

Supplementary Appendix

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Section S1. Further details on data sources

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) testing in the healthcare system in Qatar is done at a mass scale, and mostly for routine reasons, where about 5% of the population are tested every week.^{1 2} About 75% of those diagnosed are diagnosed not because of appearance of symptoms, but because of routine testing.^{1 2} Every polymerase chain reaction (PCR) test and an increasing proportion of the facility-based rapid antigen tests conducted in Qatar, regardless of location or setting, are classified on the basis of symptoms and the reason for testing (clinical symptoms, contact tracing, surveys or random testing campaigns, individual requests, routine healthcare testing, pre-travel, at port of entry, or other). All facility-based testing done during follow-up in the present study was factored in the analyses of this study.

Rapid antigen test kits are available for purchase in pharmacies in Qatar, but outcome of home-based testing is not reported nor documented in the national databases. Since SARS-CoV-2-test outcomes are linked to specific public health measures, restrictions, and privileges, testing policy and guidelines stress facility-based testing as the core testing mechanism in the population.

While facility-based testing is provided free of charge or at low subsidized costs, depending on the reason for testing, home-based rapid testing is de-emphasized and not supported as part of national policy.

Comorbidity classification

Comorbidities were ascertained and classified based on the ICD-10 codes for chronic conditions as recorded in the electronic health record encounters of each individual in the Cerner-system national database that includes all citizens and residents registered in the national and universal public healthcare system. All encounters for each individual were analyzed to determine the

comorbidity classification for that individual, as part of a recent national analysis to assess healthcare needs and resource allocation. The Cerner-system national database includes encounters starting from 2013, after this system was launched in Qatar. As long as each individual had at least one encounter with a specific comorbidity diagnosis since 2013, this person was classified with this comorbidity. Individuals who have comorbidities but never sought care in the public healthcare system, or seek care exclusively in private healthcare facilities, are classified as individuals with no comorbidity due to absence of recorded encounters for them.

Table S1. STROBE checklist for cohort studies.

	Item No	Recommendation	Main Text page
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	Abstract
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	Abstract
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Introduction
Objectives	3	State specific objectives, including any prespecified hypotheses	Introduction
Methods			
Study design	4	Present key elements of study design early in the paper	Methods ('Study design and cohorts', 'Mortality in the national cohort of Qatar', 'Differences in mortality by nationality', & 'Differences in mortality by socio-economic population sector')
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Methods ('Study population and data sources', 'Study design and cohorts', 'Mortality in the national cohort of Qatar', 'Differences in mortality by nationality', 'Differences in mortality by socio-economic population sector', & 'Classification of COVID-19 death'), & Section S1 in Supplementary Appendix
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed	Methods ('Study design and cohorts', 'Mortality in the national cohort of Qatar', 'Differences in mortality by nationality', & 'Differences in mortality by socio-economic population sector')
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Methods ('Study design and cohorts', 'Mortality in the national cohort of Qatar', 'Differences in mortality by nationality', 'Differences in mortality by socio-economic population sector', & 'Classification of COVID-19 death', & Section S1 & Tables S2-S3 in Supplementary Appendix
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Methods ('Study population and data sources' & 'Statistical analysis'), & Section S1 in Supplementary Appendix
Bias	9	Describe any efforts to address potential sources of bias	Methods ('Differences in mortality by nationality', 'Differences in mortality by socio-economic population sector', & 'Statistical analysis')
Study size	10	Explain how the study size was arrived at	Methods ('Study design and cohorts', 'Mortality in the national cohort of Qatar', 'Differences in mortality by nationality', & 'Differences in mortality by socio-economic population sector')
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Methods ('Differences in mortality by nationality', 'Differences in mortality by socio-economic population sector', & 'Statistical analysis'), & Table S2-S3 in Supplementary Appendix
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	Methods ('Statistical analysis')
		(b) Describe any methods used to examine subgroups and interactions	Methods ('Differences in mortality by nationality', 'Differences in mortality by socio-economic population sector', & 'Statistical analysis')
		(c) Explain how missing data were addressed	Not applicable, see Methods ('Study population and data sources')
		(d) If applicable, explain how loss to follow-up was addressed	Methods ('Statistical analysis, paragraph 2')

		(e) Describe any sensitivity analyses	Not applicable
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram	Tables S2-S3 in Supplementary Appendix
Descriptive data	14	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Tables S2-S3 in Supplementary Appendix
		(b) Indicate number of participants with missing data for each variable of interest	Not applicable, see Methods ('Study population and data sources')
		(c) Summarise follow-up time (eg, average and total amount)	Results ('Mortality in the national cohort of Qatar'), & Figures 1-3
Outcome data	15	Report numbers of outcome events or summary measures over time	Results, Figures 1-3, Tables 2-4, & Figures S2 in Supplementary Appendix.
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Results & Tables 1-4
		(b) Report category boundaries when continuous variables were categorized	Tables S2-S3 in Supplementary Appendix
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	Not applicable
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Results ('Differences in mortality by nationality', & 'Differences in mortality by socio-economic population sector') & Tables 2-4
Discussion			
Key results	18	Summarise key results with reference to study objectives	Discussion, paragraphs 1-5
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Discussion, paragraphs 6-9
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Discussion, paragraph 10
Generalisability	21	Discuss the generalisability (external validity) of the study results	Discussion, paragraphs 6-9
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Acknowledgements

Figure S1. SARS-CoV-2 epidemic waves and daily number of newly diagnosed SARS-CoV-2 infections between February 5, 2020 and September 19, 2022.

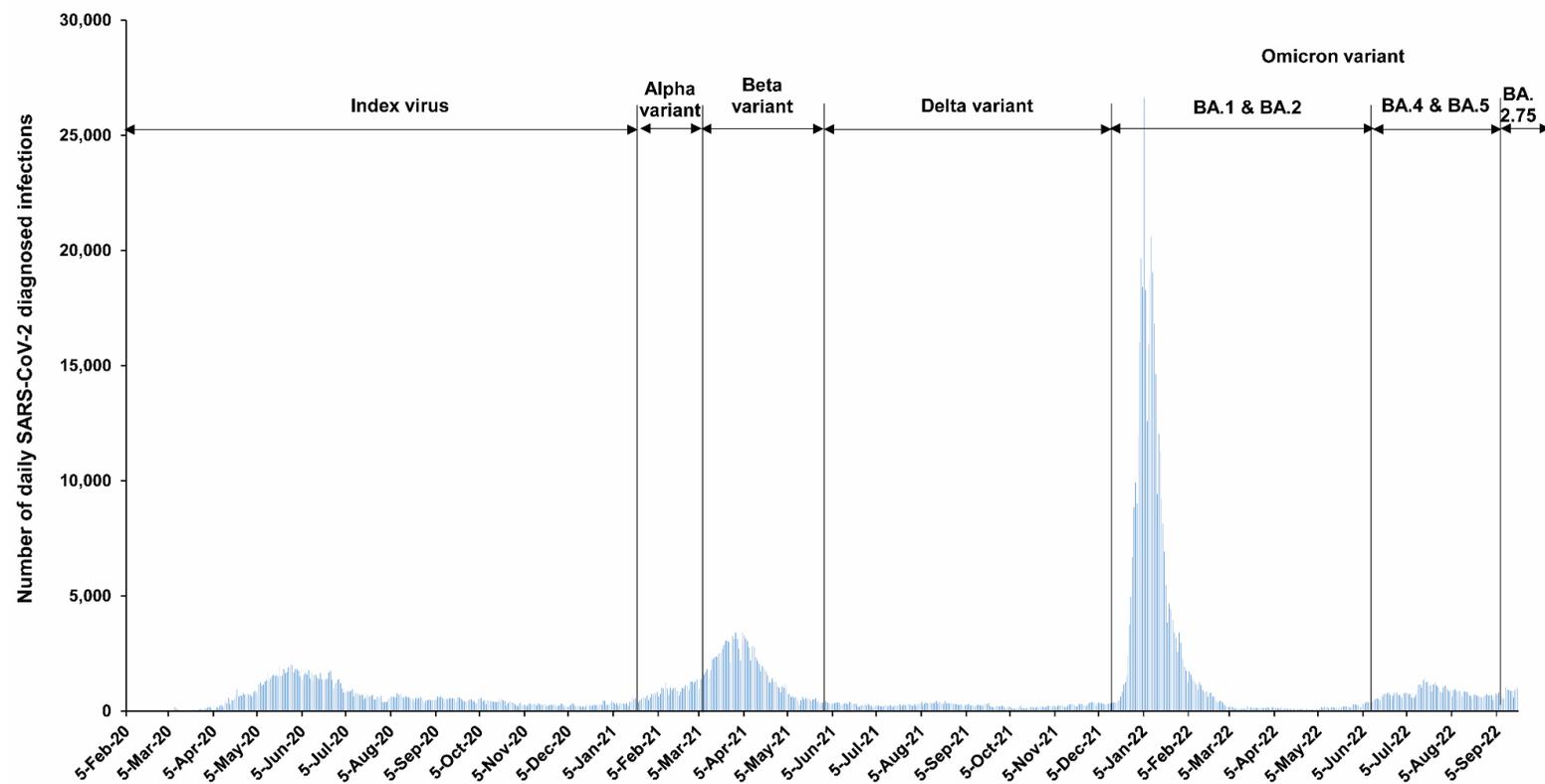
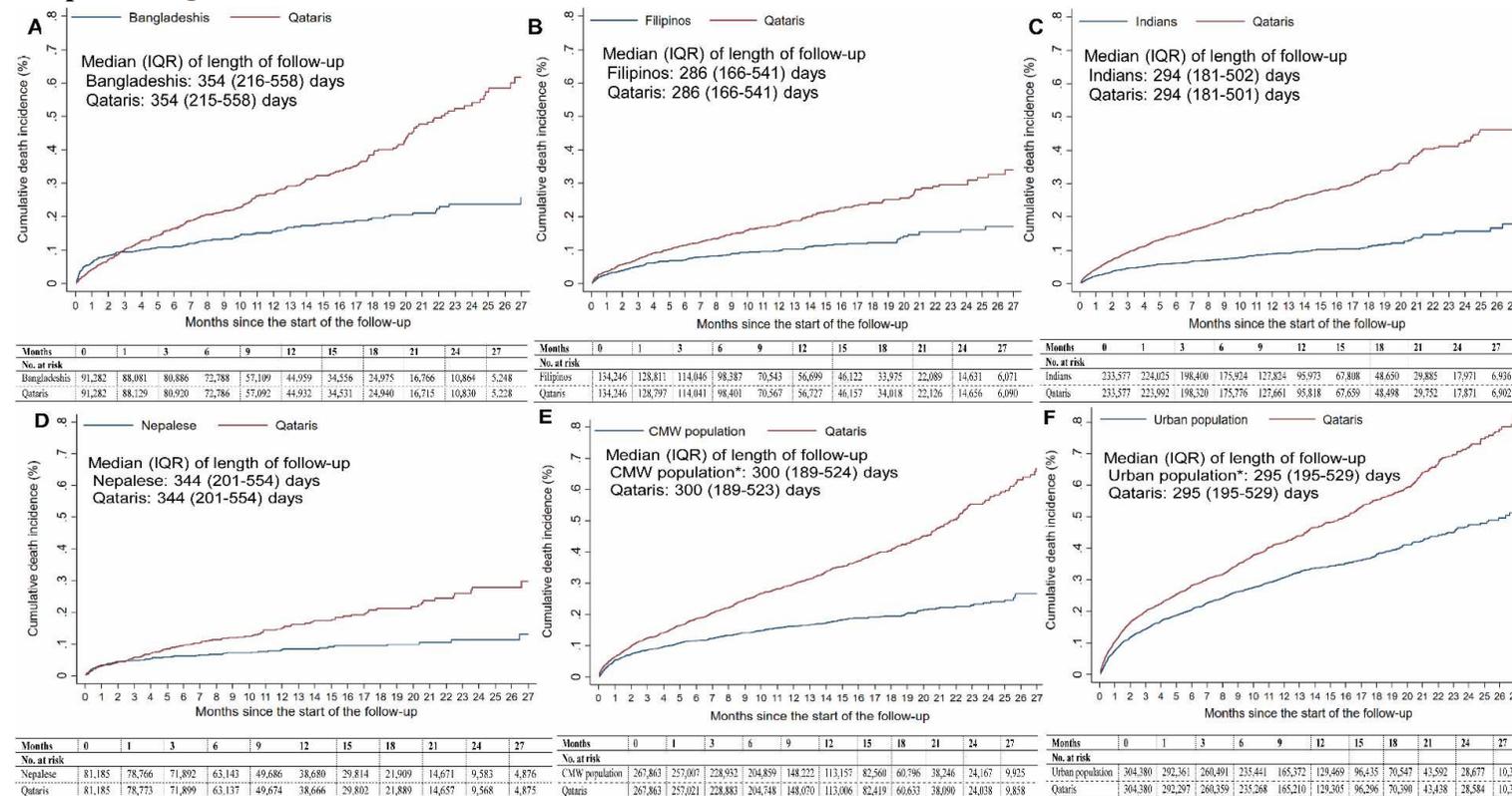


Figure S2. Cumulative incidence of death for all-cause non-COVID-19 mortality in major nationality groups in Qatar compared to Qataris.



CMW denotes civil and manual workers, and IQR, interquartile range.
 *CMW population includes Bangladeshis, Indians, Nepalese, Pakistanis, and Sri Lankans. Urban population includes all other expatriate nationalities residing in Qatar.

Table S2. Baseline characteristics of matched cohorts in the pairwise comparisons of Bangladeshis versus Qataris, Filipinos versus Qataris, and Indians versus Qataris.

Characteristics	Bangladeshis versus Qataris ^a			Filipinos versus Qataris ^a			Indians versus Qataris ^a		
	Bangladeshis	Qataris	SMD ^b	Filipinos	Qataris	SMD ^b	Indians	Qataris	SMD ^b
	N=91,282	N=91,282		N=134,246	N=134,246		N=233,577	N=233,577	
Median age (IQR)—years	34 (27-42)	33 (25-43)	0.04 [‡]	34 (27-43)	33 (24-43)	0.04 [‡]	26 (10-38)	24 (11-38)	0.01 [‡]
Age—years									
1-9	3,039 (3.3)	3,039 (3.3)		10,123 (7.5)	10,123 (7.5)		54,596 (23.4)	54,596 (23.4)	
10-19	4,160 (4.6)	4,160 (4.6)		7,739 (5.8)	7,739 (5.8)		42,191 (18.1)	42,191 (18.1)	
20-29	25,418 (27.9)	25,418 (27.9)		31,940 (23.8)	31,940 (23.8)		41,141 (17.6)	41,141 (17.6)	
30-39	29,294 (32.1)	29,294 (32.1)	0.00	39,720 (29.6)	39,720 (29.6)	0.00	40,992 (17.6)	40,992 (17.6)	0.00
40-49	16,573 (18.2)	16,573 (18.2)		27,464 (20.5)	27,464 (20.5)		27,532 (11.8)	27,532 (11.8)	
50-59	9,448 (10.4)	9,448 (10.4)		14,036 (10.5)	14,036 (10.5)		17,585 (7.5)	17,585 (7.5)	
60-69	3,229 (3.5)	3,229 (3.5)		3,061 (2.3)	3,061 (2.3)		7,997 (3.4)	7,997 (3.4)	
≥70	121 (0.1)	121 (0.1)		163 (0.1)	163 (0.1)		1,543 (0.7)	1,543 (0.7)	
Sex									
Male	74,416 (81.5)	74,416 (81.5)	0.00	59,332 (44.2)	59,332 (44.2)	0.00	124,755 (53.4)	124,755 (53.4)	0.00
Female	16,866 (18.5)	16,866 (18.5)		74,914 (55.8)	74,914 (55.8)		108,822 (46.6)	108,822 (46.6)	
Comorbidity count									
None	67,244 (73.7)	67,244 (73.7)		101,241 (75.4)	101,241 (75.4)		176,168 (75.4)	176,168 (75.4)	
1	12,633 (13.8)	12,633 (13.8)		17,615 (13.1)	17,615 (13.1)		33,437 (14.3)	33,437 (14.3)	
2	5,709 (6.3)	5,709 (6.3)		9,899 (7.4)	9,899 (7.4)		12,022 (5.2)	12,022 (5.2)	
3	2,839 (3.1)	2,839 (3.1)	0.00	3,741 (2.8)	3,741 (2.8)	0.00	5,936 (2.5)	5,936 (2.5)	0.00
4	1,490 (1.6)	1,490 (1.6)		1,170 (0.9)	1,170 (0.9)		3,560 (1.5)	3,560 (1.5)	
5	742 (0.8)	742 (0.8)		409 (0.3)	409 (0.3)		1,571 (0.7)	1,571 (0.7)	
≥6	625 (0.7)	625 (0.7)		171 (0.1)	171 (0.1)		883 (0.4)	883 (0.4)	
SARS-CoV-2 testing method									
PCR	71,150 (78.0)	71,150 (78.0)	0.00	95,868 (71.4)	95,868 (71.4)	0.00	164,583 (70.5)	164,583 (70.5)	0.00
Rapid antigen testing	20,132 (22.1)	20,132 (22.1)		38,378 (28.6)	38,378 (28.6)		68,994 (29.5)	68,994 (29.5)	

IQR denotes interquartile range, PCR, polymerase chain reaction, SARS-CoV-2 severe acute respiratory syndrome coronavirus 2, and SMD standardized mean difference.

^aCohorts were exact matched one-to-one by sex, 10-year age groups, comorbidity count, testing method (PCR versus rapid antigen testing), and calendar week of the SARS-CoV-2 test.

^bSMD is the difference in the mean of a covariate between groups divided by the pooled standard deviation. An SMD ≤0.1 indicates adequate matching.

[‡]SMD is for the mean difference between groups divided by the pooled standard deviation.

Table S3. Baseline characteristics of matched cohorts in the pairwise comparisons of Nepalese versus Qataris, craft and manual worker (CMW) population versus Qataris, and urban population versus Qataris.

Characteristics	Nepalese versus Qataris ^a			CMW ^b versus Qataris ^a			Urban population ^c versus Qataris ^a		
	Nepalese	Qataris	SMD ^d	CMW	Qataris	SMD ^d	Urban population	Qataris	SMD ^d
	N=81,185	N=81,185		N=267,863	N=267,863		N=304,380	N=304,380	
Median age (IQR)—years	31 (25-39)	31 (24-39)	0.04 [‡]	25 (10-39)	24 (11-39)	0.01 [‡]	25 (10-39)	23 (10-39)	0.01 [‡]
Age—years									
1-9	810 (1.0)	810 (1.0)		60,183 (22.5)	60,183 (22.5)		69,561 (22.9)	69,561 (22.9)	
10-19	6,229 (7.7)	6,229 (7.7)		53,095 (19.8)	53,095 (19.8)		65,697 (21.6)	65,697 (21.6)	
20-29	30,527 (37.6)	30,527 (37.6)		46,906 (17.5)	46,906 (17.5)		51,498 (16.9)	51,498 (16.9)	
30-39	24,560 (30.3)	24,560 (30.3)	0.00	43,991 (16.4)	43,991 (16.4)	0.00	44,810 (14.7)	44,810 (14.7)	0.00
40-49	13,323 (16.4)	13,323 (16.4)		30,504 (11.4)	30,504 (11.4)		31,304 (10.3)	31,304 (10.3)	
50-59	5,359 (6.6)	5,359 (6.6)		20,403 (7.6)	20,403 (7.6)		23,019 (7.6)	23,019 (7.6)	
60-69	344 (0.4)	344 (0.4)		9,950 (3.7)	9,950 (3.7)		12,530 (4.1)	12,530 (4.1)	
≥70	33 (0.04)	33 (0.04)		2,831 (1.1)	2,831 (1.1)		5,961 (2.0)	5,961 (2.0)	
Sex									
Male	63,562 (78.3)	63,562 (78.3)	0.00	137,799 (51.4)	137,799 (51.4)	0.00	150,477 (49.4)	150,477 (49.4)	0.00
Female	17,623 (21.7)	17,623 (21.7)		130,064 (48.6)	130,064 (48.6)		153,903 (50.6)	153,903 (50.6)	
Comorbidity count									
None	71,334 (87.9)	71,334 (87.9)		183,160 (68.4)	183,160 (68.4)		183,219 (60.2)	183,219 (60.2)	
1	7,195 (8.9)	7,195 (8.9)		49,486 (18.5)	49,486 (18.5)		69,759 (22.9)	69,759 (22.9)	
2	1,978 (2.4)	1,978 (2.4)		16,956 (6.3)	16,956 (6.3)		2,3989 (7.9)	2,3989 (7.9)	
3	493 (0.6)	493 (0.6)	0.00	7,883 (2.9)	7,883 (2.9)	0.00	11,020 (3.6)	11,020 (3.6)	0.00
4	135 (0.2)	135 (0.2)		4,934 (1.8)	4,934 (1.8)		7,249 (2.4)	7,249 (2.4)	
5	32 (0.04)	32 (0.04)		2,925 (1.1)	2,925 (1.1)		4,526 (1.5)	4,526 (1.5)	
≥6	18 (0.02)	18 (0.02)		2,519 (0.9)	2,519 (0.9)		4,618 (1.5)	4,618 (1.5)	
SARS-CoV-2 testing method									
PCR	62,248 (76.7)	62,248 (76.7)	0.00	192,120 (71.7)	192,120 (71.7)	0.00	217,915 (71.6)	217,915 (71.6)	0.00
Rapid antigen testing	18,937 (23.3)	18,937 (23.3)		75,743 (28.3)	75,743 (28.3)		86,465 (28.4)	86,465 (28.4)	

IQR denotes interquartile range, PCR, polymerase chain reaction, SARS-CoV-2 severe acute respiratory syndrome coronavirus 2, and SMD standardized mean difference.

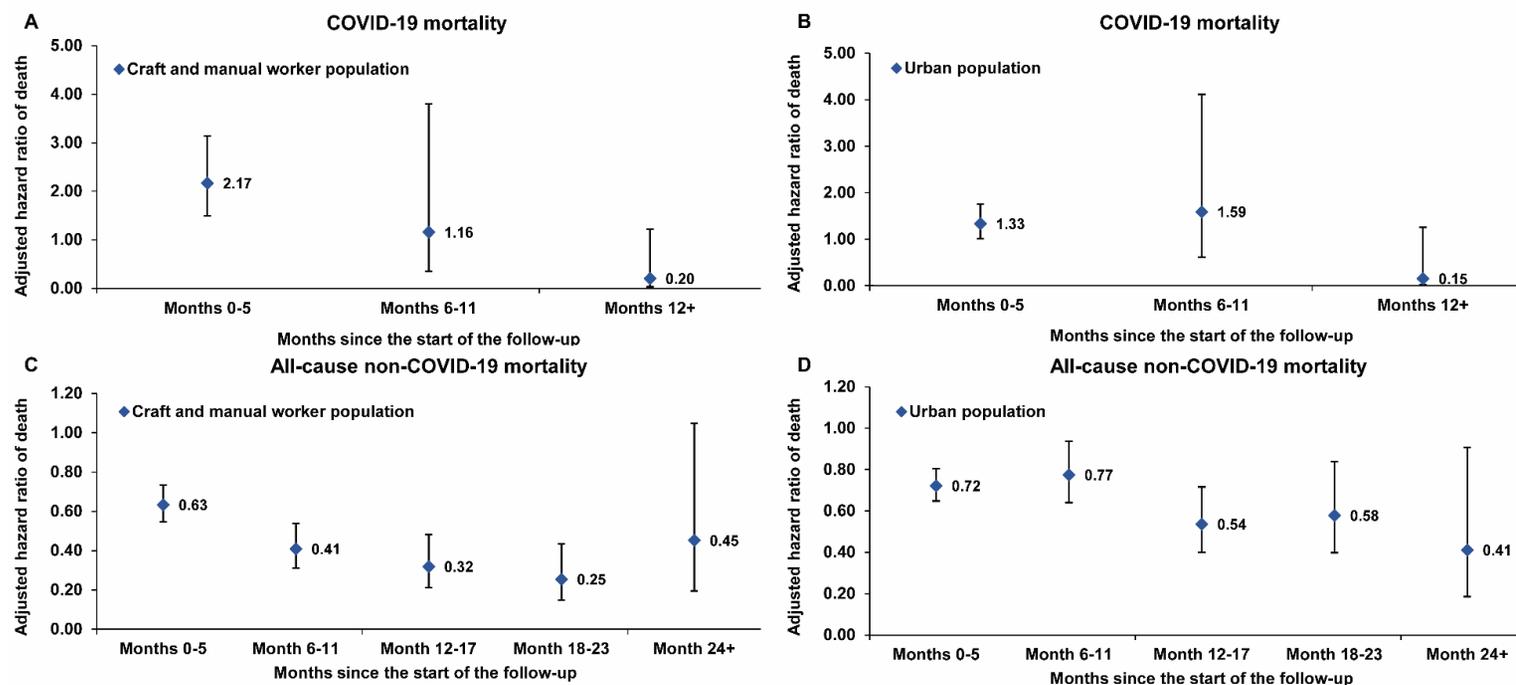
^aCohorts were exact matched one-to-one by sex, 10-year age groups, comorbidity count, testing method (PCR versus rapid antigen testing), and calendar week of the SARS-CoV-2 test.

^bSMD is the difference in the mean of a covariate between groups divided by the pooled standard deviation. An SMD ≤0.1 indicates adequate matching.

^cSMD is for the mean difference between groups divided by the pooled standard deviation.

^dCMW include Bangladeshis, Indians, Nepalese, Pakistanis, and Sri Lankans. Urban population include all other nationalities residing in Qatar.

Figure S3. Hazard ratio of death by time since the start of the follow-up for A) COVID-19 mortality in the craft and manual worker population and B) COVID-19 mortality in the urban population, and for C) all-cause non-COVID-19 mortality in the craft and manual worker population and D) all-cause non-COVID-19 mortality in the urban population, all compared to Qataris.



Hazard ratios were adjusted for sex, 10-year age group, comorbidity count, SARS-CoV-2 testing method, and calendar week of SARS-CoV-2 test.

In panels A and B, there were insufficient number of COVID-19 deaths to warrant estimation of the adjusted hazard ratio by 3-month intervals for follow-up time ≥ 12 months. Therefore, the adjusted hazard ratio was estimated for all time of follow-up ≥ 12 months.

References

1. Altarawneh HN, Chemaitelly H, Ayoub HH, et al. Effects of Previous Infection and Vaccination on Symptomatic Omicron Infections. *N Engl J Med* 2022;387(1):21-34. doi: 10.1056/NEJMoa2203965 [published Online First: 2022/06/16]
2. Chemaitelly H, Tang P, Hasan MR, et al. Waning of BNT162b2 Vaccine Protection against SARS-CoV-2 Infection in Qatar. *N Engl J Med* 2021;385(24):e83. doi: 10.1056/NEJMoa2114114 [published Online First: 2021/10/07]