The effect of social distancing on the reproduction number and number of contacts in the UK from a social contact survey
Report 9

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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Results

We estimate R_0 to be 0.67 (95% CI 0.38 to 0.98) for the UK, 0.71 (95% CI 0.41 to 1.06) for England, between the 21st May and 28th May. Prior to the 11th of May we estimated R_0 to be around 0.5 in the UK (Table 1). The interquartile range remains 1 to 3 for the number of contacts per person. The mean contacts are 3.29 in the UK overall, consistent with the mean contacts from week 8, though the mean contacts for England has increased to 3.48.

The distribution of mean contacts is skewed and affected by outliers, which likely shifts the central estimate of R_0. Removing the three participants who reported 100 contacts or more shifted the mean contacts to 3.06 in England and the R0 estimate to 0.66 (95% CI 0.38 to 0.98). The means for contacts outside the home has increased from 0.97 in full lockdown (weeks 1 through 4) to 1.89 in partial lockdown (weeks 8 and 9), however, when excluding participants who reported 100 or more contacts, mean contacts outside the home during partial lockdown is 1.29 (figure 1, table 2).

We observed minor regional differences in mean contacts in the combined data for week 8 and week 9, even when outliers (participants reporting more than 100 contacts) are not included (figure 2; table 2). The three participants who reported over 100 contacts in week 8 work in the categories Nursing and midwifery professionals, Office clerks, and Customer services clerks. In weeks 8 and 9 combined, six participants reported more than 50 contacts and 53 participants reported more than 10 contacts, most of which were work contacts.

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)	HHsize	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	0.53 (0.33 to 0.75)
UK	8	B	14/05 to 21/05	1,146	3,775	3.29 (1 to 3)	2.43	0.66 (0.36 to 1.06)
UK (< 100 contacts)	8	B	14/05 to 21/05	1,143	2,771	2.42 (1 to 3)	2.42	0.49 (0.29 to 0.72)
England	8	B	14/05 to 21/05	969	2,794	2.88 (1 to 3)	2.46	0.61 (0.34 to 1.01)
England (< 100 contacts)	8	B	14/05 to 21/05	967	2,295	2.42 (1 to 3)	2.46	0.48 (0.29 to 0.71)
UK	9	A	21/05 to 28/05	1,415	4,565	3.29 (1 to 3)	2.44	0.67 (0.38 to 0.98)
UK (< 100 contacts)	9	A	21/05 to 28/05	1,412	4,134	2.93 (1 to 3)	2.45	0.62 (0.35 to 0.91)
England	9	A	21/05 to 28/05	1,208	4,205	3.48 (1 to 3)	2.46	0.71 (0.41 to 1.06)
England (< 100 contacts)	9	A	21/05 to 28/05	1,205	3,683	3.06 (1 to 3)	2.46	0.66 (0.38 to 0.96)

Figure 1. Relative differences in mean contacts outside the home during full lockdown and partial lockdown with 95% confidence intervals. Weeks 1 through 4 were collected during full lockdown in the UK and weeks 8 and 9 during partial lockdown, with full lockdown as the reference.

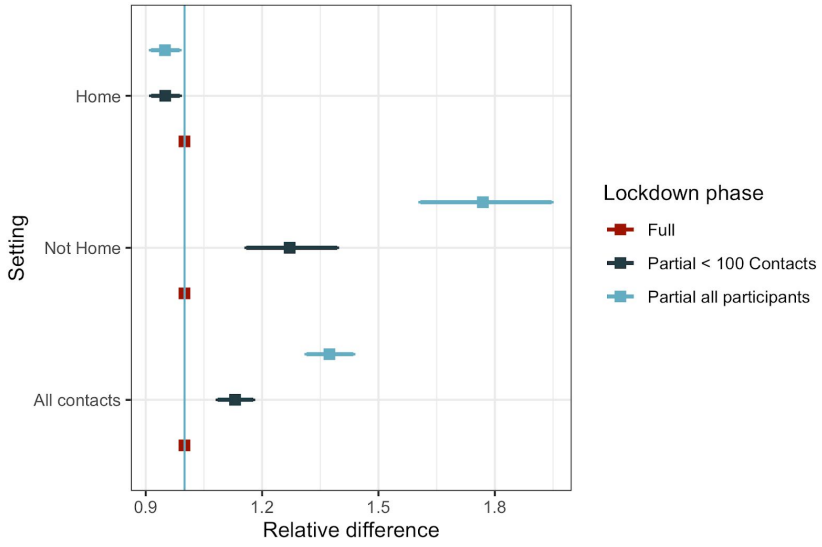

Figure 2. Relative differences in mean contacts by region with 95% confidence intervals. Mean reported contacts relative to mean contacts in London. A. All participants in weeks 8 and 9; B. Participants in weeks 8 and 9 reporting less than 100 contacts.

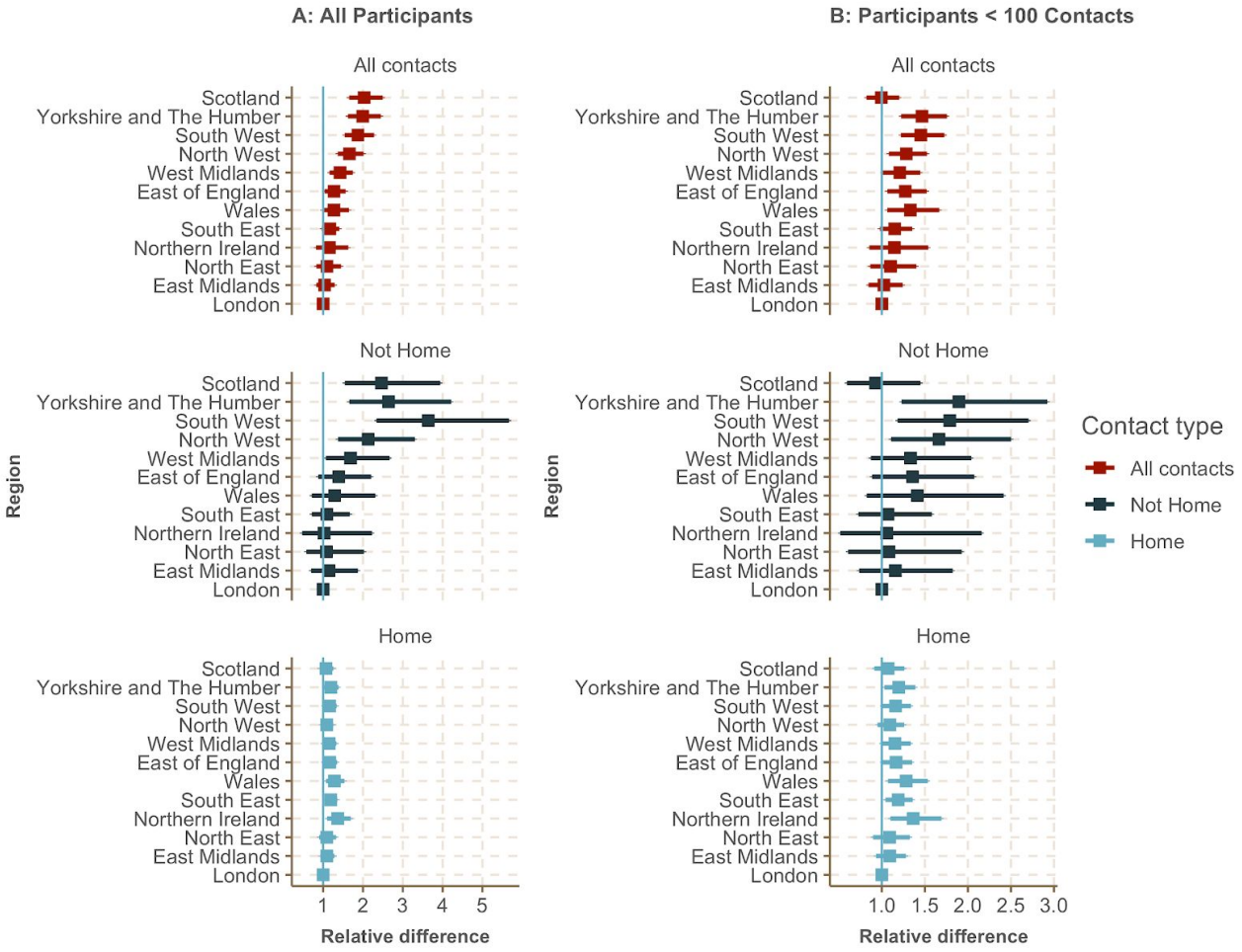

Table 2. Summary of contacts outside the home by lockdown phase and by region. Reported for all participants and participants reporting less than 100 contacts in regions where applicable.

	Participants	Observations	Mean	SD	Skew	IQR	Min to Max
Lockdown phase							
Full (weeks 1 - 4)	All	6,028	0.97	2.23	8.49	0 to 1	0 to 58
Partial (weeks 8 & 9)	All	2,561	1.89	14.99	24.22	0 to 1	0 to 505
	< 100 Contacts	2,555	1.29	5.01	9.72	0 to 1	0 to 98
Region							
East Midlands	All	192	1.08	6.53	12.76	0 to 1	0 to 89
East of England	All	236	1.45	5.29	7.55	0 to 1	0 to 60
Greater London	All	332	1.05	4.15	9.64	0 to 1	0 to 59
North East	All	98	1.11	3.55	5.35	0 to 1	0 to 27
North West	All	272	2.30	11.63	8.42	0 to 1	0 to 130
	< 100 Contacts	270	1.43	5.78	6.99	0 to 1	0 to 60
Northern Ireland	All	58	0.97	2.04	2.40	0 to 1	0 to 9
Scotland	All	211	3.30	34.83	14.17	0 to 1	0 to 505
	< 100 Contacts	210	0.91	2.97	6.64	0 to 1	0 to 27
South East	All	339	1.14	3.6	5.75	0 to 1	0 to 32
South West	All	256	3.23	25.15	14.12	0 to 1	0 to 387
	< 100 Contacts	255	1.73	7.26	10.22	0 to 1	0 to 98
Wales	All	115	1.33	4.80	8.18	0 to 1	0 to 48
West Midlands	All	238	1.90	9.95	11.89	0 to 1	0 to 141
	< 100 Contacts	237	1.31	4.14	6.29	0 to 1	0 to 42
Yorkshire and The Humber	All	214	2.92	17.87	12.49	0 to 1	0 to 250
	< 100 Contacts	213	1.76	5.63	5.31	0 to 1	0 to 43

Methods

CoMix is a behavioural survey, with a study sample recruited to be broadly representative of the UK adult population. It was launched on 24th of March 2020 and this analysis includes data collected up to the 28th of May. 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[1]. The contact survey is based on the POLYMOD contact survey, which is used as a baseline for social mixing in the UK under normal conditions[2]. The panels started with a sample size of 1,816 in Panel A, 1,560 in Panel B. Final data for Panel A Wave 5 (week 9 of the study) has 1,415 participants.

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 use the reciprocity of contacts to impute child-adult contacts from adult-child contacts. We set the age bands for under 18s to 0-4, 5-12, 13-17 to be consistent with the BBC Pandemic study. When excluding children's survey data, we impute child-child contacts using the POLYMOD UK data, setting school-contacts to 0 and adjusting contact in other settings (e.g. home) as observed for adults, and we impute child-adult contacts by reciprocating adult-child reported contacts.[1,3] 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 Polymod 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 2,000 bootstrap samples of the CoMix and POLYMOD contacts matrices, and applying these ratios to 2,000 sampled values of R_0.

Relative differences in mean contacts were calculated using an individual-level GAM assuming contacts followed a negative binomial distribution (modelled using a log link function), with smoothed terms for age, fixed terms for household size, week of survey (for regional analysis only), and either region or lockdown phase, and a random effect for participants. Full lockdown means were calculated survey results from weeks 1 through 4, and partial lockdown means from weeks 8 and 9.

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).