research

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Health apps are designed to track and share

ORIGINAL RESEARCH Cross sectional study

Mobile health and privacy

Tangari G, Ikram M, Ijaz K, Kaafar MA, Berkovsky S

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Study question Do health related mobile applications (mHealth apps) on Google Play collect users' data transparently and without privacy risks?

Methods To profile the privacy risks of mHealth apps at scale, a data collection framework was developed to automatically search through Google Play for medical and health related apps. The source codes and network traffic analysis of the mHealth apps included characterisation of the data collection operations and transmissions, an audit compliance conduct of mHealth apps' privacy policies, and investigation of complaints in apps' reviews on Google Play.

Study answer and limitations 88.0% (n=18 472) of mHealth apps included code that could potentially collect user data, and 3.9% (n=616) of apps transmitted user information in their traffic. 23.0% (724) of user data transmissions occurred on insecure communication protocols. 28.1% (n=5903) of apps provided no privacy policies, whereas 47.0% (n=1479) of user data transmissions complied with the privacy policy. Less than 1.3% (n=3609) of user reviews raised concerns about privacy. The study relied on automation tools, which despite providing high validated accuracy, could generate potentially (limited) false positives.

What this study adds This study found serious privacy issues and inconsistent privacy practices among mHealth apps. Clinicians should discuss these problems with patients who might want to use mHealth apps.

Funding, competing interests, and data sharing This work was funded by the Optus Macquarie University Cyber Security Hub and the National Health and Medical Research Council Centre of Research Excellence in Digital Health.

No competing interests. The dataset and analysis script are available at https://mhealthapps2020.github.io/.

Mobile health apps have generated substantial investment and enthusiasm for their potential to personalise interventions using real time user data. However, user data are not only invaluable for creating engaging and effective apps. Health apps are just one source of user data that is collected, transmitted to third parties, then aggregated to create detailed impressions about users and people such as them. These sources of big data are commercialised, often as consumer insights or algorithms, and used to deliver microtargeted adverts, influence political behaviours, or make decisions about health insurance, employment, and housing,[1 2] sometimes with exploitive or discriminatory effects.[3]

Even so, users might reasonably assume that apps advertised for health purposes would treat health and personal information with greater care. To question this assumption, Tangari and colleagues analysed more than 15 000 free Android apps in the "medical" and "health and fitness" categories of the Google Play store and compared their privacy practices with a random sample of more than 8000 apps from store categories unrelated to health.[4] They examined the apps' code to understand what kind of user data might be shared and with whom, and then during network traffic analysis which data were actually shared. Finally, they assessed users' awareness of privacy failings as expressed in app store reviews.

The authors found that mobile health apps were designed for tracking and sharing information.[4] Developers had programmed most health apps (88%) to enable tracking capabilities. About two thirds of apps could collect advert identifiers or cookies, which can be used to uniquely identify users across different apps and websites, even if not by name. One third could collect a user's email address, and about a quarter could identify the mobile phone tower to which a user's device is connected, potentially providing information on the user's geolocation.

Health apps then shared user data within the wider, commercial mobile ecosystem, which includes developers, their parent companies, cloud storage providers, and a host of services that developers use to monetise, improve, or learn about use of their app.[5-7] In 63% of apps, developers had embedded at least one third party service such as an advert library, analytics service, or social media provider, which most commonly were a small number of tech corporations, including Google, Facebook, and Yahoo!.[4]

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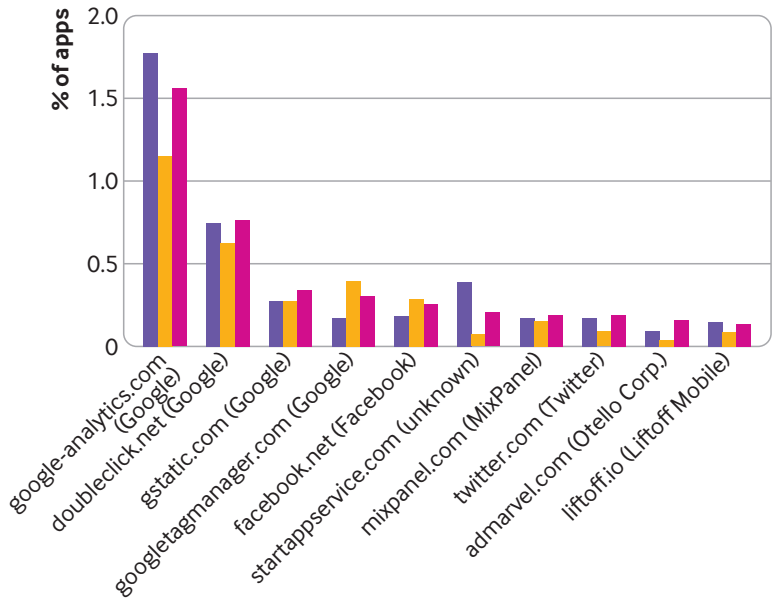
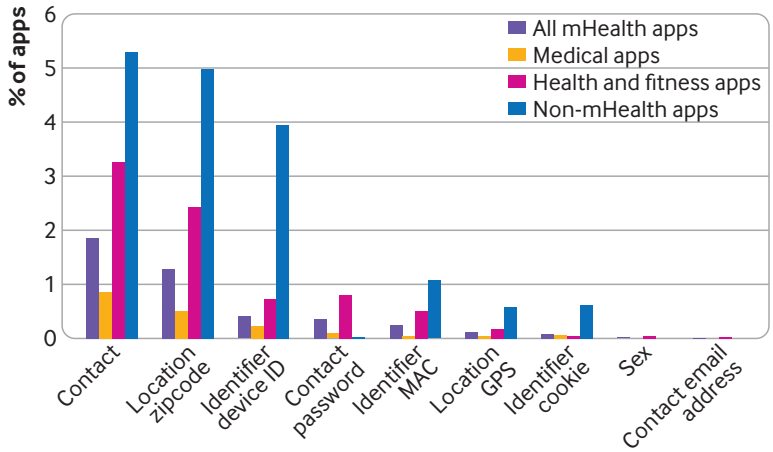
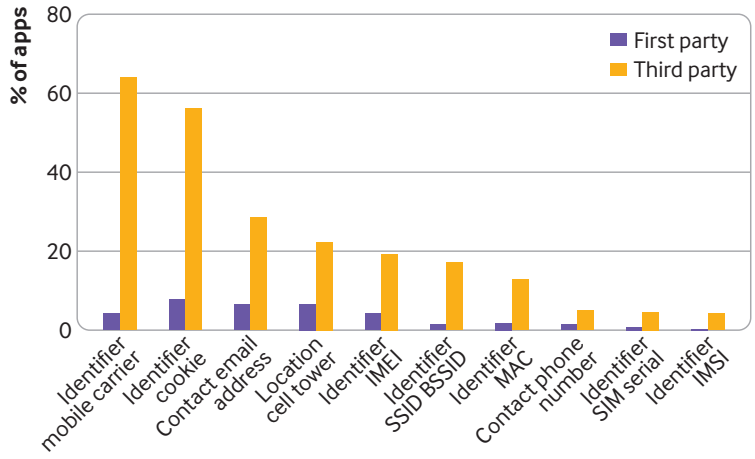


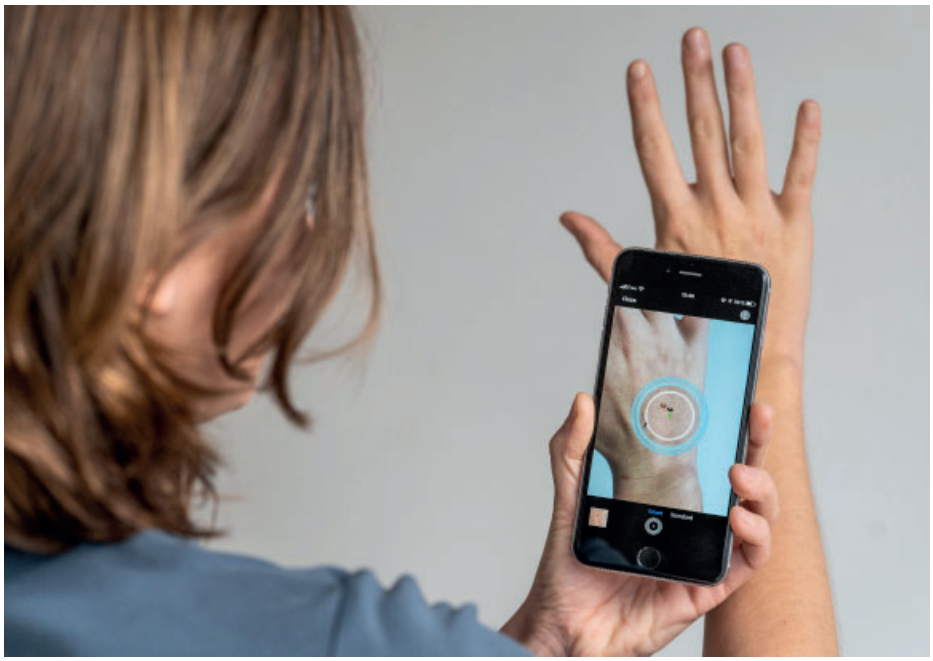
Top 15 tracker domains in mobile health (mHealth) and non-mHealth apps



Personal user data transmissions in mobile health (mHealth) app traffic. MAC =media access control; GPS=global positioning system



Personal data recipients in mobile health (mHealth) apps files and code. IMEI=international mobile equipment identity; SSID BSSID= service set identifier basic service set identifier; MAC=media access control; SIM=subscriber identity module; IMSI=international mobile subscriber identity



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Regulators continue to place the greatest responsibility on those with the least ability to prevent harm

Mobile health apps appeared to be somewhat more reticent about sharing user data with third parties than non-health apps, having fewer interactions with advert and tracking services.[4] This could reflect what users expect from health apps: users rated health apps with adverts or tracking more negatively.[4] Tangari and colleagues found that only 4% of health apps actually transmitted data; however, they measured data transmission for only 180 seconds while automatically running the app,[4] finding a much lower prevalence of data sharing than recent small, in-depth analyses, which fully explored apps' functions.[5 8]

Data protection

May 2021 marked the third anniversary of the General Data Protection Regulation (GDPR), which has improved transparency around apps' data collection and sharing practices[5 9] and requires specific measures to ensure active consent to data sharing.[10] Privacy regulation such as the GDPR continues to distinguish between sensitive and non-sensitive data, requiring more stringent controls for sensitive or personal data.[11] However, a user's health status can increasingly be inferred—accurately or not—on the basis of diverse data points such as self-reported mood, the name of the health app, postal code, search history, and race or ethnicity, calling into question whether all data, and especially aggregated data, should be treated as sensitive.

Privacy regulation also still largely relies on the idea that an "informed consumer" can choose apps with adequate privacy assurances.[11] However, 29% of the apps sampled by Tangari and colleagues failed to provide a privacy policy and another 24% collected and transmitted user data in ways that violated the terms set out in their privacy policy.[4] There is no assurance that users will know how apps track and share data, and regulators continue to place the greatest responsibility on those with the least ability to prevent harm.[12 13]

The status quo regarding health apps' privacy practices means that it is difficult and even irresponsible to offer tips to busy clinicians or consumers about how to choose a health app that protects their privacy. Consumers can, however, make it more difficult to be tracked by disabling advert identifiers, adjusting app permissions, and using advert blockers.[14] We must also advocate for greater scrutiny, regulation, and accountability on the part of key players behind the scenes—the app stores, digital advertisers, and data brokers—to address whether these data should exist and how they should be used, and to ensure accountability for harms that arise.[15]

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CORRECTION

Updating insights into rosiglitazone and cardiovascular risk through shared data: individual patient and summary level meta-analyses

This research paper by Wallach and colleagues (*BMJ* 2020;368:l7078, published in the print issue of 8 February 2020) has a correction notice. For more details please go to the paper at doi:10.1136/bmj.l7078

$P2Y_{12}$ inhibitor monotherapy or dual antiplatelet therapy after coronary revascularisation

Valgimigli M, Gragnano F, Branca M, et al

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Study question What are the risks and benefits of $P2Y_{12}$ inhibitor monotherapy compared with dual antiplatelet therapy (DAPT), and are these associations modified by patients' characteristics?

Methods Randomised controlled trials comparing an oral $P2Y_{12}$ monotherapy with DAPT on centrally adjudicated endpoints after coronary revascularisation were included. The primary outcome was the composite of all cause death, myocardial infarction, and stroke tested for non-inferiority against a margin of 1.15 for the hazard ratio. The key safety endpoint was Bleeding Academic Research Consortium (BARC) type 3 or type 5 bleeding.

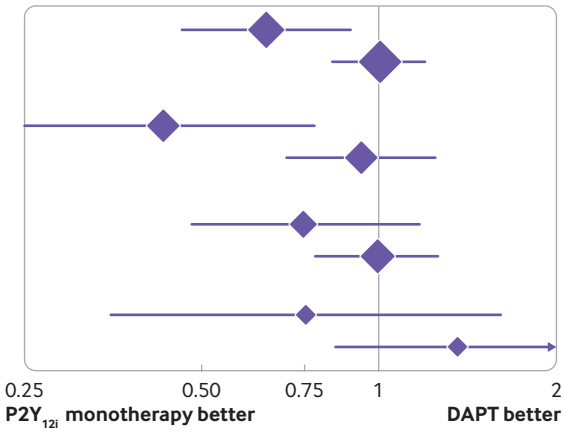
Study answer and limitations Data from six trials, including 24 096 patients, were included. The primary outcome occurred in 283 (2.95%) patients with $P2Y_{12}$ inhibitor monotherapy and 315 (3.27%) with DAPT in the per protocol population (hazard ratio 0.93, 95% confidence interval 0.79 to 1.09; P=0.005 for non-inferiority; P=0.38 for superiority; τ^2=0.00) and in 303 (2.94%) with $P2Y_{12}$ inhibitor monotherapy and 338 (3.36%) with DAPT in the intention-to-treat population (0.90, 0.77 to 1.05; P=0.18 for superiority; τ^2=0.00). The treatment effect was consistent across all subgroups, except for sex (P for interaction=0.019), suggesting that $P2Y_{12}$ inhibitor monotherapy lowers the risk of the primary ischaemic endpoint in women. The risk of bleeding was found to be lower with $P2Y_{12}$ inhibitor monotherapy than with DAPT (0.89% *v* 1.83%; hazard ratio 0.49, 0.39 to 0.63; P<0.001; τ^2=0.03). The analysis is subject to the shortcomings of the original trials, including an open label design in five of the six studies.

What this study adds Aspirin cessation from one to three months after coronary revascularisation and continuation with $P2Y_{12}$ inhibitor monotherapy may be warranted instead of continuation of DAPT, irrespective of the ischaemic or bleeding risks, and especially in women.

Funding, competing interests, and data sharing The study was funded by institutional support of the Cardiocentro Ticino Institute. See bmj.com for competing interests. Data available on request.

Trial registration PROSPERO CRD42020176853.

	$P2Y_{12i}$ monotherapy (%) (n=11 634)	DAPT (%) (n=11 674)	Hazard ratio (95% CI)	P value for interaction	Hazard ratio (95% CI)
Primary outcome					
Female	59/2717 (2.3)	91/2706 (3.6)		0.02	0.64 (0.46 to 0.89)
Male	244/8917 (3.1)	247/8968 (3.2)			1.00 (0.83 to 1.19)
All cause mortality					
Female	17/2717 (0.7)	39/2706 (1.7)		0.02	0.43 (0.25 to 0.77)
Male	90/8917 (1.1)	98/8968 (1.3)			0.93 (0.70 to 1.23)
Myocardial infarction					
Female	34/2717 (1.3)	45/2706 (1.8)		0.27	0.74 (0.48 to 1.16)
Male	133/8917 (1.7)	136/8968 (1.8)			0.99 (0.78 to 1.25)
Stroke					
Female	12/2717 (0.5)	16/2706 (0.6)		0.16	0.75 (0.35 to 1.58)
Male	39/8917 (0.5)	29/8968 (0.3)			1.35 (0.84 to 2.19)



Sex stratified analysis for primary endpoint, all cause death, myocardial infarction, or stroke in intention-to-treat population. DAPT=dual antiplatelet therapy; $P2Y_{12i}$=$P2Y_{12}$ inhibitor monotherapy