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BRIEF REPORT

SARS-CoV-2 Surface Swabs in Locations With Public Access—Potential for Improved Source Control

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The presence of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on surfaces at public locations has been minimally described. By swab testing, we investigated the presence of SARS-CoV-2 on surfaces in public locations during the pandemic in February 2022. The viability of SARS-CoV-2 was not tested. Almost 25% of surfaces were positive for SARS-CoV-2; this was most pronounced in supermarkets.

Keywords. surface swab; COVID-19; SARS-CoV-2; source control; transmission.

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a highly contagious virus, primarily transmitted through droplets or aerosols from infected individuals. Transmission by contact with contaminated surfaces has also been reported during the pandemic [1]. To improve our knowledge and potentially reduce the risk of infection in public spaces, it is important to increase our awareness of SARS-CoV-2 on surfaces in public spaces with a high population turnover.

There have been 3 coronavirus disease 2019 (COVID-19) surges in Denmark, most recently during winter 2021/2022. The highest number of reported positive SARS-CoV-2 cases in Denmark was during the third surge [2]. By February 1, all restrictions including face mask use and corona passport were lifted in Denmark. However, in hospitals and elder care, it was recommended to use face masks and to swab test regularly [3].

The Capital Region is the most populous region in Denmark, with 1.36 million inhabitants, and, as of February 25, 2022, it was the region with the highest number of registered SARS-CoV-2-positive cases and deaths in Denmark [4, 5]. Due to the large population and crowded public transportation, it is potentially a high-risk area for the presence of SARS-CoV-2 on surfaces in public areas [6].

When performing reverse transcriptase polymerase chain reaction (RT-PCR), it is difficult to differentiate between the quantity of virus RNA and the quantity of viable virus [7]. However, studies have shown that under controlled experimental conditions, SARS-CoV-2 can remain viable for up to 72 hours on surfaces such as plastic and stainless steel [8]. Therefore, contaminated surfaces may contribute to the spread of SARS-CoV-2 in public areas.

In this study, we investigated the presence of SARS-CoV-2 on surfaces in locations with public access in the Capital Region of Denmark during the COVID-19 pandemic.

METHODS

Study Design

The study was conducted in the Capital Region between February 2 and February 8, 2022, during the third SARS-CoV-2 surge. SARS-CoV-2 swab sampling was performed in different locations with public access: the airport (2 locations), bars (4 locations), educational institutions (3 locations), entertainment venues (5 locations), exercise areas (7 locations), hospitals (8 locations), indoor shopping malls (6 locations), public transportation (19 locations), and supermarkets (12 locations). At hospitals, only public areas such as lobbies and waiting areas were examined. All samples were collected when the population turnover was highest at the given place, typically at rush hour. Control samples were collected from public transportation, entertainment, indoor shopping malls, and the airport.

Sample Collection

Samples were collected from various surfaces with an expected high risk of contamination due to tactile contact by many people. Sterile sampling swabs and 5-mL vials with an inactivating transport media (Wuxi NEST Biotechnology Co., Ltd, Jiangsu, China) were used. For each surface, swabs were performed by first moisturizing the sampling swap on the inside of the vial and then thoroughly rubbing the surface while rotating the swap for 15 seconds. After sampling, the head of the sampling

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Table 1. Frequency of SARS-CoV-2-Positive Samples at Different Locations and Surfaces

Location	Item	Positive Samples (%)
Supermarkets **12 locations** (33.36%)	Handle at bake-off section	0/7 (0.00)
	Pick and choose candy	1/2 (50.00)
	Shopping cart	2/10 (16.67)
	Payment machine	7/12 (58.33)
	Freezer handle	10/26 (38.46)
Public transportation **19 locations** (28.70%)	Control	0/2 (0.00)
	Bell at reception	1/1 (100.00)
	Ticket machine	1/11 (9.09)
	Trash can	1/5 (20.00)
	Chair	1/8 (12.50)
	Bench	2/13 (15.38)
	Table	3/6 (50.00)
	Elevator buttons	3/10 (30.00)
	Button for train	3/4 (75.00)
	Check-in	6/11 (54.55)
	Handrail	6/23 (26.09)
Hospitals **8 locations** (30.47%)	Soda vending machine	0/1 (0.00)
	Alcohol dispenser	0/1 (0.00)
	Wheelchair	0/1 (0.00)
	Water dispenser	0/1 (0.00)
	Information screen	1/1 (100.00)
	Interactive exhibition	1/1 (100.00)
	Payment machine	1/3 (33.33)
	Reception counter	1/7 (14.29)
	Door handle	1/8 (12.50)
	Elevator buttons	1/8 (12.50)
	Handrail	5/8 (62.50)
Educational institutions **3 locations** (25.00%)	Door handle	0/6 (0.00)
	Chair	1/3 (33.33)
	Table	1/3 (33.33)
	Handrail	1/3 (33.33)
Exercise facilities **7 locations** (12.13%)	Bench	0/3 (0.00)
	Locker room	0/3 (0.00)
	Door handle	3/12 (25.00)
	Fitness equipment	4/17 (23.53)
Entertainment **5 locations** (22.73%)	Control	0/2 (0.00)
	Door handle	0/10 (0.00)
	Elevator buttons	0/1 (0.00)
	Soda vending machine	0/3 (0.00)
	Self check-out systems	0/6 (0.00)
	Ticket machine	1/2 (50.00)
	Payment machine	1/3 (33.33)
	Locker room	1/3 (33.33)
	Pick and choose candy	1/4 (25.00)
	Freezer handle	1/4 (25.00)
	Interactive exhibition	1/6 (16.67)
	Children play area	4/6 (66.67)
Indoor shopping malls **6 locations** (16.48%)	Control	0/1 (0.00)
	Information screen	0/2 (0.00)
	Door handle	1/11 (9.09)
	Elevator buttons	1/6 (16.67)
	Handrail	1/6 (16.67)
	Payment machine	2/5 (40.00)
Copenhagen Airport **2 locations** (12.50%)	Control	0/1 (0.00)
	Table	0/2 (0.00)
	Handrail	0/2 (0.00)
	Check-in	0/4 (0.00)
	Bench	1/2 (50.00)
Bars **4 locations** (0.00%)	Handrail	0/2 (0.00)
	Bar game	0/2 (0.00)
	Payment machine	0/3 (0.00)
	Table	0/3 (0.00)
	Bar counter	0/4 (0.00)
	Door handle	0/5 (0.00)

Abbreviation: SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

swab was sealed in a sterile 5-mL vial. Only 1 sample was collected for each surface of interest. After sampling, the examined surface was cleaned with wipes. At selected locations, control samples were collected by holding the sampling swab in the air for 30 seconds before inserting it into the vial. All samples were kept frozen at −20°C within 24 hours of collection.

Sample Treatment and Analyses

PCR analysis for SARS-CoV-2 RNA was performed using the cobas SARS-CoV-2 for cobas 6800/8800 systems (09343733190, Roche, Switzerland). The RT-PCR targets ORF1 a/b (specific to SARS-CoV-2) and the E-gene (pan-Sarbecovirus). As no other pan-Sarbecoviruses were circulating, samples were considered positive if either or both targets were detected.

Statistical Analysis

Categorical data are reported as counts and percentages of samples in each category. The mean positive percentage of locations was calculated as the mean positive percentage of the surfaces. The standard deviation used to calculate the confidence intervals is the sample deviation, using the mean from the grouping of surfaces as variables. The confidence interval is based on a 2-sided normal distribution, calculated as the 95% confidence interval. Statistical analyses were performed using R (version 4.1.0 for Windows; R Foundation for Statistical Computing and Excel, Vienna, Austria).

RESULTS

From February 2 to 8, 2022, a total of 357 samples were collected in the Capital Region of Denmark, from 66 different locations, categorized into 9 location types. Seven air control samples were collected. Overall, 84 (23.5%) of the collected samples were positive for SARS-CoV-2 RNA. All the control samples were negative.

Distribution of Positive SARS-CoV-2 Samples Across Different Locations With Public Access

Supermarkets had the numerically highest frequency of positive samples, with 20 out of 57 (35.1%), followed by public transportation with 27 out of 94 (28.7%) and hospitals with 11 out of 40 (27.5%). At exercise facilities, educational institutions, and entertainment facilities, the frequencies were 7 out of 35 (20%), 3 out of 15 (20%), and 10 out of 51 (19.6%), respectively. At indoor shopping malls, the frequency was 5 out of 31 (16.1%), and at the airport the frequency was 1 out of 11 (9.1%). No positive samples were found at bars, that is, 0 out of 21 (Table 1).

DISCUSSION

This is one of the first studies to describe the extent of SARS-CoV-2 presence on surfaces often touched by many people in different public locations. Particularly interesting, this study was conducted during a period without any COVID-19 restrictions but nevertheless a high number of SARS-CoV-2 infections. We found that almost a quarter of all the samples were positive and that the numerically highest frequency of contaminated surfaces was observed in supermarkets and on the keys on credit card terminals.

Few studies have described SARS-CoV-2-contaminated surfaces in selected public areas. An earlier study by Zhou et al. detected SARS-CoV-2 RNA on 52.3% of the surfaces at a hospital in London in April 2020 [9]. A study from a major hospital in Portugal conducted in February 2021 also showed SARS-CoV-2 contamination in locations with COVID-19 and non-COVID-9 patients both in the air and on surfaces [10]. Therefore, hospitals may be a location with a high risk of SARS-CoV-2 transmission and infection, which emphasizes the importance of looking into the SARS-CoV-2 contamination there, even though there should be higher hygiene standards compared with other public areas.

Another study using surface swabs conducted in 20 supermarkets in Italy from April to May 2021 showed a positive percentage on 4.3% of the surfaces [11]. A study from quarantined households in Germany in March 2020 showed a positive percentage on 3.4% of the surfaces, which indicates that there is a difference between public and private places [12]. It is difficult to make a direct comparison between our study and these studies as the settings were different and less varied. Our study was conducted when the omicron variant was dominant in Copenhagen, whereas the earlier studies were conducted while other SARS-CoV-2 variants were present. The risk of infection is increased with SARS-CoV-2 Omicron compared with Delta, which may also contribute to the difference in frequencies [13].

The numerically high frequencies of positive samples in supermarkets and in public transportation probably reflect the high population turnover at these places. SARS-CoV-2 can be transmitted to surfaces either through droplets and aerosols from breathing and talking or through direct contact with other contaminated surfaces [9, 11]. If a substantial number of people are at a location each day, the likelihood of some of them being SARS-CoV-2 infected increases, and thereby also the risk of contamination of surfaces [6].

The difference in frequency of positive samples on surfaces in supermarkets could be due to the placement of hand sanitizer dispensers near the shopping carts, but not near the freezer handles or credit card terminals. Surprisingly, door handles had one of the numerically lowest numbers of positive samples. We expected a high contamination rate—a potential hotspot—due to direct contact by hands. Door handles might be sanitized more often because of their frequent use. Alternatively, people have gotten used to opening doors with their elbows or sanitizing their hands before opening, which can be due to the guidelines set by the Danish Health Authorities [14].

Another interesting finding is that no positive samples were found in bars. We would have expected to find SARS-CoV-2 on the surfaces, partly because bars often are crowded with people in limited spaces and a potentially lower awareness of hand hygiene. Superspreader events are also more likely to occur when many people are gathered in crowded locations, like the superspreader event seen at a student bar in Copenhagen in 2020 [15]. The reason that no positive samples were found at bars may indicate that people are more aware of their behavior now compared with the beginning of the pandemic. This can also be due to the guidelines set by the Danish Health Authorities [14].

A limitation of this study is that we were not able to differentiate between viable and dead SARS-CoV-2 [7]. Therefore, a positive sample may not necessarily pose a risk of infecting an individual who touches the SARS-CoV-2-positive surface. This challenges the clinical impact of our findings. However, the results of our study demonstrate that many surfaces in public areas were contaminated and therefore a potential source of virus spread. These findings suggest that surface disinfection or the development of more touch-free solutions may be possible preventive measures in management of disease spread.

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Patient consent. Our study does not include factors necessitating patient consent.

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