Cardiovascular comorbidities and complications in 800,000 hospitalised patients with COVID-19 from ISARIC

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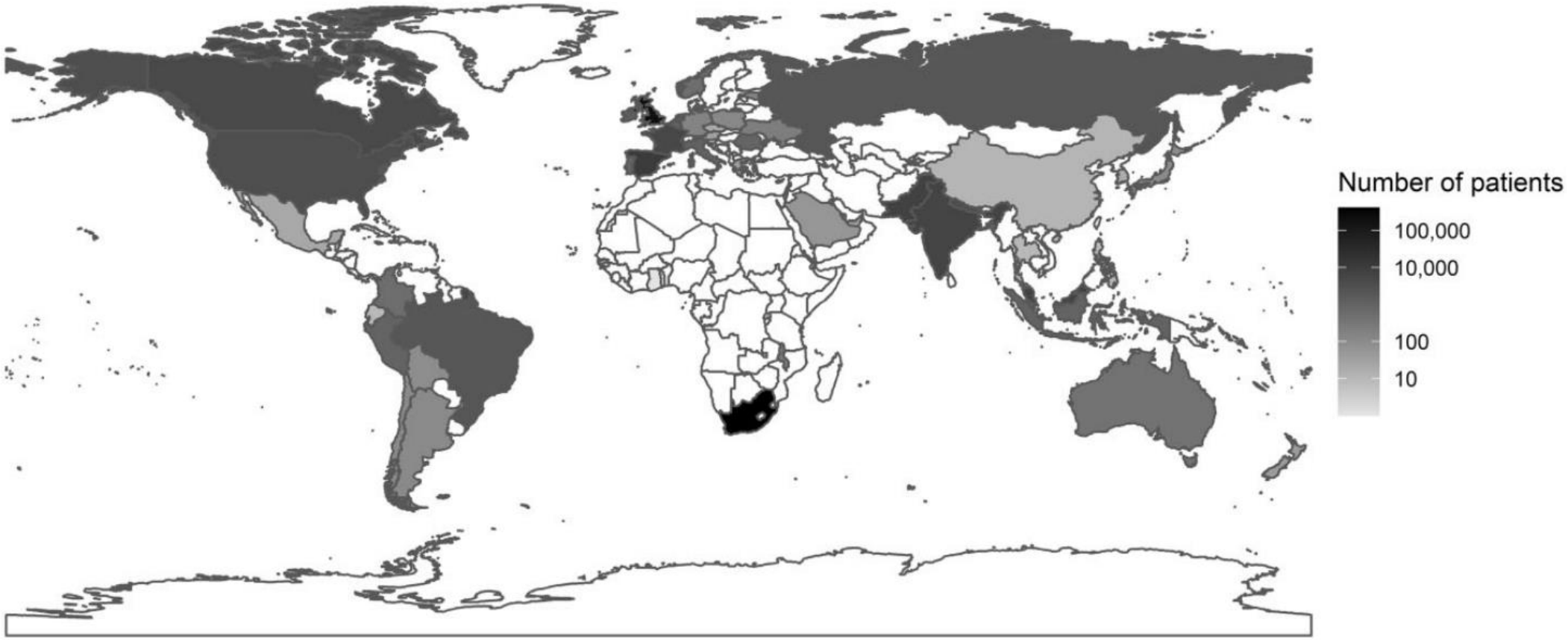
Introduction

- Individuals with cardiovascular disease are at a higher risk of COVID-19 complications

- Cardiovascular disease is common among patients hospitalised with COVID-19

International Severe Acute Respiratory and Emerging Infection Consortium (ISARIC)



Kartsonaki et al. 2023 *Int J Epidemiol*, Garcia-Gallo et al. 2022 *Sci Data*

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Patient characteristics

- 837,497 patients, recruited from 879 sites in 70 countries, Jan 2020 – Jan 2022
- The majority of patients were from sites in two countries (South Africa [56.9%] and United Kingdom [31.1%])
- 284,952 patients with CVD
- 49.3% male
- Median age 57 (interquartile range [IQR] 32)
- Median time from the latest of symptom onset and admission to the date of discharge, death or date last known to be alive was 6 (IQR 9) days
- 15.7% were admitted to ICU

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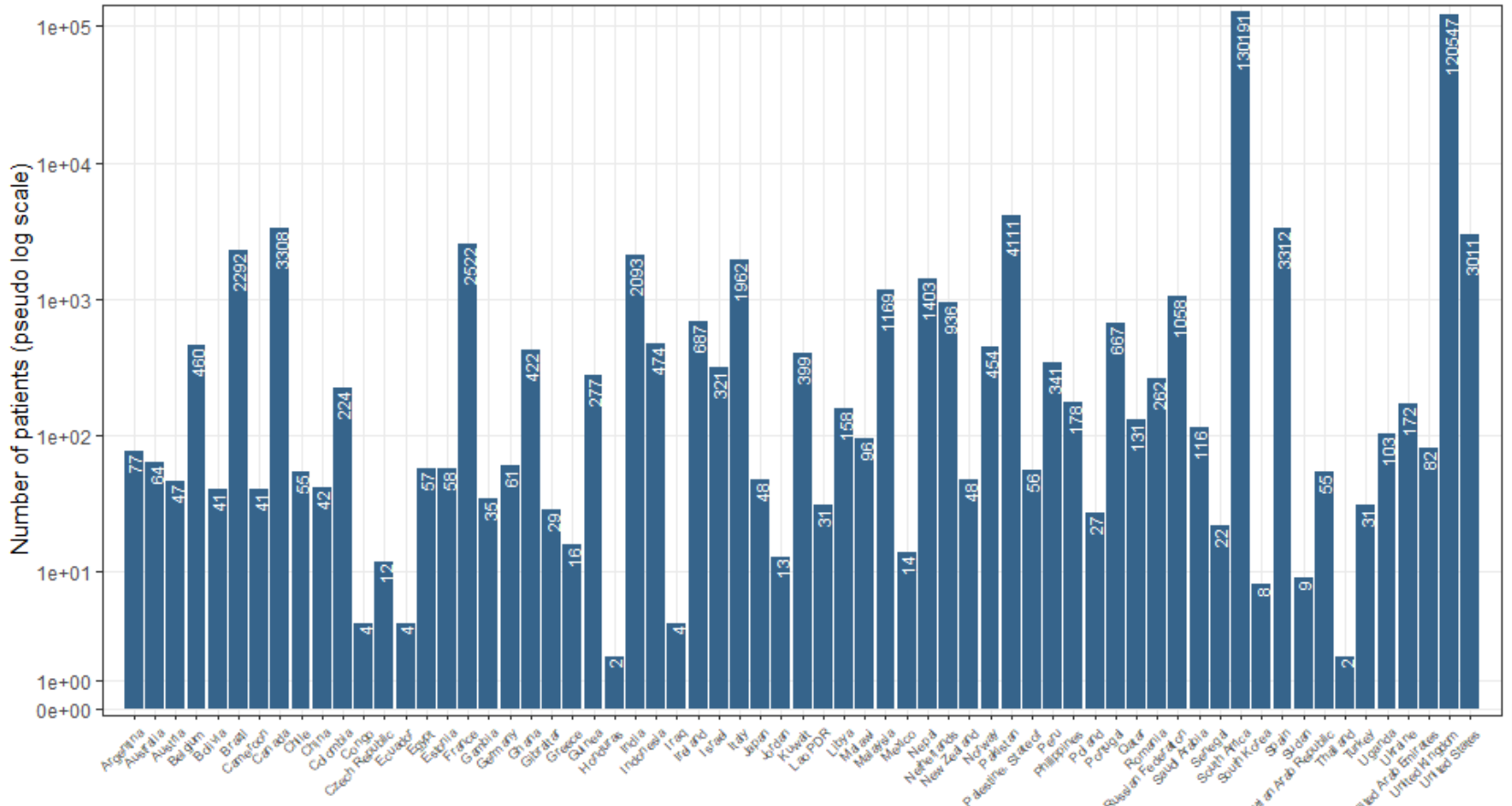
Patients with CVD by country



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Patient characteristics

	N (%)		No CVD	CVD
Length of hospital stay (days)	837497 (100.0)	Median (IQR)	6.0 (2.0 to 11.0)	8.0 (4.0 to 15.0)
Body mass index (BMI) (kg/m²)	27793 (3.3)	Median (IQR)	26.7 (23.6 to 30.5)	28.1 (24.7 to 32.3)
Admission to ICU	809041 (96.6)	Never	459785 (83.2)	225743 (79.2)
		Later admission	49059 (8.9)	34400 (12.1)
		Direct admission	22430 (4.1)	17624 (6.2)
		(Missing)	21271 (3.8)	7185 (2.5)
Outcome	837497 (100.0)	Unknown outcome	53426 (9.7)	26933 (9.5)
		Death	86743 (15.7)	79591 (27.9)
		Discharge	412376 (74.6)	178428 (62.6)

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Patient characteristics

	N (%)		No CVD	CVD
Smoking	247274 (29.5)	No	102224 (18.5)	63745 (22.4)
		Yes	38708 (7.0)	42597 (14.9)
		(Missing)	411613 (74.5)	178610 (62.7)
Obesity	368503 (44.0)	No	175754 (31.8)	136824 (48.0)
		Yes	25841 (4.7)	30084 (10.6)
		(Missing)	350950 (63.5)	118044 (41.4)

Associations with risk of death

165,628 patients died during the COVID-19-associated hospitalisation

Any cardiovascular disease

HR 1.14 (95% CI: 1.12, 1.15)

Cox regression adjusting for age, age^2, sex, and stratifying by country

Associations with risk of death

Chronic cardiac disease

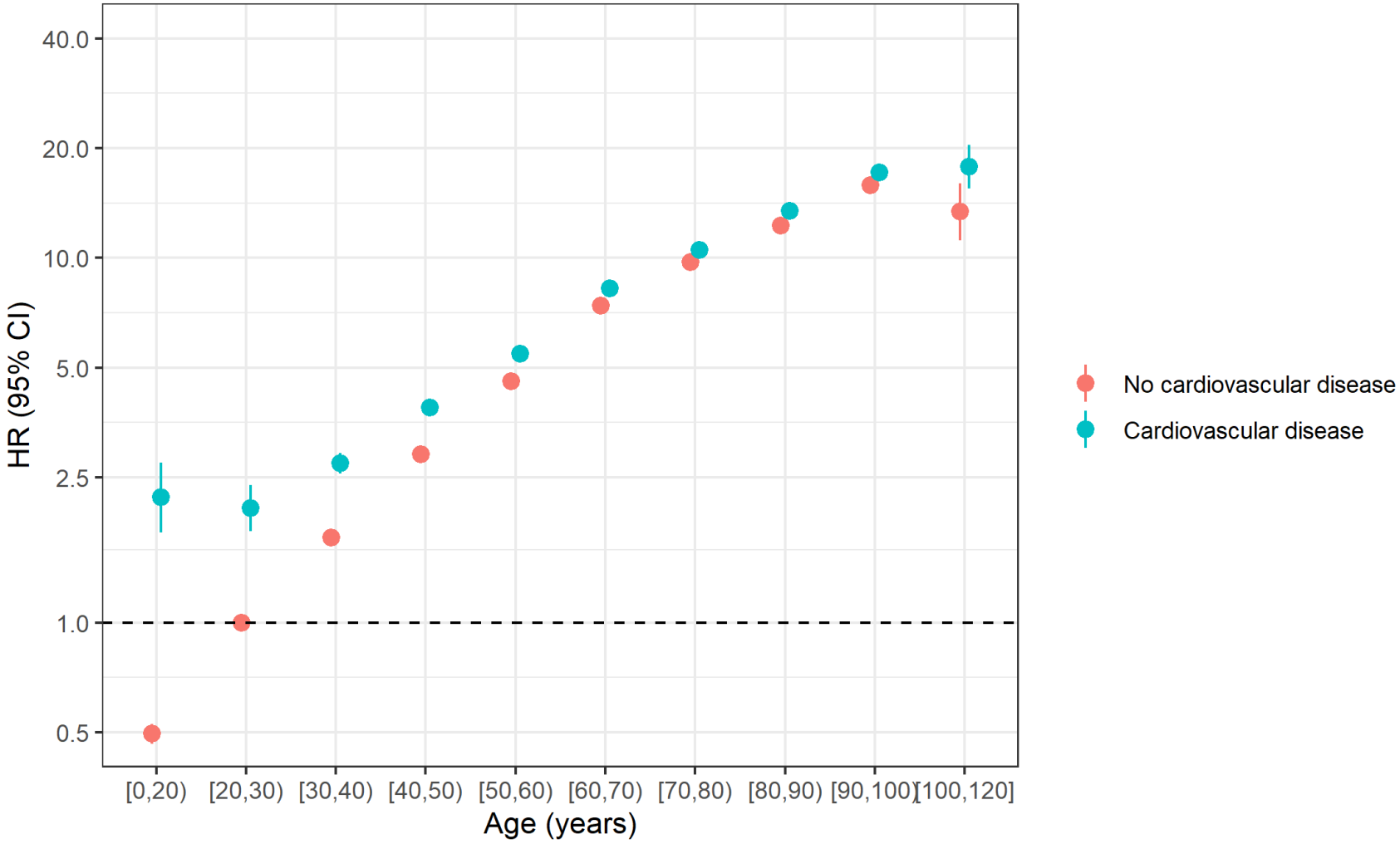
HR 1.26 (95% CI: 1.24, 1.28)

Hypertension

HR 1.18 (95% CI: 1.16, 1.19)

Cox regression adjusting for age, age^2, sex, and stratifying by country

Associations with risk of death



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Associations with admission to an intensive care unit (ICU)

122,460 patients were admitted to an ICU or high-dependency unit directly or during the COVID-19-associated hospitalisation

Any cardiovascular disease

HR 1.16 (95% CI: 1.15, 1.18)

Cox regression adjusting for age, age^2, sex, and stratifying by country

Associations with admission to ICU

Chronic cardiac disease

HR 0.92 (95% CI: 0.90, 0.93)

Hypertension

HR 1.24 (95% CI: 1.22, 1.25)

Cox regression adjusting for age, age^2, sex, and stratifying by country

Associations with use of invasive mechanical ventilation (IMV)

70,920 patients received IMV

Any cardiovascular disease

HR 1.08 (95% CI: 1.07, 1.10)

Cox regression adjusting for age, age^2, sex, and stratifying by country

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Associations with IMV

Chronic cardiac disease

HR 0.76 (95% CI: 0.74, 0.78)

Hypertension

HR 1.11 (95% CI: 1.09, 1.13)

Cox regression adjusting for age, age^2, sex, and stratifying by country

Predicting risk of major adverse cardiovascular events (MACE)

Method	Best Hypermeters	Mean Training Accuracy	Mean Validation Accuracy	Testing Accuracy	AUC-ROC
Linear discriminant analysis	solver: Least squares shrinkage: 0.2	0.8881 (0.00008)	0.8881 (0.00025)	0.8885	0.699 (0.694 – 0.705)
Quadratic discriminant analysis	reg_param: 0.35	0.8884 (0.00001)	0.8884 (0.00001)	0.8889	0.678 (0.673–0.684)
Multi-layer perceptron	activation: ReLU hidden_layer_sizes: (50, 100) learning_rate: constant solver: sgd	0.8885 (0.00004)	0.8885 (0.00009)	0.8890	0.705 (0.699 – 0.710)
Naïve Bayes	fit_prior: True	0.8343 (0.00031)	0.8339 (0.00139)	0.8334	0.667 (0.661 – 0.672)
Random forest	n_estimators: 3 max_depth: 2 min_samples_split: 2 min_samples_leaf: 2 bootstrap: True	0.8884 (0.00001)	0.8884 (0.00001)	0.8889	0.670 (0.664-0.675)
AdaBoost	n_estimators: 400 learning_rate: 0.05	0.8884 (0.00001)	0.8884 (0.00005)	0.8888	0.697 (0.691-0.702)
XGBoost	n_estimators: 250 max_depth: 3 learning_rate: 0.3 reg_alpha: 0.2 reg_lambda: 90	0.8887 (0.00012)	0.8886 (0.00026)	0.8891	0.712 (0.707- 0.717)
Histogram gradient boosting	learning_rate: 0.1 max_iter: 250 max_leaf_nodes: 45 min_samples_leaf: 10 l2_regularization: 0	0.8891 (0.00013)	0.8887 (0.00017)	0.8890	0.714 (0.708-0.719)

Safa Malik

Predicting risk of pulmonary embolism

scientific reports

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At-admission prediction of mortality and pulmonary embolism in an international cohort of hospitalised patients with COVID-19 using statistical and machine learning methods

Munib Mesinovic[1✉], Xin Ci Wong[2], Giri Shan Rajahram[3], Barbara Wanjiru Citarella[4], Kalaiarasu M. Peariasamy[2], Frank van Someren Greve[5], Piero Olliaro[4], Laura Merson[4], Lei Clifton[6], Christiana Kartsonaki[6] & ISARIC Characterisation Group*

Models	Validation AUC	AUC	Accuracy	F1-w	Sensitivity
Logistic Regression	72.5	69.4	64.9	77.3	65.5
LDA	72.2	69.2	98.4	97.6	0.0
Naive Bayes	70.4	67.2	98.3	97.6	0.5
Random forest	73.6	71.2	65.6	77.8	66.0
Stacking ensemble	63.0	65.7	66.1	78.2	65.2
Ensemble	73.0	70.3	64.7	77.1	67.0
Ensemble (XGBoost)	73.6	71.6	64.9	77.3	66.1
XGBoost	**75.6**	**74.5**	**73.4**	**83.2**	**63.5**

Mesinovic et al. 2024
Sci Rep

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Discussion

- Cardiovascular comorbidities were associated with a higher risk of admission to ICU and mortality among hospitalised patients with COVID-19, as well as higher risks of cardiovascular complications

- These findings may help inform patient management and risk prediction for COVID-19 outcomes

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