The effects of physical distancing on population mobility during the COVID-19 pandemic in the UK

In an attempt to reduce the transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), an estimated 4·5 billion people globally have been placed under some form of lockdown restriction. In the UK, non-essential movement constraints and physical distancing have been in place since March 23, 2020. Modelling and early empirical investigations indicate that physical distancing measures are crucial to reduce transmission of the virus, consequent pressure on health systems, and the number of deaths. For these policies to be successful, adequate compliance must be achieved. To help monitor this compliance, we have developed code to enable us to map national mobility data for the UK, which can also be applied to the data available for 131 other countries and 1167 subregions. The code we used is openly available online.

Adherence to movement restriction regulations is challenging and a risk of increasing non-compliance (or so-called lockdown fatigue) exists. Observational evidence suggests that rather than fatigue, the practicalities of daily living are leading some people in the UK to increase activity as their supplies decrease.[1,2] These observations are important because a key modelling study of mitigation strategies for reducing transmission in the UK assumed a 75% reduction in contacts as part of a social distancing strategy that was subsequently implemented;[3] whether this level of reduction is being achieved remains unclear.

On March 29, 2020, Google released mobility data, aggregated from mobile device location information covering the period Feb 16 to March 29, 2020.[4] These data can be used to infer the locations visited by an individual and to compare pre-restriction (baseline) to post-restriction activity. Data can be downloaded from Google as a comma separated value (CSV) file and are updated daily. We used these data because the Google Android operating system has the largest market share, and therefore is likely to capture the movements of more individuals than any other provider. Other providers have started to publish mobility data too, including Apple, although these data do not provide information on the type of mobility (ie, residential, in a park, or a workplace).

We used Google mobility data to map spatial and temporal changes in mobility across the UK in six areas: residential areas; supermarkets, grocery shops, and pharmacies; workplaces; retail and recreational areas; transit stations (subway, bus, and train stations); and parks (figure). Comparing data for March 29, 2020, with baseline data from Jan 3 to Feb 6, 2020, we saw a 63% overall reduction in movement, with retail and recreational areas (decreased by 85%; not surprising given restrictions imposed on this sector) and transit stations (decreased by 75%) showing the largest reductions. Park use initially decreased but has now increased to levels seen before the lockdown restrictions, perhaps because of good weather or people adapting their exercise requirements. However, when we viewed data up to the week of May 2, we saw a slight increase in mobility across retail and recreational areas and transit, suggesting increased movement over time.

Subsequent releases of data have allowed us to make comparisons of movement over the course of lockdown. Across the UK, non-residential and non-park movement has increased by 5% since lockdown began, increasing by 2–3% per week. Use of parks has increased since the first week of lockdown restrictions, which is to be expected, but remains 30% below the usual levels of mobility. Comparing movement on April 11 to that on April 5 and March 29, we saw no large changes in mobility and no clear trend towards increased mobility. However, by mapping these data we observe increases in mobility in specific regions, particularly the Midlands, north-east England, and Wales, where transit has increased by up to 25%. These findings show how data can provide information on differential adherence to movement restrictions geographically and over time. Dynamic spatial or temporal information could help guide the so-called exit strategy from current lockdown restrictions. Furthermore, combining data such as these with health-care information, such as COVID-19 testing results—with adequate privacy protections—could allow governments to develop localised movement policies.

Interpreting these data poses challenges because they might not reflect differences in population density. For instance, rural areas might appear to have smaller

Change in activity from baseline
March 29 *vs* Jan 3–Feb 6, 2020

Parks Parks, beaches, and public gardens	Workplace Places of work	Retail and recreation Restaurants, cafes, shopping centres, museums, libraries, cinema (not pharmacies and supermarkets or grocery shops)	Transit stations Public transport hubs such as bus, train, and subway or tube stations

−100% −75% −50% −25% 0%
Most reduction   Least reduction

Change in activity during lockdown
April 15 *vs* March 29, 2020

Parks	Workplace	Retail and recreation	Transit stations

0%   50%
No increased activity   Increased activity

Change in activity during lockdown
May 2 *vs* April 15, 2020

Parks	Workplace	Retail and recreation	Transit stations

0%   50%
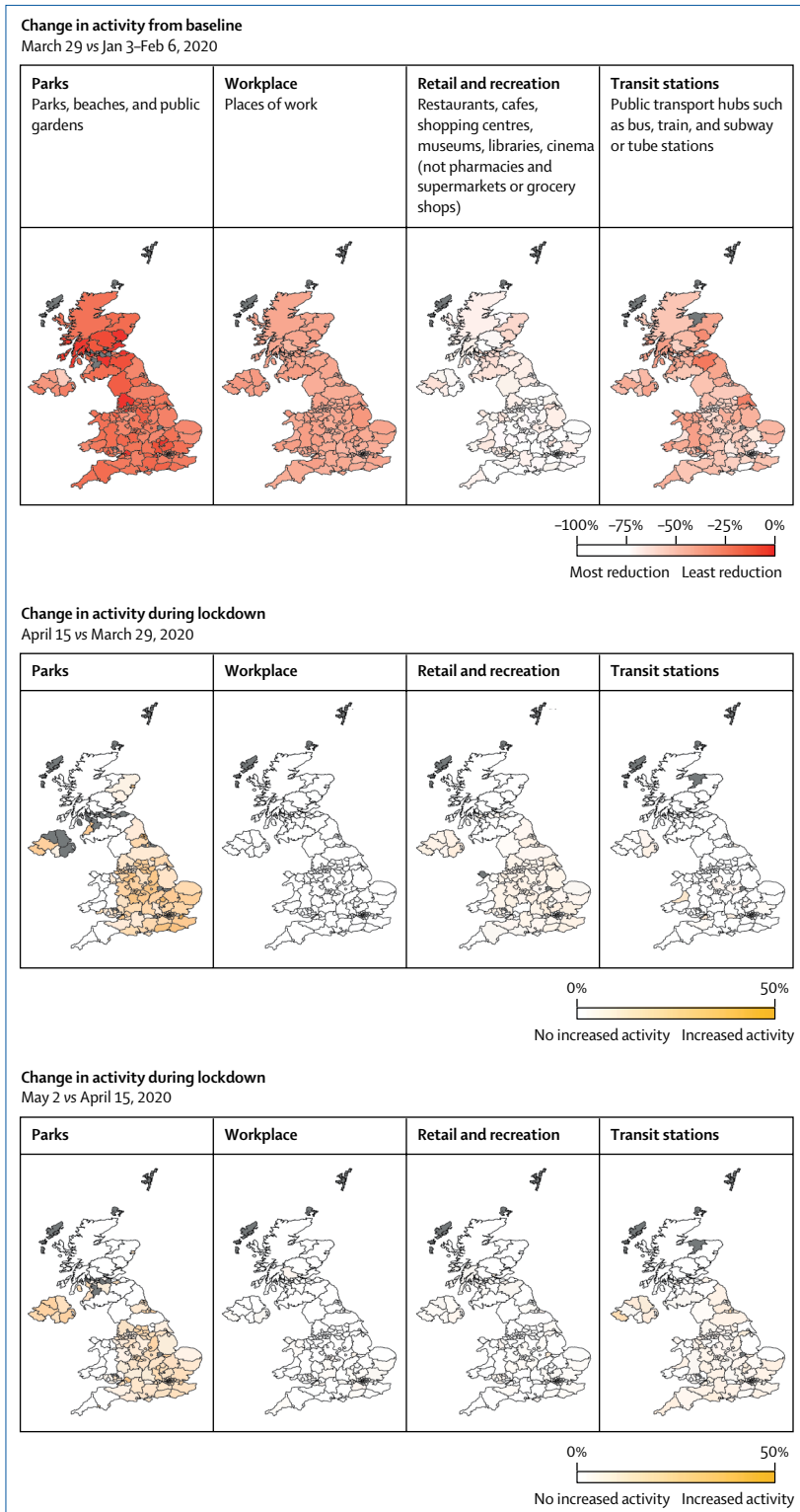No increased activity   Increased activity

Figure: Regional differences across the UK in mobility since the implementation of physical distancing

reductions in mobility due to a requirement to travel further for supplies and the differing nature of rural occupations, such as farming, where mobility in the workplace is essential. Similarly, in dense population centres, larger reductions in mobility might be required to reduce transmission effectively. For instance, for a large transport hub that process tens of thousands of passengers each day, a 50% reduction in mobility might be insufficient to reduce disease transmission due the inability for adequate physical distancing in that environment. Hence, contextualising these data is essential for fair interpretation. Demographic differences in populations might also affect these data, with some groups (including older people and those in poverty) being less likely to own a mobile phone.[5] Hence, mobility in these populations might not be captured and given the poorer health outcomes from COVID-19 in some subgroups, this is a key drawback for any mobility data that relies on consumer technology.

Monitoring the effect of lockdown policies is crucial for updating model predictions to inform health-care system response. With more time spent under lockdown restrictions, cognitive errors such as confirmation bias (interpreting information in a way to support the aim to get back to normal) and optimism bias (ie, the opinion that "it won't happen to me") might weaken resolve for physical distancing, especially when worst-case predictions are not realised.[6,7] Maintaining the behavioural changes necessitated for long periods of lockdown restriction requires a compelling narrative that addresses individual needs for autonomy, connection, and competence. Although not of our choosing, the population is learning a new skill (staying at home), and feedback is required to internalise external drivers into intrinsic motivators. Messages of thanks and approval for doing the right thing, combined with regional data on movement and infection rates can reinforce motivations to stay at home.

Concerns about the ethical use of these data are important, both now and in the future. Many individuals are not fully aware of the scale and fidelity of information collected about them. Appropriate consent, options for opting out, and stringent privacy measures are essential if public trust in this information is to be maintained.[4] Publishing these data in an anonymised and aggregated format is important to protect the privacy, safety, and trust of individuals, which must be considered to

prevent unintended consequences, such as victimising disadvantaged groups who are less able to practice physical distancing, discrimination, or even causing targeted law enforcement against these populations.

Editorial note: the *Lancet* Group takes a neutral position with respect to territorial claims in published maps and institutional affiliations.

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