The effect of patient ethnicity on the accuracy of peripheral pulse oximetry in patients with COVID-19 pneumonitis: a single-centre, retrospective analysis

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Introduction

Pulse oximetry is used widely to titrate oxygen therapy and triage inpatients that are critically ill.

There are concerns regarding the accuracy of pulse oximetry in patients with COVID-19 pneumonitis[1] and particularly in patients who have a greater degree of skin pigmentation[2].

The objective of this study was to determine the impact of patient ethnicity on the accuracy of peripheral pulse oximetry in patients who were critically unwell with COVID-19 pneumonitis.

Methodology

We conducted a retrospective, observational study of arterial blood oxygen saturation measurement (via co-oximetry) in patients with confirmed COVID-19 pneumonitis who had been admitted to our tertiary general centre for hypoxaemic respiratory failure.

For each patient, arterial oxygen saturations were compared using arterial blood gas analysis and the corresponding peripheral oxygenation saturations measured via pulse co-oximetry.

Bias was calculated as the mean difference between SaO_2 and SpO_2 measurement and limits of agreement were calculated as bias ± 1.96SD. Correction was made for in-subject variation. These were assessed using Bland-Altman plots.

To investigate if bias was affected at lower, more clinically relevant of oxygenation, analyses were repeated only including paired measurement with $SaO_2 \leq 94\%$.

	All measurements			Measurements when $SaO_2 \leq 94\%$		
	Bias	Lower limits of agreement (95%CI)	Upper limits of agreement (95%CI)	Bias	Lower limits of agreement (95%CI)	Upper limits of agreement (95%CI)
All patients	0.05	-2.21 (-2.16 to -2.26)	2.30 (2.25 to 2.35)	0.25	-2.26 (-2.17 to -2.34)	2.77 (2.68 to 2.86)
Patients of White ethnic origin	0.28	-1.79 (-1.74 to -1.85)	2.35 (2.29 to 2.40)	0.44	-1.88 (-1.79 to -1.98)	2.76 (2.67 to 2.85)
Patients of Asian ethnic origin	-0.33	-2.47 (-2.36 to -2.56)	1.80 (1.69 to 1.90)	0.16	-2.80 (-2.56 to -3.03)	2.48 (2.24 to 2.70)
Patients of Black ethnic origin	-0.75	-3.47 (-3.26 to -3.64)	1.97 (1.76 to 2.14)	-0.66	-3.85 (-3.46 to -4.34)	2.54 (2.12 to 3.02)

Results

During the analysis period from 25/02/2020 to 16/12/2020, the dataset was obtained from 194 patients (135 White, 34 Asian ethnic origin, 19 Black ethnic origin and 6 other ethnic origin) with confirmed COVID-19.

Bias (limits of agreement) between SaO_2 and SpO_2 measurements was 0.05% (-2.21 to 2.30).This is shown as a Bland-Altman graph in **Figure 1**. Patient ethnicity did not impact this to a clinically significant degree. **Figure 2** shows only those paired measurements when the patient was hypoxaemic (defined as $SaO2 \leq 94\%$).

Limitations

This was a single-centre retrospective study of a single disease state utilising one type of equipment which is dynamic and prone to artifact.

We did not study patients requiring mechanical ventilation, vasopressor support or renal replacement therapy.

Ethnic origin was determined by subjective, patient (or next of kin) self-identification.

70% of our patients were of White ethnic origin. The smaller number of patients of Asian and Black ethnic origin could have been a reason for the lack of precision around limits of agreement.

We did not measure melanin or skin pigmentation.

Figure 1

Figure 2
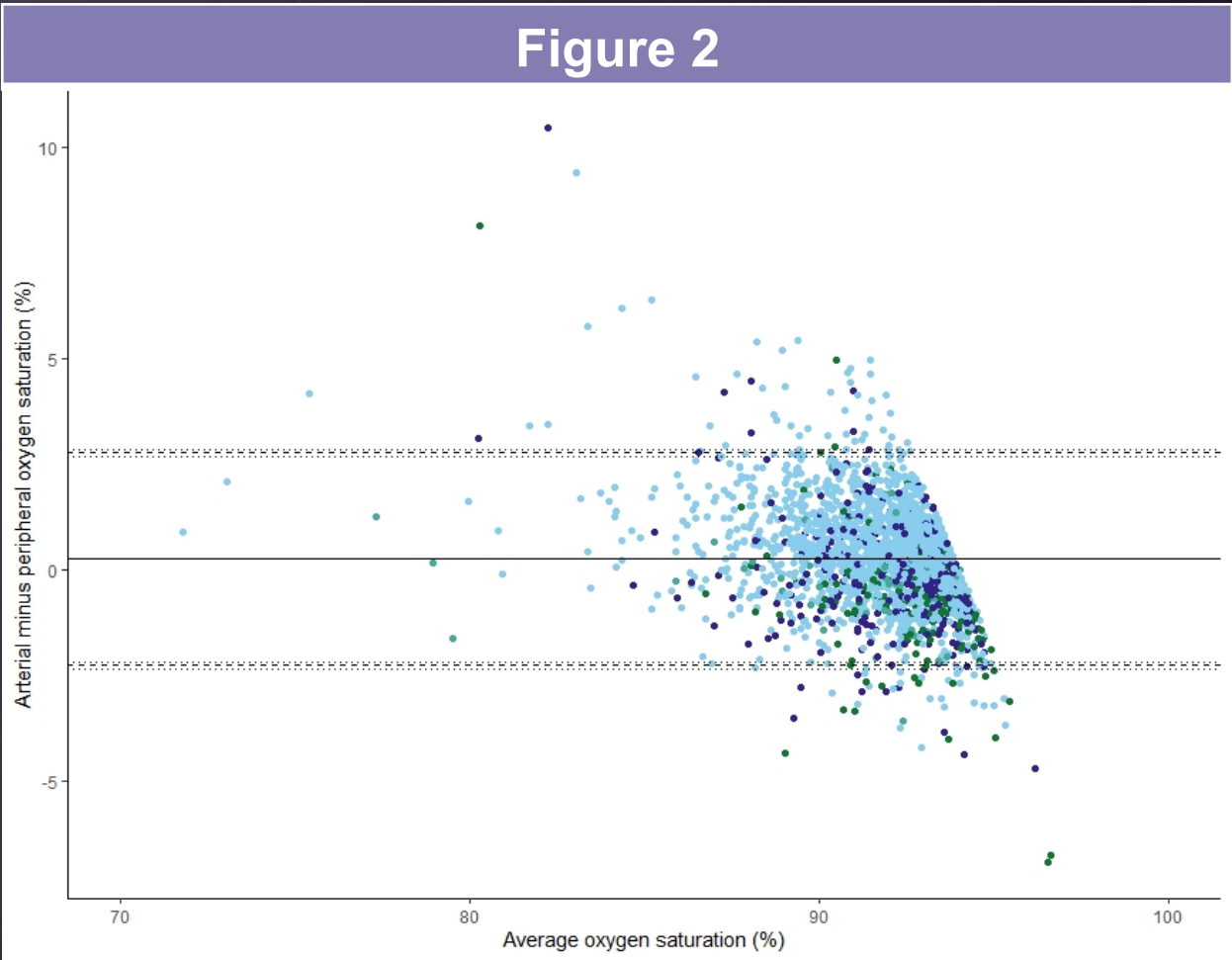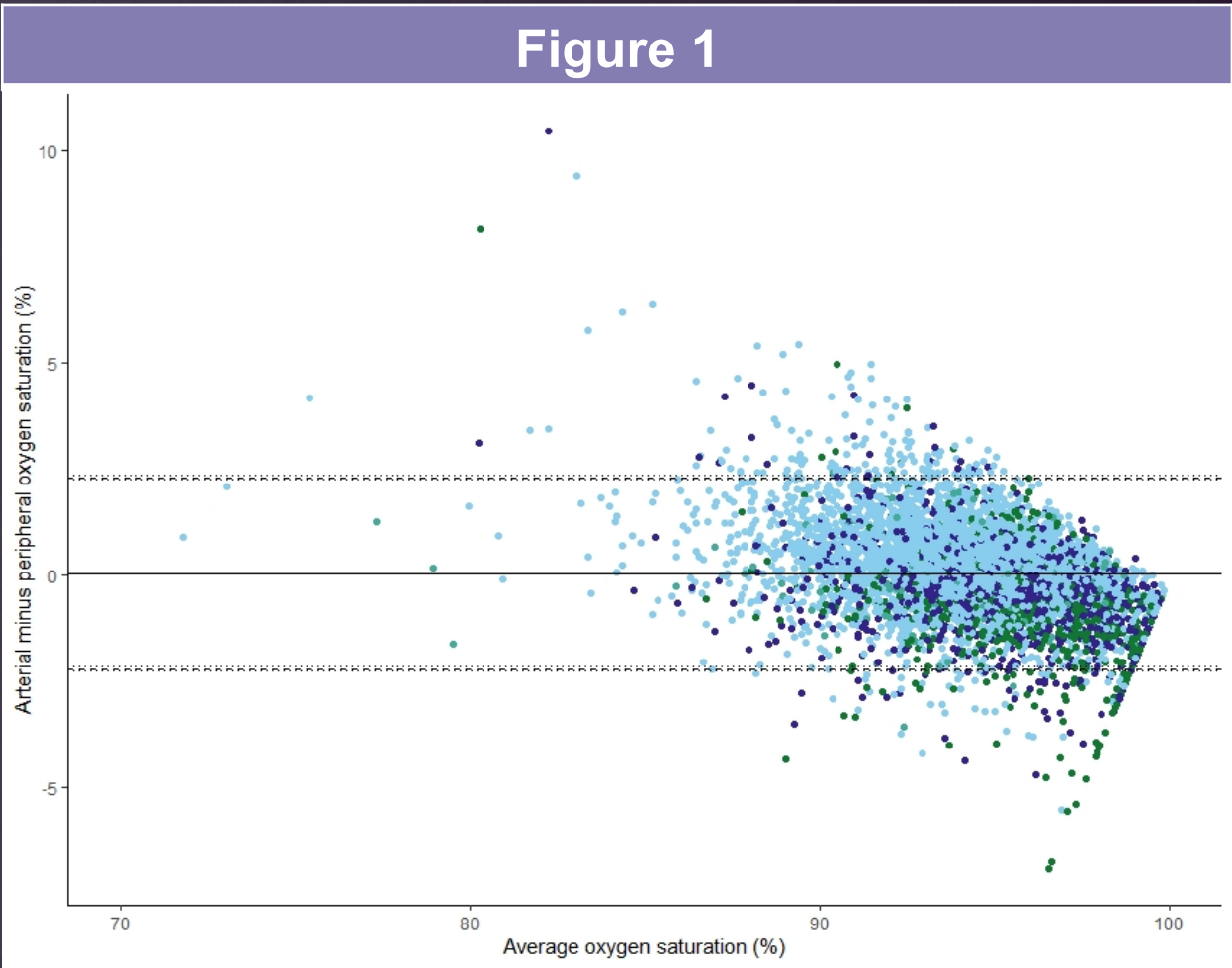
Conclusions and Recommendations

SpO_2 measurements showed a level of agreement with SaO_2 values which did not appear to be affected by ethnicity.

SpO_2 measurement remains a useful triage tool in monitoring oxygen therapy in patients of Black and Asian ethnicity with COVID-19 pneumonitis and mild to moderate hypoxaemia.

We would recommend that guidelines recommend a lower threshold for the direct measurement of SaO2 and emphasise the variable accuracy of SpO2 measurement.

References and Acknowledgements

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2. 2. Sjoding MW, Dickson RP, Iwashyna TJ, Gay SE, Valley TS. Racial Bias in Pulse Oximetry Measurement. New England Journal of Medicine 2020; 383: 2477-8. **No external funding/ competing interests declared.**

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