

A comparison of the prevalence of the ABO and RhD blood types among different racial/ethnic groups in the different provinces of the Republic of South Africa

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Abstract

Knowledge of ABO and RhD blood type prevalence within a population is essential for blood transfusion services to maintain an adequate, appropriately distributed supply, particularly for rarer types such as RhD negative blood. This retrospective study examined the distribution of ABO and RhD blood types among first-time whole blood donors (n=252,304) across the nine provinces of South Africa, stratified by four self-identified racial/ethnic groups (Black, White, Colored, Indian/Asian), using data from SANBS and WCBS collected between January 2018 and December 2019. Nationally, 93,2% of donors were RhD positive and 6,8% RhD negative, with O the most common ABO type (47,5%). Distinct patterns emerged by racial/ethnic group: White donors showed markedly higher blood type A and RhD negative prevalence, Indian/Asian donors showed elevated type B, and Black donors' distributions closely mirrored national figures, with notable regional variation in type O prevalence. These findings support more targeted blood collection and distribution strategies across South Africa's provinces.

Keywords: ABO blood type, RhD blood type, Blood donors, Racial/ethnic groups, South Africa, Transfusion medicine

Background

Knowledge of the prevalence of the ABO and RhD blood groups within a population is essential for blood transfusion services to maintain an adequate and appropriately distributed supply of blood. This is particularly important for rarer blood types, such as RhD negative blood, which is required for emergency transfusion when the ABO and RhD status of a patient is unknown; the use of RhD negative blood in this setting avoids exposing RhD negative patients – particularly women of child-bearing potential – to RhD positive blood and the associated risk of alloimmunization.

The prevalence of the ABO and RhD blood types has been reported to differ between racial/ethnic groups internationally, suggesting an underlying genetic basis linked to the historical geographical origin and migration of population groups. The Republic of South Africa (RSA) has a racially and ethnically diverse population, the composition of which differs markedly across its nine provinces. Limited data exist comparing the prevalence of the ABO and RhD blood types among the racial/ethnic groups across these provinces. This study reports on the distribution of the ABO and RhD blood types among the different racial/ethnic groups of first-time whole blood donors in each province of the RSA.

Methods

This was a retrospective study of first-time whole blood donors who donated at fixed and mobile blood donation clinics operated by the South African National Blood Service (SANBS) and the Western Cape Blood Service (WCBS) between January 2018 and December 2019. A total of 252,304 first-time donors were included in the analysis. At the time of donation, each donor was asked to self-identify as belonging to one of four racial/ethnic groups: Black, White, Colored or Indian/Asian. The ABO and RhD blood type of each donor was determined as part of routine pre-donation testing.

For each of the nine provinces of the RSA, the percentage of first-time donors belonging to each racial/ethnic group was calculated and compared with the percentage of the general population represented by that group in the corresponding province, obtained

from the 2022 national census conducted by Statistics South Africa [4]. The 2022 national census provides the closest succeeding complete enumeration baseline for comparison. Within each racial/ethnic group and province, the prevalence of RhD positive and RhD negative status, and of each ABO/RhD blood type combination (A+, A-, B+, B-, AB+, AB-, O+, O-), was expressed as a percentage of donors within that type.

Results

The percentage of first-time donors and of the general population represented by each racial/ethnic group, together with the prevalence of RhD positive/negative status and of each ABO/RhD blood type combination, are shown for each province and for the RSA as a whole in **Table 1**.

Table 1. Percentage of first-time donors relative to the population, and prevalence of the ABO and RhD blood types, among the different racial/ethnic groups in the different provinces of South Africa.

		%Donors*	%Pop#	%RhD Pos	%RhD Neg	%A+	%A-	%B+	%B-	%AB+	%AB-	%O+	%O-
Eastern Cape	Indian/Asian	1,3	0,5	94,3	5,7	30,7	1,4	25,1	1,8	6,7	0,7	31,8	1,8
	Black	58,5	85,7	97,6	2,4	34,0	0,8	18,4	0,5	6,1	0,1	39,1	1,0
	White	23,3	5,6	85,7	14,3	34,2	5,4	9,5	1,5	3,4	0,5	38,7	7,0
	Colored	16,9	7,6	96,4	3,6	35,5	1,1	17,2	0,8	6,3	0,3	37,4	1,4
	Total	100	100	94,6	5,4	34,2	1,9	16,2	0,8	5,5	0,2	38,6	2,5
Free State	Indian/Asian	0,9	0,4	94,5	5,5	23,6	0,9	28,2	0,0	4,5	0,9	38,2	3,6
	Black	63,4	88,8	96,9	3,1	31,0	1,0	18,7	0,5	5,6	0,2	41,6	1,3
	White	31,6	8,0	86,0	14,0	32,9	5,8	10,7	1,7	3,5	0,7	38,8	5,8
	Colored	4,2	2,6	96,0	4,0	34,6	0,9	16,8	0,6	7,4	0,6	37,2	1,9
	Total	100	100	93,4	6,6	31,7	2,5	16,2	0,9	5,0	0,4	40,5	2,8
Gauteng	Indian/Asian	4,1	2,2	94,6	5,4	22,4	1,3	29,9	1,7	6,7	0,4	35,5	1,9
	Black	61,5	84,6	96,2	3,8	28,6	1,1	17,5	0,7	4,5	0,2	45,6	1,9
	White	30,3	10,0	85,8	14,2	33,6	5,3	9,7	1,6	3,5	0,5	39,1	6,8
	Colored	4,1	2,9	94,7	5,3	30,6	1,7	19,3	1,2	5,5	0,3	39,4	2,1
	Total	100	100	92,9	7,1	29,9	2,4	15,7	1,0	4,3	0,3	42,9	3,4
KwaZulu-Natal	Indian/Asian	22,4	9,3	95,4	4,6	21,2	1,1	31,8	1,5	7,4	0,4	35,1	1,6
	Black	58,1	84,8	96,6	3,4	28,7	1,1	19,1	0,7	5,0	0,1	43,8	1,5
	White	15,6	4,1	84,0	16,0	33,5	6,4	9,0	1,4	3,3	0,8	38,2	7,3
	Colored	3,9	1,5	93,2	6,8	30,5	2,3	17,8	1,0	5,3	0,6	39,6	2,8
	Total	100	100	94,3	5,7	27,8	2,0	20,3	1,0	5,3	0,3	40,8	2,5
Limpopo	Indian/Asian	1,3	0,5	93,0	7,0	20,9	2,6	22,6	3,5	4,3	0,0	45,2	0,9
	Black	77,7	96,5	95,9	4,1	25,5	1,0	16,3	0,7	4,2	0,2	49,9	2,3
	White	20,1	2,5	87,0	13,0	34,2	4,8	9,0	1,5	3,9	0,6	39,8	6,1
	Colored	0,9	0,3	97,4	2,6	30,3	0,0	14,5	0,0	6,6	0,0	46,1	2,6
	Total	100	100	94,1	5,9	27,2	1,7	14,9	0,9	4,2	0,3	47,8	3,0
Mpumalanga	Indian/Asian	0,9	0,5	92,5	7,4	21,8	2,5	27,2	2,5	8,4	0,0	35,1	2,5
	Black	77,0	95,3	96,0	4,0	26,9	1,0	16,8	0,8	4,2	0,2	48,1	2,1
	White	20,8	3,6	86,6	13,4	33,7	5,2	9,3	1,4	3,4	0,7	40,2	6,2
	Colored	1,3	0,6	97,5	2,5	31,3	1,6	22,2	0,0	6,0	0,3	38,0	0,6
	Total	100	100	93,8	6,0	28,4	1,9	15,2	0,9	4,1	0,3	46,2	2,9

		%Donors*	%Pop#	%RhD Pos	%RhD Neg	%A+	%A-	%B+	%B-	%AB+	%AB-	%O+	%O-
North West	Indian/Asian	1,7	0,1	94,7	5,3	16,6	2,0	35,1	1,3	4,0	0,0	39,1	2,0
	Black	43,5	93,7	95,8	4,2	30,7	1,4	17,1	0,7	5,2	0,1	42,8	2,0
	White	52,3	4,5	86,1	13,9	32,5	5,8	10,6	1,4	3,5	0,6	39,4	6,1
	Colored	2,4	1,6	94,7	5,3	34,4	0,0	17,2	1,9	11,0	1,0	32,1	2,4
	Total	100	100	90,7	9,3	31,5	3,7	14,0	1,1	4,5	0,4	40,7	4,1
Northern Cape	Indian/Asian	0,6	0,8	96,8	3,2	32,3	0,0	16,1	0,0	3,2	0,0	45,2	3,2
	Black	30,0	50,1	96,3	3,8	30,4	1,1	18,0	0,6	5,9	0,1	42,0	1,9
	White	33,0	7,3	88,4	11,6	32,7	3,9	10,2	1,4	3,8	0,8	41,7	5,5
	Colored	36,4	41,6	96,9	3,1	35,4	1,0	18,8	0,4	6,3	0,3	36,4	1,4
	Total	100	100	93,9	6,1	33,0	2,0	15,7	0,8	5,3	0,4	39,9	2,9
Western Cape	Indian/Asian	1,8	1,1	94,7	5,3	14,4	0,7	35,4	1,7	3,1	0,0	41,9	2,9
	Black	13,1	38,8	96,7	3,1	23,6	0,7	19,9	0,7	4,6	0,1	48,5	1,6
	White	46,6	16,4	84,5	15,4	27,9	4,9	10,6	1,8	2,7	0,5	43,4	8,2
	Colored	38,5	42,1	95,3	4,5	24,7	1,2	22,3	1,0	5,4	0,3	42,9	2,0
	Total	100	100	90,5	9,4	25,9	2,8	16,8	1,4	4,0	0,3	43,8	4,9
RSA (overall)	Indian/Asian	6,2	2,6	95,1	5,1	21,5	1,3	31,1	1,6	7,0	0,4	35,5	1,8
	Black	57,0	81,0	96,5	3,7	28,9	1,1	17,9	0,7	4,8	0,2	44,9	1,7
	White	28,2	7,7	85,7	14,7	32,7	5,4	9,8	1,6	3,4	0,5	39,8	6,9
	Colored	8,6	8,8	95,5	4,5	29,7	1,4	19,9	0,9	5,8	0,3	40,1	1,9
	Total	100	100	93,1	9,5	30,0	2,3	16,1	1,0	4,7	0,3	42,4	5,9

* Percentage of first-time donors of the racial/ethnic group.

Percentage of the racial/ethnic group in the province.

Indian/Asian

The Indian/Asian population was most highly represented among first-time donors in KwaZulu-Natal, where this group comprised 22,4% of donors, considerably higher than the next-highest proportion of 4,1% recorded in Gauteng. Across most provinces, the percentage of blood type A among Indian/Asian donors was lower than that of the combined racial/ethnic groups, the Northern Cape being the exception; conversely, the percentage of blood type B among Indian/Asian donors exceeded that of the combined groups in every province and in the RSA overall.

Black

Black donors constituted the highest percentage of first-time donors in all provinces except the Northern and Western Cape, broadly reflecting the percentage of the Black population in these provinces. The highest percentages of Black first-time donors were recorded in Limpopo (77,7%) and Mpumalanga (77,0%). In general, the percentages of the various ABO/RhD blood types among Black donors were similar to those of the combined racial/ethnic groups in each province and in the RSA. Exceptions were noted in Limpopo and Mpumalanga, where the percentage of type O donors (52,2% and 50,2% respectively) was notably higher than the corresponding national figure for Black donors (46,6%) and the global percentage of 42,49%. In the Western Cape, the percentage of blood type A among Black donors was lower than in other provinces, while in KwaZulu-Natal the percentage of blood type B among Black donors exceeded both the provincial and national values.

White

White donors comprised the highest percentage of first-time donors in North West, the Western Cape, the Northern Cape, Gauteng and the Free State, despite being a numerical minority of the general population in each of these provinces. Among White donors, the percentage of blood type A was significantly higher than that of the combined racial/ethnic groups in every province and in the RSA, while the percentages of blood types B and AB were significantly lower. The percentages of blood type A negative and O negative donors were also markedly higher among White donors than among the combined racial/ethnic groups in each province and in the RSA, contributing to the overall higher percentage of RhD negative donors in this group.

Colored

The largest percentages of Colored first-time donors were recorded in the Western Cape (38,5%) and the Northern Cape (36,4%), corresponding to the high proportion of Colored individuals within the general population of these provinces. The percentages of blood types B, AB and O among Colored donors differed from those of the combined racial/ethnic groups in each province and in the RSA, whereas the distribution of blood type A among Colored donors followed the same trend observed for the combined groups.

Summary of results

This study included 252,304 first-time donors, most of which were female (58,3%) and Black (57%) and between the ages of 16 to 25 years.

The ABO and RhD distribution for South Africa were consistent with those found globally with type O being 47,5%, type A being 31,9%, type B being 17,6% and type AB being 4,9%. The results showed that 93,2% of the first-time donors were RhD positive while 6,8% were RhD negative. Further analysis indicated that the descending frequency of the ABO and RhD as O Positive (42,5%), A Positive (29,6%), B Positive (16,6%), AB Positive (4,6%), O Negative (3,2%), A Negative (2,3%), B Negative (1,0%) and AB Negative (0,3%).

The Kruskal-Wallis test showed a statistically significant difference between the ABO and RhD blood types for the different racial/ethnic groups in the RSA as the Asymp. Sig. (p-value) were less than or equal 0,05. The outcome of the Mann-Whitney test to determine which racial/ethnic groups were responsible for these observed differences was not conclusive.

The comparison of data for the ABO and RhD blood types for the different racial/ethnic groups in the provinces indicated that for the Indian/Asian group the percentages for blood type A were noticeably lower than those for the combined racial/ethnic groups in most of the provinces except for the Northern Cape, while the percentages for the B blood type was well above those for the combined racial/ethnic groups in each province and the RSA. Furthermore, the general percentages for all blood types of the Black first-time donors were similar to those for the combined racial/ethnic groups in each province and the RSA. In the White population the percentage of blood type A were significantly higher than those of the combined racial/ethnic groups for each of the provinces and the RSA, while for blood type B and AB the percentages were significantly lower than those for the combined racial/ethnic groups in each of the provinces and the RSA. The distribution for blood types B, AB, and O for the Colored differs from those for the combined racial/ethnic groups in each province and the RSA, however, for the distribution for the A blood type follows the trend for the provinces and the RSA.

The ABO and RhD breakdown per racial/ethnic group showed that the type O had the greatest frequency in the Black population, the type A was found in the White population, the type B as well as AB in the Indian/Asian population. The Colored population did not show any outstanding blood type however all the values fall within the ranges of the three other racial/ethnic groups.

Discussion

Indian/Asian

The pattern of lower blood type A and higher blood type B prevalence observed among Indian/Asian donors in this study is consistent with the findings of Patidar and Dhiman [1], who reported a similarly lower prevalence of blood type A relative to blood type B in the Indian population, suggesting a possible genetic basis for this distribution.

Black

The concentration of Black first-time donors in Limpopo and Mpumalanga corresponds to provinces where the Black population has historically resided [2]. The relatively high proportion of Black first-time donors in most provinces suggests that targeted recruitment strategies implemented by South African blood services have been successful in broadening participation among historically underrepresented Black populations [3]. The notably higher prevalence of type O blood among Black donors in Limpopo and

Mpumalanga suggests a higher prevalence of type O blood among Black donors in these provinces. The higher prevalence of blood type B among Black donors in KwaZulu-Natal is possibly explained by the fact that more than 80% of the Black population of this province are Zulu [4]. These observations are consistent with the work of Bodmer and Cavalli-Sforza [6], who demonstrated that the genetic makeup of a particular racial/ethnic group can be linked to its historical patterns of migration and population clustering.

White

The concentration of White first-time donors in the economic hubs of Gauteng and the Western Cape [5] likely reflects socio-economic factors associated with these regions. Historically, South Africa's blood donor pool has been disproportionately composed of White donors despite Whites representing a minority of the population. This imbalance has been attributed to a complex interaction of historical, socio-economic, cultural, and trust-related factors, prompting targeted efforts to recruit donors from underrepresented population groups [6,7].

Colored

The high percentage of Colored first-time donors in the Northern Cape reflects the high proportion of Colored individuals within the general population of this province; most of these individuals are descendants of the Griqua [8]. The distribution of blood types among Colored donors, which differs from that of the other racial/ethnic groups for blood types B, AB, and O, and may be reflecting the mixed ancestral origins of the Colored population [9].

Limitations

Our study has some limitations including: donor population not being an accurate representation of South African population (Black people make up 56% of SANBS donor base but make up 81% of the population) and comparison with 2022 census data.

Conclusion

These findings contribute to the international body of knowledge on the distribution of the ABO and RhD blood types among different racial/ethnic groups and may assist South African blood transfusion services with the collection and distribution of this vital resource. The prevalence of RhD negative first-time donors varied considerably between racial/ethnic groups, being more common among White donors (14,7%) than among Black donors (3,7%). Blood services must maintain an adequate stock of type O RhD negative blood at all times to ensure its availability for emergency transfusion when the ABO and RhD status of a patient is not known, since the use of RhD negative blood in this context avoids exposing RhD negative patients to RhD positive blood and the associated risk of alloimmunization.

It is envisaged that these findings of the prevalence of the ABO and RhD blood types among different racial/ethnic groups will support the provision of an appropriate and adequate blood supply across the provinces of the Republic of South Africa.

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