

Factors associated with COVID-19 length of hospitalization and mortality during four epidemic waves, March 2020–November 2021, Suriname

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ABSTRACT

Objective. To determine the sociodemographic risk factors associated with coronavirus disease 2019 (COVID-19) mortality in Suriname.

Methods. This was a retrospective cohort study. All registered deaths from COVID-19 in Suriname ($n=1112$) between March 13, 2020 and November 11, 2021 were included. Data were collected from medical records and included demographic variables and hospitalization duration of patients who died. Descriptive statistics, chi-squared tests, ANOVA models, and logistic regression analyses were used to determine associations between sociodemographic variables, length of hospitalization, and mortality during four epidemic waves.

Results. The case fatality rate over the study period was 22 per 1 000 population. The first epidemic wave was from July to August 2020, the second from December 2020 to January 2021, the third from May to June 2021, and the fourth from August to September 2021. Significant differences were found in the number of deaths and hospitalization duration by wave ($p<0.001$). Patients were more likely to have a longer hospitalization during the first (OR 1.66; 95% CI: 0.98, 2.82) and third waves (OR 2.37; 95% CI: 1.71, 3.28) compared with the fourth wave. Significant differences in mortality were also seen between ethnicities by wave ($p=0.010$). Compared with the mixed and other group, people of Creole ethnicity (OR 2.7; 95% CI: 1.33, 5.29) and Tribal people (OR 2.8; 95% CI: 1.12, 7.02) were more likely to die during the fourth wave than the third wave.

Conclusions. Tailored interventions are needed for males, people of Creole descent, Tribal and Indigenous peoples, and people older than 65 years.

Keywords

COVID-19; mortality; social determinants of health; Suriname.

Globally, the coronavirus disease 2019 (COVID-19) pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) affected the social and economic landscape (1), and greatly affected the Caribbean region (2).

Recent data (December 2022) show that 639 572 819 confirmed cases of COVID-19 and 6 615 258 deaths occurred

worldwide (3). Most deaths were reported in elderly people, who were more likely to develop acute respiratory distress syndrome and require mechanical ventilation. Studies in China and Brazil show that most deaths were in men, people aged 65 years and older, and those with with comorbidities (4, 5). This higher mortality rate in men was also observed in Ecuador (6).

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Other studies found racial differences in the proportion of cases and death rates, such as in Black and Hispanic people living in the USA. Higher mortality rates appear to be related to income, poverty, and working in the health care and essential service sector (7).

From the start of the COVID-19 pandemic, many epidemic waves have been recorded. Studies have shown that the different epidemic waves were largely related to the different circulating variants of SARS-CoV-2, which led to variability in morbidity and mortality. In Israel and Malaysia, the third COVID-19 wave had more confirmed cases and deaths compared with the first and second waves (8, 9). In Japan, the overall severity in the fourth wave was higher than the first three waves; however this did not result in a significant difference in mortality (10). In most countries, the total number of deaths in waves three and four were similar or higher than in wave two (11). In general, the delta variant was the dominant variant in epidemic waves three and four.

Suriname is a middle-income Caribbean country. Similar to other countries in this region (12), pressure on the health care system has far-reaching consequences, making public health planning and hospital management particularly important. Suriname is among the countries in the Caribbean region with the highest mortality rate from COVID-19 (206.07 deaths per 100 000 inhabitants), higher than Ecuador (193.97 per 100 000 inhabitants), Guyana (136.69 per 100 000 inhabitants), and Uruguay (178.87 per 100 000 inhabitants) (12). Suriname had its first COVID-19 death in April 2020. From the start of the epidemic in Suriname in March 2020 until November 2021, four different COVID-19 waves occurred, which resulted in 1 166 registered deaths and 50 760 COVID-19 cases up to November 30, 2021 (13). While the COVID-19 epidemic placed a heavy burden on the already fragile health care system and hence required rigorous health planning, no studies have yet been conducted on COVID-19 morbidity and mortality in Suriname. The objective of this study therefore was to identify sociodemographic risk factors for death from COVID-19 in Suriname.

METHODS

Our study was a retrospective cohort design. All people who died of COVID-19 in Suriname ($n=1\ 112$) between March 13, 2020 (epidemiological week 14) and November 11, 2021 (epidemiological week 46) were included in this study. This was regardless of nationality, residency or legal status. For hospital deaths, data were obtained from the records of all hospitals in Suriname, namely: the Academic Hospital Paramaribo; Dia-konessenhuis Hospital; Medical Mungra Centre; Regional Hospital Wanica; 's Lands Hospital; and St Vincentius Hospital (Figure 1). The non-hospital deaths were patients who died at home or at a primary health care clinic (Regional Health Services clinic or Medical Mission Primary Health Care Suriname clinic). The diagnosis of COVID-19 was confirmed by a positive result for SARS-CoV-2 based on a polymerase chain reaction test. Patients with a positive COVID-19 diagnosis who were hospitalized or admitted to a primary health care clinic were included in the study.

The data collected included demographic variables (age, sex, ethnicity, and place of residence) and information on the date of admission and death. The duration of hospitalization was defined as the period between the date of admission and date of

death. Ethnicity was self-reported and categorized as follows: Chinese, Creole (of African descent mixed with any other race), Hindustani, Indigenous, Javanese, Tribal (of African descent), and other (mixed, Caucasians). Region was categorized as: urban (Paramaribo and Wanica); rural (Nickerie, Coronie, Saramacca, Commewijne, and Para); and Hinterlands of Suriname (Marowijne, Brokopondo, and Sipaliwini). The classification of region is according to the General Bureau of Statistics (14). The mortality rate by age, sex, and ethnicity was expressed per 10 000 people with the latest census data from 2012 from the Bureau of Statistics (14).

During the study period, four epidemic waves were identified in Suriname by the Ministry of Health (15), based on number of people with positive COVID-19 tests. The first wave was from July to August 2020, the second wave from December 2020 to January 2021, the third from May to June 2021 and the fourth from August to September 2021. For this study, we distinguished waves based on mortality and called these fatality waves.

Statistical analysis

Data were analyzed using SPSS, version 20 (IBM Corp., Armonk, NY, USA). Descriptive statistics include absolute values, relative frequencies, and mortality rates per 10 000 inhabitants. The one-sample chi-squared test was used to determine differences in the number of deaths per wave for each independent variable. Bivariate logistic regression analysis was used to determine an association between duration of hospitalization and wave. Chi-squared tests and ANOVA models were used to examine differences between the independent variables during the four waves. A multivariable logistic regression analysis was used to estimate the magnitude of the relationship between ethnicity and mortality in the second, third and fourth waves compared with the first COVID-19 wave. Odds ratios (OR) and 95% confidence intervals (CI) are given. A p -value ≤ 0.05 was considered statistically significant. The case fatality rate was calculated by dividing the number of confirmed deaths by the number of confirmed cases during the study period (3).

Ethical considerations

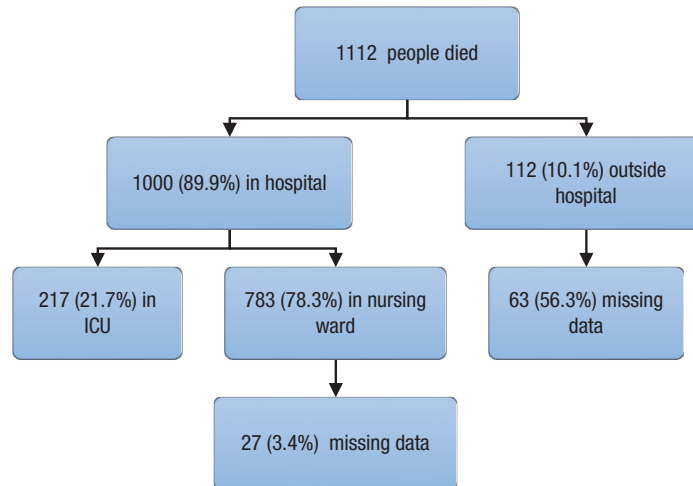
This study was approved by the Medical Ethical Commission of Suriname's Ministry of Health. Consent was waived because the study was a secondary analysis of de-identified data.

RESULTS

Table 1 shows the demographic characteristics of the people who died from COVID-19. The median age was 66 years (interquartile range 56.0–75.5 years), with a range of 17–100 years. Of the people who died, 52.6% were aged ≥ 65 years, 56.2% were males, and 29.0% were of Creole ethnicity, followed by 26.8% of Hindustani ethnicity. Most of the patients lived in urban areas (76.8%). The highest mortality rates were among the Indigenous peoples and people of Creole ethnicity, both 34 deaths per 10 000, followed by people of Javanese ethnicity (24 deaths per 10 000).

Figure 2 shows the epidemic waves based on confirmed cases and the fatality waves from March 2020 until November 2021. The overall case fatality rate of COVID-19 was 22 per 1 000

FIGURE 1. Diagram of COVID-19 deaths in Suriname



COVID-19, coronavirus disease 2019; ICU, intensive care unit.
 Source: prepared by authors from results taken from published data.

TABLE 1. Deaths from COVID-19 and mortality rate by sociodemographic characteristics, Suriname

Characteristic (n=1112)	n (%)	Population, N	Mortality rate (deaths per 10 000)
Age, in years^a			
15–24	9 (0.9)	93 950	1
25–34	35 (3.5)	85 000	4
35–44	59 (5.8)	75 530	8
45–54	129 (12.7)	59 870	22
55–64	248 (24.5)	39 400	63
65–74	260 (25.7)	22 490	116
≥70	273 (26.9)	12 250	223
Missing	99 (–)	NA	NA
Sex			
Male	574 (56.2)	27 2690	21
Female	447 (43.8)	26 7220	17
Missing	91 (–)	NA	NA
Ethnicity			
Creole	291 (29.0)	84 933	34
Hindustani	269 (26.8)	148 443	18
Indigenous	70 (7.0)	20 344	34
Javanese	181 (18.0)	73 975	24
Tribal	75 (7.5)	117 567	6
Mixed and other	117 (11.7)	87 391	13
Missing	109 (–)	NA	NA
Region			
Urban	514 (76.8)	361 736	14
Rural	129 (19.3)	111 224	12
Interior	26 (3.9)	71 268	4
Missing	443 (–)	NA	NA

COVID-19, coronavirus disease 2019; NA, not applicable.

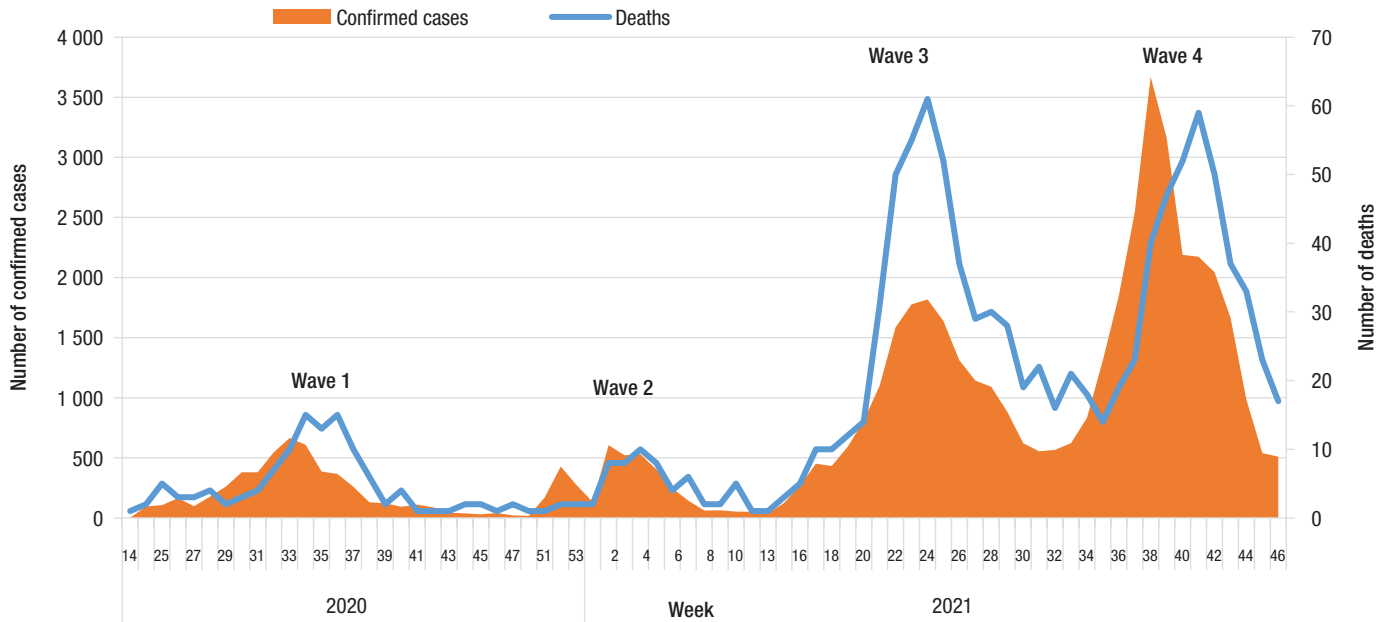
^a Median age was 66 years.

Source: Prepared by authors from the results, based on published data.

positive COVID-19 cases. The number of deaths in each wave (and as a proportion of all deaths during the study period) is as follows: 74 (6.7%, first wave), 38 (3.4%, second wave), 391 (35.2%, third wave), and 304 (27.3%, fourth wave). The number of deaths per wave differed significantly ($p<0.001$).

Table 2 shows the sociodemographic characteristics of hospitalized patients who died in the four waves. The median age of patients in these waves varied between 65 and 70 years. The median duration of hospitalization differed significantly by the fatality wave ($p<0.001$). Patients were more likely to have

FIGURE 2. Trend in COVID-19 cases and deaths during the four epidemic waves, March 2020–November 2021, Suriname



COVID-19, coronavirus disease 2019.
 Source: prepared by authors from results taken from published data.

TABLE 2. Sociodemographic characteristics of hospitalized patients who died from COVID-19 by epidemic wave, Suriname

Characteristic	Wave				p-value
	One (week 31–37, 2020)	Two (week 2–6, 2021)	Three (week 17–28, 2021)	Four (week 35–42, 2021)	
Median age, in years	66	70	65	66	0.437
Median duration of hospitalization, in days	7.0	3.5	6.0	3.0	0.001
Sex, n (%)					0.294
Male	48 (64.9)	24 (63.2)	209 (54.3)	143 (55.0)	
Female	26 (35.1)	14 (36.8)	176 (45.7)	117 (45.0)	
Ethnicity, n (%)					0.010
Creole	16 (22.5)	8 (22.9)	106 (28.3)	100 (38.5)	
Hindustani	14 (19.7)	9 (25.7)	100 (26.7)	68 (26.2)	
Indigenous	11 (15.5)	4 (11.4)	18 (4.8)	16 (6.2)	
Javanese	13 (18.3)	6 (17.1)	80 (21.3)	36 (13.8)	
Tribal	7 (9.9)	3 (8.6)	21 (5.6)	17 (6.5)	
Others	10 (14.1)	5 (14.3)	50 (13.3)	23 (8.8)	
Region, n (%)					0.846
Urban	36 (80.0)	13 (81.2)	162 (77.9)	155 (76.7)	
Rural	6 (13.3)	3 (18.8)	39 (18.8)	40 (19.8)	
Interior	3 (6.7)	0 (0.0)	7 (3.4)	7 (3.5)	

COVID-19, coronavirus disease 2019.
 Source: Prepared by authors from the results, based on published data.

a longer hospitalization duration (above the median) during the first (OR 1.66; 95% CI: 0.98, 2.82) and third fatality waves (OR 2.37; 95% CI: 1.71, 3.28) compared with the fourth wave. Although not significant, more male patients died of COVID-19 than female patients during each fatality wave. A significant association was seen between the different ethnicities and the four fatality waves ($p=0.010$). When compared with the mixed and other groups, patients of Creole ethnicity (OR 2.7; 95% CI: 1.33, 5.290; $p=0.006$) and Tribal people (OR 2.8; 95% CI: 1.12,

7.02; $p=0.028$) were more likely to die during the fourth wave than the third wave.

DISCUSSION

This study examined the COVID-19 mortality rate and its associated sociodemographic determinants, as well as hospitalization duration, between the COVID-19 epidemic waves in Suriname. As expected, the so-called fatality waves closely

followed the epidemic waves in time and distribution. The case fatality rate of COVID-19 in Suriname was 22 per 1 000 cases. This rate was 0.018 deaths per 1 000 in Paraguay (16). Notably, our study showed that more deaths were recorded in the third and fourth waves. A possible explanation for this may be the different variants that emerged after the second epidemic wave, potentially causing higher mortality in Suriname. The P1, B.1.1.7, and B.1.351 variants were confirmed during these epidemic waves, as well as the delta variant during the third epidemic wave in Suriname (17, 18). The COVID-19 variants were assessed through genomic surveillance.

Proportionally more people of Creole descent and Indigenous peoples died of COVID-19 in Suriname. These higher rates are in line with other studies showing higher mortality rates in Black people and Indigenous populations (7, 19). Significantly more people of Creole descent and Tribal peoples died than people of mixed and other ethnicity during the fourth fatality wave compared with the third fatality wave. Underlying factors may relate to a lack of access to or use of health care services, social determinants such as poor work safety, poverty, and crowded housing (20, 21), as well as pre-existing health conditions and biological susceptibilities (22, 23).

Most of the people who died were men, a finding that concurs with other studies (5, 6). However, it should be noted that an increase in the number of women who died was seen in the third and fourth fatality waves. This finding may be related to the type of variants that were circulating during the corresponding epidemic waves. We also found that mortality was highest in patients 65 years and older, which is consistent with other studies (4, 5). Our study showed a significantly longer duration of hospitalization during the first and third waves, compared with the second wave. These differences may be explained by the changed virulence and pathogenicity of the circulating variants.

A strength of our study is that it included all registered deaths from COVID-19, from the start of the epidemic in Suriname until November 2021. Another strength is that the data were retrospectively collected in a short period of time using the hospital databases. We were therefore able to analyze the most recent data. Since almost 90% of the COVID-19 deaths occurred in hospitals, our results can be seen as representative of the Surinamese population. A limitation of our study was that data on all people in Suriname who tested positive for COVID-19

were not available. Therefore, we could not compare our results with the demographic variables of all confirmed cases or the waves as defined by the Ministry of Health. While most of the data were readily available, there was a backlog in entry of some data, such as on comorbidities. This was due to the effects of the epidemic on personnel with more sick leave and higher workloads. It should be noted that an important proportion of people may have had COVID-19 but were asymptomatic. Our study focused on hospitalized and thus symptomatic patients; hence asymptomatic people were not included.

Conclusion

This study showed that important sociodemographic differences in COVID-19 mortality rates exist in Suriname. Based on our findings, groups that can be identified as vulnerable are: men; people aged 65 years and older; people of Creole descent; and Tribal and Indigenous peoples. These groups require tailored interventions. The duration of hospitalization related to the different waves and circulating variants during the COVID-19 epidemic in Suriname also highlights that close monitoring of variants can help inform health planning. To gain further insight into the spread and effect of COVID-19 in Suriname, future studies should assess knowledge, attitudes, and behaviors of the Surinamese population regarding COVID-19, and include other sociodemographic factors, such as income, comorbidities, and vaccination status.

Author contributions. All authors conceived the original idea, collected and analyzed the data, interpreted the results, and wrote and reviewed the paper. All authors reviewed and approved the final version.

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Conflicts of interest. None declared.

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Factores asociados a la duración de la hospitalización y la mortalidad por COVID-19 en cuatro oleadas epidémicas, de marzo del 2020 a noviembre del 2021 en Suriname

RESUMEN

Objetivo. Determinar los factores de riesgo sociodemográficos asociados a la mortalidad por la enfermedad por el coronavirus del 2019 (COVID-19) en Suriname.

Métodos. Este fue un estudio de cohortes retrospectivo. Se analizaron todas las muertes por COVID-19 registradas en Suriname (n=1112) entre el 13 de marzo del 2020 y el 11 de noviembre del 2021. Los datos se recopilaban a partir de los expedientes médicos, e incluyeron las variables demográficas y la duración de la hospitalización de los pacientes fallecidos. Se utilizaron métodos estadísticos descriptivos, la prueba de la ji al cuadrado, modelos de análisis de la varianza y análisis de regresión logística para determinar las asociaciones entre las variables sociodemográficas, la duración de la hospitalización y la mortalidad durante cuatro oleadas epidémicas.

Resultados. La tasa de letalidad en el período del estudio fue de 22 por cada 1 000 habitantes. La primera oleada epidémica fue de julio a agosto del 2020; la segunda, de diciembre del 2020 a enero del 2021; la tercera, de mayo a junio del 2021; y la cuarta, de agosto a septiembre del 2021. Se observaron diferencias significativas en el número de muertes y la duración de la hospitalización entre las oleadas ($p < 0,001$). Fue más probable que los pacientes tuvieran una hospitalización más prolongada durante la primera oleada (razón de posibilidades [odds ratio, OR] 1,66; IC del 95%: 0,98, 2,82) y la tercera (OR 2,37; IC del 95%: 1,71, 3,28) en comparación con la cuarta. También se observaron diferencias significativas en la mortalidad entre etnias según la oleada ($p = 0,010$). En comparación con el grupo poblacional de origen mixto y de otro origen, las personas de la etnia criolla (OR 2,7; IC del 95%: 1,33, 5,29) y de origen tribal (OR 2,8; IC del 95%: 1,12, 7,02) tuvieron una mayor probabilidad de fallecer durante la cuarta oleada que durante la tercera.

Conclusiones. Es preciso llevar a cabo intervenciones diseñadas específicamente para los hombres, las personas de ascendencia criolla, los pueblos tribales e indígenas y las personas mayores de 65 años.

Palabras clave

COVID-19; mortalidad; determinantes sociales de la salud; Suriname.

Fatores associados à duração da internação e à mortalidade por COVID-19 durante quatro ondas epidêmicas, de março de 2020 a novembro de 2021, no Suriname

RESUMO

Objetivo. Determinar os fatores de risco sociodemográficos associados à mortalidade por doença pelo coronavírus 2019 (COVID-19) no Suriname.

Métodos. Este foi um estudo de coorte retrospectivo. Foram incluídos todos os óbitos por COVID-19 registrados no Suriname ($n=1112$) entre 13 de março de 2020 e 11 de novembro de 2021. Os dados foram coletados de registros médicos e incluíram variáveis demográficas e a duração da internação dos pacientes que morreram. Estatísticas descritivas, testes de qui-quadrado, modelos de ANOVA e análises de regressão logística foram usados para determinar associações entre variáveis sociodemográficas, a duração da internação e a mortalidade durante quatro ondas epidêmicas.

Resultados. A taxa de letalidade durante o período do estudo foi de 22 por 1 000 habitantes. A primeira onda epidêmica ocorreu de julho a agosto de 2020, a segunda, de dezembro de 2020 a janeiro de 2021, a terceira, de maio a junho de 2021 e a quarta, de agosto a setembro de 2021. Foram encontradas diferenças significativas no número de mortes e na duração da internação entre as ondas ($p<0,001$). Os pacientes tinham maior probabilidade de ter uma internação mais longa na primeira (razão de chances [RC]: 1,66; intervalo de confiança [IC 95%]: 0,98–2,82) e na terceira onda (RC: 2,37; IC 95%: 1,71–3,28) em comparação com a quarta. Também foram observadas diferenças significativas entre etnias na mortalidade por onda ($p=0,010$). Em comparação com o grupo misto e outros, as pessoas de etnia crioula (RC: 2,7; IC 95%: 1,33–5,29) e tribal (RC: 2,8; IC 95%: 1,12–7,02) tinham maior probabilidade de morrer na quarta onda do que na terceira onda.

Conclusões. São necessárias intervenções adaptadas para homens, pessoas de descendência crioula, povos tribais e indígenas e pessoas com mais de 65 anos.

Palavras-chave COVID-19; mortalidade; determinantes sociais da saúde; Suriname.