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## Letter to the Editor

## Effectiveness of COVID-19 digital proximity tracing app in Finland

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## To the Editor,

Mathematical modelling studies have suggested that digital proximity tracing (DPT) apps (also called digital contact tracing apps) have an impact on reducing COVID-19 transmission [1–3]. However, modelling studies have limitations that make extrapolation to real-world effectiveness difficult, and few studies with real-world data are available [4–7]. Millions of people have been using the DPT apps; therefore, their value in preventing onward transmission should be investigated in all COVID-19 incidence levels.

The Finnish national DPT app, Koronavilkku, was launched in September 2020. It was downloaded by half of all mobile phone owners (2.5 million times) making it one of the most penetrated national COVID-19 DPT apps [8]. Koronavilkku is produced by the Finnish Institute for Health and Welfare to alert the user that he or she may have been exposed to an individual with a positive laboratory result for COVID-19. Receipt of the alert and prevention of onward transmission requires several steps:

1. Both the infected and the exposed individuals actively use the app.

2. Local authorities send an SMS activation code to the PCR-positive case. In our region, the code was not sent if the case had been in quarantine for 48 hours before symptom onset or the contact tracing (CT) call revealed that the app would not send meaningful notifications.
3. The Bluetooth signal has worked properly in the exposure setting. Three parameters are calculated: the distance between the mobile phones, the time spent in proximity, and the time since the index case's symptom onset. If a certain value is exceeded, the contact is notified.
4. The test-positive case enters the activation code in the app within 4 (April 2021 onwards 12) hours. There is a technical delay before the contacts receive the notification; this was reduced from approximately 24 hours to 1–2 hours during the study period.
5. Potentially exposed individuals receive the notification before their infectious period begins and change behaviour accordingly.

Due to strong privacy protection of the decentralized Finnish DPT system, the number of sent notifications is unknown; consequently, the attack rate (the number of people who get infected divided by the number of people who receive the notification) among the recipients is unknown.

We assessed the population-based effectiveness of the Koronavilkku app in the Pirkanmaa region (population 540 000), which had an estimated 250 000 DPT app users. Effectiveness was defined as the percentage of COVID-19-positive cases who had been notified by the app before being contacted by the CT team, and the percentage of positive cases who had changed their behaviour due to the notification. Data were obtained from the CT database of the Pirkanmaa Hospital District Infectious Diseases Department, which coordinates all COVID-19 CT in the region; all laboratory-confirmed cases in the district are included in the database. All COVID-19-positive cases were interviewed by trained health care worker. This is a retrospective analysis of our contact tracing registry data; because of acute public health response, ethical review or informed consent was not required according to the Infectious Disease Law.

From 1 October 2020 to 31 May 2021, 4557 PCR-positive COVID-19 cases were identified; 4110 (90%) were  $\geq 12$  years old (Table 1).

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**Table 1**  
Background data on laboratory confirmed COVID-19 cases and characteristics of the digital proximity tracing app Koronavilkku in Pirkanmaa hospital district 1 October 2020 to 31 May 2021

	N (%)
<b>Background data</b>	
Residents, N	540 465
COVID-19 PCR positive cases, n	4557
Cases aged $\geq 12$ y, n (%)	4110 (90.2)
Transmission source abroad, n (%)	228 (5.0)
High-risk contacts placed in quarantine, n	25 849
Quarantines per each positive case (n), median (range)	2 (0–187)
Hospitalized COVID-19 patients, n (%)	295 (6.5)
<b>Characteristics of the digital proximity tracing app</b>	
Estimated downloaded apps in Pirkanmaa, N <sup>a</sup>	250 000
COVID-19 PCR positive cases, n	4557
Koronavilkku in use, n (%)	976 (21.3)
Koronavilkku not in use, n (%)	1392 (30.5)
No data, n (%)	2189 (48.2)
SMS activation codes of the notification signal sent to PCR-positive cases, n (%)	541 (11.9)
Cases who had received notification signal before the contact tracing call, n (%)	53 (1.2)
Cases who did not know about their exposure to COVID-19 before the notification signal, n (%) <sup>b</sup>	18 (0.4)
Cases who changed their behaviour due to the notification signal, n (%)	8 (0.2)

<sup>a</sup> There were more than 2.5 million downloads nationally, and our region is approximately 10% of the total population.

<sup>b</sup> No data on two cases.

The average 14-day case notification rate was 49 per 100 000 population. We were able to contact over 99% of the index cases, 99.4% within 24 hours. During the CT interview, we asked about Koronavilkku usage; of 2368 cases (58% of cases  $\geq 12$  years), 970 (41%) reported actively using it. Based on information obtained during the CT call (see the aforementioned step two) and occasional logistic problems, activation codes were sent to 541 (56%) cases. Activation codes were not sent to individuals whose use of the app was unknown. Based on information from the first CT call, the DPT app had given a notification before the call in 53 cases (2.2% of cases with usage information). These cases were interviewed again in a second call. Cases whose index was from the same household were excluded ( $n = 15$ ). Among the 38 cases, the exposure information was known for 20 cases before the app notification—for example, the case was in quarantine due to known exposure (other than household), the information had been disseminated in the workplace, or a friend had reported the exposure. Of the remaining 18,

only 8 (0.3% of cases with usage information; no data on 2 cases) reported having changed their behaviour because of the notification (e.g. decided to get tested).

In conclusion, if the incidence is low enough for manual CT to work effectively, the DPT app appears to provide only marginal benefit. Real-world data are needed from areas with widespread community transmission.

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### Author contributions

All authors: writing—review and editing. JR: conceptualization, methodology, formal analysis, writing—original draft. PT: formal analysis. RH: investigation, formal analysis. JPN: formal analysis, supervision. JS: formal analysis, supervision.

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