in MNSs blood group system in the present study (n = 200) and other studies in India**

Phenotype	Present study(%) (n=200)	Subramaniyan et al (%) (n = 188)	Setya et al. (%) (n = 6678)	Agarwal et al. (%) (n = 508)
M+N-S+s-	5.5	4.26	7.46	7.09
M+N-S+s+	19	19.68	17.64	14.96
M+N-S-s+	17.5	18.09	12.86	13.78
M+N+S+s-	3	2.13	5.48	5.12

M+N+S+s+	15	17.02	15.68	20.87
M+N+S-s+	25	23.4	16.77	28.74
M-N+S+s-	1.5	0.53	4.22	1.18
M-N+S+s+	5	6.38	9.18	3.15
M-N+S-s+	8.5	8.51	10.71	5.12
M+N-S-s-	0	0	0	0
M-N+S-s-	0	0	0	0

## DISCUSSION

Red blood cell (RBC) alloimmunization is an immune response in a patient which occurs due to blood transfusions and pregnancies.<sup>[17]</sup> The risk of developing RBC alloantibodies is dependent on factors like age, sex, and genetic makeup and frequency of transfusions that a patient has received.<sup>[18]</sup> The antibodies to MNS blood group antigens are one of the most commonly reported specificities.<sup>[19,20]</sup> There are only a few studies reported from our country about the frequencies of clinically significant blood group antigens.<sup>[15,16]</sup> In the present study, we investigated the frequencies of MNS antigens in South Indian blood donors.

The prevalence of the antigens in the present study were as follows: M antigen (85%), N (58%), S (49%), and s (90%). These observations were relatively similar to the a study from a blood centre in South India.<sup>[15]</sup> The findings of the current study were similar to Agarwal et al and Subramaniyan et al, that the M+N+ and S-s+ were found to be the most frequent phenotypes.<sup>[15,21]</sup> while Setya and colleagues reported the M+N- and S+s+ as their most frequent phenotypes.<sup>[22]</sup> Nine phenotypes were found in our population. Among the phenotype combinations of MNS antigens, the M+N+S-s+ was the most frequent phenotype in the present study as similar to a study from South India.<sup>[15]</sup> The studies conducted in other regions of India and a study from Saudi Arabia reported the most common phenotypes to be M+N-S+s+.<sup>[22,23]</sup> Conversely, the least observed phenotype was M-N+S+s- (1.5%).

## CONCLUSION

The drawback of this study was that the sample size was relatively small compared to our population. This study may aid our transfusion services to establish an antigen negative inventory by screening of voluntary blood donors. This will help in finding a suitable compatible unit for alloimmunised patients without delay.

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