Persons with SARS-CoV-2 during the First and Second Waves in Catalonia (Spain): A Retrospective Observational Study Using Daily Updated Data

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Abstract

Background: Description of persons with infection by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) comparing the first and second waves could help adapt the health services to manage this highly transmissible disease.

Objective: We aimed to describe the epidemiology and characteristics of persons with suspected SARS-CoV-2 infection, comparing first and second waves.

Methods: This retrospective observational study analysed daily updated data of persons with a positive reverse-transcription polymerase chain reaction or rapid antigenic test for SARS-CoV-2. Patients' severity was defined by their admission to hospital; intermediate respiratory care; intensive care; or by decease. The first wave was from 01/03/2020 to 24/06/2020, and the second from 25/06/2020 to 08/12/2020.

Results: The number of tests and cases was lower in the first wave, but the percentage of positive results was higher (12.0% in the first wave versus 8.4% in the second). Of persons with a positive diagnostic test, a higher proportion needed hospitalisation in the first wave (26.1%, versus 5.8% in the second wave). The group that was not admitted to hospital included older persons and with more comorbidities in the first wave, whereas the characteristics of the groups admitted to hospital were more alike.

Conclusions: A higher percentage of persons with a positive test for SARS-CoV-2 infection was found in the first wave, despite being a less numerous group. These persons were older and in worse health condition.

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Abstract

Background: Description of persons with infection by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) comparing the first and second waves could help adapt the health services to manage this highly transmissible disease.

Objective: We aimed to describe the epidemiology of persons with suspected SARS-CoV-2 infection, and the characteristics of patients with a positive test comparing first and second waves in Catalonia, Spain.

Methods: This study had two stages. First, we analysed daily updated data on SARS-CoV-2 infection of persons from Girona (Catalonia); second, we compared two retrospective cohorts of patients with a positive reverse-transcription polymerase chain reaction or rapid antigenic test for SARS-CoV-2. Severity of patients with a positive test was defined by their admission to hospital; intermediate respiratory care; intensive care; or by decease. The first wave was from 01/03/2020 to 24/06/2020, and the second from 25/06/2020 to 08/12/2020.

Results: The number of tests and cases was lower in the first wave: 26,096 tests and 3140 cases in the first wave versus 140,332 tests and 11,800 cases in the second; but the percentage of positive results was higher in the first wave, 12.0%, than in the second, 8.4%. Of persons with a positive diagnostic test, 818 needed hospitalisation in the first wave and 680 in the second; however, the percentage of hospitalised persons was higher in the first wave 26.1% than in the second, 5.8%. The group that was not admitted to hospital included older persons and with higher percentage of comorbidities in the first wave, whereas the characteristics of the groups admitted to hospital were more alike.

Conclusions: A higher percentage of persons with a positive test for SARS-CoV-2 infection was found in the first wave, despite being a less numerous group, likely due to improvement in the surveillance systems during the second wave. The characteristics of persons with the infection in the first and second waves differed substantially; persons in the first wave were older and in worse health condition.

Keywords: epidemiology; SARS-CoV-2; timeline; comparison; pandemic; waves; population characteristics.

Introduction

Since the first case of pneumonia caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in December 2019, this pandemic struck the world with, probably, one of the most challenging outbreaks in the XXI century[1]. Nearly 90 million confirmed cases and nearly two

million covid19-related deaths accrued in all the continents until 11 January 2021, as reported by the World Health Organisation[2].

The first cases in Europe were detected in Italy and spread throughout the continent before societies realised the severity of the situation[3,4]. Health systems were suddenly burdened with persons infected by this highly transmissible new disease, to the point of collapse in certain countries[5]. Strict lockdown measures were applied in most countries to decrease the number of cases and ensure adequate care for patients in critical condition[6]. These measures proved certain effectiveness and the first coronavirus disease 2019 (COVID-19) wave faded away during the summer in Europe[7], only to give way to a second wave shortly after, with the easing of the restrictions, and presumably also related to the initiation of school terms[8,9] -although later reports questioned this point[10–12]-, and transfer of social life into indoor spaces[13]. The steady second increase of cases in Europe was initially evident in Spain from where it spread again, although this time at a slower pace, even within the Spanish regions[14]. After all, health systems had had a (short) period to organise their structure provided a second wave hit in the autumn, as was the case.

The arrival of the epidemics caught the health systems quite unaware and unprepared, and uncertainty had a synergic effect with the lack of knowledge about the new virus, the infection, and the disease[15–17]. And it spread: at an assistance level, the optimal actions to be taken were unclear[18]; at a management level, administrations had to adapt primary care and hospital health services; at an informative level, the sources were neither prepared nor connected enough, and did not have methods to obtain reliable and complete data on SARS-CoV-2 infection[15,16]. Information systems on SARS-CoV-2 infection had to be built from scratch during the first wave, and refined during the second.

However much has been learnt about the virus and its transmissibility, many gaps of knowledge remain, including the comparison of the first and the whole of the second waves -which has received limited attention- [19,20], and the consideration of persons with various degrees of severity. Inquiry into such differences would improve our understanding on the effectiveness of the applied measures, and thus it would help plan and improve the optimal public health strategies to tackle, or at least alleviate, the consequences of this infection. The evidence suggests that the context plays an important role in the presentation and spread of this infection[7,21]. Indeed, contributing factors and their weight may vary due to climatic conditions, government actions, culture, and behaviour of the population, or could differ in patients attended in primary care settings and in hospital[7,21]. At the time the study was conducted, Catalonia was facing the end of the second wave and foreseeing the possibility of initiation of a third wave in the subsequent months [22]. A detailed epidemiological framework by country was recommended, to consider the conditions for deployment of massive testing, within the strategies to control this epidemic [22]. Accordingly, this study aimed to describe and compare the first and second waves of the SARS-CoV-2 epidemic in Catalonia (Spain). Particularly, we sought to report the daily counts, incidences, and number of hospitalised patients with this infection; and to compare characteristics of cases in the first and second waves considering various degrees of severity.

Methods

This study was structured in two stages. First, in the general population, we examined the number of positive SARS-CoV-2 tests in each wave. Second, within the population with a positive test, we compared the characteristics of two retrospective cohorts, one for each wave. The first wave lasted

from 1 March 2020 to 24 June 2020 and the second from 25 June 2020 to 08 December 2020.

Analysis of the general population

Enrolment included individuals from the province of Girona (Catalonia, Northern Spain), within the area of influence of Hospital Universitari de Girona Doctor Josep Trueta and Parc Hospitalari Martí i Julià from Salt (Girona).

For each wave, we counted the number of persons with corresponding tests results and the number of tests per diagnosis. On a daily basis, we tallied the number of persons with a positive test from the general population; the daily empiric reproduction number (ρ7) at day 7 -the empiric reproduction number is related to the reproduction number[30]-, and the incidence rate of positive cases at 14 days. Pseudonymised data for these analyses were obtained from the primary care and hospital records.

Comparison of cohorts of persons with a positive SARS-CoV-2 test

The cohorts included persons with a confirmed SARS-CoV-2 infection whose episode was closed, hereinafter also referred to as cases. Confirmed SARS-CoV-2 infection was defined by a positive test result, either using real-time reverse transcription polymerase chain reaction (RT-PCR) test for SARS-CoV-2 virus[23] -requiring a cycle threshold under 39 as per laboratory standards in the daily routine of the two hospitals included in this study)- or by a positive rapid antigenic test [24–26]. Index date was the date of the positive test result, except where there was a COVID-19 related registry in a primary care centre within 7 days before the positive test result, in which cases the index date was the date of the visit instead. An episode was followed up to 30 days after a positive test result in the primary care records, if they had no record of hospital discharge; if they had so, they were considered up until the time of discharge. For cases defined from the primary care records, a deceased person was considered if it occurred up until 30 days after a positive diagnostic test; for cases defined from hospital records, death was considered up until the time of discharge. Data records were obtained up to 8/01/2021.

For each wave, we characterised the cases (persons with confirmed SARS-CoV-2 infection) using pseudonymised data registered in clinical health records from primary care. We considered the following variables up to index date: age, sex, vascular risk factors (smoking, high alcohol consumption, obesity, diabetes mellitus, dyslipidaemia, hypertension), other comorbidities (atrial fibrillation, heart failure, ischemic heart disease, peripheral arterial disease, cerebrovascular disease, chronic obstructive pulmonary disease, asthma, sleep apnoea, chronic kidney disease, malignant neoplasms, dementia, depression), and treatment with acetylsalicylic acid. We also recorded previous influenza and pneumococcal vaccination, and calculated the Charlson index for every participant[27]. The Charlson index is a validated method to classify comorbidity, weighting the amount and severity of comorbid diseases in an integrated score that predicts 1-year mortality risk[28,29].

Censoring applied at the time of closing the case. The highest degree of severity at censoring was the outcome. It was defined by admission to hospital –or lack of it- and department of admission

(for admitted participants). Outcomes were considered by increasing severity as follows: mild infection (not admitted to hospital); admitted to conventional hospitalisation (neither in intermediate respiratory care (IRC) nor in the intensive care unit (ICU)); admitted to IRC, i.e. requiring non-invasive ventilation; to ICU, i.e. requiring invasive ventilation; or deceased. Allocation of participants to the hospital departments was determined from pseudonymised inpatient administrative data, whereas allocation as mild infection (not admitted to hospital) was determined from pseudonymised hospital emergencies records and from the primary health records.

For each wave, we estimated the cumulative incidence of the outcomes (degrees of severity) at 30 days. We also counted the total and daily number of persons in hospital within cases (persons with confirmed SARS-CoV-2 infection). For each degree of severity (outcome), baseline characteristics described cases in the first and second waves using the mean (standard deviation) for continuous variables, and the cumulative number (percentage) for categorical variables; comparison of these characteristics was carried out using Student's t-test for continuous variables and Fisher exact test for categorical ones; level of significance was set at .05. We also calculated the absolute differences of the means (95% CI) for continuous variables and the odds ratios (OR) (95% CI) for categorical ones in the second wave with respect to the first. All analyses were performed using R-software (version 4.0.3; R Foundation for Statistical Computing, Vienna, Austria)[31].

Results

Figure 1 provides a general overview of the two stages in this study. On the one hand, it shows the counts of positive tests in the general population; on the other hand, the number of persons for each outcome within persons with a positive test.

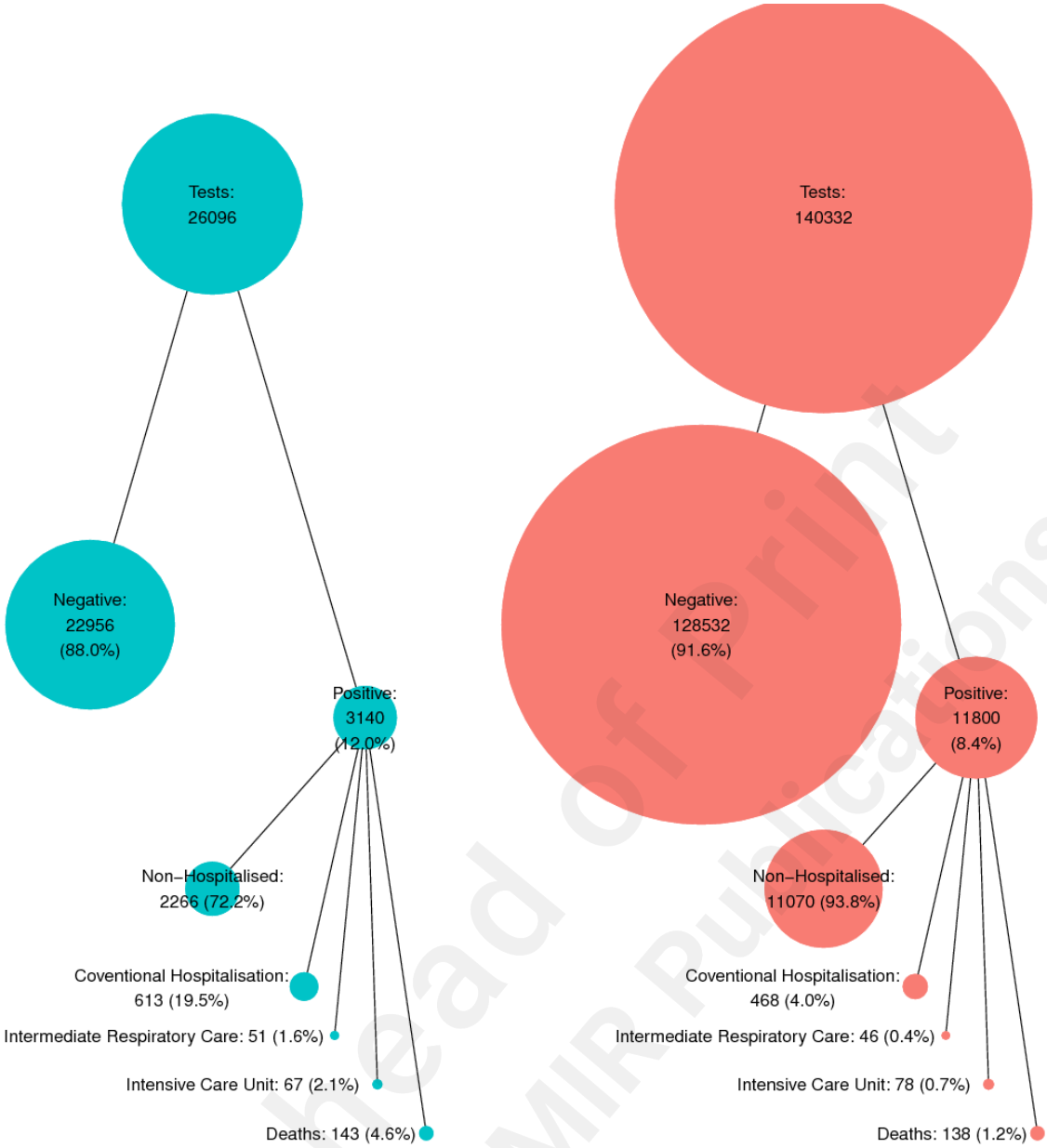

Figure 1. Comparison of number and percentage of suspected and confirmed cases in the first SARS-CoV-2 wave (from 1 March 2020 to 24 June 2020) and second (from 25 June 2020 to 8 December 2020) in Girona (Catalonia).

Analysis of the general population

Total counts showed that the first wave presented much lower number of positive cases, over 3000, than the second, nearly 12,000, but had a higher percentage of positive tests with respect to all suspected persons: 12.0% in the first wave *versus* 8.4% in the second (Figure 1). The number of tests per case was 8.3 in the first wave (a total of 26,096 tests and 3140 cases) and 11.9 in the second (a total of 140,332 tests and 11,800 cases).

Two waves could be clearly distinguished in the timeline of COVID-19 cases. The first wave of the overall population (hospitalised and non-hospitalised) presented an increase of cases in March (Figure 2); then the number of cases decreased, until the beginning of summer (at the end of June),

when a slow increasing trend appeared again (Figure 2). The second wave was longer, and many more positive cases were detected in that period, nearly fourfold (Figure 1). However, if we considered an additional group of possible cases, that is, persons with no confirmatory test but with symptoms compatible with COVID-19 (indicated as Only clinical diagnosis in Figure 2) the situation would become more even (Figure 2). Figure 2 also shows that the number of daily negative diagnostic test results was much higher in the second wave.

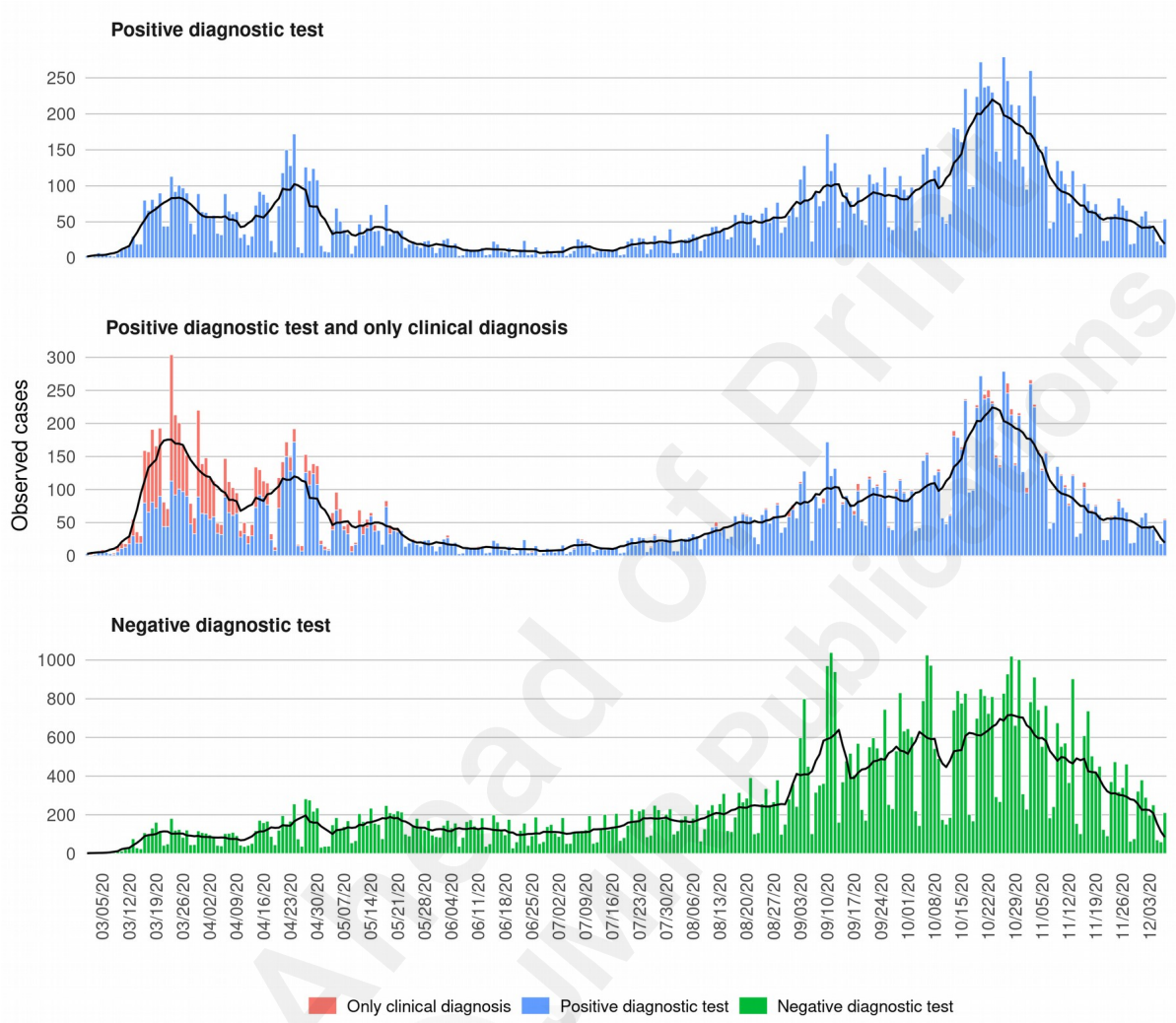

Figure 2. Daily number of persons with a positive and/or negative SARS-CoV-2 test in Girona (Catalonia) from 1 March 2020 to 8 December 2020.

SARS-CoV-2 transmission in the community was also monitored with the cumulative incidence rate of SARS-CoV-2 infection at 14 days, and with the transmission rate at 7 days, indicated by the empiric reproduction number, ρ7 (Figure 3). At the beginning of the first wave, the ρ7 increased, followed by an increase in the incidence rate. Social distancing and ultimately strict lockdown led to a drop in the ρ7; when it was under one, the incidence started to decrease. The decrease went on as far as the ρ7 was predominantly under 1. But at the end of June, this ρ7 reached a value over 1 and remained there, which led to a slow but constant increase in the incidence rate and subsequently to the second wave.

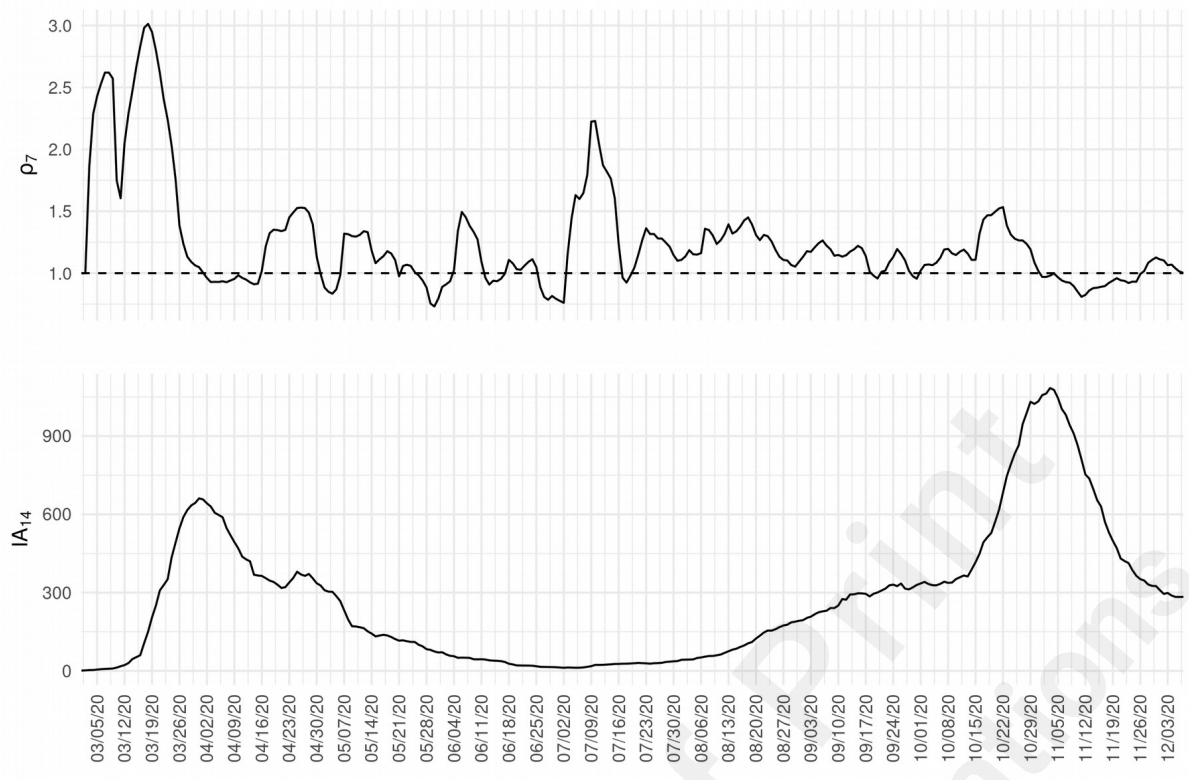

Figure 3. Daily evolution of empiric reproduction number (7 days) and cumulative incidence rate (14 days) of positive cases in Girona (Catalonia), from 1 March 2020 to 8 December 2020.

Comparison of cohorts of persons with a positive SARS-CoV-test

Figure 1 shows the cumulative incidences at 30 days for each outcome within each wave, with respect to all persons with a positive test result (cases): the first wave contained a lower percentage of persons with mild SARS-CoV-2 infection (non-hospitalised), and a higher percentage of patients who were on conventional hospitalisation, admitted to intermediate respiratory care, intensive care unit, and who passed away (including in- and out-of-hospital deaths).

As for hospitalised cases, they amounted to 818 persons out of 3140 cases in the first wave and 680 out of 11,800 cases in the second, a cumulative incidence at 30 days of 26.1% and 5.8%, respectively. During the first wave, 613 patients were cases in conventional hospitalisation (a cumulated incidence at 30 days of 74.9%, with respect to all hospitalised), 51 (6.2%) in intermediate respiratory care, 67 (8.2%) in the intensive care unit, and 87 (10.6%) passed away. The corresponding figures within hospitalised cases during the second wave were 468 (68.8%), 46 (6.8%), 78 (11.5%), 88 (12.9%), respectively. The daily number of persons in hospital showed a much steeper increase during the first wave than the second, the initiation of which was more progressive (Figure 4).

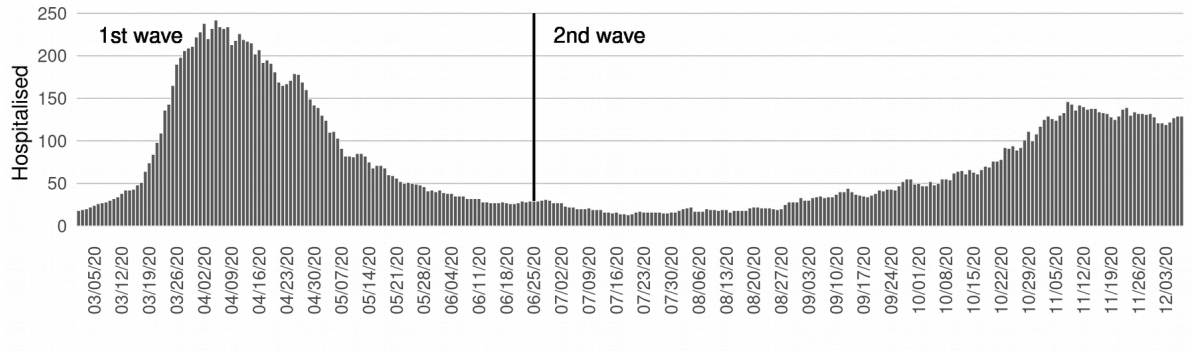

Figure 4. Daily number of persons with a positive SARS-CoV-2 test in hospital over time (from 1 March 2020 to 8 December 2020) in Girona (Catalonia).

Comparison of the baseline characteristics (of persons with a positive test –cases-) showed that persons with mild SARS-CoV-2 infection (non-hospitalised) were almost 10 years older in the first wave (Table 1), $P < .001$. The absolute difference between the mean age in second wave and the first supported statistical significance (Supplementary Table 1); the absolute difference was -8.67 (95% CI, -9.71; -7.63). Regarding other degrees of severity, the mean age of persons with conventional hospitalisation and of persons admitted to intensive care was slightly higher in the second wave, with P values of .04 and .02, respectively. The 95% CI of the absolute differences supported statistical significance: they were 2.5 (95% CI .15; 4.85) and 5.15 (95% CI .66; 9.64). As for the rest of population characteristics, the percentage of persons with other comorbidities and risk factors in the first wave was mostly higher than in the second, in the group with no hospital admission (Table 1), with significant *P*-values. These results were supported by ORs under one, with significant confidence intervals (Supplementary Table 1). Characteristics in the rest of the groups (hospitalised) were similar in the first and second waves, with few exceptions. The group admitted to conventional hospitalisation presented higher percentage of persons in the second wave with dyslipidaemia, hypertension, cerebrovascular disease, and receiving acetylsalicylic acid in the second wave. And these results were also supported by OR over 1 in Supplementary Table 1, and significance of the 95% CI. Those admitted to intermediate respiratory care included higher percentage of persons receiving acetylsalicylic acid in the second wave, and the OR comparing the second with respect to the first wave was 3.01 with significance in the 95% CI (1.63; 5.77). The group admitted to intensive care presented higher percentage of persons with diabetes and a higher Charlson index in the second wave, with significant *P*-values, and significance of the 95% CI of the OR and the absolute difference. Finally, the group of deceased persons presented a higher percentage of patients who had had atrial fibrillation, previous pneumococcal vaccination, and were treated with acetylsalicylic acid in the second wave. *P*-values for such differences supported statistical significance; and so did the 95% CI of the OR.

Table 1. Comparison of baseline characteristics of persons with a positive SARS-CoV-2 test from Girona (Catalonia), in the first SARS-CoV-2 wave (1 March 2020 to 24 June 2020) and second (25 June 2020 to 8 December 2020) by degree of severity

	No admission			Admission no IRC or ICU			Admission IRC			Admission ICU			Deceased		
Wave	**1st**	**2nd**	**p-val**	**1st**	**2nd**	**p-val**	**1st**	**2nd**	**p-val**	**1st**	**2nd**	**p-val**	**1st**	**2nd**	**p-val**
n	2266	11070		613	468		51	46		67	78		143	138	
Age	54.5 (22.3)	45.8 (26.3)	<.001	58.6 (18.9)	61.1 (20.0)	.04	64.6 (14.7)	61.7 (15.4)	.35	56.2 (13.1)	61.3 (14.2)	.02	81.0 (12.4)	81.7 (11.3)	.61
Men	703 (31.0)	5223 (47.2)	<.001	300 (48.9)	235 (50.2)	.71	34 (66.7)	30 (65.2)	.99	48 (71.6)	63 (80.8)	.24	73 (51.0)	69 (50.0)	.90
Smoker	393 (23.9)	1910 (26.5)	.10	92 (17.9)	54 (13.7)	.24	5 (10.4)	6 (14.3)	.83	6 (10.7)	6 (9.0)	.49	17 (13.8)	17 (14.2)	.46
Ex-Smoker	140 (8.5)	603 (8.4)	.10	74 (14.4)	61 (15.5)	.24	8 (16.7)	6 (14.3)	.83	10 (17.9)	18 (26.9)	.49	13 (10.6)	19 (15.8)	.46
Alcohol consumption of high risk	35 (1.5)	115 (1.0)	.048	19 (3.1)	15 (3.2)	.99	0 (0.0)	0 (0.0)	-	2 (3.0)	3 (3.8)	.99	7 (4.9)	6 (4.3)	.99
Obesitat	538 (23.7)	2404 (21.7)	.16	248 (40.5)	205 (43.8)	.23	30 (58.8)	25 (54.3)	.15	33 (49.3)	39 (50.0)	.79	50 (35.0)	53 (38.4)	.50
Diabetes	194 (8.6)	575 (5.2)	<.001	117 (19.1)	110 (23.5)	.08	16 (31.4)	7 (15.2)	.09	9 (13.4)	25 (32.1)	.01	47 (32.9)	51 (37.0)	.53
Dyslipidaemia	420 (18.5)	1192 (10.8)	<.001	169 (27.6)	158 (33.8)	.03	17 (33.3)	17 (37.0)	.83	22 (32.8)	27 (34.6)	.86	55 (38.5)	65 (47.1)	.15
Hypertension	574 (25.3)	1475 (13.3)	<.001	220 (35.9)	215 (45.9)	.001	24 (47.1)	24 (52.2)	.69	24 (35.8)	39 (50.0)	.09	101 (70.6)	106 (76.8)	.28
Atrial fibrillation	102 (4.5)	145 (1.3)	<.001	44 (7.2)	33 (7.1)	.99	9 (17.6)	3 (6.5)	.13	1 (1.5)	1 (1.3)	.99	18 (12.6)	35 (25.4)	.009
Heart Failure	63 (2.8)	51 (0.5)	<.001	23 (3.8)	19 (4.1)	.87	4 (7.8)	2 (4.3)	.68	0 (0.0)	1 (1.3)	.99	11 (7.7)	17 (12.3)	.23

	No admission			Admission no IRC or ICU			Admission IRC			Admission ICU			Deceased		
Wave	**1st**	**2nd**	**p-val**	**1st**	**2nd**	**p-val**	**1st**	**2nd**	**p-val**	**1st**	**2nd**	**p-val**	**1st**	**2nd**	**p-val**
Ischemic heart disease	64 (2.8)	146 (1.3)	<.001	38 (6.2)	37 (7.9)	.28	8 (15.7)	4 (8.7)	.36	3 (4.5)	8 (10.3)	.22	14 (9.8)	21 (15.2)	.21
PAD	52 (2.3)	91 (0.8)	<.001	24 (3.9)	24 (5.1)	.37	1 (2.0)	1 (2.2)	.99	3 (4.5)	3 (3.8)	.99	11 (7.7)	6 (4.3)	.32
Cerebrovascular disease	52 (2.3)	84 (0.8)	<.001	15 (2.4)	29 (6.2)	.003	2 (3.9)	1 (2.2)	.99	2 (3.0)	1 (1.3)	.60	11 (7.7)	12 (8.7)	.83
COPD	65 (2.9)	137 (1.2)	<.001	44 (7.2)	33 (7.1)	.99	10 (19.6)	6 (13.0)	.42	2 (3.0)	4 (5.1)	.69	15 (10.5)	19 (13.8)	.47
Asthma	132 (5.8)	539 (4.9)	.06	42 (6.9)	24 (5.1)	.25	3 (5.9)	4 (8.7)	.70	2 (3.0)	3 (3.8)	.99	4 (2.8)	11 (8.0)	.06
Sleep apnoea	56 (2.5)	210 (1.9)	.08	33 (5.4)	33 (7.1)	.30	9 (17.6)	3 (6.5)	.13	5 (7.5)	6 (7.7)	.99	7 (4.9)	7 (5.1)	.99
Chronic kidney disease	167 (7.4)	217 (2.0)	<.001	61 (10.0)	65 (13.9)	.05	9 (17.6)	7 (15.2)	.79	3 (4.5)	6 (7.7)	.51	42 (29.4)	46 (33.3)	.52
Malignant neoplasms	175 (7.7)	358 (3.2)	<.001	69 (11.3)	52 (11.1)	.99	9 (17.6)	4 (8.7)	.24	7 (10.4)	13 (16.7)	.34	51 (35.7)	42 (30.4)	.38
Dementia	232 (10.2)	208 (1.9)	<.001	44 (7.2)	35 (7.5)	.91	2 (3.9)	1 (2.2)	.99	0 (0.0)	2 (2.6)	.50	46 (32.2)	38 (27.5)	.43
Depression	199 (8.8)	530 (4.8)	<.001	73 (11.9)	44 (9.4)	.20	7 (13.7)	3 (6.5)	.32	4 (6.0)	6 (7.7)	.75	22 (15.4)	26 (18.8)	.53
Previous flu vaccination	598 (26.4)	1254 (11.3)	<.001	183 (29.9)	142 (30.3)	.89	19 (37.3)	17 (37.0)	.99	14 (20.9)	15 (19.2)	.84	84 (58.7)	79 (57.2)	.81
Previous pneumococcus vaccination	533 (23.5)	1739 (15.7)	<.001	199 (32.5)	179 (38.2)	.05	24 (47.1)	16 (34.8)	.30	17 (25.4)	26 (33.3)	.36	85 (59.4)	107 (77.5)	.001
ASA	57 (2.5)	190 (1.7)	.01	17 (2.8)	37 (7.9)	<.001	0 (0.0)	4 (8.7)	.047	3 (4.5)	7 (9.0)	.34	12 (8.4)	24 (17.4)	.03
CharIson	2.3 (2.0)	2.0 (1.8)	<.001	2.8 (2.3)	2.8 (2.2)	.86	2.8 (2.4)	1.9 (1.2)	.07	1.7 (1.1)	2.7 (2.7)	.03	3.1 (2.3)	3.5 (2.7)	.23

Values are presented as mean (SD) or No. (%).
ASA indicates acetylsalicylic acid; COPD, chronic obstructive pulmonary disease; IRC, intermediate respiratory care; ICU, intensive care unit; PAD, peripheral arterial disease.

Discussion

Principal Results

We compared the epidemiology and characteristics of persons with SARS-CoV-2 infection in the first and second waves in Catalonia. The first wave struck more suddenly, and although SARS-CoV-2 positive persons were less numerous, the percentage with respect to all suspected persons was higher than in the second wave. Moreover, persons with a positive diagnostic test were healthier in the second wave, as indicated by the lower proportion of persons who required hospitalisation (26.1% in the first wave *versus* 5.8% in the second) and the lower percentages of patients with comorbidities within the non-hospitalised. However, these lower percentages might also be attributed to the younger age of the population in the second wave, because younger persons tend to have a better health condition. Once in hospital, the differences in age and comorbidities between the first and second waves were much less notorious.

During the first wave, no screenings to the general population were performed, simply because there was no time yet to organise them and tests were not available for everyone. In March and April 2020, RT-PCR tests were performed to patients admitted to hospital, and to health workers; and up to early June in screenings directed to old persons in nursing homes, centres for disabled persons, supervised flats, and penitentiaries. These screenings represented one third of all PCR tests carried out during the first wave. That is, positive cases were prioritised for the most vulnerable population. However, if we consider the number of clinically diagnosed cases in the first wave (persons who were considered to suffer COVID-19 based on signs and symptoms but in whom no diagnosis test was performed), the number of persons with COVID-19 becomes more similar. Even conceding that the infection spread was just starting during the period included in the first wave, it is likely that a large number of asymptomatic cases were unnoticed (in that wave). This idea would be supported by previous reports[32], and coherent with our results: the comparison of Figure 2 with Figure 4 showed that hospitalised cases were more numerous and the number increased more abruptly in the first wave than in the second (Figure 4), but the number of daily overall cases detected with diagnostic tests was much lower in the first wave (Figure 2).

In the second wave, surveillance and health systems were more organised and proactive, especially in areas where the transmission rate increased, which allowed a huge amount of screening tests to be carried out. This volume of tests during the second wave would explain the much higher number of positive cases (almost fourfold) than in the first wave. The lower percentage of positive cases in the second wave shows the efforts and success of the screening systems to find, test, and isolate the contacts when needed. This is another crucial aspect in the epidemiology comparing the first and second waves in this pandemic: the means to diagnose it, the consideration of a person as a case, the availability of diagnostic tests, and the capacity of the surveillance systems to organise screenings and preventive measures at a large scale[33].

In hospitals, the situation was also very different during the two waves. The first wave arrived so suddenly that the system collapsed, the criteria to allocate and treat patients according to severity kept changing and were different from the second wave. During the second wave the population, especially vulnerable persons, knew how to protect themselves, which smoothened the increase of cases, and thus the situation in hospitals was tense but not collapsed: the criteria to allocate and treat patients were more established, and health professionals could be more pro-active to admit and treat patients with milder forms of the disease.

Within hospitalised patients, the second wave included higher percentage of persons with certain conditions in the group of patients with conventional hospitalisation (dyslipidaemia, hypertension, cerebrovascular disease, or treatment with acetylsalicylic acid), in the intensive care unit (diabetes), or who passed away (atrial fibrillation, pneumococcus vaccination, treatment with acetylsalicylic acid). This could be partly explained because of a slightly higher age average. Finally, the second wave lasted longer than the first, which resulted in a fairly similar total number of patients in intermediate respiratory care, intensive care, and who passed away in both waves.

Strengths and Limitations

We had access to daily-updated and reliable data that could be structured for analysis up to a date that included the second wave. Moreover, we could assess all persons with a diagnostic test for SARS-CoV-2, i.e., with negative or with positive result, which allowed a complete description of the situation, since a high number of positive mild cases could be, as the case actually was, due to an increase in the number of tests performed. However, we acknowledge that in February and March 2020, clinical diagnosis or definition of close contacts was determined according to epidemiological criteria from countries who first reported COVID-19 cases (China[34], Italy[35]), thus, many patients that must have been positive were not identified as such, and some close contacts were overlooked. Additionally, antigenic tests were not available in the first wave, only in the second. In this second wave, the tests were performed in certain situations, like screening in schools or in symptomatic persons, and the criteria to apply them changed to adapt and avoid too much pressure on the health systems. We decided to include them in the analysis to be able to account for all persons who tested positive, and appraise the performance of the screenings.

Comparison with Prior Work

A letter to the editor on an analysis from Japan reported higher pressure on the health system, higher proportion of persons with comorbidities, and older mean age in the first wave, in line with our results. However, they could not include data to complete the second wave, and thus there was a possibility that future findings differed from their results at the time of publication[19]. Nevertheless, comparison of results in Japan and in South of Europe remains of high interest. Indeed, preparedness for the pandemic differed between countries, before[36] and during the spread of this pandemic. Some

countries had some time to equip themselves for the second wave, but they could not adapt readily enough to it, with the subsequent burden on the health system, and thus the population[32]. Further analyses that compare the first and the second waves in other countries would be very useful to determine expected common characteristics and differences. A couple of previous reports characterised the first wave in Spain, as at April and August 2020 [37,38]. The authors of a report from the working group for the surveillance and control of COVID-19 observed much higher percentage of hospitalised patients amongst persons who tested positive for diagnostic test than us, 45% versus 11%, which could be explained by the definition of case. They considered a person as case if they had symptoms of severe acute respiratory infection and they had travelled to COVID-19-affected areas or had epidemiological links with COVID-19 laboratory-confirmed cases[37]. Finally, an analysis of the first wave in Catalonia studied data from the Primary Care settings to compare characteristics of persons with and without COVID-19, and the deceased *versus* living patients with COVID-19; our results in the first wave for non-hospitalised persons and for deceased patients were comparable to this study[38].

Conclusions

Screening systems for SARS-CoV-2 infection were scarce during the first wave, but more adequate during the second, reflecting the usefulness of surveillance systems to detect a high number of asymptomatic infected persons and their contacts, to help control this pandemic. Persons infected by SARS-CoV-2 differed substantially during the first and second waves in Catalonia. Infected persons were older and with more comorbidities in the first wave, more of them needed hospitalisation. Hospitals collapsed in the first wave, but tension was lower in the second, which contributed to a better care for a broader spectrum of the population.

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Conflicts of Interest

None declared.

Abbreviations

COVID-19: coronavirus disease 2019

RT-PCR: reverse-transcription polymerase chain reaction
SARS-CoV-2: severe acute respiratory syndrome coronavirus 2
ρ7: empiric reproduction number

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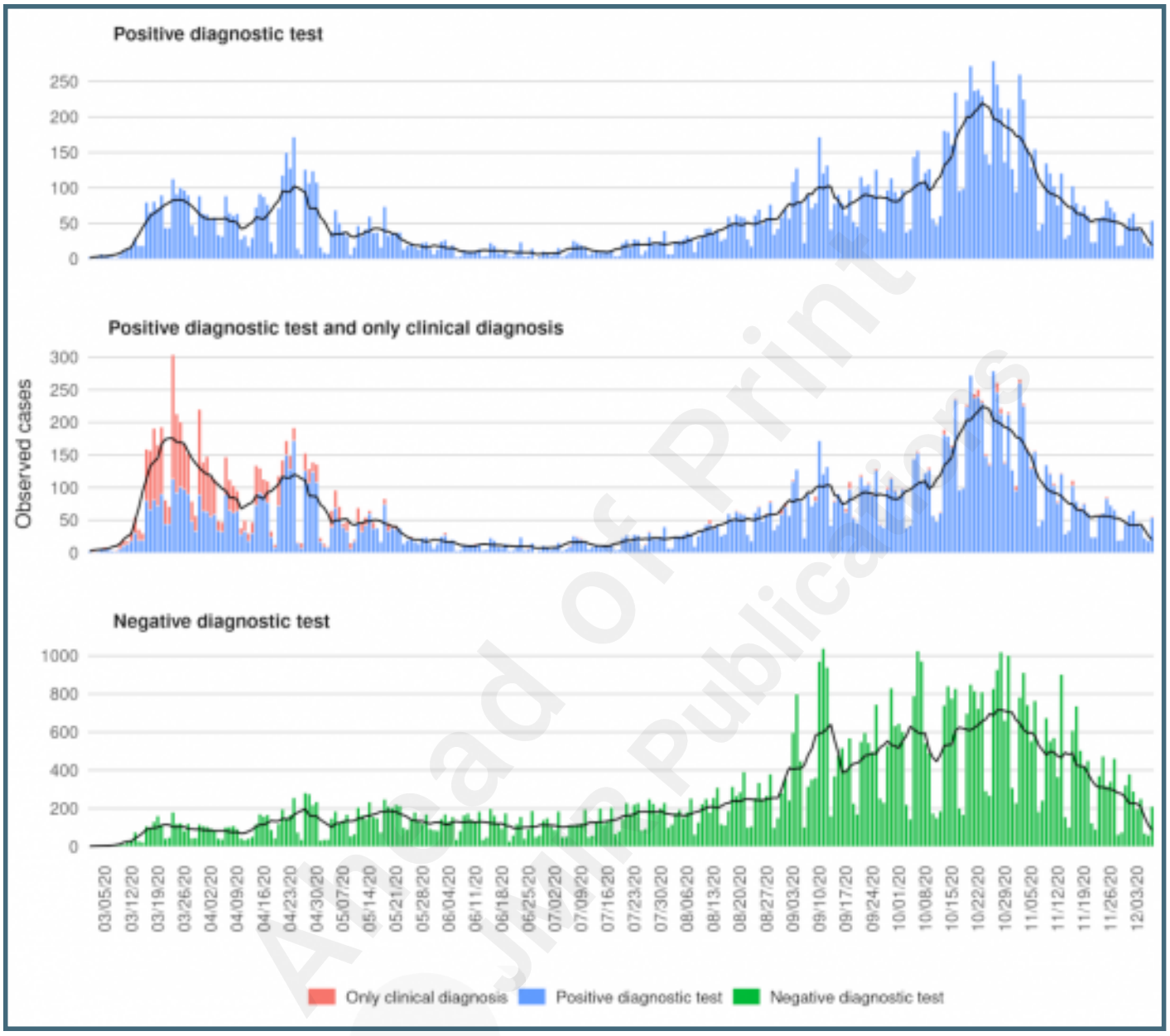
Supplementary Files

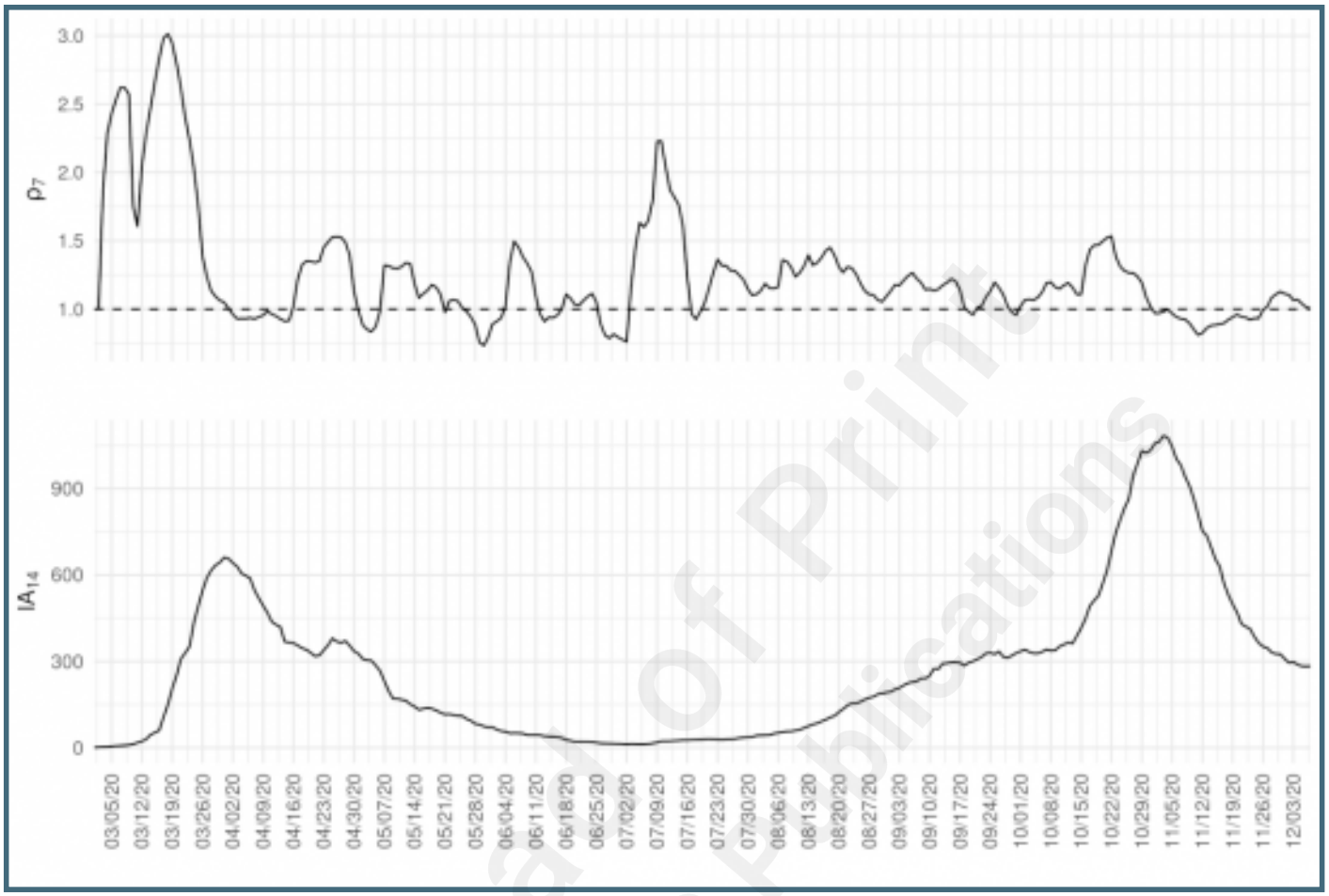
Figures

Comparison of number and percentage of suspected and confirmed cases in the first SARS-CoV-2 wave (from 1 March 2020 to 24 June 2020) and second (from 25 June 2020 to 8 December 2020) in Girona (Catalonia).

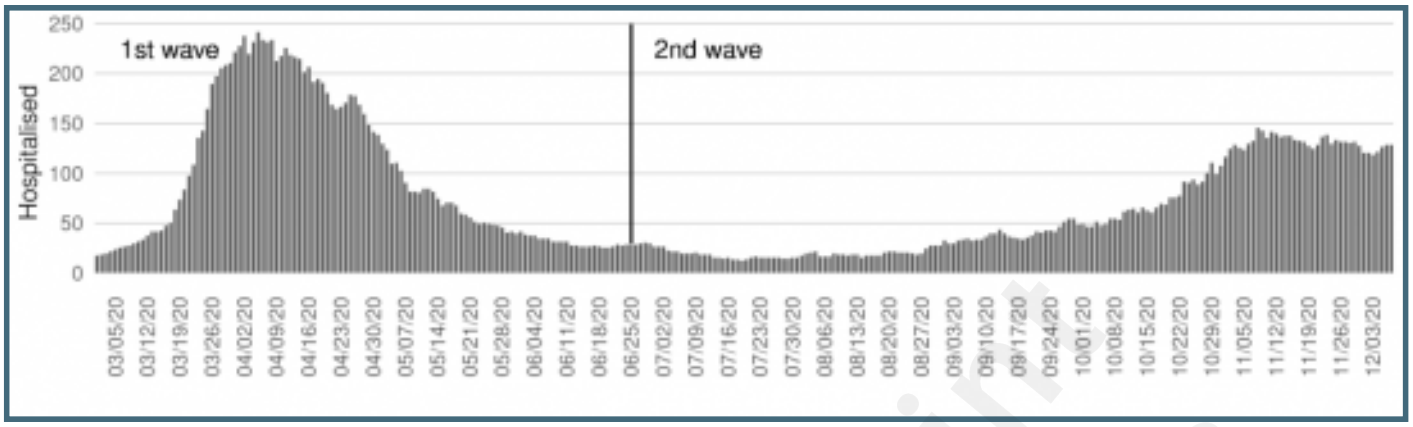
Daily number of persons with a positive and/or negative SARS-CoV-2 test in Girona (Catalonia) from 1 March 2020 to 8 December 2020.



Daily evolution of empiric reproduction number (7 days) and cumulative incidence rate (14 days) of positive cases in Girona (Catalonia), from 1 March 2020 to 8 December 2020.



Daily number of persons with a positive SARS-CoV-2 test in hospital over time (from 1 March 2020 to 8 December 2020) in Girona (Catalonia).



Multimedia Appendixes

Supplement.
URL: http://asset.jmir.pub/assets/1e752956d69bdb0dfb9dafd0109acad8.docx

TOC/Feature image for homepages

Daily number of persons with a positive and/or negative SARS-CoV-2 test in Girona (Catalonia) from 1 March 2020 to 8 December 2020.