The effect of social distancing on the reproduction number and number of contacts in the UK from a social contact survey
Report 12

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Summary:

- There appears to have been a small increase in the reproduction number in many English regions. Each of these changes is small, and may be due to the behaviour of a small number of individual survey respondents. However, it is noteworthy that across the 10 regions and countries of the UK the median estimate of the reproduction number is unchanged or slightly increased in 9 out of 10 instances.
- We have, for the first time, presented summary data on the nature of contacts. Contacts outside the home tend to be of shorter duration now than before the epidemic. Over the period of the survey (from March 23rd) there has been an increase in mask wearing across different settings. However, there appears to have been a very modest decrease in hand washing and over recent weeks there appears to have been an increase in contacts occurring inside. These trends will need further analysis and careful tracking.

Results

Social contacts and basic reproduction number

We estimate R_0 to be 0.64 (95% CI 0.36 to 0.93) for the UK and 0.63 (95% CI 0.37 to 0.91) for England, between the 11th June and 18th June, calculated by excluding reports of over 100 contacts. The R_0 estimates including all data are 0.81 (95% CI 0.46 to 1.29) for the UK and 0.81 (95% CI 0.44 to 1.26) 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.

Children's contacts have been described separately from the adult contacts in Table 2. 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.

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. There are consistent regional differences. London and Scotland have the lowest estimates with medians of 0.58 and 0.52 respectively

(Table 3). The estimate of R_0 is the highest for the North West and South West regions in England, though these estimates are driven by a small number of individuals with a high number of contacts. There were two children aged less than 5 with 21 and 15 contacts, and two 30 to 40 years olds who reported 65 and 77 contacts at work. These values are plausible and in line with opening up schools and workplaces, but are much higher compared to previously reported contacts in the region and the reported contacts in other regions. It is noteworthy that, our median estimates of R_0 are greater than or equal to the previous estimate in 9 out of the 10 regions/countries of the UK, though in each case the differences are small and CIs overlap (Table 3).

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*	11	A & C	05/06 to 11/06	1,850	6,997	3.78 (1 to 3)	2.89	0.94 (0.39 to 1.24)
UK* (< 100 contacts)	11	A & C	05/06 to 11/06	1,847	5,492	2.97 (1 to 3	2.89	0.71 (0.43 to 1.01)
England*	11	A & C	05/06 to 11/06	1,564	6,262	4.00 (1 to 3)	2.89	1.00 (0.52 to 1.76)
England* (< 100 contacts)	11	A & C	05/06 to 11/06	1,561	4,747	3.05 (1 to 3)	2.89	0.74 (0.43 to 1.07)
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	A & C	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	A & C	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	A & C	11/06 to 18/06	1,087	2,748	2.53 (1 to 3)	2.75	0.63 (0.37 to 0.91)

* 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

Table 2. 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)

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)

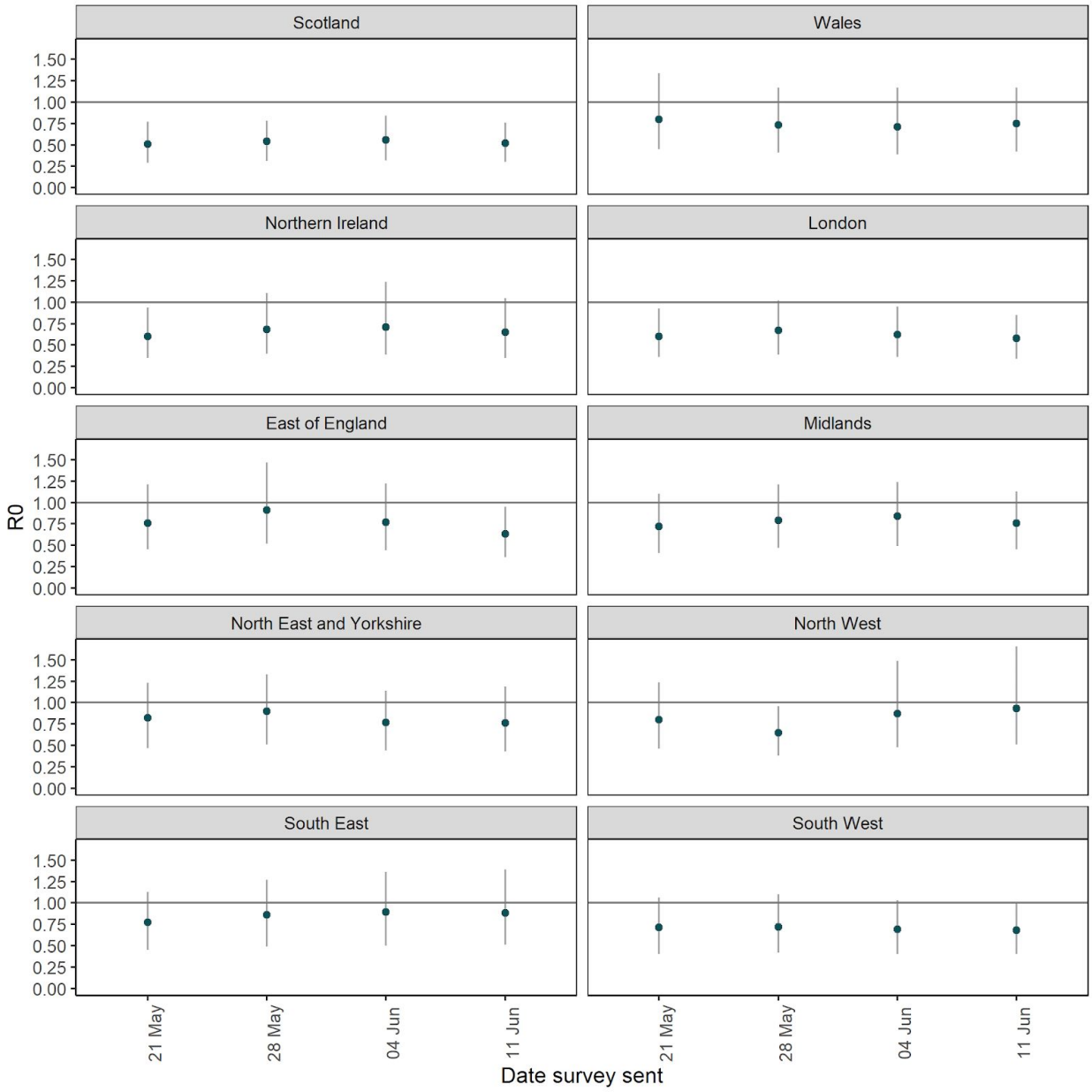

Figure 1. R_0 estimates by countries of the UK and NHS regions of England for the previous four weeks. The estimates for each week are a combination of the prior week and the current week. For example the survey sent out on the 21st of May includes the survey data sent out on the 14th of May through 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.*

Table 3 R_0 estimates by region in the UK. *R_0 scaled assumed that the baseline R_0 estimate followed a normal distribution with mean 2.6 and standard deviation 0.54 everywhere.*

Area	R_0 Median (95%) 28/05 to 11/06	R_0 Median (95%) 4/06 to 17/06
North West	0.82 (0.43 to 1.51)	0.93 (0.51 to 1.66)
South East	0.80 (0.45 to 1.23)	0.88 (0.51 to 1.39)
Midlands	0.76 (0.44 to 1.12)	0.76 (0.45 to 1.13)
North East and Yorkshire	0.75 (0.44 to 1.14)	0.76 (0.43 to 1.19)
East of England	0.69 (0.38 to 1.13)	0.63 (0.36 to 0.95)
Wales	0.68 (0.35 to 1.22)	0.75 (0.42 to 1.17)
South West	0.64 (0.37 to 0.93)	0.68 (0.40 to 1.00)
Northern Ireland	0.60 (0.33 to 0.95)	0.65 (0.35 to 1.05)
London	0.56 (0.31 to 0.86)	0.58 (0.34 to 0.85)
Scotland	0.52 (0.29 to 0.79)	0.52 (0.30 to 0.76)

Descriptive analysis of contacts and preventive behaviour

There is evidence that the nature of contacts has changed as a result of social distance measures in addition to the number of contacts. CoMix allows us to measure the duration of contact, whether contacts occurred inside or outside (which may be safer) and whether individuals have adopted precautionary behaviours such as mask wearing and hand washing.

Contact Duration

Figure 2 shows the proportion of contacts by reported duration, grouped to match the POLYMOD (pre-epidemic) duration groups for comparison to Comix results in full lockdown and partial lockdown conditions. CoMix respondents report a marked reduction in long duration contacts outside the home, and a corresponding proportionate increase in short duration contacts outside the home, compared with POLYMOD.

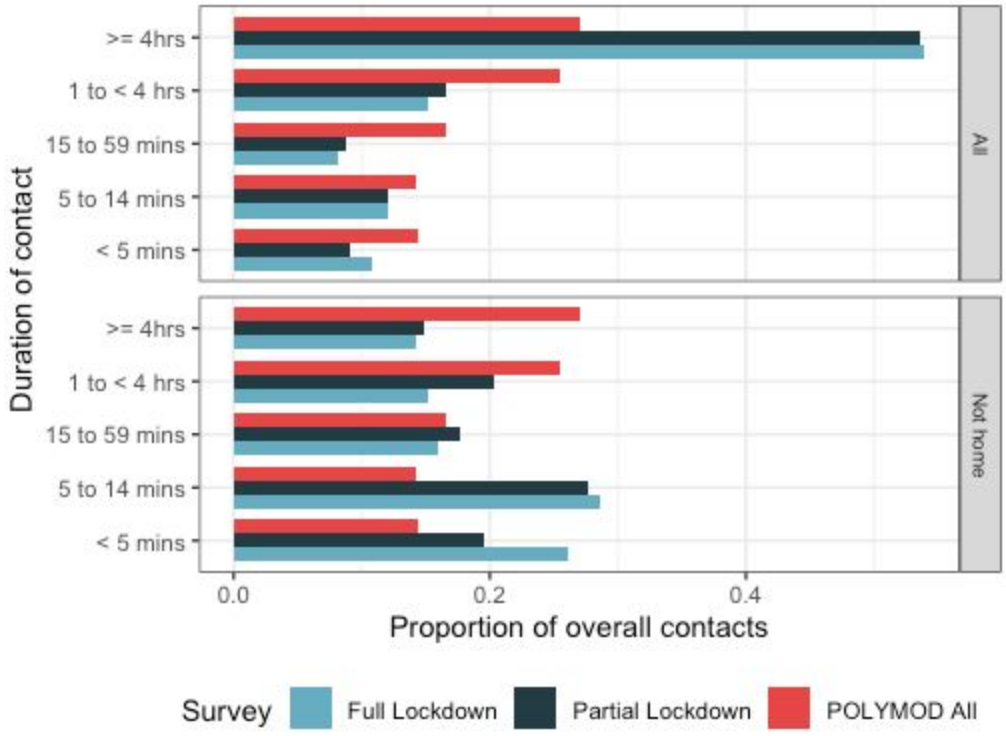

Figure 2. Contact duration. Proportion of participants by duration of contact for all contacts and contacts outside the home, for individually reported contacts. A small portion of contacts do not have a known duration, which are omitted. Full lockdown are the contacts reported between 24 March and 27 April and partial lockdown are contacts reported between 15 May and 18 June.

Indoor versus outdoor contacts

Individuals may report that a contact occurred in more than one setting (e.g. indoors and outdoors). The proportion of contacts reported to have been at least partially outdoors has steadily increased over the period of study (since 23rd March). However, the proportion has decreased in weeks 11 and 12, with outdoor only contacts following the same trend. That is there has been an increase in indoor contacts over the last 2 weeks of the survey.

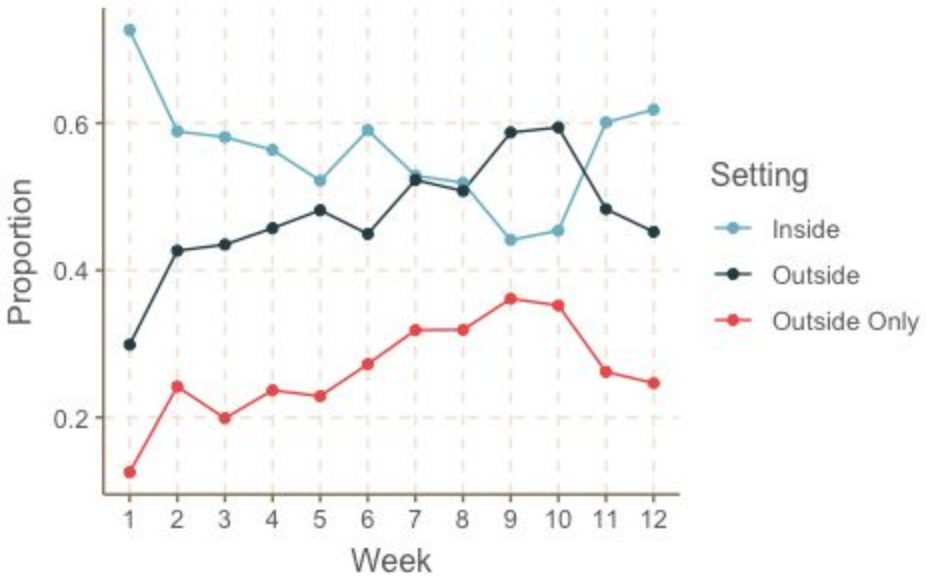

Figure 3. Indoor and outdoor contact proportions. Proportion of participants reported indoors and outdoors for contacts individually reported. Contacts can be recorded as both indoor and outdoor contacts. Contacts reported as outside and also specifically indicated as not indoor contacts are plotted separately. The question was not required, though most contacts have a reported setting.

Preventative behaviour

The potential for transmission between contacts may be reduced by the use of masks and hand washing. Over the course of the last few months, a growing proportion of participants report wearing masks in several settings, including on public transport and while shopping (Figure 4). Handwashing frequency appears to have remained relatively stable since the beginning of the survey (Figure 5) although this may hide relatively complex trends that may require further study. The fraction of respondents who report washing their hands more than 3 times in the 3 hours before the survey has remained stable. However, the fraction reporting less frequent hand washing (at least once or at least twice in the prior 3 hours) has gradually declined. This seems more apparent in younger adults (<55 years of age). These trends are very gradual, but may indicate that more respondents are not washing their hands frequently and it is those that washed their hands less frequently earlier in the epidemic who may have changed their behaviour.

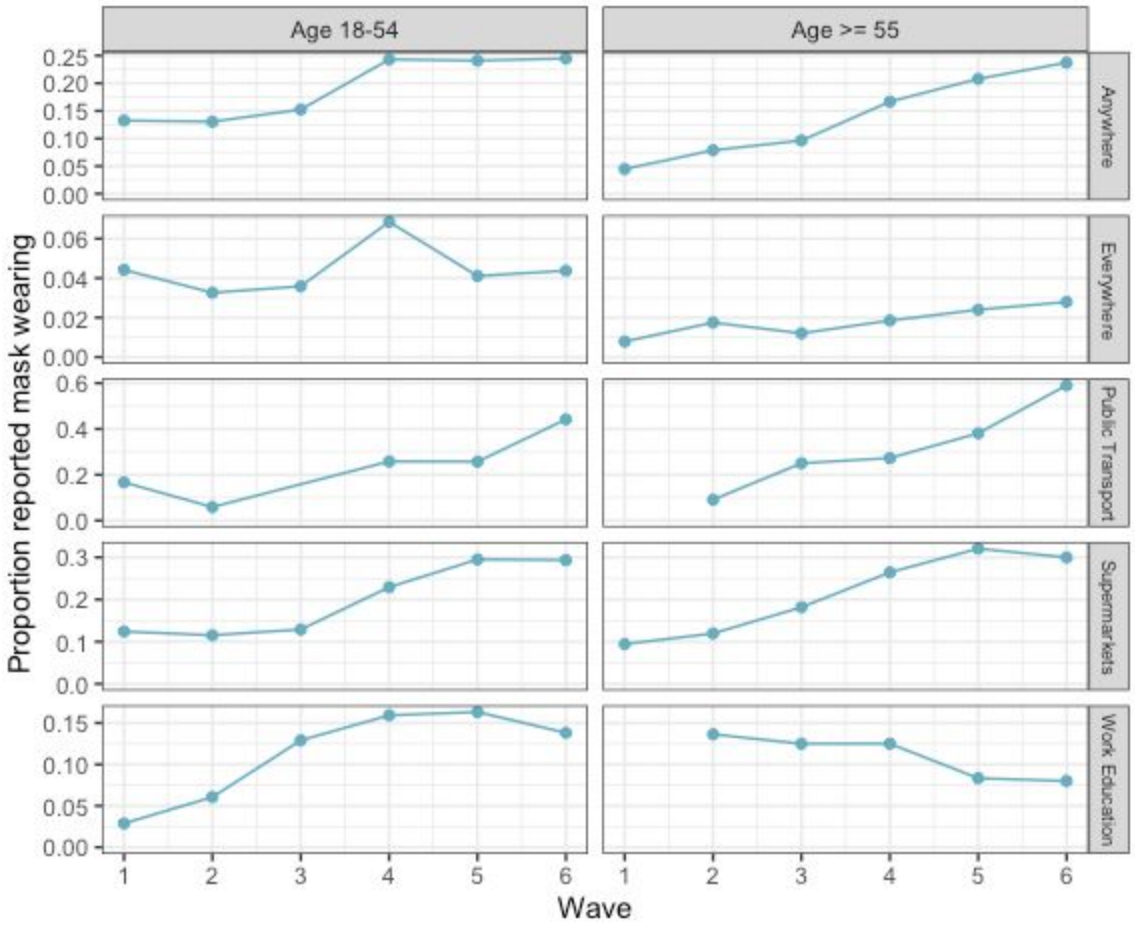

Figure 4. Proportions of participants reporting wearing a mask by setting and age group. Proportions are calculated by relevancy for setting: “Anywhere” and “Everywhere” proportions include participants who reported contacts outside the home; “Public Transport” proportions include participants who reported using public transportation; and “Supermarkets” and “Work Education” included participants who reported contacts in the corresponding setting. Participants are grouped by panel wave, Wave 1 includes Week 1 and 2 and so on.

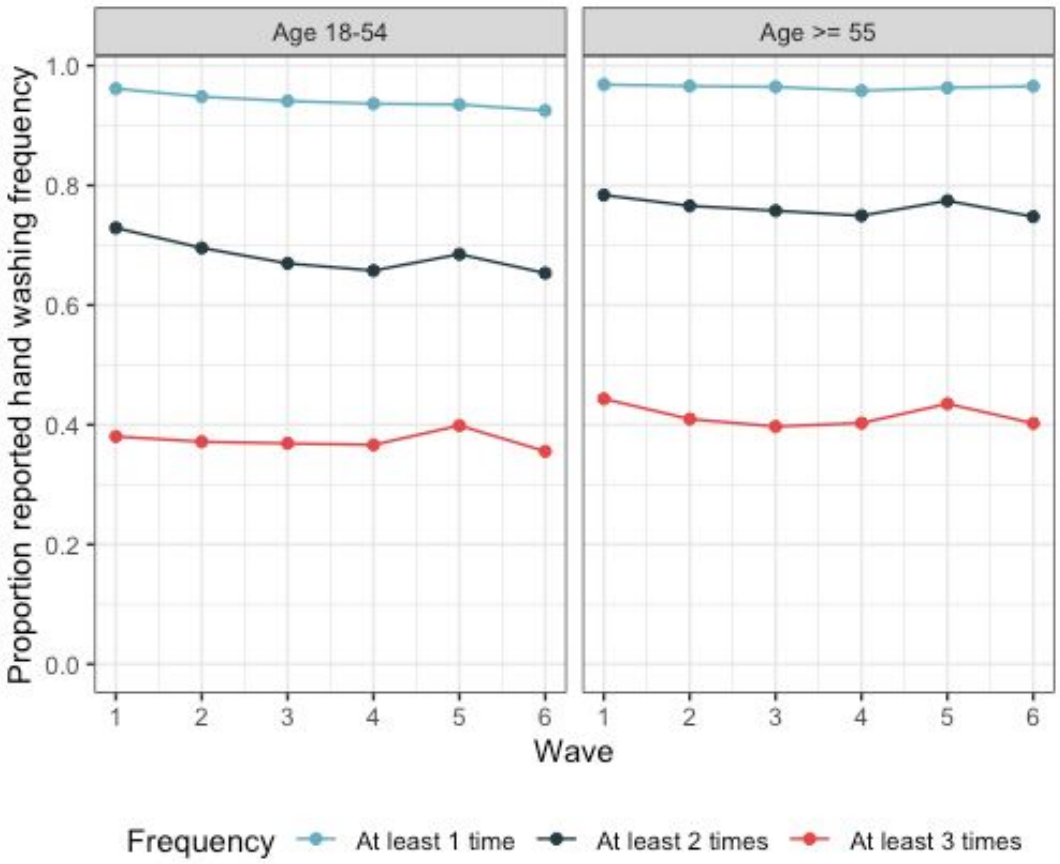

Figure 5. Proportions of participants with reported hand washing frequency. Participants were asked to report the number of times they washed their hands in the three hours prior to the survey, and grouped for washing hands in the last three hours at least one, two, and three times in the last three hours. Participants are grouped by panel wave, Wave 1 includes Week 1 and 2 and so on.

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 19th 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[1]. 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[2]. 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.[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 1,000 bootstrap samples of the CoMix and BBC contacts matrices, and applying these ratios to 1,000 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.

Descriptive analysis of behaviours

We describe participants' reported hand washing and mask wearing behaviour as proportions. We calculated proportions for mask wearing by relevancy for setting. The denominator population for "Anywhere" and "Everywhere" proportions only includes participants who reported contacts outside the home, "Public Transport" proportions include participants who reported using public transportation, and "Supermarkets" and "Work Education" included participants who reported contacts in the corresponding setting. We calculated the proportions of reported hand

washing frequency by at least one, two, and three times in the last three hours. We reported proportions by the age groups 18 to 54 years and 55 years and older.

References

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