

Zhang, J., Pellicori, P., Schutte, R. and Cleland, J.G. (2021) The association between blood groups and COVID-19 infection: a study from the UK Biobank. *Journal of Internal Medicine*, 289(5), pp. 747-748.

There may be differences between this version and the published version. You are advised to consult the publisher's version if you wish to cite from it.

This is the peer reviewed version of the following article:

Zhang, J., Pellicori, P., Schutte, R. and Cleland, J.G. (2021) The association between blood groups and COVID-19 infection: a study from the UK Biobank. *Journal of Internal Medicine*, 289(5), pp. 747-748, which has been published in final form at <http://dx.doi.org/10.1111/joim.13226>

This article may be used for non-commercial purposes in accordance with [Wiley Terms and Conditions for Self-Archiving](#).

<http://eprints.gla.ac.uk/227100/>

Deposited on: 10 December 2020

# **The association between blood groups and COVID-19 infection: a study from the UK Biobank**

<sup>1</sup>Jufen Zhang, <sup>2</sup>Pierpaolo Pellicori, <sup>3</sup>Rudolph Schutte, <sup>2</sup>John G. Cleland

<sup>1</sup>School of Medicine, Faculty of Health, Education, Medicine and Social Care, Anglia Ruskin University, U.K.

<sup>2</sup>Robertson Centre for Biostatistics, University of Glasgow, U.K.

<sup>3</sup>Allied Health, Faculty of Health, Education, Medicine and Social Care, Anglia Ruskin University, U.K.

**Conflict of interest:** none declared

Corresponding author: Dr Jufen Zhang

Medical School

Faculty of Health, Education, Medicine and Social Care

Anglia Ruskin University

Bishop Hall Lane

Chelmsford | CM1 1SQ

E-mail: [Jufen.Zhang@aru.ac.uk](mailto:Jufen.Zhang@aru.ac.uk)

Blood groups might influence susceptibility to COVID-19 [1-7]. We investigated associations between blood groups and COVID-19 infection in UK Biobank participants, a prospective population-based study that, between 2006 and 2010, enrolled 502,620 people aged 38–73 years in the United Kingdom. All participants gave written informed consent for their data to be used for research purposes, which was also approved by an ethics committee.

Six blood group genotypes (AA, AB, AO, BB, BO and OO) provided four phenotypes (A, B, AB and O) [2]. Blood groups O (43.4%; n = 211,412) and A (43.4%; AA Genotype: n = 36,332; AO Genotype: n = 175,173) were similarly common; blood groups B (9.6%; BB genotype: n = 2,789; BO genotype: n = 44,049) and AB (3.6%; n = 17,610) less so. Blood group was not available for 15,520 (3.0%) participants. By the 24<sup>th</sup> of August 2020, of 18,221 participants (3.6%) tested for COVID-19, 1,713 (0.3% of all participants) had at least one positive test, of whom 623 (36.4%) were hospitalised and 318 (18.6%) died. Of those who tested negative, 4,623 were hospitalised (28.0%) and 597 (3.6%) died. Blood group was known for all but 635 (3.5%) of those tested. Amongst those tested for COVID-19, median age (70 years at the time of infection) and the proportions who were men (48%) were similar amongst blood groups but those with blood group B were less likely to be white (82.7%) compared to other blood groups (89.3% for O, 91.6% for A and 85.2% for AB). Participants had similar level of higher education (college or university) for all blood groups (28%).

The percentage of participants tested was similar amongst blood groups as was the rate of positive tests for COVID-19 (Table 1). However, participants with blood group O were less likely to be hospitalised with COVID-19 after a positive test (33.3% versus 38.0%). Amongst those who tested negative for COVID-19, the rate of subsequent hospitalisation was similar amongst blood groups (data not shown).

In contrast to our results, others have found that people with blood group O have lower rates for a positive COVID-19 test but that the risk of developing severe symptoms requiring hospitalisation after a positive test is similar amongst blood groups [3][4][5]. The reasons for these observed associations and the disparities amongst reports remain speculative [6, 7] but could reflect the play of chance, differences in case ascertainment or variations in the prevalence of blood groups according to ethnicity. We did not have information on Rhesus factor or other blood groups. To date, too few deaths have occurred to conduct reliable analyses for mortality. Our findings should be added to the accumulating evidence on the relationship between blood group and COVID-19.

## **Acknowledgements**

This research has been conducted using UK Biobank resource under application number 23183.

## **Disclosure**

The authors declared no conflict of interest.

## **Authors contributions**

JZ, JC designed the study and drafted the letter; JZ, JC, PP and RS interpreted the data; JZ analyzed the data. All authors critically revised and approved the final version of the letter.

Table 1: Blood groups were associated with COVID-19 using univariate analysis\*

<b>Blood Group by Genotype</b>						
ABO group	N	<i>Testing for Covid-19 Infection</i>			<i>Hospitalisation following a positive test for Covid-19</i>	
		<i>Tested</i>	<i>Positive Test (% of those tested)</i>	<i>OR (95%CI) (for a positive test if tested)</i>	<i>Percentage of Cases with a Positive Test who were Hospitalised</i>	<i>OR (95%CI) (for being hospitalised with COVID-19 if testing positive)</i>
OO	211,412	7,466 (3.5%)	682 (9.1%)	Reference	227 (33.3%)	Reference
All groups other than OO	275,953	10,120 (3.7%)	1,031 (9.5%)	1.05 (0.95-1.17)	365 (38.0%)	1.23 (1.00-1.51)
AA	36,332	1,404 (3.9%)	142 (10.1%)	1.12 (0.93-1.35)	57 (40.1%)	1.34 (0.93-1.95)
AB	17,610	613 (3.5%)	56 (9.4%)	1.00 (0.75-1.33)	20 (35.7%)	1.11 (0.63-1.97)
AO	175,173	6,340 (3.6%)	586 (9.2%)	1.01 (0.90-1.14)	216 (36.9%)	1.17 (0.93-1.47)
BB	2,789	130 (4.7%)	16 (12.3%)	1.39 (0.82-2.37)	8 (50.0%)	2.00 (0.74-5.41)
BO	44,049	1,633 (3.7%)	161 (9.9%)	1.09 (0.91-1.30)	64 (39.8%)	1.32 (0.93-1.88)
<b>Blood Group by Phenotype</b>						
O	211,412	7,466 (3.5%)	682 (9.1%)	Reference	227 (33.3%)	Reference
All groups other than OO	275,953	10,120 (3.7%)	1,031 (9.5%)	1.05 (0.95-1.17)	365 (38.0%)	1.23 (1.00-1.51)
A	211,505	7,744 (3.7%)	728 (9.4%)	1.03 (0.92-1.15)	273 (37.5%)	1.20 (0.97-1.50)
B	46,838	1,763 (3.8%)	177 (10.0%)	1.11 (0.93-1.32)	72 (40.7%)	1.37 (0.98-1.93)
AB	17,610	613 (3.5%)	56 (9.1%)	1.00 (0.75-1.33)	20 (35.7%)	1.11 (0.63-1.97)

\*Compared with O/OO other blood group (either genotype or phenotype) was not significantly associated with both cases using the multivariate analyses adjusted for age, sex, education and ethnicity groups.

## References

- [1]. Rita Rubin, Investigating Whether Blood Type Is Linked to COVID-19 Risk. *JAMA* Published online September 16, 2020.
- [2]. Groot HE, Villegas Sierra LE, Said MA, Lipsic E, Karper JC, van der Harst P. Genetically Determined ABO Blood Group and its Associations With Health and Disease. *Arterioscler Thromb Vasc Biol.* 2020 Mar;40(3):830-838. doi: 10.1161/ATVBAHA.119.313658. Epub 2020 Jan 23.
- [3]. Ellinghaus D, Degenhardt F, Bujanda L, et al. Severe Covid-19 GWAS Group. Genomewide Association Study of Severe Covid-19 with Respiratory Failure. *N Engl J Med.* 2020 Jun 17:NEJMoa2020283.
- [4]. Goel A, Raizada A, Bansal K, Gaur N, Abraham J, Yadav A. Profile of Patients Suspected to be COVID-19: A Retrospective Analysis of Early Pandemic Data. *Cureus.* 2020 Aug 29;12(8):e10125. doi: 10.7759/cureus.10125.
- [5]. Golinelli D, Boetto E, Maietti E, Fantini MP. The association between ABO blood group and SARS-CoV-2 infection: A meta-analysis. *PLoS One.* 2020 Sep 18;15(9):e0239508. doi: 10.1371/journal.pone.0239508.
- [6]. Focosi D. Anti-A isohaemagglutinin titres and SARS-CoV-2 neutralization: implications for children and convalescent plasma selection. *Br J Haematol.* 2020 Aug;190(3):e148-e150. doi: 10.1111/bjh.16932.
- [7]. O'Sullivan JM, Ward S, Fogarty H, O'Donnell JS. More on 'Association between ABO blood groups and risk of SARS-CoV-2 pneumonia'. *Br J Haematol.* 2020 Jul;190(1):27-28. doi: 10.1111/bjh.16845.