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Checkpoint for the Diagnosis of SARS-CoV-2 Infection: A Model from Switzerland

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Abstract

Background: The world has experienced several phases of waves and remission of the SARS-CoV-2 called "pandemic waves" during the past two years: The first one in February and March 2020, followed by a remission in summer and a relapse in autumn 2021. In Ticino several Check-points (CP) have been created as hubs where citizens could get an oropharyngeal swab for free since the end of March 2020.

Methods: The study was conducted from March 2020 until the end of March 2021. All subjects undergoing an oropharyngeal swab for the detection of SARS-CoV-2 infection at any Checkpoint filled the questionnaire on personal data, symptoms, chronic diseases and the reason for the swab. Checkpoints were created in Ticino with the purpose of collecting people with symptoms of COVID-19, who needed a swab. They were meant to protect emergency rooms and family doctors from an overload of patients needing testing for COVID-19 and a quick medical evaluation.

Results: We collected epidemiological data from 12525 subjects, of which 12082 were included in the analysis. We registered a "first and second wave" of the pandemic in Ticino, in March and April 2020 and from October 2020 until March 2021. The most frequent reason for having a swab was the presence of symptoms. We found that men, elderly persons and persons with specific symptoms (fever, loss of taste and smell, and cough) were more likely to have a swab positive for SARS-CoV-2 infection.

Conclusion: The Ticino model of creating CPs where people could quickly get a medical check-up and an oropharyngeal swab, was useful in flattening the pandemic curve. Ticino experienced two major pandemic waves, as noticed in the CPs' attendance.

Keywords: SARS-CoV-2; Bronchitis; Pneumonia; Taste dysfunction

Introduction

In early December 2019, the city of Wuhan, China, first reported cases of a novel disease, Coronavirus disease 2019 (COVID-19), caused by an enveloped RNA β-coronavirus currently named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1,2].

Corona Viruses (CoV) belong to the Coronavirinae subfamily and are named after their microscopic crown-like appearance. SARS-CoV-2 is a human RNA virus that belongs to the β-CoVs in the CoV phylogenetic tree [3]. Differently from what could be imagined, the evolution of SARS-CoV-2 was genetically distant from the previously known Severe Acute Respiratory Syndrome (SARS) and Middle East Respiratory Syndrome (MERS) viruses [4]. SARS-CoV-2 is transmitted from person-to-person *via* respiratory droplets and has a basic reproductive number of approximately [1-7].

Respiratory symptoms such as nasal congestion, rhinorrhoea and pharyngodynia are typical in COVID-19 [4]. Fever, dry cough, dyspnoea and fatigue are frequently reported in COVID-19. Olfactory and taste dysfunction are reported in up to 88% of COVID-19 patients worldwide and are considered specific symptoms in the diagnosis of mild disease [8-12]. Less frequently reported symptoms are headache and conjunctivitis [13-15]. In severe cases, the infection can progress to pneumonia, bronchitis, and Acute Respiratory Distress Syndrome (ARDS) [16].

From December 2019 to February 2020, SARS-CoV-2 quickly spread to other provinces of China and to other continents. In March 2020, the World Health Organization (WHO) considered the disease pandemic [17].

Early in January 2020, measures to limit the rapid spread of the disease were put in place, such as the mandatory use of facial masks, the limitation of travels and people gatherings, and the closure of schools, malls, theatres, and places where could meet in crowds [18].

Switzerland had one of the highest documented numbers of COVID-19 cases per capita in the world before the omikron wave, with over 7,000 confirmed cases per 100,000 people [19,20]. In the timeframe of our study, Switzerland experienced three major "pandemic waves"; the first one from late February 2020 until May 2020, the second one from October 2020 until January 2021, and the last one from the second half of February till April 2021.

This manuscript describes an observational study performed during the first two waves of COVID-19 disease in Canton Ticino, Switzerland. The aim of our study was observing the population with positive and negative SARS-CoV-2 tests in outpatients' settings in the canton of Ticino during and between the two waves and to assess factors associated with test positivity.

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Materials and Methods

Study design and binding

This is an observational study conducted in Ticino, with the collaboration of the OMCT (Ordine dei Medici del Canton Ticino). All subjects older than 18 years, who underwent an oro-pharyngeal swab for the diagnosis of SARS-CoV-2 infection were eligible for the study. All participants gave oral consent to the use of data for the epidemiological analysis. All questionnaires were anonymous and the names and addresses of participants were recorded on separate paper forms to be stored apart. Both the statistician and the data manager did not have access to these data. The study was approved by the Ethical Committee of the Canton Ticino.

Study setting

The study was conducted from 25 March 2020 until 25 March 2021 in Ticino, Switzerland among persons who attended one of the six Check points in Ticino for SARS-CoV-2-tests.

The Check Points (CPs) were instituted by the local public health authorities to face the emergency of the pandemic in March 2020. People who needed an oropharyngeal swab for the diagnosis of SARS-CoV-2 infection could be tested throughout the whole year. The CPs constituted a valid alternative to the General Practitioner clinics for SARS-CoV-2 tests, with the positive effect that patients who needed a swab, did not overcrowd GP clinics. At Canton level, two hotlines were created to support people during the pandemic. During the "first wave", one doctor was employed to answer to the GP's questions on how to handle the protections tools, how to sanitize the clinic, how to behave with the positives and trace the contacts and how to perform a correct swab. The second hotline was for the population and non-medical use: a telephone operator was hired to answer people on how to behave, protect themselves, when to undergo a test and any further question on the newborn pandemic.

At the checkpoint, persons underwent an oropharyngeal swab for the detection of SARS-CoV-2 infection which was then analyzed using PCR, and they were asked basic demographic information, the reasons for the swab, and the presence of specific symptoms. Moreover, they underwent measurements of body temperature, blood pressure and heart rate. All the records were collected in a questionnaire (Annex 1) filled by the CP doctor or nurse.

Statistics and data management

Questionnaires were regularly sent from the CP's to the OMCT where data were entered into data base. IDs were created as consecutive numbers. Duplicate records which were marked as re-test were excluded from the analyses.

The descriptive part of the analysis includes a table with the frequencies of basic characteristics for the study sample as a whole and according to test positivity. Symptom prevalences are tabulated for the three different periods Mar to April 2000, May to Sep 2000 and Oct 2000 to Mar 2001. Moreover, a plot of the monthly rates of test positivity is included. A multivariable logistic regression model was used to assess predictors of test positivity.

Results

Overall, we collected epidemiological data from 12525 subjects, as shown in the Flowchart. Out of those, 366 were excluded because they had incomplete demographic data, 50 did not have an available swab test result, and 27 underwent an oropharyngeal swab twice. After exclusion, 12082 patients were included in the analysis. The characteristics of the analyzed population are shown in Table 1.

The mean age was 42.8 (1-99), 5551 were male (45.9%), 11977 (99.1%) were Caucasian, 3343 (27.7%) had a contact with a SARS-CoV-2 positive patient, of which 962 (28.8%) resulted positive at the oropharyngeal swab. Ten thousand and eight (82.8%) underwent the swab because of symptoms, among them 2056 (20.5%) were positive. The next most frequent reasons were epidemiological research (contact tracing) (10.0%), and pending hospital admission (6.5%). Among subjects reporting symptoms, 20.2% were positive for SARS-CoV-2 infection, whereas 7.5% of asymptomatic patients had a positive test. The positivity rate among these asymptomatic patients varied from 0% during summer up to 33% in November.

The affluence to the CPs during the year was consistent with the registered "COVID-19 waves" in Ticino, being higher in March-May 2020 and from November until March 2021 (Figure 1). Symptoms were the most frequent reason, as shown in Table 2. In the first two months 88% of patients had symptoms, and this percentage increased to 93% during the second "wave". During summer and around Christmas, people also tested for travel and holiday reasons, before hospital admission, or before undergoing a medical examination. The number of tests performed during the "second wave" doubled the number of the first months of 2020.

Variable	Total (N=12082)		Positive test (N=2171)		Negative test (N=9911)	
	N	%	N	%	N	%
Women	6531	54.1	1086	16.6	5445	54.9
Age groups:						
<30 years	3366	27.9	471	21.7	2895	29.2
30-49 years	4174	34.5	733	33.8	3441	34.7
50-64 years	2870	23.8	608	28	2262	22.8
65-79 years	1411	11.7	297	13.7	1114	11.2
80 years and over	261	2.2	62	2.9	199	2
Contact with positive person (N=12071)	3373	27.9	968	44.6	2405	24.3
Current smoking (N=11388)	2971	26.1	377	18.2	2594	27.9

Table 1: Characteristics of the analyzed population (N=12082).

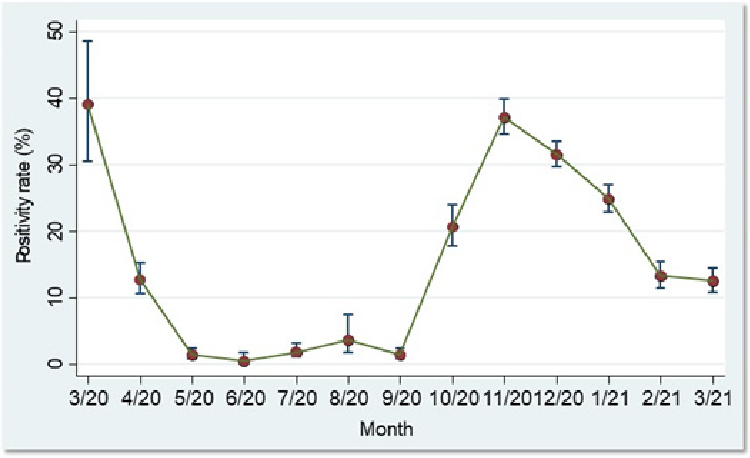

Figure 1: Positivity rate of the performed tests per month (with 95%-confidence intervals).

Variables	March-April 2020			Jun-Sep 2020			Oct 2020-Mar 2021		
	%	Cases	N	%	Cases	N	%	Cases	N
Any symptom	88.4	130	147	75.5	40	53	93.5	1918	2052
Cough	57.1	84	147	39.6	21	53	52.4	1076	2052
Weakness	45.6	67	147	30.2	16	53	43	883	2052
Headache	42.2	62	147	30.2	16	53	46.9	963	2052
Cold	40.8	60	147	41.5	22	53	47.2	969	2052
Fever	38.1	56	147	30.2	16	53	39.8	817	2052
Loss of taste	36.1	53	147	18.9	10	53	14.7	301	2052
Sore throat	34	50	147	26.4	14	53	37.7	773	2052
Loss of smell	32.7	48	147	13.2	7	53	13.9	286	2052
Diarrhoea	21.1	31	147	11.3	6	53	12	247	2052
Conjunctivitis	12.9	19	147	5.7	3	53	0.5	11	2052
Dyspnoea	8.8	13	147	11.3	6	53	7.7	158	2052

Table 2: Prevalence of symptoms among positive tested persons by period.

Consistently, the positive rates of the swabs, were high in March and April 2020 (39% and 13% respectively), decreased during summer to below 4%, and increased again, reaching the peak in November-December 2021, with a positivity rate of 37% (Figure 2).

Only four patients needed to be referred to the hospital for further analysis. From Table 2, we can see the trends of symptoms across the different "waves"; at the very beginning of the pandemic, cough, weakness, headache, and fever were most frequent, with more than 40% of positives reporting them.

We had a statistically significant drop in symptoms during summer ($p<0.001$) compared to the other two periods representing waves. During the first months of data collection, loss of taste and smell were among the most prevalent symptoms, but they significantly decreased after summer ($p<0.001$), as was the case for conjunctivitis and diarrhea. All the other reported symptoms did not vary significantly from the first to the second wave, including the influenza-like symptoms cold, diarrhea, conjunctivitis, sore throat, and nausea. Among the out-patient subjects, dyspnea was seldom mentioned.

Figure 3 shows that, at the beginning of the pandemic, the majority of patients was over 80 years old, followed by the 60-40 and 40-20 years old. The teenagers' group were not present during the first month of the pandemic.

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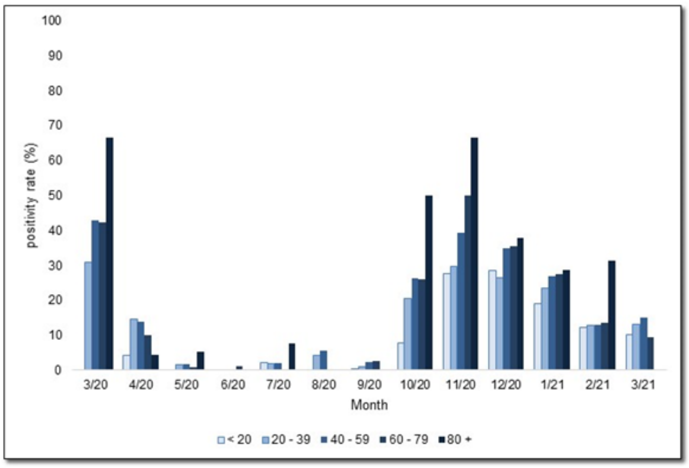

Figure 2: Monthly positivity rates by age group from March 2020 until March 2021. **Note:(** □ **)**<20; (■) 20-39; (■) 40-59; (■) 60-79; (■) 80+

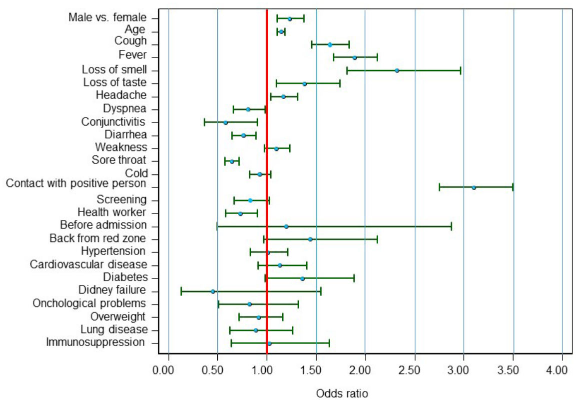

Figure 3: Associations between test positivity and different predictor variables (N =12082).

From March to April 2020, the percentage of positives, which was over 60% in the oldest age group in March, decreased significantly to below 10% in all age groups. Positivity rates were very low in all age groups from May to September 2020, to sharply increase again in October and reaching their peak in November 2020.

Predictors of test positivity in the entire sample

In Figure 3 the strongest predictors of test positivity in the entire sample were: Male gender (aOR=1.28, 95%-CI=1.16 to 1.42), and age (aOR=1.12, 95%-CI=1.09 to 1.16, for a 10 yr increment in age). Among the reasons for undergoing a test, the strongest predictors were symptoms (aOR=3.03, 95%-CI=2.41 to 3.79), and contact with an infected person (aOR=2.99, 95%-CI=2.67 to 3.34).

Travelling to a red zone as test reason was a weaker predictor of test positivity (aOR=1.63, 95%-CI=1.15 to 2.31), especially because "red regions" were limited to the very beginning of the pandemic but lost meaning when the virus evenly spread.

Among the chronic diseases, diabetes showed a significant positive association with a SARS-COV-2 infection (aOR=1.36, 95%-CI=1.01 to 1.84).

Conversely, the following reasons for testing showed significant negative associations with a positive test result: test taken before traveling (aOR=0.55, 95%-CI=0.25 to 1.12), by health workers (aOR=0.72, 95%-CI=0.59 to 0.88) and for epidemiological screening (aOR=0.70, 95%-CI=0.58 to 0.86).

Tests performed before admission showed a non-significant negative association with test positivity (aOR=0.68, 95%-CI=0.38 to 1.20).

Patients with kidney failure or oncological problems were less likely to have a positive test result (aOR=0.64, 95%-CI=0.22 to 1.89 and aOR=0.86, 95%-CI=0.55 to 1.33). However, these associations were far from reaching statistical significance. Odds ratios were obtained from a logistic regression model including all listed variables along with indicator variables for the months, Odds ratios are represented as points and confidence intervals as bars. In case of age, the odds ratio refers to an increase by 10 years.

Discussion

We analyzed epidemiological, demographic, and clinical data, including symptoms and concomitant diseases, from 12082 subjects with a SARS-CoV-2 test performed during the first year of the pandemic.

The aim of our study was to assess changes in test positivity over time during the pandemic waves and factors associated with test positivity [21,22].

In line with the European epidemic pattern 37, the total number of tests and test positivity increased from March to end of April 2020, decreased during ssummer and increased again starting from September 2020 until February 2021. If we compare the first and second "wave", we can clearly notice a sharper peak during March 2020 with a sharp decrease in April and May and a trough in summer, as observed elsewhere [21]. The impact of warm/hot weather on the pandemic is highly debated. At the beginning, experts thought that, as a respiratory virus, SARS-CoV-2 would have followed the winter pattern [23]. However, this belief lost support when COVID-19 spread in tropical countries as fast and devastatingly as in the more temperate regions [24]. Air humidity was also studied as a facilitator in the viral spreading [25]. From the available evidence of the COVID-19 transmission pattern , a major role is played by the physiological status of the host, and by the persistence, dynamics and ability of the virus to infect the host [26].

As shown in our data, the age distribution of positively tested persons slightly varied during the first year of the pandemic, with a high initial positivity rate among people above 80 years old, followed by the 60-40 and 40-20 years old [27]. After April this changed, due to restrictions and recommendations to elderly people to stay indoors and avoid contacts with others. The summer pattern, when more teenagers and young adults were positive, could be interpreted as a consequence of the summer relaxation of measures for COVID-19 containment. The decrease in positivity rate among people >60 years after December 2020 might be due to the advent of the vaccine in late December 2020, when this age group was targeted as a priority [28,29].

Our data show that during the first months, more than 90% of the swabs were done because of symptoms. Due to the initial global shortness of material and laboratory reagents, people were only tested if they were symptomatic. Since summer 2020 the criteria were widened; epidemiological surveys started to identify new foci of infection and small outbreaks. Other common reasons for testing reported in our study were having had a contact with a COVID-19 patient; pre and post-travel, and periodic screening of health care workers who had an increased risk of infection [30,31].

Our research had a special focus on detecting the most prevalent symptoms in the first year in outpatients, who had an initial or light disease, and we were able to spot cough, fever, loss of smell and taste at the beginning of the pandemic. However, the latter two symptoms were less present in the second wave, as was the case for conjunctivitis and diarrhea, which was more present in the pediatric population during the following "waves" [16,32]. We did not find any statistically significant relationship between chronic diseases and test positivity. As other authors, we observed that patients with kidney disease or diabetes had a non-significantly increased risk of testing positive, while the risk was decreased among oncological patients [33-35]. However, it is known that data on cancer patients and SARS-CoV-2 infection are still limited [36]. We did not find any association with hypertension among our patients, confirming that its role as a risk factor for COVID-19 is controversial [37].

Conclusion

The data collected in this study provide a tangible proof of the dynamic and epidemiological changes of the epidemic of SARS-CoV-2 infection over time in Ticino. The Ticino model, albeit on a small scale, was very efficient in answering to the urgent need of having accessible hubs where to get a swab and a medical check. Along with the other public health measures, the CPs have contributed, to flattening the curve of the pandemic, allowing the citizens to be screened and helping the Canton Medical Office to perform an accurate contact tracing.

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