

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

## Report 13

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### Changes this week:

- To limit the impact of a few participants reporting very large numbers of contacts, contacts are truncated at 100 contacts per day per person for baseline  $R_0$  calculations, with priority set, in order, for individually reported, home, work, and school. Prior to this participants were removed.

### Summary:

- The overall estimate of  $R_0$  for the UK is 0.81 (95% CI 0.49 to 1.17), though there is some evidence that differences between the nations of the UK may be emerging, with Scotland and Wales reporting generally lower and stable  $R_0$  estimates over time, whereas some regions of England have seen a gradual increase over recent weeks (trends for Northern Ireland are difficult to interpret due to small numbers).
- The North West, South West and South East regions have median estimates of  $R_0$  at or above 1.

## Results

### *Social contacts and basic reproduction number*

We estimate  $R_0$  to be 0.81 (95% CI 0.49 to 1.17) for the UK and 0.85 (95% CI 0.47 to 1.25) for England, between the 18<sup>th</sup> June and 24<sup>th</sup> June, calculated by truncating contacts to a maximum of 100 per participant. The  $R_0$  estimates including all data are 0.99 (95% CI 0.58 to 1.41) for the UK and 1.06 (95% CI 0.63 to 1.48) for England, though these estimates are skewed by a few participants reporting over 100 contacts. The interquartile range remains 1 to 3 for the number of contacts per person. Table 1 presents  $R_0$  estimates excluding participants that report over 100 contacts, as most of these contacts are listed as work contacts, and dependent on the day of the week that the participant completes the survey.

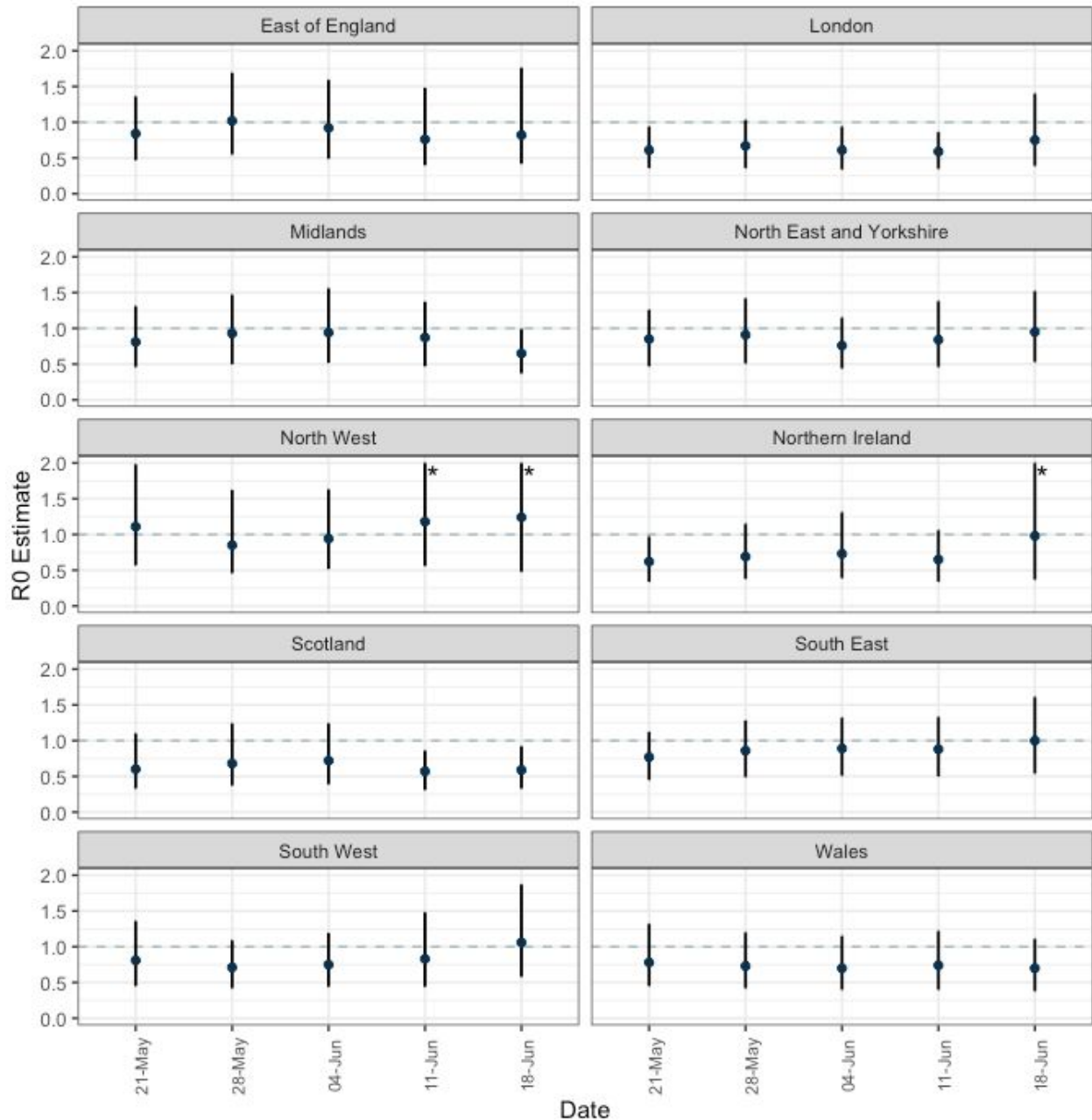
The median  $R_0$  estimates for the different regions and countries of the UK are still below one, though CIs now include 1 for most regions/countries (Figure 1, Table 2). The North West, South West, and South East median estimates are at or above 1, though these estimates, along with a wide confidence interval in some regions including the North West and Northern Ireland, are driven by a small number of individuals with a high number of contacts.

Children’s contacts have been described separately from the adult contacts in Table 3. Most reported contacts occurring outside the home are at school, with all contacts closely aligned with household size for children not attending school. Roughly a third of parents who reported their child’s school was open reported sending their child to class since schools began re-opening.

**Table 1. Numbers of participants, reported contacts and reproduction numbers.** Numbers of participants in each panel, their average number of contacts reported and the estimate of the reproduction number,  $R_0$ .

Group	Week	Panel	Dates	Observations	Contacts	Mean (IQR)	HH size	$R_0$ mean (95% CI)
UK	1,2	A & B	24/03 to 10/04	3,376	8,943	2.64 (1 to 3)	2.72	0.60 (0.35 to 0.85)
UK*	12	B & D	11/06 to 18/06	1,301	3,988	3.01 (1 to 3)	2.74	0.81 (0.46 to 1.29)
UK* ( $< 100$ contacts)	12	B & D	11/06 to 18/06	1,297	3,356	2.59 (1 to 3)	2.74	0.64 (0.36 to 0.93)
England*	12	B & D	11/06 to 18/06	1,090	3,274	3.00 (1 to 3)	2.76	0.81 (0.44 to 1.26)
England* ( $< 100$ contacts)	12	B & D	11/06 to 18/06	1,087	2,748	2.53 (1 to 3)	2.75	0.63 (0.37 to 0.91)
UK*	13	A & C	18/06 to 24/06	1,844	7,043	3.82 (1 to 3)	2.86	0.99 (0.58 to 1.41)
UK* ( $< 100$ contacts)	13	A & C	18/06 to 24/06	1,836	5,514	2.81 (1 to 3)	2.86	0.67 (0.40 to 0.94)
<b>UK* (truncate 100 contacts)</b>	<b>13</b>	<b>A &amp; C</b>	<b>18/06 to 24/06</b>	<b>1,844</b>	<b>5,950</b>	<b>3.23 (1 to 3)</b>	<b>2.86</b>	<b>0.81 (0.49 to 1.17)</b>
England*	13	A & C	18/06 to 24/06	1,564	6,288	4.02 (1 to 3)	2.85	1.06 (0.63 to 1.48)
England* ( $< 100$ contacts)	13	A & C	18/06 to 24/06	1,557	4,504	2.89 (1 to 3)	2.86	0.71 (0.42 to 0.98)
<b>England* (truncate 100 contacts)</b>	<b>13</b>	<b>A &amp; C</b>	<b>18/06 to 24/06</b>	<b>1,564</b>	<b>5,200</b>	<b>3.32 (1 to 3)</b>	<b>2.85</b>	<b>0.85 (0.47 to 1.25)</b>

\* observations includes Panel C or Panel D, as indicated, in which adult participants were asked to answer contact questions on behalf of one child in their household



**Figure 1.  $R_0$  estimates by countries of the UK and NHS regions of England for the previous four weeks.** The estimates for each week are a combination of the prior week and the current week. For example the survey sent out on the 21st of May includes the survey data sent out on the 14th of May through the 28th May. Data prior to the 21st of May is not presented as we did not collect information on children contacts prior to the week before the 7th May.  $R_0$  assumed that the baseline  $R_0$  estimate followed a normal distribution with mean 2.6 and standard deviation 0.54 for all regions over time. \* indicates that the data extends past the limits of the plot, see table 3 for estimates.

**Table 2.  $R_0$  estimates by region in the UK.**  $R_0$  scaled assuming that the baseline  $R_0$  estimate followed a normal distribution with mean 2.6 and standard deviation 0.54. The estimates for each week are a combination of the prior week and the current week. For example the survey sent out on the 21st of May includes the survey data collected from the 14th of May through the 28th May. Data prior to the 21st of May is not presented as we did not collect information on children contacts prior to the week before the 7th May.

Region	R0 median (95% CI) 14 May to 28 May	R0 median (95% CI) 21 May to 4 Jun	R0 median (95% CI) 28 May to 11 June	R0 median (95% CI) 4 Jun to 18 June	R0 median (95% CI) 11 Jun to 24 June
East of England	0.84 (0.47 to 1.36)	1.02 (0.55 to 1.69)	0.92 (0.49 to 1.59)	0.76 (0.4 to 1.48)	0.82 (0.42 to 1.76)
London	0.61 (0.36 to 0.94)	0.67 (0.36 to 1.03)	0.61 (0.34 to 0.94)	0.59 (0.35 to 0.86)	0.75 (0.39 to 1.4)
Midlands	0.81 (0.46 to 1.31)	0.93 (0.5 to 1.47)	0.94 (0.52 to 1.56)	0.87 (0.47 to 1.37)	0.65 (0.37 to 0.99)
North East and Yorkshire	0.85 (0.47 to 1.26)	0.91 (0.51 to 1.42)	0.76 (0.44 to 1.15)	0.84 (0.46 to 1.38)	0.95 (0.53 to 1.52)
North West	1.11 (0.57 to 1.98)	0.85 (0.46 to 1.62)	0.94 (0.52 to 1.63)	1.18 (0.56 to 2.34)	1.24 (0.48 to 2.64)
Northern Ireland	0.62 (0.34 to 0.97)	0.69 (0.38 to 1.15)	0.73 (0.39 to 1.31)	0.65 (0.34 to 1.06)	0.98 (0.37 to 3.99)
Scotland	0.6 (0.33 to 1.1)	0.68 (0.37 to 1.24)	0.72 (0.39 to 1.24)	0.57 (0.31 to 0.86)	0.59 (0.33 to 0.92)
South East	0.77 (0.45 to 1.12)	0.86 (0.49 to 1.28)	0.89 (0.51 to 1.32)	0.88 (0.5 to 1.33)	1 (0.54 to 1.61)
South West	0.81 (0.45 to 1.36)	0.71 (0.42 to 1.09)	0.75 (0.44 to 1.19)	0.83 (0.44 to 1.48)	1.06 (0.58 to 1.87)
Wales	0.78 (0.45 to 1.32)	0.73 (0.42 to 1.2)	0.7 (0.4 to 1.15)	0.74 (0.4 to 1.22)	0.7 (0.38 to 1.11)

**Table 3. Summary of participants and contacts in child contact survey.** Numbers of participants reporting on behalf of a child in their household in each panel, their average number of contacts reported overall and not home.

Description	Week	Participants	Contacts	All contacts Mean (IQR)	Not Home Contacts Mean (IQR)
All children	7	564	1,740	3.09 (2 to 4)	0.2 (0 to 0)
	8	507	1,650	3.25 (2 to 4)	0.62 (0 to 0)
	9	512	1,992	3.89 (2 to 4)	0.79 (0 to 0)
	10	359	1,407	3.92 (2 to 4)	1.26 (0 to 0)
	11	511	2,616	5.12 (2 to 4)	2.31 (0 to 0)
	12	305	1,270	4.16 (2 to 4)	1.63 (0 to 0)
	13	509	2,238	4.4 (2 to 4)	1.78 (0 to 0)
Attended school	7	10	53	5.3 (3.25 to 6.75)	2.6 (0 to 3.75)
	8	17	100	5.88 (2 to 7)	4.06 (0 to 4)
	9	10	56	5.6 (3 to 7)	2.9 (0 to 4.75)
	10	16	171	10.69 (2.75 to 15.25)	8.56 (0 to 11.75)
	11	14	142	10.14 (4.25 to 15.25)	7.29 (0 to 11.75)
	12	25	221	8.84 (3 to 13)	5.88 (0 to 9)
	13	33	470	14.24 (4 to 19)	11.85 (1 to 1)

## Methods

CoMix is a behavioural survey, with a study sample recruited to be broadly representative of the UK adult population. It was launched on 24<sup>th</sup> of March 2020 and this analysis includes data collected up to the 19<sup>th</sup> of June, with contact data representing the day prior to the survey date. Data is collected weekly, using two different panels each for adults and children who are interviewed using the same questionnaire in alternate weeks. The questionnaires for children are completed by a parent within their household as a proxy. Participants recorded direct, face-to-face contacts 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>. The contact survey is based on the POLYMOD contact survey. The BBC social contact survey is now used as a baseline for social mixing in the UK under normal conditions<sup>2</sup>. Previously we used POLYMOD. In two additional panels (C and D), participants are asked to answer the contact questions on behalf of a child in their household, and returning participants will be asked about the same child each week. The panels started with a sample size of 1,816 in Panel A, 1,560 in Panel B, 564 in Panel C, and 507 in Panel D.

We calculated the average number of contacts in the settings home, work, school, and other. We sample uniformly between the minimum and maximum age reported for the contact, as we do not record exact ages for contacts. We set the age bands for under 18s to 0-4, 5-12, 13-17 to be consistent with the BBC Pandemic study. We take the mean of reciprocated contacts to form symmetric matrices.

We assume that  $R_0$  prior to physical distancing measures were in place follows a normal distribution with a mean of 2.6 and sd of 0.54. We then apply a scaling factor of the ratio of dominant eigenvalues between CoMix and BBC contact matrices to estimate  $R_0$  under the observed contacts patterns in our study following the approach found in Wallinga et al.<sup>4</sup>. This assumes that all other elements of the Next Generation Matrix remain constant, such as transmissibility by age group, which may not be the case. Uncertainty in the estimates of reduction in  $R_0$  is obtained using either 200 or 1,000 bootstrap samples of the CoMix and BBC contacts matrices, and applying these ratios to the corresponding number of sampled values of  $R_0$ .

### *Estimating $R_0$ by region*

Each regional estimate of  $R_0$  is a combination of the week reported and the week prior. For example, week 9 includes data from week 8 and 9, week 10 includes data from week 9 and 10. This was chosen to maximise the amount of data we have per region. It does mean that the

estimate will be slower to react to a jump in reproduction number but as can be seen the uncertainty is quite large around the estimates and calculating for one region for a single week would lead to greater uncertainty. Since the 9th of May (week 7) we have collected contacts on children by proxy by asking their parents to report on their contacts. We no longer impute the children data from POLYMOD but calculate the contacts directly. In addition to this we have moved to using the BBC as the main comparison for the contact matrix as it allows for consistency between overall and regional  $R_0$  calculations.

## References

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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.* **164**, 936–944 (2006).