Social contacts in the UK from the CoMix social contact survey
Report for survey week 51

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Summary
- Mean contacts for children aged 5 to 17 years old has increased significantly following re-opening of schools. Mean contacts amongst other age groups (<5 years of age and adults) have remained low. Patterns of contacts now closely resemble those during the second lockdown, when schools were open.
- We estimate that the increase in contacts amongst children has increased the reproduction number to be above 1.
- Throughout the epidemic, part-time workers have recorded higher mean rates of contact than full-time workers and those that are self-employed.
- Throughout the epidemic, recorded mean contact rates have tended to be higher in those with lower incomes (<£20,000 per year) and are lowest in those with higher incomes (>£45,0000 per year).

Main

Mean contacts amongst adults have remained low across all age groups since the beginning of the third lockdown on the 5th of January (Figure 1). As previously seen, individuals 70+ report fewer contacts than those 18-69. Changes in work contacts are the main drivers of changes in adult contacts by age group (Figure S1).

Mean contacts amongst children age 5-17 have increased substantially reflecting that schools are now open again (Figure 2). For children under 4, mean contacts have remained steady since the beginning of Feb.

Mean contacts for adults remain low across the four nations and English regions. There are no major differences in reported contact rates by region/nation (Figure 3).

The contact patterns observed recently (since school reopening) are very consistent with those observed during the second lockdown in England (Figure 4). Using an age-structured susceptibility profile from Davies et al. [1] and fitting to estimates from independent case-based time-varying reproduction number [2], we estimate that reopening schools is consistent with R increasing to above 1 (Figure 5). These results support our estimates presented in the report for survey week 43b.

We consider the impact of employment on work contacts when their work is open. Since March 2020, we see that those in full and part time employment have a higher number of work contacts than those who are self employed. Individuals with an income of less than £20,000 have had on average higher contacts than those earning more than £20,000. When stratifying income by full and part time employment, the general trends are similar but there is greater uncertainty due to the smaller number of participants in each of the strata.
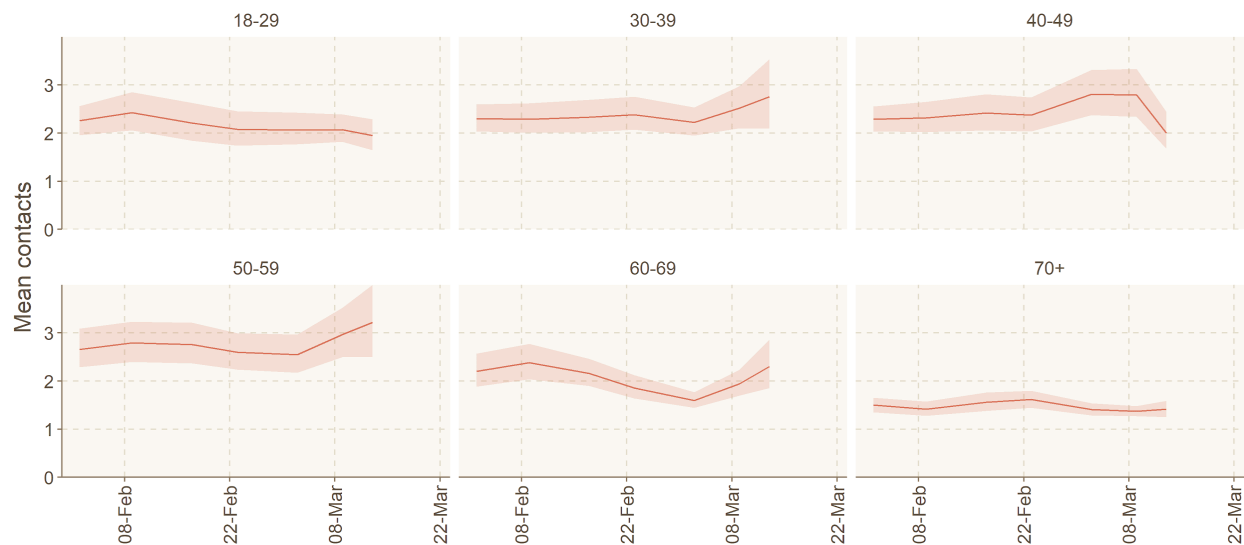
Figure 1: Mean contacts in all settings by age-group for adults over time. Uncertainty calculated using bootstrapping. Contacts truncated to 50 contacts per participant. Observations are smoothed over two weeks to account for panel effects. Date on x axis refers to the midpoint of the survey period.
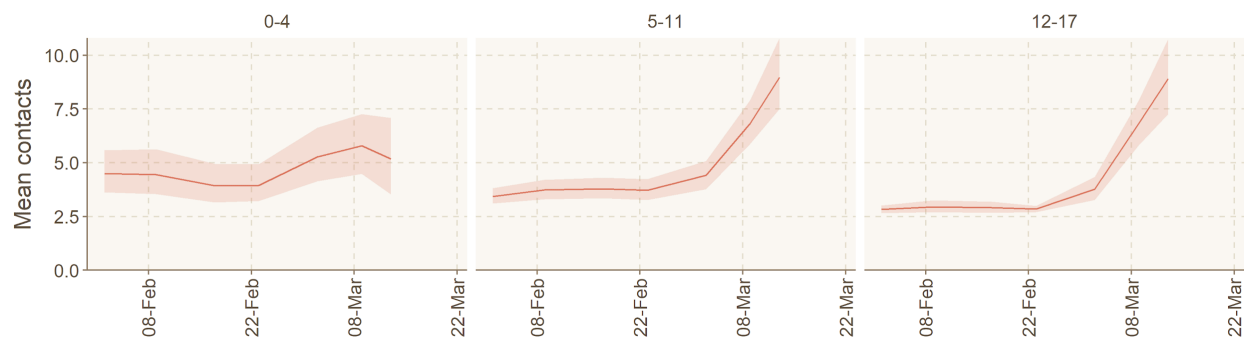

Figure 2: Mean contacts in all settings by age-group for children over time. Uncertainty calculated using bootstrapping. Contacts truncated to 50 contacts per participant. Observations are smoothed over two weeks to account for panel effects. Date on x axis refers to the midpoint of the survey period.
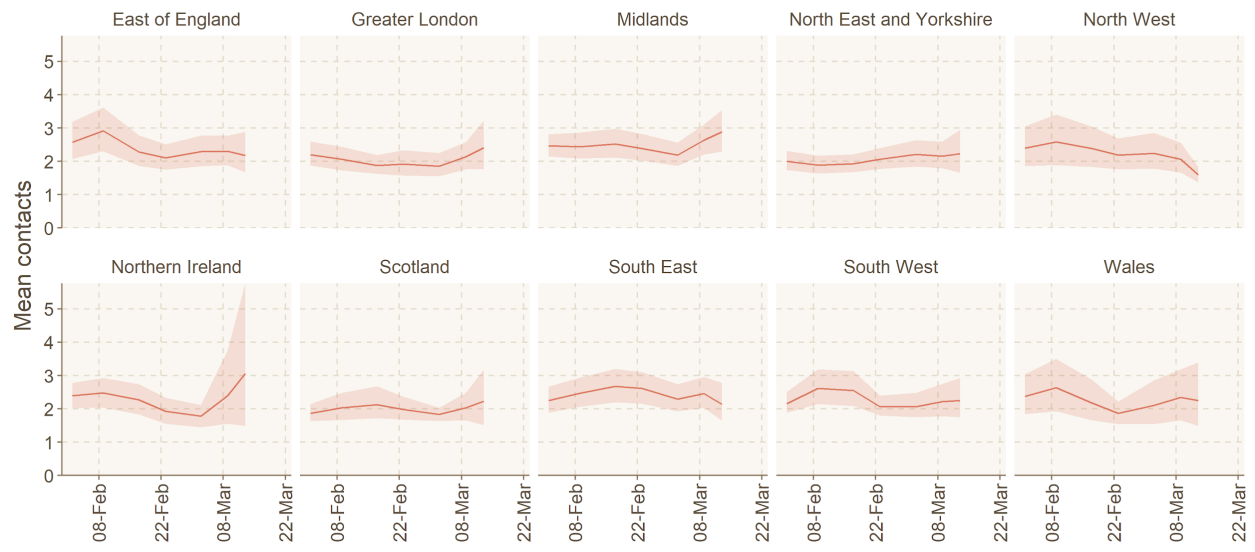
Figure 3: Mean contacts in all settings in adults for UK nations and English regions over time. Uncertainty calculated using Bootstrapped accounting. Contacts truncated to 50 contacts per participant. Observations are smoothed over two weeks to account for panel effects. Date on x axis refers to the midpoint of the survey period.
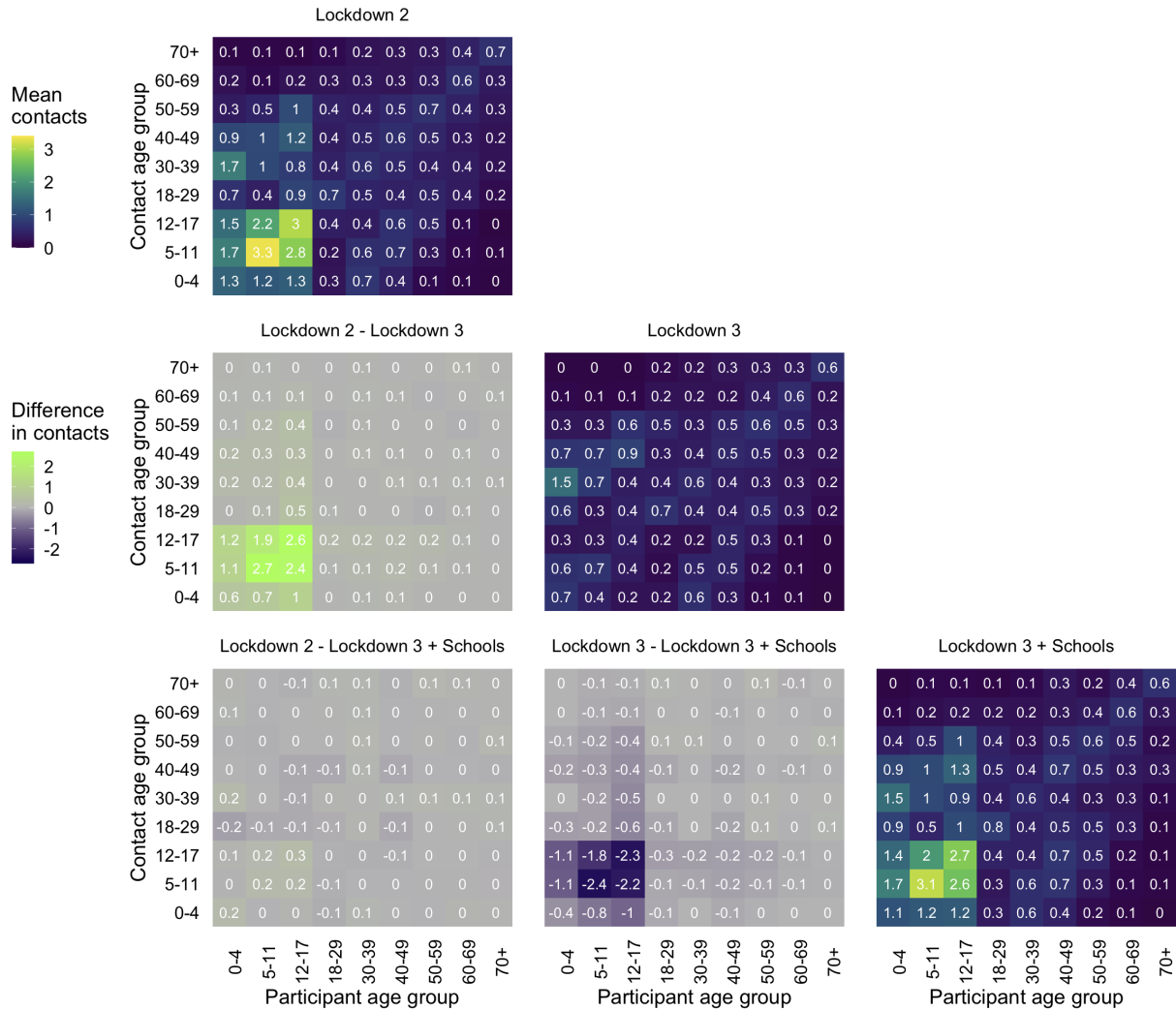
Figure 4: Comparison of contact matrices from different periods. Diagonal shows contact matrices constructed from data collected during Lockdown 2 (5th November - 2nd December 2020), Lockdown 3 (5th January - 7th March 2021) and since schools have returned (8th - 16th March 2021). Off-diagonal matrices show absolute differences between the contact matrices as indicated.
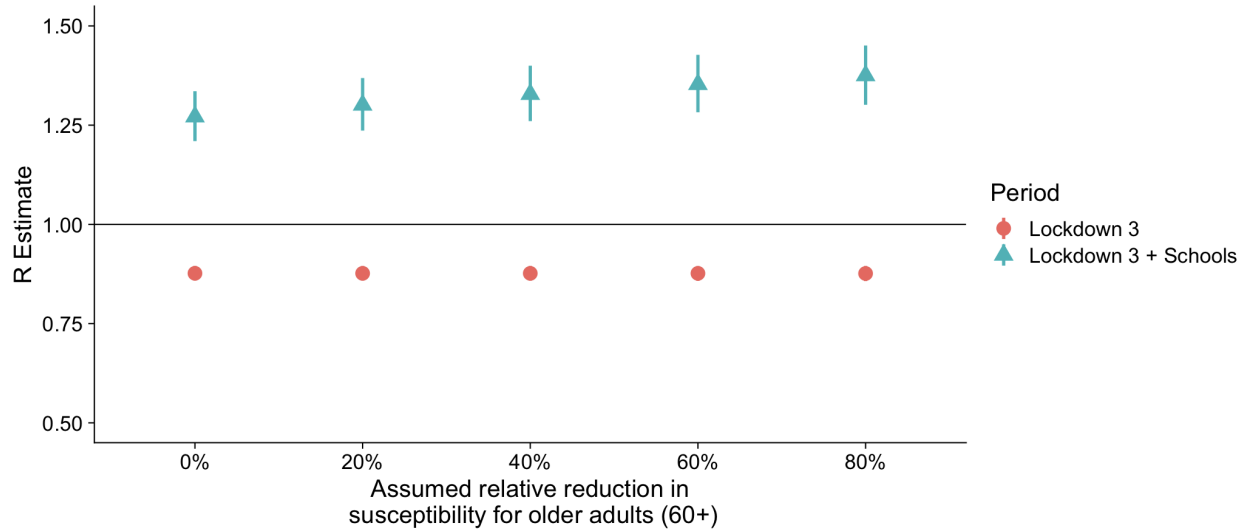
Figure 5: Reproduction number estimates before and after opening schools. Points show the median and bars show the 90% CI estimate of reproduction number before (circles) and after (triangles) reopening for different assumed relative reduction in susceptibility amongst over 60s.
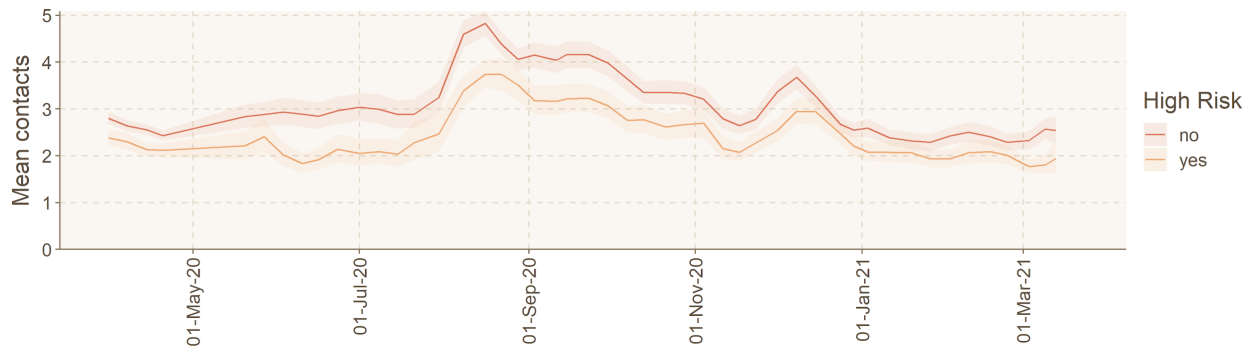

Figure 6: *Mean contacts in all settings by risk group for adults over time.* Uncertainty calculated using Bootstrapped accounting. Contacts truncated to 50 contacts per participant. Observations are smoothed over two weeks to account for panel effects. Date on x axis refers to the midpoint of the survey period.

Figure 7: *Mean contacts at work for adults whose work is open. A) Comparing type of employment, B) Comparing income level, C) Comparing income level between Full time and Part time employees.* Uncertainty calculated using Bootstrapped accounting. Contacts truncated to 50 contacts per participant. Observations are smoothed over two weeks to account for panel effects. Date on x axis refers to the midpoint of the survey period.
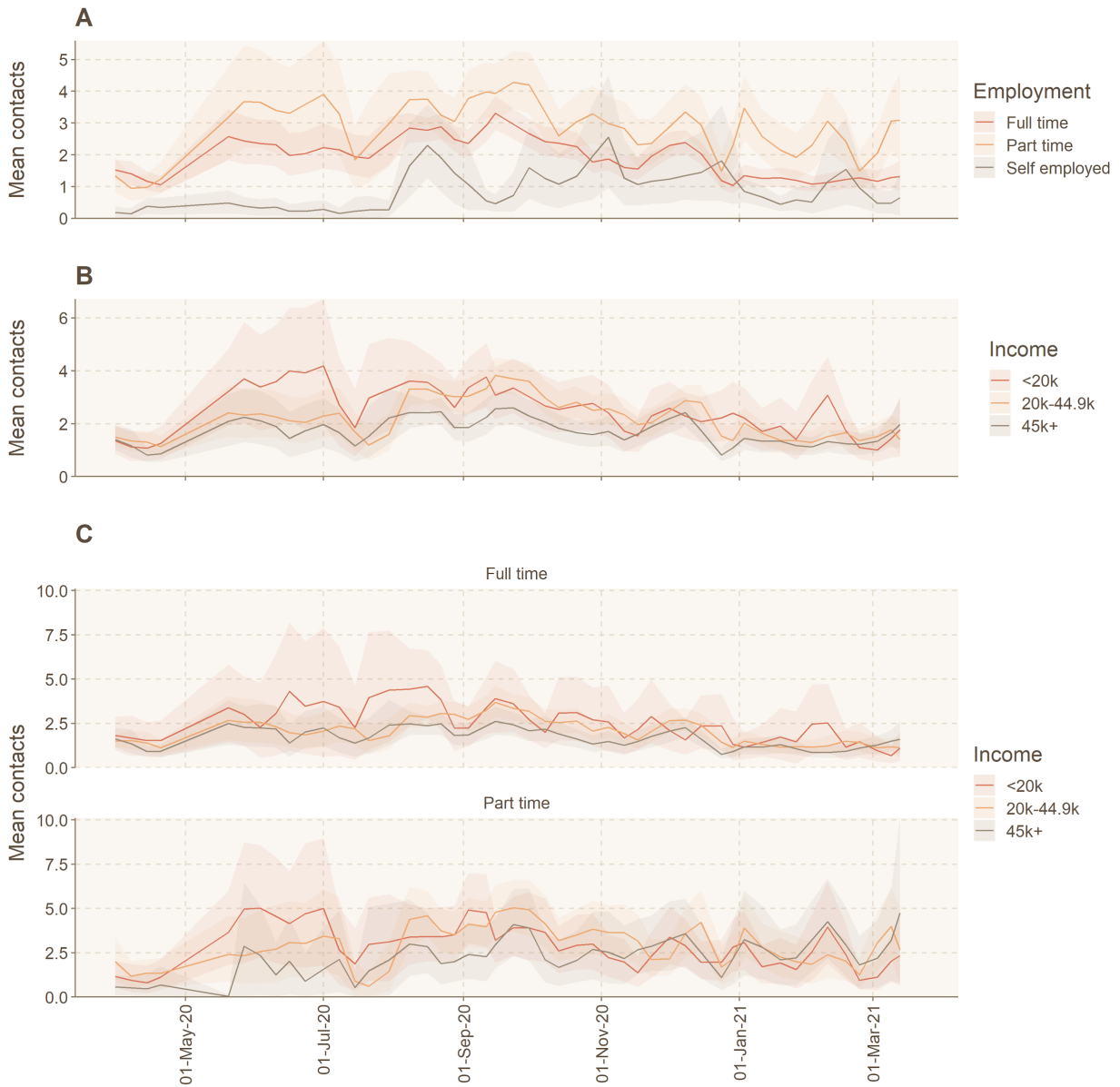
Methods

CoMix is a behavioural survey, launched on 24th of March 2020. The sample is broadly representative of the UK adult population. Participant's are invited to respond to the survey once every two weeks. We collect weekly data by running two alternating panels. Parents complete the survey on behalf of children (17 years old or younger). Participants record 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 [3]. The contact survey is based on the POLYMOD contact survey [4].

We calculated the mean contacts using 1000 bootstrap samples. Bootstrap samples were calculated at the participant level, then all observations for those participants are included in a sample to respect the correlation structure of the data. We collect data in two panels which alternate weekly, therefore we calculated the mean smoothed over the 2 week intervals to give a larger number of participants per estimate and account for panel effects. We calculated the mean number of contacts in the settings home, work and school (including all educational establishments, including childcare, nurseries and universities and colleges), and "other" (mostly leisure and social contacts, but includes shopping). We look at the mean contacts by age, country, and region of England. The mean number of contacts is influenced by a few individuals who report very high numbers of contacts (often in a work context). The means shown here are calculated based on truncating the maximum number of contacts recorded at 50 per individual per day.

We calculated mean contacts at work for individuals by employment status and by reported income. We also calculated mean contacts for all settings by risk group, a high risk individual was denied as somebody who would receive the flu vaccine for free. Note that graphs present data smoothed over two weeks where mean contacts are aligned to the middle time point of each survey round and therefore include data up to one week before and after date stated in graphs.

We constructed age-stratified contact matrices for nine age-groups (0-4, 5-11, 12-17, 18-29, 30-39, 40-49, 50-59, 60-69, and 70+). For children participants and contacts, we did not have exact ages and therefore sampled from the reported age-group uniformly. We fitted a truncated negative binomial model to calculate the mean contacts between each participant and contact age-groups. To find the population normalised symmetrical contact matrix, we multiplied the columns of the matrix by the mean-normalised proportion of the UK population in each age-group.

We created the matrix for the second lockdown using data from the period of 5th November to 2nd December 2020, for the third lockdown using data from the period of 5th to the 7th of March 2021 and for the period since schools reopened, 8th of March 2021. Individual element absolute

differences of the matrices were calculated comparing the third and the second lockdown (Figure 4).

We created weekly contact matrices smoothed over 2 weeks. To account for variation in susceptibility and infectiousness by age, we used estimates from Davies et. al. [1]. We converted measured contact matrices to effective contact matrices by taking the outer product of the estimated age stratified infectiousness profile and susceptibility profile vectors and calculating the eigenvalues of the Hadamard product of the resulting matrix and the contact matrices. We inferred a scale factor for transforming the dominant eigenvalue of the effective contact matrix to reproduction number by fitting the weekly R estimates to estimates of time-varying reproduction number estimated from time-series of cases [2]. We explored the potential impact of reduced susceptibility in older age groups (60+) due to vaccination, by scaling the relevant cells of the susceptibility profile vector by between 80% - 20% before fitting the R estimates (Figure S3). To estimate R in the period following the reopening of schools, we applied these profiles and the corresponding scale-factors to the contact matrix constructed using data since the 8th March 2021. We present the resulting values in Figure 6 alongside estimates using the contact matrices constructed from the data collected during the entire Lockdown 3 period (January 5th - March 7th 2021).

References

1. Davies NG, Klepac P, Liu Y, Prem K, Jit M, CMMID COVID-19 working group, et al. Age-dependent effects in the transmission and control of COVID-19 epidemics. Nat Med. 2020;26: 1205–1211.

2. Abbott S, Hellewell J, Thompson RN, Sherratt K, Gibbs HP, Bosse NI, et al. Estimating the time-varying reproduction number of SARS-CoV-2 using national and subnational case counts. Wellcome Open Res. 2020;5: 112.

3. Jarvis CI, Van Zandvoort K, Gimma A, Prem K, CMMID COVID-19 working group, Klepac P, et al. Quantifying the impact of physical distance measures on the transmission of COVID-19 in the UK. BMC Med. 2020;18: 124.

4. Mossong J, Hens N, Jit M, Beutels P, Auranen K, Mikolajczyk R, et al. Social contacts and mixing patterns relevant to the spread of infectious diseases. PLoS Med. 2008;5: e74.
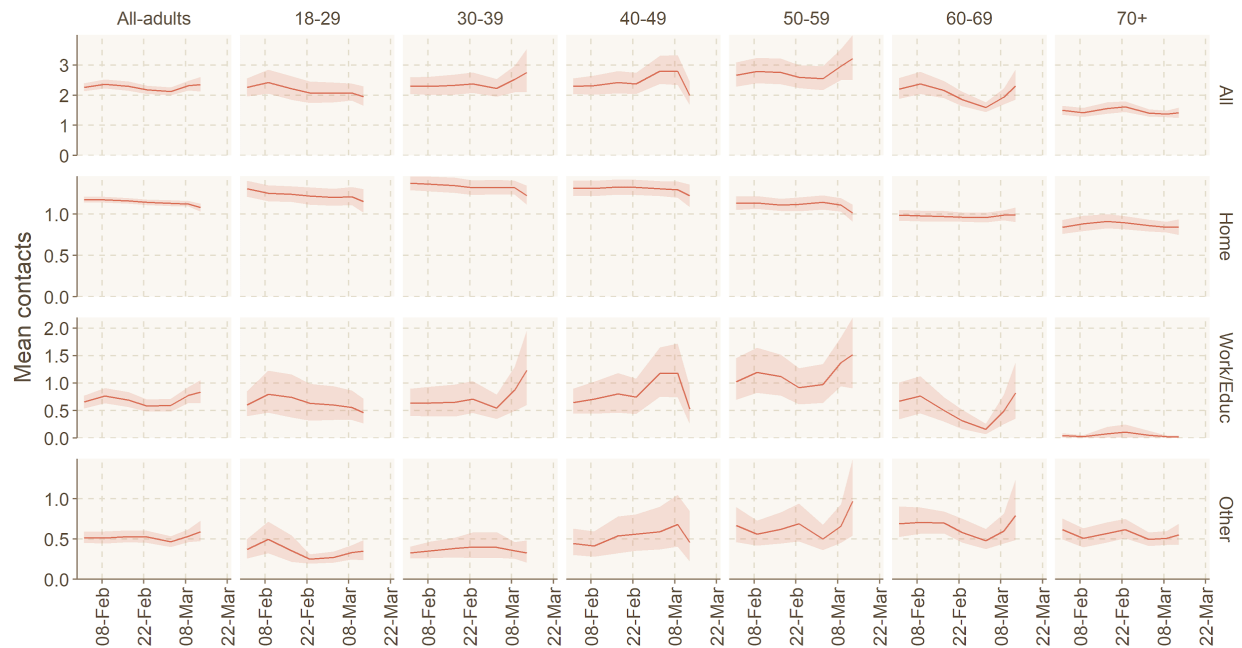
Figure S1: Setting-specific mean contacts by age-group for adults over time. Uncertainty calculated using bootstrapping. Contacts truncated to 50 contacts per participant. Observations are smoothed over two weeks to account for panel effects. Educ = educational setting. Date on x axis refers to the midpoint of the survey period.
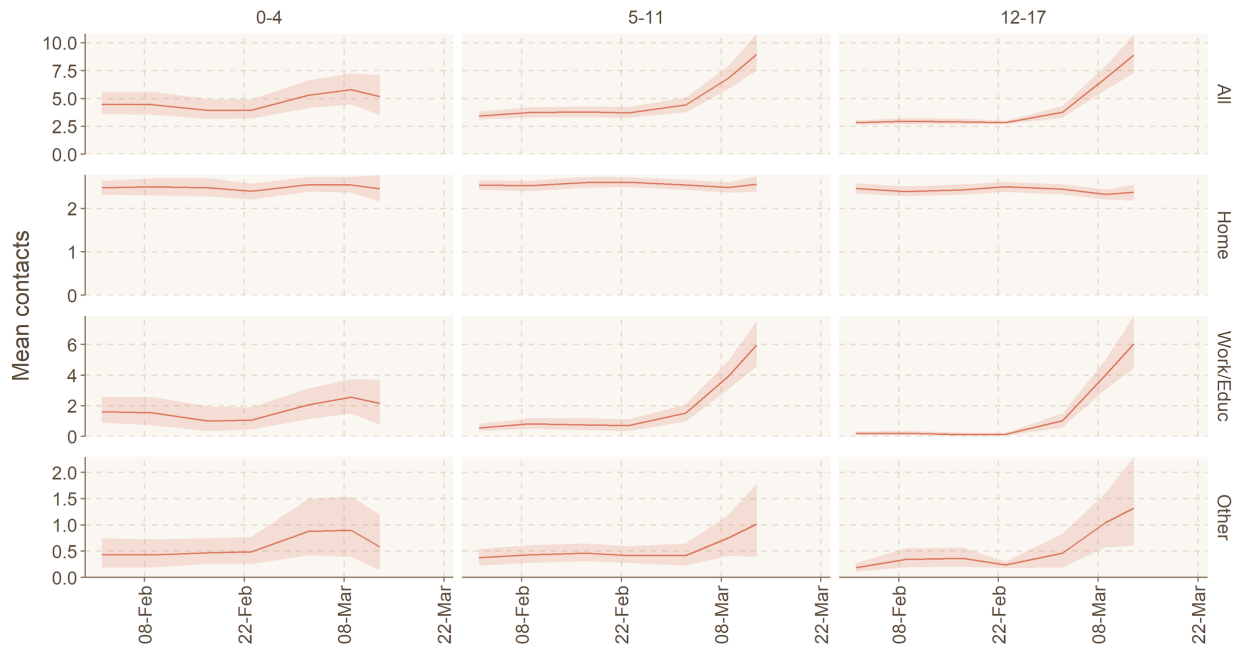
Figure S2: Setting-specific mean contacts by age-group for children over time.
Uncertainty calculated using bootstrapping. Contacts truncated to 50 contacts per participant.
Observations are smoothed over two weeks to account for panel effects. Educ = educational
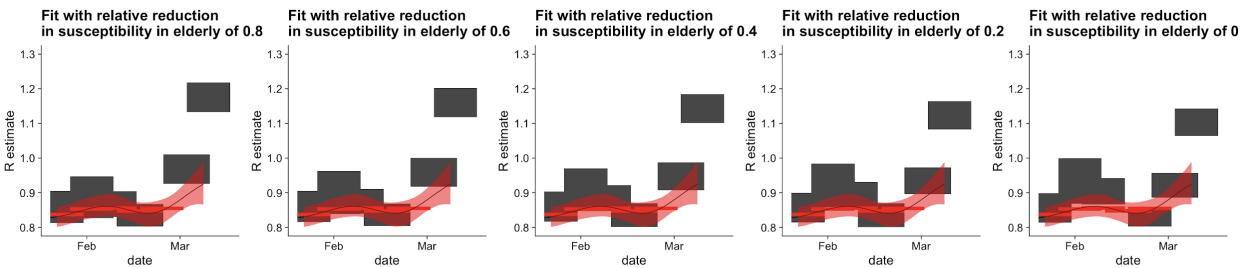setting. Date on x axis refers to the midpoint of the survey period.

Figure S3: Fit of the CoMix R estimates to time-varying estimates based on case data. *R
estimates (90% CI range) using CoMix (Grey Boxes) and case based estimates from EpiNow2
(ribbon), assuming between 0 and 80% reduction in susceptibility amongst elderly adults
relative to pre-vaccination-era age-stratified susceptibility profiles.*