The effect of social distancing on the reproduction number and number of contacts in the UK from a social contact survey
Report 3

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Aims

1. Assess temporal changes in contact patterns and the reproduction number of COVID-19 under social distance measures in the UK.
2. Assess regional differences in the number of contacts for different settings across the UK.

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 24th of March 2020 and this analysis includes data collected up to the 14th of April. Data is collected weekly, with the same questions asked in alternate weeks to two panels of roughly 1,600 participants. Participants recorded face-to-face contacts that they made on the previous day, specifying physical or non-physical contact as well as the age of those contacted and the setting in which these contacts 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].

Change in contact patterns over time

We calculated the average number of contacts in different settings for each of the three weeks of the survey.

As per previous reports, due to children (<18 years) not being included in the survey, we imputed contacts for lower age groups (child-child and child-adult contacts) using the POLYMOD UK data, setting school-contacts to 0 and adjusting contact in other settings (e.g. home) as observed for adults. Further details of the approach can be found here[1,3]. We assume that R_0 follows a normal distribution with a mean of 2.6 and sd of 0.54 and apply a scaling factor of the ratio of dominant eigenvalues of between CoMix and Polymod 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 age groups contribute equally to transmission which may not be the case. Uncertainty in the estimates of R_0 is obtained using 5,000 bootstrap samples of the CoMix and POLYMOD contacts matrices and applying the ratio to the 5,000 sampled values of R_0.

We repeated this process separately for each of the three weeks of data collection so far and present the estimates of R_0 if all contacts are potentially infectious (all contacts) and if only physical contacts are potentially infectious (physical).

Regional differences in contacts for different settings across the UK.

We assessed regional differences in the number of contacts. We used generalised additive models to calculate the relative and absolute difference in number of contacts, for all contacts, contacts within the home, and contacts outside of the home. Relative differences were calculated using an individual level generalised additive models with a poisson distribution (log link function) with smoothed terms for age and household size, and fixed terms for region, gender, week of survey, and survey panel. Absolute differences were calculated using an individual level generalised additive models with a poisson distribution (identity link function) with smoothed terms for age, a linear term for household size, and a fixed term for region. The model was simplified for the absolute difference due to extra complexities of fitting a GAM with an identity link function with a Poisson distribution.

Results

Between the 24th of March and the 14th of April we collected 4,684 observations from 3,376 participants, with information on 12,158 contacts. These consist of two full rounds of survey for panel A and panel B, and a third, partial, round for Panel A.

*Change in contact patterns and estimation of reproduction number*

Table 1 gives the reported number of contacts made by the participants and the overall estimate of the reproduction number for the three weeks of the survey (also shown in Figure 1).

For week 3 (Between 7th April and 14th April) we estimated R_0 to be 0.57 (95% CI 0.33 to 0.80) for all contacts and 0.37 (95% CI 0.21 to 0.53) if only physical contacts are potentially infectious. There was a slight suggestion in reduction in average contacts from 2.72 in week 1 to 2.46 in week 3 for all contacts, though the absolute differences are small. There was little variation in the average number of physical contacts over the three weeks and between panels, which included the Easter and bank holiday weekend in the third week, as can be seen in Table 1. This was reflected in the estimates of R_0 which remain consistently around 0.6 based on the difference between POLYMOD and CoMix for all contacts and 0.38 for physical contacts only. The majority of contacts continue to occur within homes and other indoor settings, most participants report few contacts at work, with some outliers reaching over 50 contacts.

Table 1. Numbers of participants, reported contacts and reproduction numbers by week.
Numbers of participants (N) in each panel, their number of contacts reported and the estimate of the reproduction number, R_0 by week and type of contact.

Week	Panel	Dates	N	Contact Type	Contacts	Mean	R_0 mean (95% CI)
1	A	24/3 - 1/4	1816	all	4941	2.72	0.61 (0.36, 0.86)
				physical	1522	0.84	0.38 (0.23, 0.55)
2	B	2/4 - 10/4	1560	all	4002	2.57	0.57 (0.34, 0.80)
				physical	1266	0.81	0.38 (0.23, 0.54)
3	A	7/4 - 14/4	1308	all	3215	2.46	0.57 (0.33, 0.80)
				physical	1101	0.84	0.37 (0.21, 0.53)
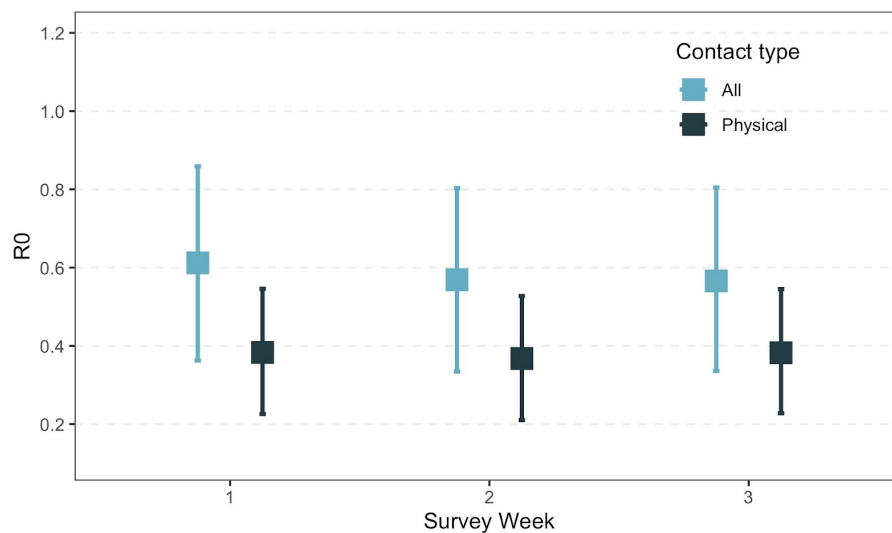
Figure 1: Weekly R_0 estimates.

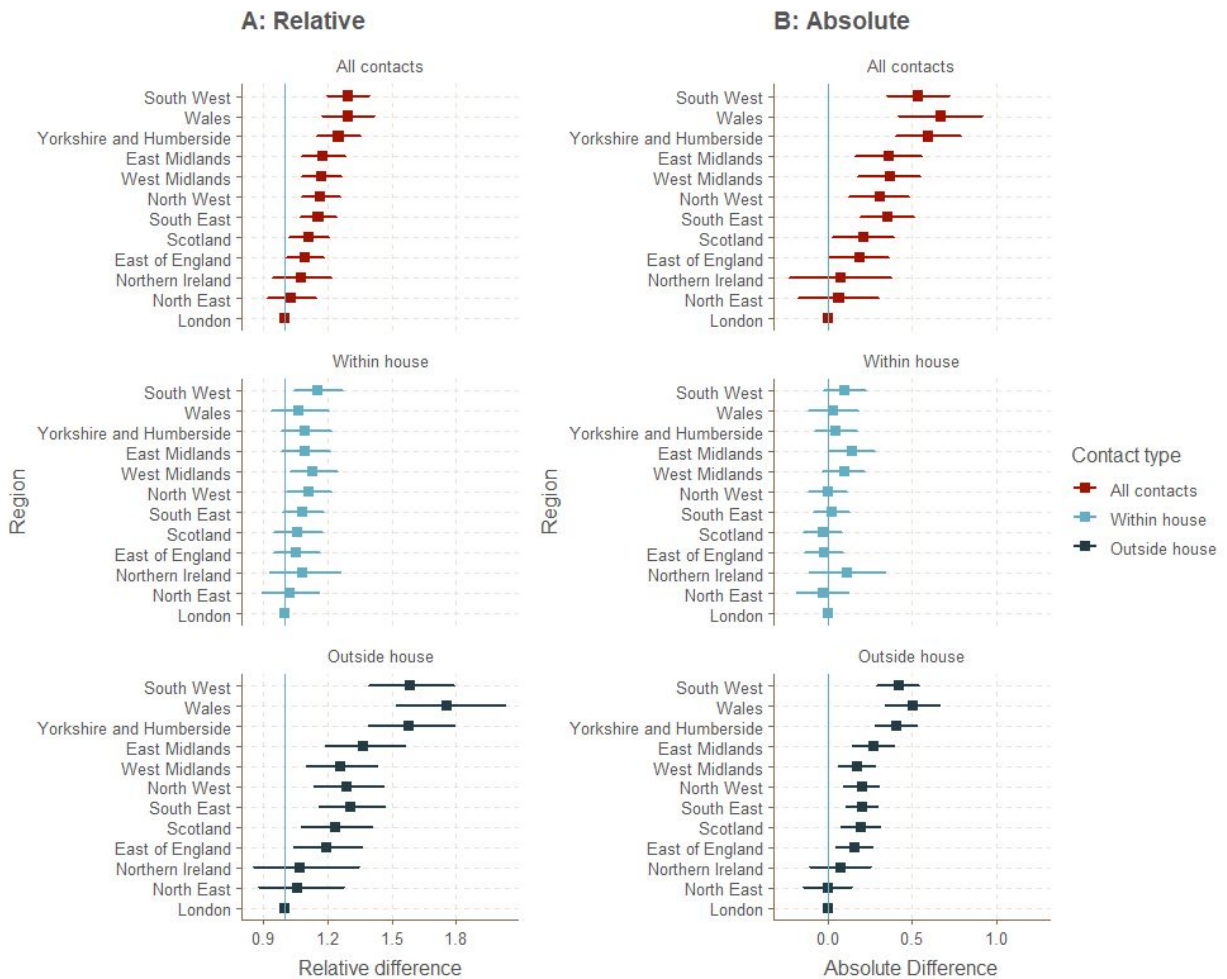*Regional differences in contacts for different settings across the UK.*

The crude mean number of contacts was lowest in Greater London (2.31) and highest in the South West and Wales (2.93 and 2.92). The majority of contacts are recorded as being at home, and this is consistent across all regions. The average number of contacts reported at work is lower within London than the other regions (Table 2), with participants in Yorkshire and Humberside reporting the greatest number of work-related contacts per day. The average daily work contacts for participants in all regions, is well below 1, however, and the absolute differences are small. The household sizes and average ages of participants are consistent across regions.

Table 2: Comparison of mean daily contacts reported across regions for different settings. Regions are ranked as per the magnitude of the relative difference in overall contacts as per Figure 3 panel A. The mean household size and age are presented for reference.

Region	N	Mean contacts							HH size	Age
		All	Home	Not home	Work	School*	Indoors	Outdoors		
South West	439	2.93	1.74	1.19	0.45	0.03	2.27	1.12	2.7	51.7
Wales	214	2.92	1.56	1.36	0.62	0.02	2.33	0.84	2.6	50.1
Yorkshire and Humberside	391	2.72	1.54	1.18	0.70	0.01	2.24	0.91	2.6	51.1
East Midlands	351	2.70	1.66	1.04	0.45	0.02	2.22	0.91	2.7	49.3
West Midlands	413	2.68	1.71	0.96	0.48	0.00	2.12	0.85	2.7	50.3
North West	487	2.62	1.66	0.96	0.40	0.02	2.12	0.72	2.7	52.0
South East	659	2.63	1.63	1.00	0.43	0.01	1.98	1.03	2.7	50.0
Scotland	384	2.39	1.42	0.96	0.31	0.01	1.83	0.64	2.5	50.4
East of England	445	2.41	1.51	0.90	0.32	0.00	1.92	0.79	2.6	51.0
Northern Ireland	110	2.66	1.85	0.82	0.25	0.02	2.24	0.75	3.0	49.1
North East	183	2.40	1.58	0.83	0.28	0.00	1.93	0.62	2.8	49.6
Greater London	608	2.31	1.54	0.77	0.19	0.01	1.82	0.65	2.8	47.1

*Participants below 18 were not included in the survey which will affect the number of school contacts.

Figure 2 displays the relative and absolute difference between the average number of contacts in all regions compared to London adjusting for participant's age and household size. All regions were higher compared to London although the North East, Northern Ireland, East of England and Scotland were still consistent with Greater London for relative and absolute difference.
All other regions had higher average number of contacts with the South West and Wales having the largest relative and absolute differences. The absolute differences between regions are small with all regions within 0.6 contacts of London for each setting. However, stratifying the analysis by contact within and outside of the house suggests that these increases are heavily driven by differences in contacts outside of the house as opposed to within the house. Adjusting for age and household size does not affect the qualitative comparison (Table 2).

Figure 2: Comparison of number of contacts by setting comparing all regions to London.
A: The relative difference in number of contacts for overall, within the house, and outside of the house. B: The absolute difference in number of contacts for overall, within the house, and outside of the house. Relative differences were calculated using an individual level generalised additive models with a poisson distribution (log link function) with smoothed terms for age and household size, and fixed terms for region, gender, week of survey, and survey panel. Absolute differences were calculated using an individual level generalised additive models with a poisson distribution (identity link function) with smoothed terms for age, a linear term for household size, and a fixed term for region. The model was simplified for the absolute difference due to extra complexities of fitting a GAM with an identity link function with a Poisson distribution.

Discussion

The third week of this contact survey corresponds to the third week of the lockdown in the UK. There is no evidence of any changes in behaviour over these three weeks, and so we estimate that the reproduction number has remained unchanged at around 0.6 (assuming that it was 2.6 on average before interventions).

There are some regional differences in behaviour, particularly regarding contacts outside the home. Participants from London report fewer contacts than elsewhere, particularly work contacts, whereas participants from Wales, the South West and Yorkshire and Humberside report greater numbers of contacts. The differences are small in absolute numbers, but large relative to each other. For instance, participants in Yorkshire and Humberside report, on average, 0.7 work contacts per day, which contrasts with 0.19 per day in London. Further work is required to understand what might be driving these differences, however, they do imply that regional differences in the effectiveness of the lockdown might be expected to emerge. Indeed, the latest regional nowcasts (from the 5th April, Abbott et al.[5]), which are based on the epidemiological data (and therefore lagged by 2-3 weeks) suggests that the reproduction number in London is somewhat lower than the other regions (0.8; CI 0.7-0.9) and the South West has the highest regional reproduction number (1; CI 0.8-1.2), in line with our behavioural findings.

References

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