

Distribution and Association of ABO and Rh Blood Group Antigens with BMI Among Nepalese and Indian Students Studied in a Medical College of Nepal

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ABSTRACT

Introduction

Blood group antigens and body mass index (BMI) of human are gaining importance for many diseases. Some attempts were reported to find any relationship between BMI and Blood groups with some contradictions. The possible association between BMI and blood groups of Nepalese and Indian medical students is yet to be established.

Methods

Blood groups, ABO and Rh systems and body mass index (BMI) of participants, medical students of Nepalese and Indian origin were determined and analyzed statistically.

Results

The distribution frequencies of 10.56%, 17.08%, 3.06%, and 20.28% females and 9.03%, 16.39%, 3.61% and 20.0% males of both the countries were present in A, B, AB and O blood groups, respectively. Rh-negative participants were predominantly present in O blood group. The observed frequencies of participants with different BMI group were distributed as 56.11%, 24.72%, 10.69% and 8.47% in Normal, Overweight, Underweight and Obese groups, respectively. Underweight participants were prevalent in O group and in females. The difference between the distribution of Nepalese females and males with Normal BMI was found significant in A and O. A distribution pattern of B>O>A>AB was observed for Overweight group. The occurrence of Obese is few folds higher among Indian participants than Nepalese and prevalent in males. Obese participants were found more associated with B and O blood group.

Conclusions

Participants with A were more prevalent among Nepalese in respect to Indian. Rh-negative participants were distributed as 1.67% and 5.0% in Nepalese and Indians, respectively and predominantly present in O (4.44%) and are more prevalent in Indian males. In Normal BMI Nepalese were significantly more as compared to Indians. In the Underweight group females were significantly more prevalent as compared to males and found maximally associated with O blood group and most of them are Nepalese. In Overweight group males were more than females. Participants with obesity were mostly present in B and O blood group and most of them are Indian.

Keywords: ABO blood group system; body mass index; Rh blood group; underweight; obesity; Nepalese medical students; Indian medical students.

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INTRODUCTION

Study of blood groups, mainly ABO and Rh systems has been given high priority because of its medical importance.¹⁻⁵ The presence of any one or in combination of the major blood group antigens, A, B, AB and O of ABO system, based on H-antigen, a complex oligosaccharide mostly ceramide-linked and others are N-linked glycan to some plasma membrane proteins, especially Band 3 and D-antigen of Rh system, a protein is inevitable to display on the plasma membrane of red blood cells of any individual following Mendelian rules of inheritance, which is considered as unique lifelong fingerprint.⁶ The antigens of ABO system are involved in maintaining erythrocyte cytoskeleton integrity, as well as in membrane transport, cell signaling, immune complement regulation, and as receptors and modulators of many diseases.²⁻⁸ The function of Rh system is still ill defined. The respective antigens of ABO blood group system is also present on other tissues and secretions. Particularly, as widely expressed the ABO histo-blood group antigens throughout the body is considered the single most important blood group for selection and transfusion of blood products as well as transplantation of solid organ and bone marrow.^{2,9,10}

In the early human life, particularly the period of neonate to infant, the development of antibody producing cells against self-antigens are clonally deleted, so, the subject has non-corresponding antibody against particular ABO system antigens, which is known as the Karl Landsteiner Law.¹¹ The recipient immune response against incompatible red cell antigens, particularly Rh, rather than ABO system antigens encountered through transfusion, transplantation or pregnancy may include antibody production and following agglutination and/or complement activation resulting in hemolysis, e.g., transfusion reaction; fetal death, hemolytic

disease of the newborn (HDN).^{2,4} Inherently different levels of energy metabolism require for the maintenance of huge amount of different blood group antigen in human. Deviation in the energy balance is prerequisite for different BMI. Age-groups, gender and race specific changes in BMI are gaining importance in medical sciences.

Obesity in young is spreading across the globe^{12,13}, that is largely depending on the excess metabolic gain based on socioeconomic status of the subject, primarily, nutrition, schooling, playing, exercise and physical work.¹⁴⁻¹⁶ Obesity is considered linked to a spectrum of diseases, e.g., Coronary artery disease, hypertension, hyperlipidemia, diabetes mellitus, and musculoskeletal, immune, and nervous system disorders affecting quality of life by curbing normal physiological activities, particularly physical activities^{17,18} causing a global death toll of 3.4 million apart from loss of 3.8% of the disability-adjusted life years.¹⁹ Still, all the reasons for the obesity are yet to ascertain. In many studies, it has been tried to find out if there is any correlation between any disease including obesity and blood group antigens and a wide variation has been found among different groups of population, particularly age, sex, socioeconomic status around the globe.^{14,17,20-24} Though the Nepalese and Indian students share similar kind of culture and food to some extent, there are also dissimilarities along with biological make up. The distribution of ABO and Rh blood group in different population in different regions from time to time²² is varied due to admixture of population in the advent of increasing migration and settling for many reasons, e.g., urbanization, war, employment, interracial marriage, studying for a long period, e.g., in medical, etc. The knowledge is helpful for the improvement of local blood banking and enlightening many medical issues, e.g., underweight, obesity, etc.

Our goal of this study was to assess the distribution pattern of ABO blood groups and BMI among students in a medical college in Nepal and the possible relationship between BMI and blood group of the subjects considering gender and their nationality, i.e., Nepalese or Indian. Homogenous group was used in respect of age and profession.

METHODS

A descriptive cross-sectional study was conducted in the department of Physiology, College of Medical Sciences and Teaching Hospital, Bharatpur, Nepal during September 2016 to October 2017 after obtaining the permission from the Institutional Review Committee (IRC), College of Medical Sciences, Bharatpur, Nepal. The data collection was done considering gender, age, Nationality, blood groups (ABO and Rh), height and weight of each participant (N=720) with their consent. The participants were first year MBBS and dental students of age between 18 to 21 years and healthy having no history of current and past chronic illness. Homogenous group was used in respect of age and profession.

Blood groups, ABO and Rh factor of the participants were determined in the Physiology Department using standard agglutination method.²⁵ Based on the blood group, participants were presented in three groups, i.e., Rh positive ABO (A+, B+, AB+ & O+), Rh negative ABO ((A-, B-, AB- & O-), and ABO irrespective of Rh factor (A, B, AB & O). Equal number of Nepalese and Indian students with a total of 720 were enrolled as the study participants. Body mass index (BMI) was calculated by using the formula: body weight (kg)/ square of body height in meter (kg/m²).²⁶ The measurement of weight was taken about two hours after breakfast. The subjects were not allowed to do exercise on the day before the measurement was over. For

the female students, the measurements were taken within 8 to 10 days after menstruation following the same condition for the elimination of unwanted factors contributing to the **body** weight. All these conditions were explained to the participating students few days in advance for the convenience. Then on the basis of BMI, the subjects were categorized into <18.5, 18.5-24.9, 25-29.9 and >30 defined as underweight (UnW), normal (Nor), overweight (OvW) and obese (Obe), respectively in accordance with the WHO recommendation.²⁷

All the collected data were processed and analyzed by using Microsoft Office Excel 2016 software and Statistical Package for Social Science (SPSS), IBM software, version 20. To test the difference and/or any association among the different relevant variables, e. g., male vs female; Nepalese vs Indian in respect to different blood groups and body mass index (BMI), Pearson Chi Square (χ^2) test was used and the $p < 0.05$ was considered statistically significant for the presence of difference in the distribution.

RESULTS

In this cross-sectional study, we are reporting a comparative distribution pattern of ABO and Rh blood group antigens and BMI groups, i.e., UnW, Nor, OvW and Obe among medical student participants of two Nationality in our Medical College. The association of any blood group with any BMI group on the basis of prevalence among participants are also addressed.

The occurrences of ABO and Rh blood group systems with different BMI groups among Indian and Nepalese medical student participants of both sexes.

This study is reporting about the occurrences of ABO and Rh blood group systems with different BMI groups among 720 Indian and Nepalese medical students of both sexes of 19.55±1.07 (mean±SD, N=720) years young.

Table 1 shows 367 (50.97%) females and 353 (49.03%) males from both the Nations. The prevalence of participants including males and females in different blood groups were found in the following order: O (40.28%)>B (33.47%)>A (19.58%)>AB (6.67%). The

distribution frequencies for females and males of both the countries were 10.56% & 9.03; 17.08 & 16.39; 3.06 & 3.61 and 20.28 & 20.0 in A, B, AB and O blood groups, respectively and the presence of difference were not statistically significant.

Table 1. Distribution of different blood groups in male and female subjects among all participants (Nepalese and Indian)

Blood groups	All participants (Nepalese + Indian)						χ ² : p-value
	Female		Male		Total (Female + Male)		
	N	%	N	%	N	%	
A	76	10.56	65	9.03	141	19.58	0.487
B	123	17.08	118	16.39	241	33.47	0.984
AB	22	3.06	26	3.61	48	6.67	0.476
O	146	20.28	144	20.00	290	40.28	0.831
Total	367	50.97	353	49.03	720	100	0.792 [#]

*statistically significant least at 5% level of significance

[#], χ²: p-value calculated for the all variables

Table 2 shows the results of occurrence of different blood groups among 360 Nepalese and 360 Indians participants. Participants with A were more prevalent among Nepalese (N=93, 12.92%) than that were present among Indian (N=48, 6.67%) (P<0.001). There were no significant

differences in the occurrence of participants with other blood groups. The distribution frequencies 12.92%, 15.69%, 3.33% and 18.06% and 6.67%, 17.78%, 3.33% and 22.22% for A, B, AB and O group among Nepalese and Indian participants, respectively.

Table 2. Distribution of different blood groups in Nepalese and Indian subjects among all participants (Females and males)

Blood groups	All participants (Female + Male)						χ ² : p-value
	Nepalese		Indian		Total (Nepalese + Indian)		
	N	%	N	%	N	%	
A	93	12.92	48	6.67	141	19.58	0.000*
B	113	15.69	128	17.78	241	33.47	0.333
AB	24	3.33	24	3.33	48	6.67	1.000
O	130	18.06	160	22.22	290	40.28	0.078
Total	360	50	360	50	720	100	0.000* [#]

*statistically significant least at 5% level of significance

[#], χ²: p-value calculated for the all variables

Table 3 & 4 show the results of distribution pattern of different blood groups in male and female participants among Nepalese and Indians, respectively. Participants with AB blood group were equally distributed among Nepalese and Indian. But the presence of difference in the distribution of females (22) and males (26) was noted. Sixteen males (2.22%) and 8 females (1.11%) of 24 Indian participants with AB blood group were present indicating prevalence of males in this group. In A blood group, the prevalence of both Nepalese males (6.25%)

and females (6.67%) were more noted than that were in Indian males (2.78%) and females (3.89%). In B blood group 63 & 60 females, 50 & 68 males were belong to Nepalese and Indian, respectively. Seventy & 76 females and 60 & 84 males were Nepalese and Indian distributed in O blood group, respectively. However, there were no statistically significant differences in the distribution of male and female Nepalese or Indian participants recorded for any blood group.

Table 3. Distribution of different blood groups in male and female subjects among Nepalese participants

Blood groups	Nepalese						χ^2 : p-value
	Female		Male		Total (Female + Male)		
	N	%	N	%	N	%	
A	48	6.67	45	6.25	93	12.92	0.006*
B	63	8.75	50	6.94	113	15.69	0.448
AB	14	1.94	10	1.39	24	3.33	0.682
O	70	9.72	60	8.33	130	18.06	0.212
Total	195	27.08	165	22.92	360	50	0.020*#

Table 4. Distribution of different blood groups in male and female subjects among Indian participants

Blood groups	Indian						χ^2 : p-value
	Female		Male		Total (Female + Male)		
	N	%	N	%	N	%	
A	28	3.89	20	2.78	48	6.67	0.003*
B	60	8.33	68	9.44	128	17.78	0.475
AB	8	1.11	16	2.22	24	3.33	0.157
O	76	10.56	84	11.67	160	22.22	0.212
Total	172	23.89	188	26.11	360	50	0.005*#

Out of 720 participants, 672 (93.33%) (Table 7) and 48 (6.67%) were Rh-positive and Rh-negative ABO blood groups, respectively (Table 5). The distribution of Rh-negative participants was found as 1.67% and 5.0% in Nepalese and Indians, respectively. The occurrence is in the order of O (4.44%)>B (1.39%)>A (0.28%) & AB (0.56%). Rh

negative participants are more prevalent in Indian males than Indian females and significantly differed from the distribution of Nepalese males and females. Rh negative subjects are about two fold more prevalent in males (3.33%) than females (1.67%) among Indians, but there is no significant difference in Nepalese.

Table 5. Distribution of Nepalese and Indian male and female participants in Rh-negative ABO blood groups

Blood group	Participants										χ ² : p-value	
	Nepalese					Indian						Total in each Blood group
	Female		Male			Female		Male				
	N	%	N	%	N	%	N	%	N	%		
A-	2	0.28	0	0.00	0	0.00	0	0.00	2	0.28	0.008*	
B-	0	0.00	2	0.28	0	0.00	8	1.11	10	1.39	0.084	
AB-	0	0.00	0	0.00	4	0.56	0	0.00	4	0.56	0.007*	
O-	5	0.69	3	0.42	8	1.11	16	2.22	32	4.44	0.996	
Total	7	0.97	5	0.69	12	1.67	24	3.33	48	6.67	0.000*#	

The distribution frequency of four BMI groups with different blood groups

Table 6 shows the distribution frequency of four BMI groups with different blood groups were shown considering irrespective of Rh group among all participants. The observed frequencies were as follows: maximum (56.11%) in normal category followed by overweight (24.72%), then underweight (10.69%) and the least in persons with obesity (8.47%) and the occurrences are

significantly different (p<0.001). According to the prevalence of OvW participants in ABO blood groups was appeared as B (8.33%)>O (7.78%)>A (5.97%)>AB (2.64%). According to the prevalence of participants with any BMI group in any blood group it appears in the order of O>B>A>AB; O>B>A>AB; OB>O>A>AB; and B>O>A in UnW, Nor, OvW and Obe, respectively. Thirty two (4.44%) and 25 (3.47%) of 61 Obe were present in B and O blood group, respectively.

Table 6. Distribution of different BMI groups in different blood groups irrespective of Rh factor among participants

Blood group	BMI										χ ² : p-value
	UnW		Nor		OvW		Obe		Total in each Blood group		
	N	% ^a	N	%	N	%	N	%	N	%	
A	9	1.25	85	11.81	43	5.97	4	0.56	141	19.58	0.017*
B	23	3.19	126	17.50	60	8.33	32	4.44	241	33.47	0.057
AB	2	0.28	27	3.75	19	2.64	0	0.00	48	6.67	0.016*
O	43	5.97	166	23.06	56	7.78	25	3.47	290	40.28	0.043*
Total	77	10.69	404	56.11	178	24.72	61	8.47	720	100	0.000*#

Table 7 shows the distribution profile of BMI groups in Rh-positive blood groups among participants. Out of 720 participants, 672 (93.33%) were present in Rh-positive ABO blood groups. Except in O+ there are fewer less participants were noted in A+, B+ and AB+ in respect to A,

B, AB and O blood groups, irrespective of Rh-factor, who are present in Rh-negative blood groups. In O+ blood group, 0.69%, 2.66%, and 1.11% the reduced frequencies were observed in UnW, Nor and OvW , respectively.

Table 7. Distribution of different BMI groups in different Rh-positive blood groups among participants

		BMI										χ^2 : p-value
		UnW		Nor		OvW		Obe		Total in each Blood group		
		N	%	N	%	N	%	N	%	N	%	
Blood group	A+	9	1.25	83	11.53	43	5.97	4	0.56	139	19.31	0.013*
	B+	23	3.19	120	16.67	60	8.33	28	3.89	231	32.08	0.205
	AB+	2	0.28	23	3.19	19	2.64	0	0.00	44	6.11	0.013*
	O+	38	5.28	147	20.42	48	6.67	25	3.47	258	35.83	0.027*
	Total	72	10.00	373	51.81	170	23.61	57	7.92	672	93.33	0.0001*#

Rh-negative participants with O blood group were distributed as 0.69%, 2.64%, and 1.11% in UnW, Nor and OvW groups, respectively (Table 8). A predominant distribution of 43 (5.97%) of 77 (10.69%) UnW was noted in O group, and its 5

(0.69%) participants were found in Rh-negative and belong to only O- group. Four of 48 Rh-negative participants were with obesity and they were in B- blood group (p<0.01).

Table 8. Distribution of different BMI groups in different Rh-negative blood groups among participants

		BMI										χ^2 : p-value
		UnW		Nor		OvW		Obe		Total in each Blood group		
		N	%	N	%	N	%	N	%	N	%	
Blood group	A-	0	0.00	2	0.28	0	0.00	0	0.00	2	0.28	0.108
	B-	0	0.00	6	0.83	0	0.00	4	0.56	10	1.39	0.009*
	AB-	0	0.00	4	0.56	0	0.00	0	0.00	4	0.56	0.400
	O-	5	0.69	19	2.64	8	1.11	0	0.00	32	4.44	0.0009*
	Total	5	0.69	31	4.31	8	1.11	4	0.56	48	6.67	0.0000*#

Distribution of male or female participants in different BMI group was shown in Table 9. The presence of UnW participants was significantly more in female (N=54, 7.50%) than male (N=23, 3.19%) (p<0.001). Whereas, in OvW group

males (N=110, 15.28%) were more than female participants (N=68, 9.44%) (p<0.001). The distribution of males and females in Nor and Obe categories was not statistically significantly different.

Table 9. Distribution of female and male participants with different BMI groups

		Total Participants						χ^2 : p-value
		Female		Male		Total		
		N	%	N	%	N	%	
BMI	UnW	54	7.50	23	3.19	77	10.69	0.0008*
	Nor	219	30.42	185	25.69	404	56.11	0.193
	OvW	68	9.44	110	15.28	178	24.72	0.0007*
	Obe	26	3.61	35	4.86	61	8.47	0.192
	Total	367	50.97	353	49.03	720	100	0.0000*#

Table 10. Describes the distribution of Indian and Nepalese participants in different BMI group. Except UnW group, the distribution of Indian and Nepalese participants was significantly different in other three BMI groups ($p < 0.001$). A

large population of Obe participants was Indian ($N=56, 7.78\%$), whereas only 5 (0.69%) were recorded. Significant difference was present in between Nepalese (35%) and Indian (21.11%) ($p < 0.001$) participants in the Nor group.

Table 10. Distribution of Nepalese and Indian participants with different BMI groups								
BMI		Total Participants						χ^2 : p-value
		Nepalese		Indian		Total		
		N	%	N	%	N	%	
	UnW	37	5.14	40	5.56	77	10.69	0.732
	Nor	252	35.00	152	21.11	404	56.11	0.0000*
	OvW	66	9.17	112	15.56	178	24.72	0.0006*
	Obe	5	0.69	56	7.78	61	8.47	0.0000*
	Total	360	50	360	50	720	100	0.0000*#

Occurrences of males or females of Indian or Nepalese in different blood groups with different BMI groups are described in the Table 11 - 14.

Occurrences of males or females of Indian or Nepalese in different blood groups with UnW BMI group are described in the Table 11. In UnW group, out of 77 participants distributed in all blood groups, 30 (8.33%) females and 7 (1.94%) males of 37 Nepalese, and 24 (3.33%) females and 16 (2.22%) males of 40 Indian were

significantly different ($p < 0.05$). The distribution of 5 & 0, 5 & 2, 2 & 0, and 18 & 5 Nepalese females and males were found in A, B, AB and O blood groups, respectively and except in O group ($p < 0.05$) these are not significantly different. Among Indian UnW group no female in A and none in males and females in AB were noted. The distribution of 4 & 8 Indian males and 12 & 12 females was found in B and O, respectively, which were distinctly different, but these were statistically insignificant.

Table 11. Distribution of Nepalese or Indian female and male participants with BMI: Underweight in different blood groups											
Blood group		BMI: UnW									
		Nepalese				χ^2 : p-value	Indian				χ^2 : p-value
		Female	%	Male	%		Female	%	Male	%	
	A	5	0.69	0	0.00	0.220	0	0	4	0.56	0.026*
	B	5	0.69	2	0.28	0.108	12	1.67	4	0.56	0.129
	AB	2	0.28	0	0.00	0.495	0	0.00	0	0.00	0.102
	O	18	2.50	5	0.69	0.032*	12	1.67	8	1.11	0.333
	Total	30	4.17	7	0.97	0.028*	24	3.33	16	2.22	0.013*#

Occurrences of males or females of Indian or Nepalese in different blood groups with Nor BMI group are shown in the Table 12. Significant difference was present in between Nepalese (35%) and Indian (21.11%) ($p < 0.001$) participants in the Nor group. The distribution of 147 (20.42%) females and 105 (14.58%) males of 252 Nepalese, or 72 (10.0%) females and 80 (11.11%) males of 152 Indians of 404 participants with Nor BMI

was found significantly different ($p < 0.005$). The difference between the distribution of Nepalese females and males in A and O was found significant ($p < 0.05$). The distribution of Indian females and males is significantly different ($P < 0.05$) in all blood group except AB. Significant difference was present in between Nepalese (35%) and Indian (21.11%) ($p < 0.001$) participants in the Nor group.

Table 12. Distribution of Nepalese or Indian female and male participants with BMI: Normal group in different blood groups

		BMI: Nor									
		Nepalese				χ^2 : p-value	Indian				χ^2 : p-value
		Female	%	Male	%		Female	%	Male	%	
Blood group	A	40	5.56	25	3.47	0.021*	12	1.67	8	1.11	0.044*
	B	50	6.94	40	5.56	0.408	16	2.22	20	2.78	0.035*
	AB	12	1.67	3	0.42	0.095	4	0.56	8	1.11	0.226
	O	45	6.25	37	5.14	0.044*	40	5.56	44	6.11	0.004*
	Total	147	20.42	105	14.58	0.005*	72	10.00	80	11.11	0.000* [#]

Occurrences of males or females of Indian or Nepalese in different blood groups with OvW group are described in the Table 13. The distribution of 16 (2.22) females and 50 (6.94%) males of 66 Nepalese, and 52 (7.22%) females and 60 (8.33%) males of 112 Indians of 178 participants with OvW were documented significantly different ($p < 0.01$). In both cases males were found more prevalent than

females. The presence of difference between the distribution of Nepalese females and males in A, B and AB was found significant ($p < 0.05$). The distribution of Indian females and males is significantly different ($p < 0.05$) in AB and O blood groups. There is no significant difference in the distribution between Indian and Nepalese male participants with OvW group.

Table 13. Distribution of Nepalese or Indian female and male participants with BMI: Overweight group in different blood groups

		BMI: OvW									
		Nepalese				χ^2 : p-value	Indian				χ^2 : p-value
		Female	%	Male	%		Female	%	Male	%	
Blood group	A	3	0.42	20	2.78	0.001*	12	1.67	8	1.11	0.217
	B	8	1.11	8	1.11	0.015*	24	3.33	20	2.78	0.114
	AB	0	0.00	7	0.97	0.024*	4	0.56	8	1.11	0.043*
	O	5	0.69	15	2.08	0.201	12	1.67	24	3.33	0.050*
	Total	16	2.22	50	6.94	0.000*	52	7.22	60	8.33	0.008* [#]

Occurrences of males or females of Indian or Nepalese in different blood groups with Obe BMI group are described in the Table 14. Two females and 3 males of 5 Nepalese, and 24 females and 32 males of 56 Indians of 61 participants with Obe were distributed in ABO blood groups. In Obe group, Nepalese participant were found only in O group ($p < 0.05$) and there was no Indian

participants present in AB group. The presence of 4, 8 and 12 Indian females with obe were distributed in A, B and O blood groups. Twenty four and 8 of 32 Indian male participants with Obe, was registered in B and O blood groups. Among Indian with Obe group, males are more prevalent than females ($p < 0.001$) and again it is more significant in B blood group.

Table 14. Distribution of Nepalese or Indian female and male participants with BMI: Obese group in different blood groups

		BMI: >30									
		Nepalese				χ^2 : p-value	Indian				χ^2 : p-value
		Female	%	Male	%		Female	%	Male	%	
Blood group	A	0	0.00	0	0.00	0.322	4	0.56	0	0.00	0.012*
	B	0	0.00	0	0.00	0.196	8	1.11	24	3.33	0.000*
	AB	0	0.00	0	0.00	0.564	0	0.00	0	0.00	0.053
	O	2	0.28	3	0.42	0.035*	12	1.67	8	1.11	0.120
	Total	2	0.28	3	0.42	0.060	24	3.33	32	4.44	0.000*#

DISCUSSION

Deviation from Normal BMI is a risk factor for many diseases^{17,18} and focusing on this point is obviously important for medical students. Considering the life style of medical students, some factors deserve high concern, like, lacking physical activity, eating of junk food, etc. which are some of the major contributors for developing obesity and subsequent complications^{19,25}. Reports correlating of BMI and blood group²⁰ prompted us to study and revalidate the fact in medical students in our college. Being in good health and spirit is obviously essential for medical students, even for anyone. Although BMI has a limitation in the distinction between body fat and muscle mass²¹, still, it is beneficial to access the social make-up and helpful for prevention of possible health hazard and improvement in the quality of life.

The relationship between blood groups and disease is continuously gaining importance^{5,8}.

This report describes the occurrence pattern of ABO and Rh Blood group system associated with different BMI groups. Nepalese students with A or B appear more with normal BMI than Indian participants. Persons with obesity are prevalent most in B+ followed by O+; and least chance to occur in AB+ subjects. These findings are corroborated with the other's report²³. But in some studies, highest number of persons with obesity were observed in O+^{14,24}. Our study also finds persons with underweight are prevalent in O+ and majority of them are Nepalese female students. Significantly large population is present among females than males in UnW category. The difference in the distribution of female participants of both the countries was not significant in UnW group. In UnW group, presence of Indian males is at least 2-fold more than Nepalese males.

Our results show that 6.67% of 720 participants are Rh negative blood group and its three-

fourth are Indian. Rh negative subjects are about two fold more prevalent in males (3.33%) than females (1.67%) among Indians, but there is no significant difference in Nepalese. However, two and four-fold higher population were noted for Indians than Nepalese in males and females, respectively. One third of 48 Rh-negative participants were belong to O blood group (4.44%) ($p < 0.001$) with a distribution frequencies of 0.69%, 2.64%, and 1.11% in UnW, Nor and OvW groups. This report also shows an increase in the O- subjects compared to other study considering medical students studying in Nepal²⁶. Occurrence of Rh- blood group was found varied widely ranging from zero percent in Meghalaya, 0.53% in Sikkim, 0.03% in West Bengal; about 5.0% in South India, Central India, Western India and Uttar Pradesh of North India to about 10.0% in rest of the North India, reviewed by Rai & Singh²⁷. Subjects with AB- blood group have the highest mean BMI observed in Turkis seafarers²⁰ and in South Indian medical students²¹ and this is not corroborated with our results for a group of Indian and Nepalese medical students. The distribution of the ABO blood groups varies in populations from race to race throughout the world²⁸. In many countries, e.g., Nepal²⁹, Australia³⁰, Britain²⁵, and USA⁴, the prevalence of ABO blood groups is in the following order O>A>B>AB²². There are reports that the occurrence of Rh+ people are most in Asian (99%) followed by American blacks (95%) and all white people (85%)³¹.

The persons with O and B blood groups show no preference for any particular BMI group. The wide spectrum of distribution of BMI from underweight to obese are associated with O as well as B blood groups. It was observed that in persons with overweight and obesity and having low physical activity levels, the risk of abdominal obesity, increased blood glucose concentration,

elevated blood pressure and higher concentration of abnormal triglycerides was higher compared to those doing high physical activity, regardless of BMI³². BMI is considered as a significant predictor of cardiovascular disease and type 2 diabetes mellitus^{20,33}. It has been suggested that the individuals with specific blood group of ABO and Rh systems are differently susceptible to certain diseases.

Our results show that 8.47% of 720 participants are persons with obesity and they are concomitant with B, O, and A blood groups by 3.33%, 1.53% and 0.56%, respectively, indicating that persons with A and AB may have least chance to develop obesity. Probably it is due to metabolism of additional aminated sugar, NAcGal to H antigen for the production of A group. The basic difference lies in the amino group of NAcGal metabolism for A antigen than other blood group of ABO system.

In Overweight group, Indian females are more prevalent as compared to the prevalence of Nepalese females and they are found associated with an order of A>B>O. Nepalese participants with obese were present only in O blood group. Participants with obesity are prevalent in Indians of both sexes and their association were accounted as B>O>A blood groups. A major population of participants with obesity were Indian males. Although, in this study, subjects with overweight or obesity are apparently doing normal as others and none is having a history of diabetes at least up to their age of about 20 years covering this study period, it is an alarming scenario for Indian subjects who may develop obesity with the advancement of age and it demands adaptation of preventive measures including exercise and dietary innovations³⁶. Further study is needed to ascertain the fact where more participants and extended to different age groups.

CONCLUSION

The prevalence of subjects in different blood groups are as follows: O >B>A>AB). More or less equal frequencies of occurrences of these blood groups were observed among males and females. The major difference in distribution frequencies of Nepalese (12.92%) and Indian (6.67%) participants was present with A blood group. Out of 720 participants, 672 (93.33%) and 48 (6.67%) were Rh-positive and Rh-negative, respectively. Majority of Rh-negative subjects are belonging to O blood group. Our results indicate that though the number of participants with normal BMI is the highest, a considerable number of underweight, overweight and obese categories were also found. Nepalese girls are more in underweight and majority of them are associated with O blood group. Nepalese boys

are prevalent in overweight and associated mainly with A and O blood groups. Indian participants of both sexes appear equally susceptible to be overweight where females and males are associated with B and O blood groups, respectively. Majority of obese are Indian and prevalent in males and associated with B as well as O blood group. This study might be helpful to understand the distribution and association of blood groups and BMI and measures can be taken for the betterment of public health.

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