The effect of social distancing on the reproduction number and number of contacts in the UK from a social contact survey
Report for Weeks 20 to 23

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

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Updates

- Week 20 of the survey marked an updated questionnaire and newly recruited panels E and F (from week 21) with data collected from both adults and children
- There has been an increase in reported contacts since week 20, resulting in increased estimates of the reproduction number.
- Schools have opened in Scotland, resulting in more contacts especially between children and an increase in the overall UK and Scottish reproduction number estimate
- As contact means are sensitive to the right-skewed distribution of reported contacts, R estimates are now calculated based on contact data truncated to 50 contacts per participant

Results

Figure 1 shows changes in estimated age-contact matrices over time. Compared with pre-epidemic levels, contacts remain reduced, However, diagonal elements are apparent in the matrix (reflecting within-age-group mixing, as are off diagonal elements reflecting contact within households). The highest rate of mixing is between young adults (18-29 years).

Between the 27h August and 3rd September (week 23 of CoMix) we estimate R_0 to be 1.05 (95% CI 0.63 to 1.52) for the UK and 1.01 (95% CI 0.59 to 1.44) for England, when truncating contacts to a maximum of 50 per participant (Table 1, figure 2). This is a result of higher recorded contacts for both adults (Figure 3) and children (Figure 4) in recent weeks. Regional estimates vary widely, with Scotland reaching reproduction estimates above two (Figure 2, Table 2).

Schools in Scotland have opened which have contributed to increases in mean contacts overall for children (Figure 4), and results in higher estimates of the basic reproduction number (Figure 1). There is uncertainty around regional, weekly estimates of the reproduction number. Trends and longer-term patterns are probably more reliable.

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 for the first two weeks of the survey (immediately after lockdown) and the most recent two weeks of the survey.

Group	Week	Panel	Dates	Observations	Contacts	Mean (IQR)	HH size	R_0 mean (95% CI)
UK* (truncated **50** contacts)	20	E	9/8 to 18/8	3,798	17,410	4.58 (1 to 5)	2.66	1.19 (0.68 to 1.69)
England* (truncated **50** contacts)	20	E	9/8 to 18/8	3,189	14,544	4.56 (t to 5)	2.67	1.16 (0.68 to 1.65)
UK* (truncate **50** contacts)	21	F	13/8 to 24/8	3,997	18,054	4.52 (1 to 5)	2.59	1.20 (0.68 to 1.70)
England* (truncated **50** contacts)	21	F	13/8 to 24/8	3,333	14,355	4.31 (1 to 5)	2.61	1.13 (0.66 to 1.59)
UK* (truncate **50** contacts)	22	E	23/8 to 1/9	3,040	12,699	4.18 (1 to 4)	2.57	1.06 (0.63 to 1.49)
England* (truncated **50** contacts)	22	E	23/8 to 1/9	2,516	10,141	4.03 (1 to 4)	2.59	1.01 (0.59 to 1.43)
UK* (truncate **50** contacts)	23	F	27/8 to 3/9	3,039	11,719	3.86 (1 to 4)	2.45	1.05 (0.63 to 1.52)
England* (truncated **50** contacts)	23	F	27/8 to 3/9	2,540	9,533	3.75 (1 to 4)	2.47	1.01 (0.59 to 1.44)

* Observations includes data for children's contacts, in which adult participants were asked to answer social contact questions on behalf of one child in their household

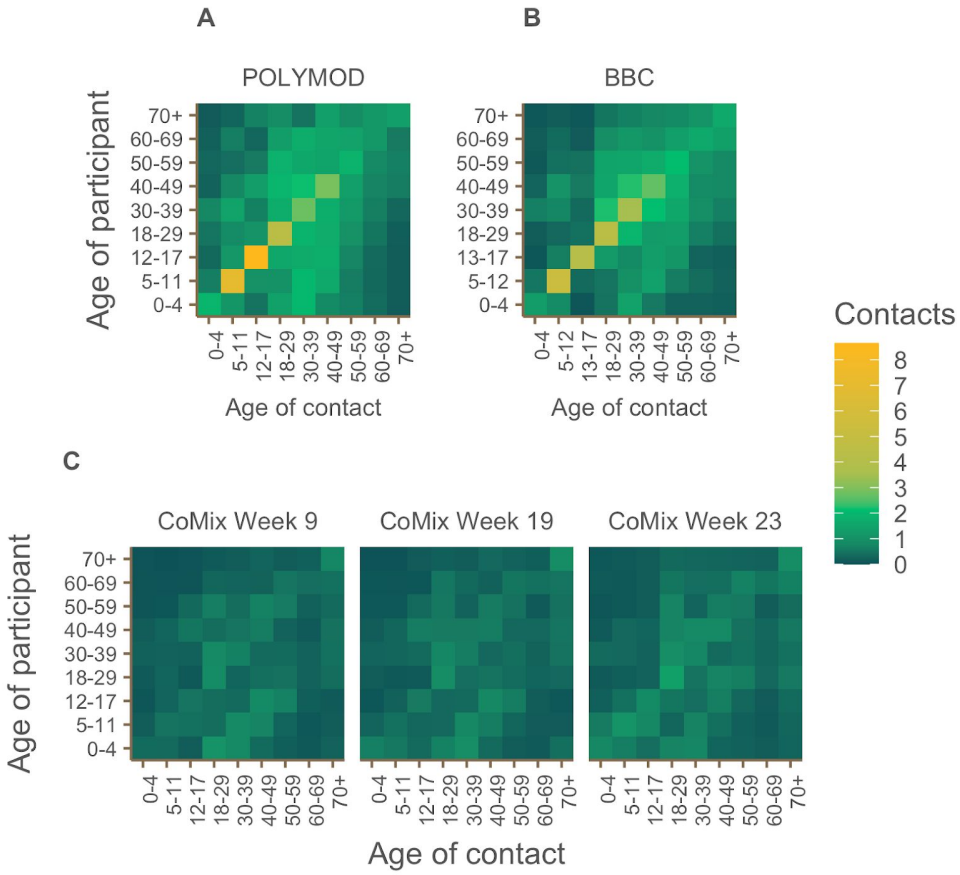

Figure 1. Contact matrices by Study and study week. A) Symmetric, reciprocal contact matrix from the POLYMOD study; B) Symmetric, reciprocal contact matrix from the BBC Pandemic study; C) Raw contact matrices for CoMix for the UK in week 9 (20 May to 28 May), Week 19 (30 Jul to 08 Aug), and week 23 (27 Aug to 03 Sep). CoMix week 23 includes school re-opening in Scotland and Northern Ireland, which is reflected in the brighter green colour in children's age groups.

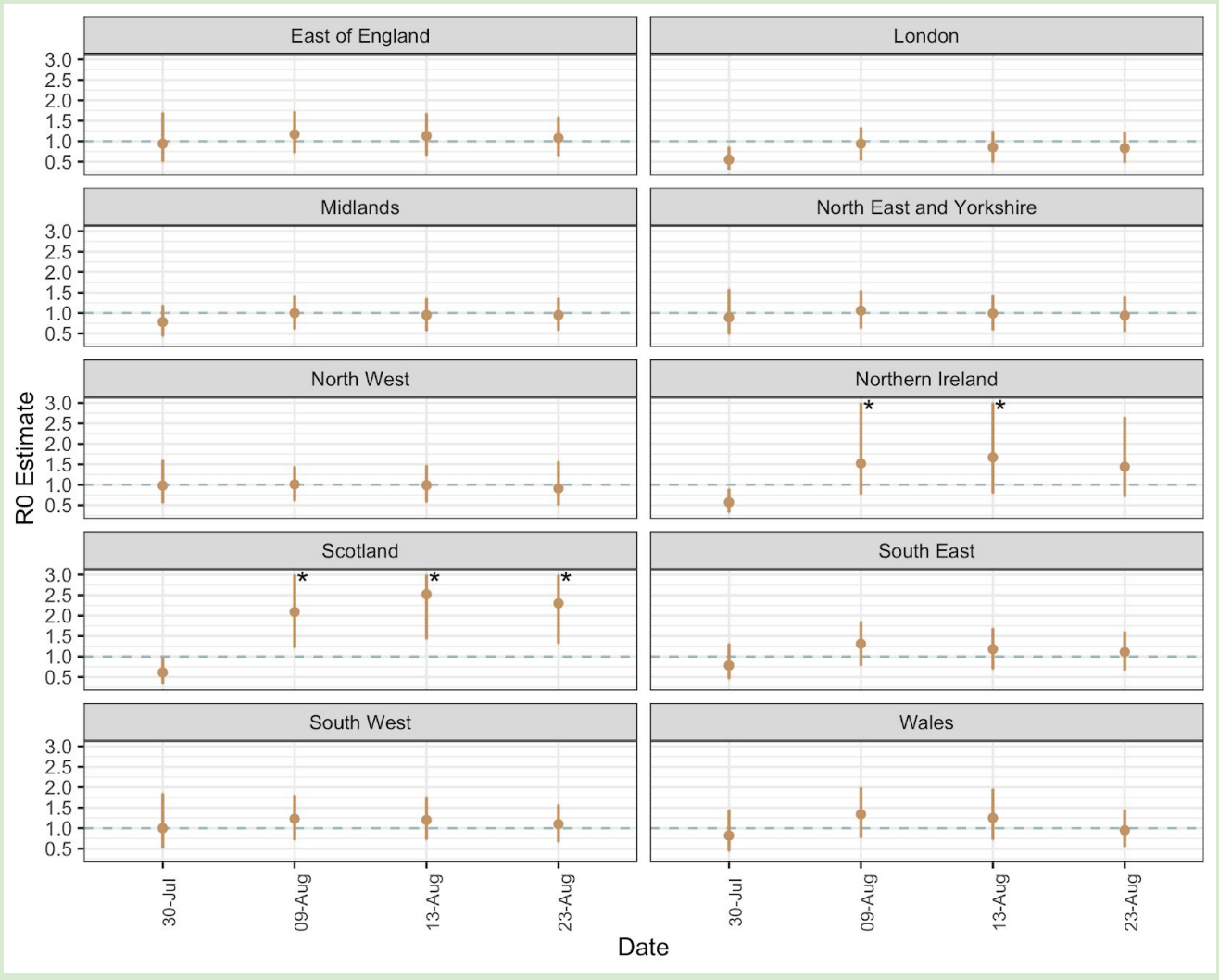

Figure 2. R_0 estimates by countries of the UK and NHS regions of England. The estimates for time periods are a combination of two survey weeks, except for the data starting 30 July which uses two weeks of adult data and the latest available children's data, see table below for date ranges. We assume 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 2 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 data is a rolling average of two weeks in order to increase the sample size for the regional estimates. Data before. Date in brackets corresponds to date given in the graph above.

Region	R0 median (95% CI) (8 Jul to 8 Aug) (30 July)	R0 median (95% CI) (9 Aug to 24 Aug) (9 August)	R0 median (95% CI) (13 Aug to 1 Sep) (13 August)	R0 median (95% CI) (23 Aug to 3 Sep) 23 August)
East of England	0.94 (0.5 to 1.7)	1.17 (0.71 to 1.73)	1.13 (0.65 to 1.68)	1.08 (0.64 to 1.6)
London	0.55 (0.31 to 0.86)	0.94 (0.53 to 1.34)	0.85 (0.48 to 1.25)	0.83 (0.47 to 1.23)
Midlands	0.78 (0.43 to 1.19)	1 (0.6 to 1.42)	0.95 (0.56 to 1.36)	0.95 (0.57 to 1.37)
North East and Yorkshire	0.89 (0.48 to 1.58)	1.06 (0.62 to 1.55)	0.99 (0.58 to 1.43)	0.94 (0.54 to 1.4)
North West	0.98 (0.55 to 1.6)	1.01 (0.6 to 1.45)	0.99 (0.57 to 1.48)	0.91 (0.5 to 1.57)
Northern Ireland	0.57 (0.32 to 0.9)	1.52 (0.76 to 3.17)	1.67 (0.79 to 3.5)	1.44 (0.7 to 2.66)
Scotland	0.61 (0.34 to 0.97)	2.09 (1.21 to 3.22)	2.52 (1.42 to 3.88)	2.3 (1.31 to 3.51)
South East	0.78 (0.45 to 1.31)	1.31 (0.77 to 1.86)	1.18 (0.69 to 1.69)	1.11 (0.66 to 1.61)
South West	1 (0.52 to 1.85)	1.23 (0.71 to 1.81)	1.2 (0.72 to 1.77)	1.1 (0.66 to 1.58)
Wales	0.82 (0.44 to 1.44)	1.34 (0.76 to 2)	1.25 (0.72 to 1.96)	0.95 (0.54 to 1.45)

*As Children's data was not available for week 18, the data from week 16 was used to boost the sample size.

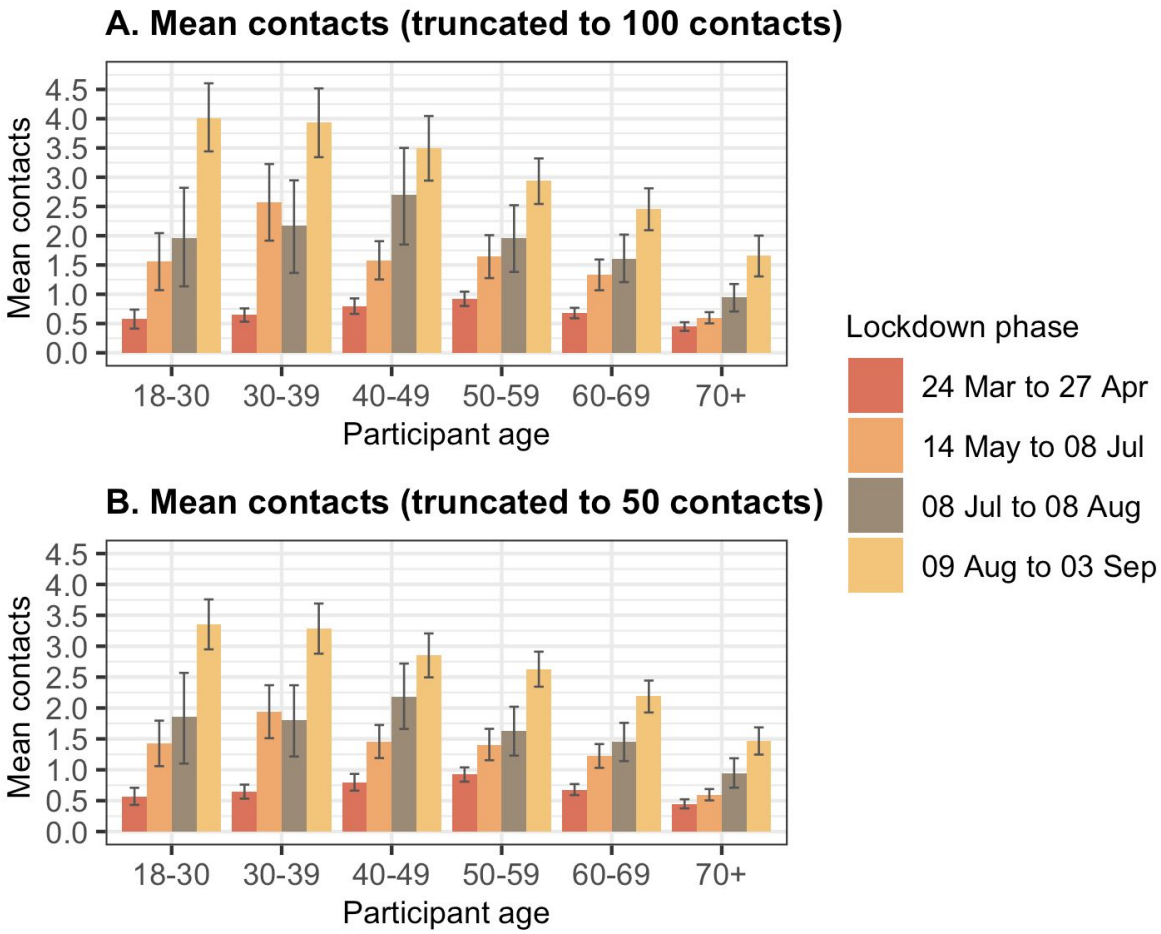

Figure 3. Adult mean contacts outside the home with non-household members by age group and time period.

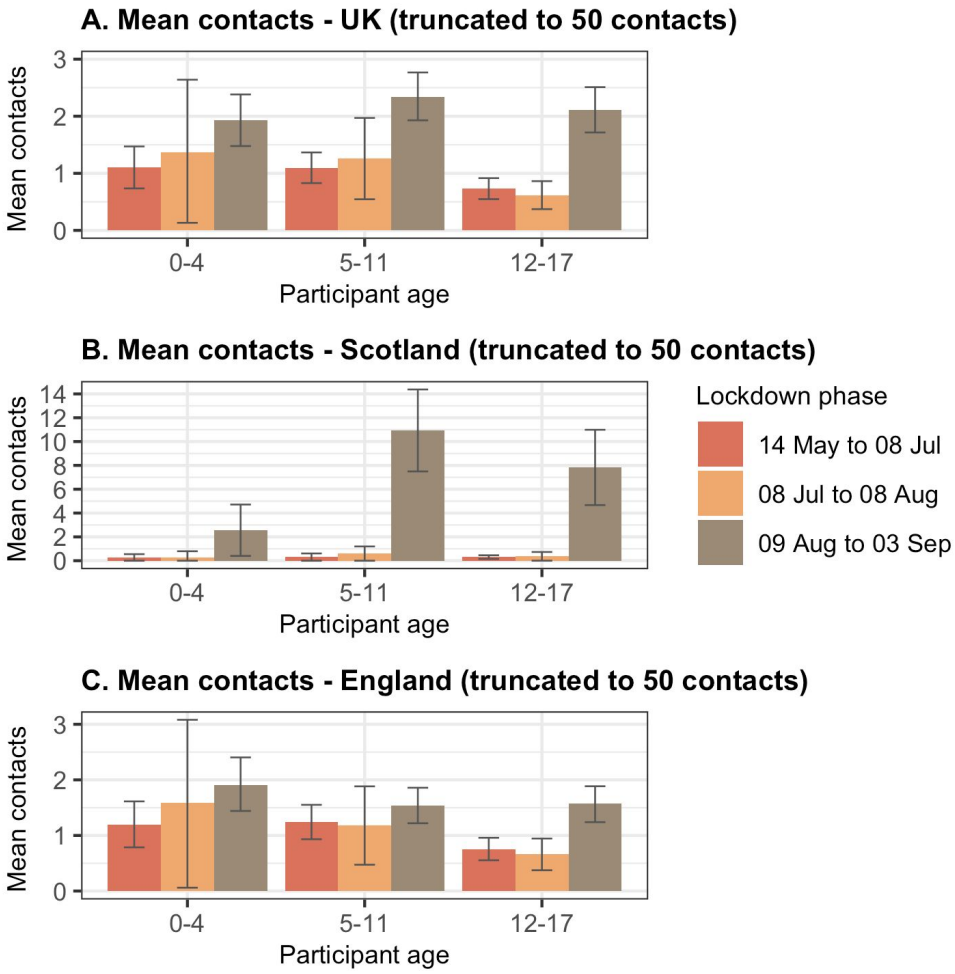

Figure 4. Child mean contacts outside the home with non-household members by age group and time period. Mean contacts for the UK and Scotand have reflected an increase in contacts for children as schools open in Scotland. Children's data was not collected in weeks 1 to 5.

Methods

CoMix is a behavioural survey, with a study sample recruited to be broadly representative of the UK population. It was launched on 24th of March 2020. Data is collected weekly, using two different panels (Panels E and F) for alternating 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[1]. The contact survey is based on the POLYMOD contact survey[2]. The BBC social contact survey is now used as a baseline for social mixing in the UK under normal conditions[3].

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.[4] 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 200 bootstrap samples of the CoMix and BBC contacts matrices, and applying these ratios to the corresponding number of sampled values of R_0.

Mean contacts by date category

Mean contacts were calculated for weeks 1 through 5, the first stage of lockdown in the UK, weeks 8 to 15, with partial lifting of lockdown restrictions, week 16 to 19, when non-essential workers were permitted to return to the office, and weeks 20 to 23 of the new survey. We calculated 95% confidence interval means of 1000 bootstrapped contact totals.

References

1. Jarvis, C. I. *et al.* Quantifying the impact of physical distance measures on the transmission of COVID-19 in the UK. *medRxiv* (2020) doi:10.1101/2020.03.31.20049023.
2. Mossong, J. *et al.* Social contacts and mixing patterns relevant to the spread of infectious diseases. *PLoS Med.* **5**, e74 (2008).
3. Klepac, P. *et al.* Contacts in context: large-scale setting-specific social mixing matrices from the BBC Pandemic project. *Epidemiology* (2020) 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.* **164**, 936–944 (2006)