

# The effect of social distancing on the reproduction number and number of contacts in the UK from a social contact survey

## Report 6

Authors: Kevin Van Zandvoort, Amy Gimma, Christopher Jarvis, Petra Klepac, and John Edmunds on behalf of the LSHTM COVID-19 Modelling Team

Date: 5th May 2020

### Main conclusion

Using our best estimates, we estimate that  $R_0$  is below one nationally and in all regions. There is small variation between regions. In some regions, we cannot rule out that  $R_0$  is below one, though all central estimates are below one .

### Methods

CoMix is a behavioural survey, with a study sample recruited to be broadly representative of the UK adult (18+) population. It was launched on 24<sup>th</sup> of March 2020 and this analysis includes data collected up to the 27<sup>th</sup> of April. Data is collected weekly, using two different panels who are interviewed using the same questionnaire in alternate weeks. Participants recorded direct, face-to-face contacts that they made on the previous day, specifying certain characteristics for each contact including the age and sex of the contact, whether contact was physical (skin-to-skin contact), and where contact occurred (e.g. at home, work, while undertaking leisure activities, etc). Further details have been published elsewhere.<sup>1</sup>

#### *Change in contact patterns over time by region*

We combined the final week for Panel A (week 5; 1,144 participants) and B (week 4; 1,326 participants) to get estimates in each region. Estimates for child-child contacts had to be imputed from national POLYMOD data<sup>2</sup>, but scaled accordingly in each region. We used BBC Pandemic data<sup>3</sup> in each region as the baseline of contacts prior to the lockdown. We made two assumptions for the baseline  $R_0$  estimates in each region: we either assumed  $R_0$  followed a normal distribution with mean 2.6 and standard deviation 0.54 in all regions, or used the first reported estimated  $R_t$  by Abbot et al<sup>5</sup> in each region (shown in Table 1).

**Table 1. First available  $R_t$  estimates.** First available  $R_t$  estimates available by region from Abbot et al

| Region         | Date       | Rt estimate      |
|----------------|------------|------------------|
| Greater London | 28-02-2020 | 2.21 (1.75-2.92) |
| North West     | 01-03-2020 | 2.14 (1.56-3)    |

|                          |            |                  |
|--------------------------|------------|------------------|
| South West               | 02-03-2020 | 1.94 (1.36-2.72) |
| East Midlands            | 03-03-2020 | 2.06 (1.5-2.86)  |
| East of England          | 03-03-2020 | 2.1 (1.53-2.96)  |
| South East               | 03-03-2020 | 2.07 (1.62-2.8)  |
| West Midlands            | 05-03-2020 | 2.1 (1.67-2.76)  |
| Northern Ireland         | 07-03-2020 | 1.98 (1.38-2.85) |
| Yorkshire and The Humber | 07-03-2020 | 2.03 (1.56-2.7)  |
| Scotland                 | 09-03-2020 | 2.06 (1.62-2.71) |
| North East               | 13-03-2020 | 2.07 (1.62-2.7)  |
| Wales                    | 15-03-2020 | 1.87 (1.54-2.32) |

### *Change in contact patterns over time nationally*

We individually compared the contacts in the final weeks for each panel to get national estimates. Estimates for child-child contacts had to be imputed from national POLYMOD data<sup>2</sup>. We used national POLYMOD<sup>2</sup> and BBC Pandemic data<sup>3</sup> as the baseline of contacts prior to the lockdown. We assumed  $R_0$  followed a normal distribution with mean 2.6 and standard deviation 0.54.

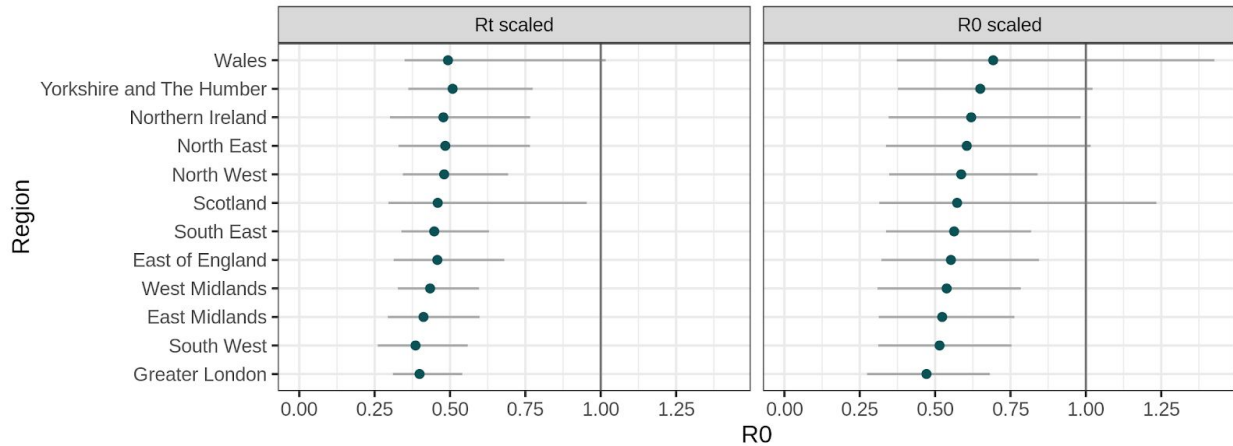
Current  $R_0$  estimates are compared by multiplying the baseline  $R_0$  estimates by the ratio between the maximum eigenvalue of the baseline and CoMix contact matrices, as calculated and corrected for the population distribution using the method proposed by Wallinga et al<sup>4</sup>. We bootstrapped all matrices and  $R_0$  values 2,000 times to assess uncertainty around our estimates.

## **Results**

### *National reproduction number*

Combining data from Panel A (week 5) and Panel B (week 4), and POLYMOD<sup>2</sup> contacts as a baseline, we estimate the mean current  $R_0$  to be 0.42 (0.25 - 0.52). Using BBC Pandemic contacts<sup>3</sup> as a baseline, we estimate the mean current  $R_0$  to be 0.53 (0.32 - 0.66).

### *Reproduction number by region*



**Figure 1.  $R_0$  estimates by region in the UK.**  $R_t$  scaled uses the first available  $R_t$  estimates by Abbott et al as a baseline, while  $R_0$  scaled assumed that the baseline  $R_0$  estimate followed a normal distribution with mean 2.6 and standard deviation 0.54 everywhere.

**Table 2  $R_0$  estimates by region in the UK.**  $R_t$  scaled uses the first available  $R_t$  estimates by Abbot et al<sup>5</sup> as a baseline, while  $R_0$  scaled assumed that the baseline  $R_0$  estimate followed a normal distribution with mean 2.6 and standard deviation 0.54 everywhere. The N column shows the total number of participants in each region.

| Region                   | Pariticipants | $R_t$ scaled     | $R_0$ scaled     |
|--------------------------|---------------|------------------|------------------|
| Wales                    | 112           | 0.54 (0.35-1.02) | 0.74 (0.37-1.43) |
| Yorkshire and The Humber | 206           | 0.52 (0.36-0.77) | 0.66 (0.38-1.02) |
| Northern Ireland         | 54            | 0.49 (0.3-0.77)  | 0.63 (0.35-0.98) |
| North East               | 92            | 0.50 (0.33-0.77) | 0.62 (0.34-1.02) |
| North West               | 256           | 0.49 (0.34-0.69) | 0.59 (0.35-0.84) |
| Scotland                 | 203           | 0.50 (0.30-0.95) | 0.62 (0.31-1.23) |
| South East               | 336           | 0.46 (0.34-0.63) | 0.57 (0.34-0.82) |
| East of England          | 219           | 0.47 (0.31-0.68) | 0.56 (0.32-0.84) |
| West Midlands            | 231           | 0.44 (0.33-0.6)  | 0.54 (0.31-0.78) |
| East Midlands            | 188           | 0.42 (0.29-0.6)  | 0.52 (0.31-0.76) |
| South West               | 246           | 0.39 (0.26-0.56) | 0.52 (0.31-0.75) |
| Greater London           | 327           | 0.40 (0.31-0.54) | 0.47 (0.27-0.68) |

## Discussion

The overall epidemic in the UK is made up of different components: the community epidemic and outbreaks in enclosed settings, most notably hospitals and care homes. This survey provides estimates of epidemiologically relevant behaviours in the community.

We estimate that the reproduction number of this community epidemic is below one both nationally and across regions. There is little variation in  $R_0$  between regions, but we estimate Wales to have the highest  $R_0$  estimate (0.74) and Greater London the lowest (0.47). Using  $R_t$  estimates from Abbot et al<sup>5</sup> as the baseline value for  $R_0$ , we estimate lower values. However, we cannot exclude that social distancing was already affecting the contacts prior to the lockdown, when these values were taken.

A major potential limitation is that this study may not be capturing individuals who are breaking lockdown rules and there may be a social desirability bias which results in an underreporting of the number of contacts. In addition, we had to impute values for child-child contacts, and were not able to calculate baseline estimates for contacts prior to the lockdown.

## References

- 1 Jarvis CI, Van Zandvoort K, Gimma A, *et al.* Quantifying the impact of physical distance measures on the transmission of COVID-19 in the UK. *Epidemiology*. 2020; published online April 3. DOI:10.1101/2020.03.31.20049023.
- 2 Mossong J, Hens N, Jit M, *et al.* Social contacts and mixing patterns relevant to the spread of infectious diseases. *PLoS Med* 2008; **5**: e74.
- 3 Klepac P, Kucharski AJ, Conlan AJK, *et al.* Contacts in context: large-scale setting-specific social mixing matrices from the BBC Pandemic project. *Epidemiology*. 2020; published online Feb 19. DOI:10.1101/2020.02.16.20023754.
- 4 Wallinga J, Teunis P, Kretzschmar M. Using data on social contacts to estimate age-specific transmission parameters for respiratory-spread infectious agents. *Am J Epidemiol* 2006; **164**: 936–44.
5. Epiforecasts. National and Subnational estimates for the United Kingdom [Internet]. CMMID; 2020 Apr [cited 2020 May 5]. (Temporal variation in transmission during the COVID-19 outbreak). Available from: <https://github.com/epiforecasts/covid-regional/tree/master/united-kingdom/regional-summary>