nature portfolio

Peer Review File

Post-pandemic social contacts in Italy: implications for distancing measures on in-person school and work attendance

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This file contains all reviewer reports in order by version, followed by all author rebuttals in order by version.

Version 0:

Reviewer comments:

Reviewer #1

(Remarks to the Author)
The manuscript "Post-pandemic social contacts in Italy: implications for distancing measures on in-person school and work attendance" presents the post-pandemic contact pattern relevant for the spread of close contact infection in Italy. The authors present the results from a two-wave survey representative of the Italian population in terms of age, sex and area of residence. The results of the survey are used to assess the impact of potential intervention strategies targeting school and working venues. The manuscript is well written, with all the details of the methodology provided (either in the main manuscript or in the supporting information), allowing to reproduce the study. The results are very relevant for the infectious disease community, and provide a solid background for preparedness for future pandemics.
Although the manuscript is very clear and detailed, I have two minor comments that I think that would improve the quality of the manuscript:
- The authors assess the impact of the different interventions under the assumption of equal susceptibility/infectiousness of adults and children. While this is the best assumption for an unknown pathogen, it has the potential to profoundly affect the results. My suggestion is to include, as a sensitivity analysis, an analysis done with an age-specific susceptibility/infectiousness that could be the one of COVID-19 or the one of the 2009 pandemic Influenza (or both!). This would help to assess the robustness of the results and allow drawing more general considerations.
- Although the next generation matrix approach is quite established in literature and the reference model is specified, the authors may want to include a section in the supporting information where they detail the computation of the next generation matrix in the block form at the beginning of page 9.

In conclusion, this manuscript has a high level of maturity and should be considered for publication, once my suggestions have been considered/discussed.

Reviewer #2

(Remarks to the Author)
This work examines patterns of post-pandemic social contact over two waves of data in March 2022 and 2023 in Italy. Data are collected online from nationally representative (by age, sex and region) participants recruited via email. Surveys include demographic information such as level of income, household size and level of education, providing an important opportunity to understand drivers of heterogeneity in contact behavior. Contact surveys enquire about both close and incidental contacts from the previous data, an extension from many pre-pandemic surveys recognising the potential for airborne transmission, and collecting age data regarding close contacts as is common for contact surveys of this type.

While many participants are represented in both waves of data collection, the analysis focuses on aggregate data. The authors fit a multi-variate generalised linear model in order to understand which attributes are associated with the number of contacts. Sensitivity analyses including regarding the assumptions of the age of indirect contacts are presented. The results are used to compute the relative transmission potential of a virus under various school closure and work from home strategies assuming contact numbers are linearly related to transmission potential.

Overall, the emerging data sets, and the analysis, are very important for building representative epidemic models in the post-covid era, and understanding the benefit of NPIs in epidemic and pandemic scenarios. My opinion is that this is an important and thorough piece of work. I have some (minor) comments that may aid the clarity of this work.

* In the abstract, the claim "They support a nuanced approach to social distancing policies, balancing public health benefits with economic and social considerations." seems a bit vague, and though likely true, unclear how it relates to the findings -- consider making this more precise.

* The authors have attempted to generate representative samples across a number of factors. Potential bias in recruitment of children is noted, are there additional concerns due to the method of contact, in particular with regard to the elderly, despite them being overrepresented in your sample?

* Perhaps this is another paper, but it would be very interesting to see how/if individuals are changing their behaviour over the waves, and if this varies with social and demographic factors?

* Sometimes there are slips where the authors use "transmission" rather than "transmission potential" when discussing the role of contacts of viral spread. Of course contacts may not map linearly to transmissibility; there may be age and environmental impacts that modify how contacts relate to transmission. This could potentially be addressed by emphasising assumptions about transmissibility in lines 310-328 of the supplementary material.

* It seems that the only mention of contact duration in the online survey is when defining indirect contact. Is this correct, and should the limited data on contact duration when defining the transmission potential be considered?

* From my reading of the scenarios analysis with workplace and school closure, it seems that the behaviour of adults and children are considered to be independent? In reality for adults who are care providers this is not the case (e.g. if young children are at home, at least one adult needs to provide care) and so if this limitation exists I think it is worth highlighting when discussing these NPIs.

* The comparison to POLYMOD work is very interesting and appears to suggest substantial changes from pre-pandemic behaviour even in 2022. I understand there are methodological differences between surveys (e.g. paper versus online) but I think this is also an important finding that could be further highlighted (e.g. in the main text).

* I understand that the baseline scenario assumes pre-pandemic rate of home working but after looking at the supplementary material I'm still not 100% certain that the authors use their contract matrices rather than the POLYMOD data for the baseline scenario, consider clarifying this.

Reviewer #3

(Remarks to the Author)
Review of the manuscript 'Post-pandemic social contacts in Italy: implications for distancing 1 measures on in-person school and work attendance' by Lorenzo Lucchini and colleagues, submitted to Communications in Medicine.

Summary
In this manuscript, the authors provide results on an online social contacts study performed in Italty in early 2022 and early 2023 to help gauge the impact of non-pharmaceutical interventions. The authors stratify data by direct contacts (verbal/physical contact) and indirect contacts (presence in same indoor environment). The authors show that presence at work and at school increased the number of contacts considerably. Based on the inferred contact matrices. the authors provide some simulations of non-pharmaceutical interventions, and conclude that combining working from home combined distance learning (by schoolchildren) could reduce transmissibility by more than 20%.

Evaluation
The manuscript contains interesting information on contact patterns in Italy during various stages of the SARs-CoV-2 pandemic. Further, as far as I can judge the data and analyses are sound. I believe that the intervention scenarios could have been developed further and presented better. Data and code should be made available.

Major comments
1) Data and code availability. The paper will have a much longer shelf-life if the underlying material is openly shared. Could you please deposit the raw, de-identified contact diaries, the processed age-specific contact matrices (e,.g., plain CSV), the full analysis and plotting code, and a public repository (zenodo and else github will probably suffice).

2) Scenario analyses and Figure 3. The intervention analysis section feels a bit underdeveloped and untethered from reality, as you do not calibrate or fit the baseline model to the observed epidemic curve. I certainly would applaud such an undertaking and believe it could substantially strengthen the ms, ie fit first, extrapolate second. Even a quick back-of-the-envelope calibration to the January-March 2022 COVID notification curve for Italy (or, better, a sero-attack-rate) would anchor the R0 that drives your simulations. Additionally, could you show more relevant quantities ie replace or complement panel C with infection attack rates under each scenario. Additionally, as age is such an important determinant of severity I strongly suggest to disaggregate the infection attack rates by age.

Specific comments

-Abstract. Spell out “transmissibility”: we quantify the percentage reduction in the basic reproduction number R0. Even better, also report the resulting overall infection attack rate for the most extreme scenario so readers get a more direct impact figure.

-Data stratification. Could you split the 70–79 y and = 80 y groups? Italy’s demographic pyramid is heavily skewed towards the elderly and they bear the brunt of severe outcomes.

-“Social distancing” vs “physical distancing”. Pick one term and stick to it (WHO now prefers physical distancing).

-Introduction—what is new? You say updated post-pandemic contact data are “still missing”, but you then cite CoMix, Jarvis et al., Jeong et al. and others. Clarify that no nation-wide Italian data covering BOTH direct and indoor co-location contacts after all mandates were lifted have been published—that is your unique contribution (or anything else, but make sure that you make it very specific what you add specifically).

-30-minute colocation threshold. Earlier studies used anything from 5 min to 15 min as a cut-off (if I recall this correctly). Justify the 30 min choice and discuss.

-Lines 79-80—paired analysis. You actually have 1,236 repeat respondents. A quick within-subject comparison would show whether the mean contact increase from 2022 to 2023 is driven by behavioural change rather than sample composition. Also, have you considered a full paired analysis? If not, can you discuss the options?

-Regional heterogeneity. Italy’s North-South gradient in both demography and pandemic impact well known. Even a simple stratified analysis ie North-West/North-East/Centre/South would be valuable.

-Line 454—“credible interval". You use a frequentist bootstrap, and I think this should read CI.

-SI 1.3. Make vectors and matrices boldface to prevent confusion.

-Table SI3. Great table, but please discuss it! Why are your mean contacts still well below pre-pandemic POLYMOD?

Recommendation
Based on the above evaluation that is largely positive I recommend a revision of the manuscript by Lucchini and colleagues that addresses the above points. I do think that making the data and results publicly available is imperative.

Version 1:

Reviewer comments:

Reviewer #1

(Remarks to the Author)
The authors have addressed all my previous comments. I think that the manuscript is ready for publication.

Reviewer #2

(Remarks to the Author)
Thank you to the authors for thoroughly responding to my comments, I am very happy to recommend this manuscript for acceptance.

Reviewers' comments:

Reviewer #1 (Remarks to the Author):

The manuscript "Post-pandemic social contacts in Italy: implications for distancing measures on in-person school and work attendance" presents the post-pandemic contact pattern relevant for the spread of close contact infection in Italy. The authors present the results from a two-wave survey representative of the Italian population in terms of age, sex and area of residence. The results of the survey are used to assess the impact of potential intervention strategies targeting school and working venues. The manuscript is well written, with all the details of the methodology provided (either in the main manuscript or in the supporting information), allowing to reproduce the study. The results are very relevant for the infectious disease community, and provide a solid background for preparedness for future pandemics.

We thank the reviewer for their positive feedback and constructive comments. Below, we report a structured letter with point-by-point responses to their suggestions.

Although the manuscript is very clear and detailed, I have two minor comments that I think that would improve the quality of the manuscript:

R1.1 - The authors assess the impact of the different interventions under the assumption of equal susceptibility/infectiousness of adults and children. While this is the best assumption for an unknown pathogen, it has the potential to profoundly affect the results. My suggestion is to include, as a sensitivity analysis, an analysis done with an age-specific susceptibility/infectiousness that could be the one of COVID-19 or the one of the 2009 pandemic Influenza (or both!). This would help to assess the robustness of the results and allow drawing more general considerations.

We thank the reviewer for this suggestion. Following their recommendation, we have performed two additional sensitivity analyses considering heterogeneous susceptibility across age groups, as estimated for the 2009 H1N1 pandemic virus and for SARS-CoV-2 ancestral lineages.
Using H1N1 estimates, which showed higher susceptibility in children compared to adults and the elderly [Merler et al, PLoS One, 2013], we found that interventions targeting only in-person work were much less effective, whereas measures affecting school attendance had a substantially stronger impact compared to results from the main analysis. Specifically, in the absence of school closures, limiting in-person work to essential workers reduced the reproduction number by less than 1% (vs. 5.5% in the main analysis). In contrast, combining full school closure with in-person attendance restricted to essential workers yielded an average reduction of 62.0% (95%CI: 52.1–69.8%), nearly twice the effect estimated under the homogeneous susceptibility assumption (about 30%).
Conversely, when adopting SARS-CoV-2 susceptibility estimates, where the elderly are more susceptible compared to adults and children [Hu et al, Nature Communications, 2021], interventions targeting workers produced more pronounced effect compared with the main analysis. Without school closures, limiting in-person work to essential workers reduced transmissibility by 8.8% (95%CI:6.5–10.8%), higher than the 5.5% estimated in the main analysis. However, combining full school closure with the minimum level of in-person work resulted in a transmissibility reduction of 20.3% (95%CI: 9.5–27.9%), smaller than the 29.1% obtained under homogeneous susceptibility, due to the reduced susceptibility of children.

These new analyses are now presented in Figure SI14, reported below, which has been added to the revised Supplementary Information (section SI2.5).

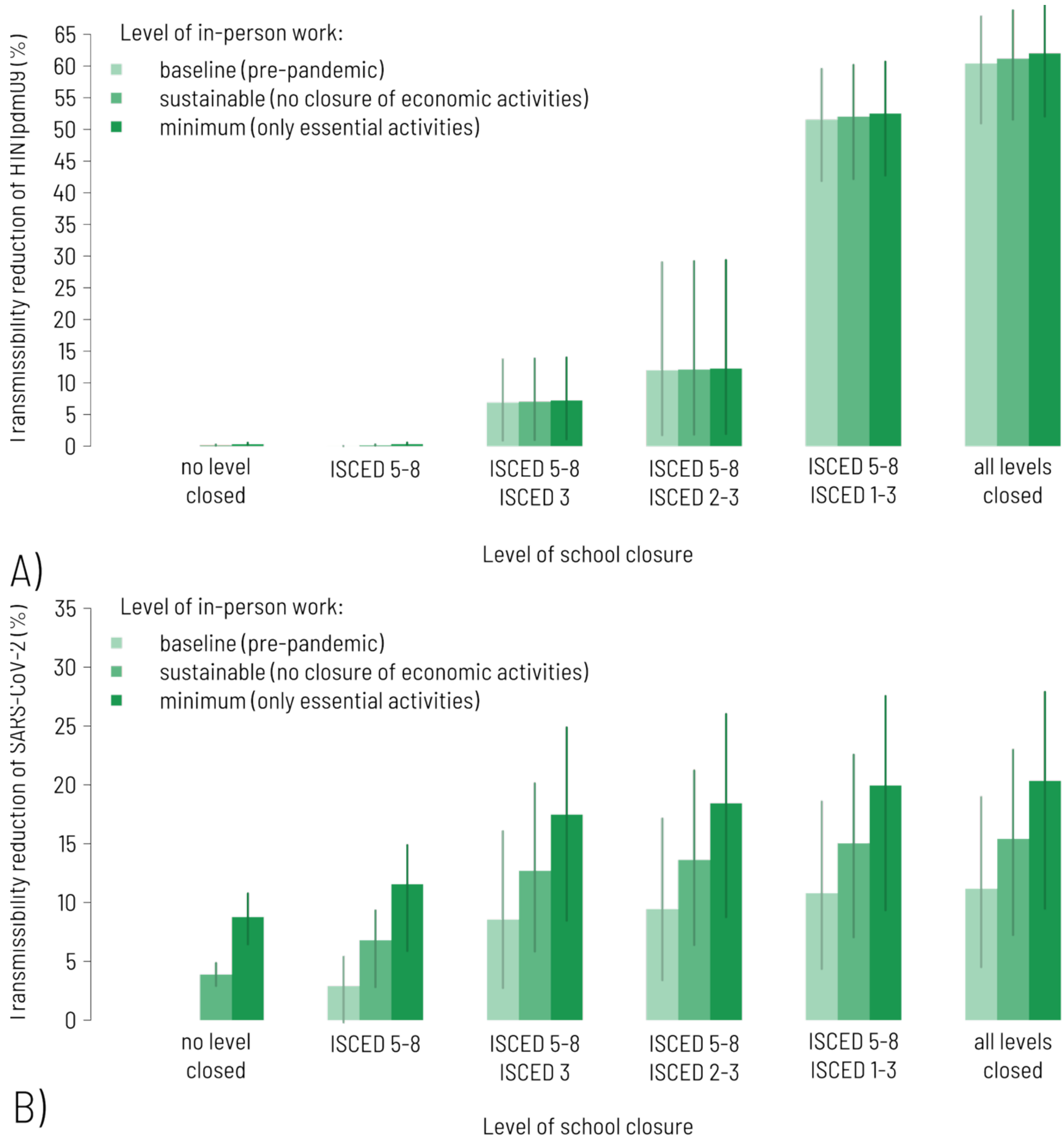


Figure SI14. *Transmissibility reduction under different scenarios of work/school attendance considering age-specific susceptibility* A) Transmissibility reduction of H1N1pdm09 associated with intervention scenarios combining different levels of school closures (including distance-learning mandates) and in-person work, compared to a baseline scenario where the in-person workers are set at pre-pandemic levels and students across all education levels attend in person. B) As A) but for SARS-CoV-2

To describe these findings, we have added the following paragraphs to the Results and the Discussion sections, respectively:

> *"To assess the robustness of our results to alternative assumptions on age-specific susceptibility, we conducted two sensitivity analyses using susceptibility estimates from the 2009 H1N1 pandemic virus and from SARS-CoV-2 ancestral lineages [Merler et al, PLoS One 2013, Hu et al, Nature Communications 2021]. Under the H1N1 estimates, where susceptibility is higher in children compared to adults and the elderly, interventions targeting work attendance alone were markedly less effective in reducing the transmissibility than in the main analysis, which assumed homogeneous susceptibility across ages (see Figure SI14A). We estimated that limiting in-person work to essential workers reduced the reproduction number by 0.33% (95%CI: 0.16–0.56%), compared with 5.5% (95%CI: 3.0–7.8%) in the main analysis. In contrast, combining full school closure with the maximum level of work restrictions*

resulted in an average reduction of 62.0% (95%CI: 52.1–69.8%), nearly twice the effect obtained in the main analysis (29.1%). By contrast, when adopting the SARS-CoV-2 estimates, where susceptibility is higher in the elderly compared to adults and children, interventions targeting work attendance were estimated to be more effective than in the main analysis (see Figure SI14B). Without school closure, restricting in-person work to essential workers yielded an 8.8% transmissibility reduction (95%CI: 6.5–10.8%), slightly higher than in the main analysis. Conversely, the maximum combined effect of full school closure and work restrictions was weaker, resulting in a 20.3% reduction (95%CI: 9.5–27.9%), compared with 29.1% in the main analysis."

"Our findings suggest that the impact of work-from-home and distance learning measures on the reproduction number may depend on the epidemiological characteristics of the pathogen considered, such as the age-specific susceptibility to infection. In particular, interventions targeting schools tend to be more effective for pathogens with higher susceptibility among younger age groups, while measures acting on in-person work attendance have a more limited effect."

In addition, since estimates of the reproduction number are available for H1N1 and SARS-CoV-2, we included in the Supplementary Information an additional analysis showing how the transmissibility reductions shown in Figure SI14 translate into changes in the reproduction number.

Specifically, for H1N1 we considered a basic reproduction number of 1.44, as estimated for Italy [Merler et al, PLoS One, 2013]. As shown in Figure SI15A (reported below for the reviewer's convenience and now included in the SI), for a virus with these transmissibility features, closing schools from the primary level upwards would bring the effective reproduction number below the epidemic threshold of 1. When interpreting these results, it is important to note that the intervention scenarios considered here only act on the redistribution of individuals between in-person and remote attendance. They do not assume any additional restrictions on social interactions, nor the implementation of further infection-prevention measures, whether spontaneous or mandated, such as mask use in public places (e.g., public transport, supermarkets, schools, workplaces), hand hygiene, surface sanitation, isolation of cases or quarantine of contacts, and so on. During the COVID-19 pandemic, this combination of measures was estimated to reduce SARS-CoV-2 transmissibility by approximately 44% (95%CI: 36–52%) [Marziano et al, PNAS, 2021]. Considering a similar reduction also for H1N1, we estimated that the effective reproduction number would fall below the epidemic threshold even in the scenario with full in-person attendance (Figure SI15B). However, it should be noted that the 44% reduction was estimated for SARS-CoV-2. The set of infection-prevention measures that would be acceptable to apply in the case of a virus such as H1N1 would likely be more limited and would thus result in a reduction in transmissibility lower than that estimated for SARS-CoV-2. Therefore, the effective reproduction numbers shown in Figure SI15B should be interpreted as a lower bound for H1N1, as a smaller reduction in transmissibility would lead to higher values of the effective reproduction number.

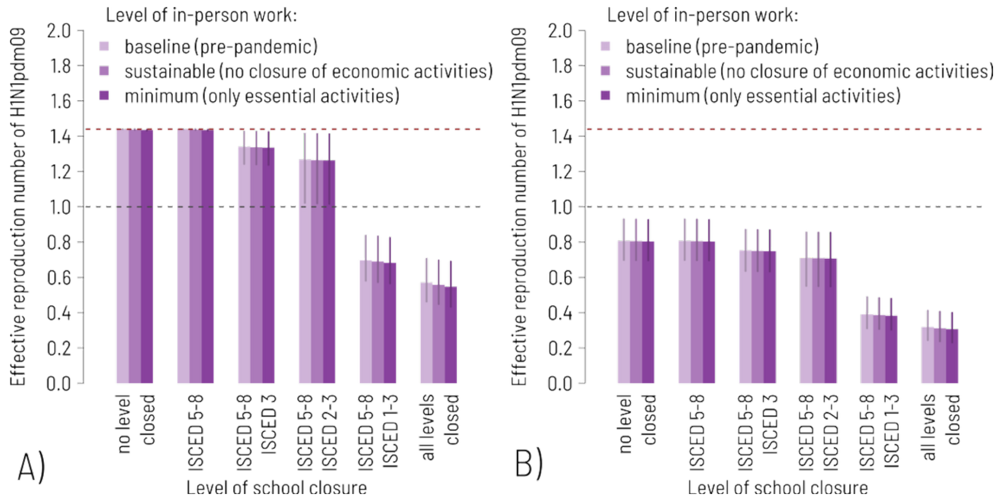


Figure SI15. A) Effective reproduction number of H1N1pdm09 associated with intervention scenarios combining different levels of school closures and in-person work. B) Effective reproduction number of H1N1pdm09 associated with intervention scenarios combining different levels of school closures and in-person work and considering an additional transmissibility reduction due to other infection-prevention measures of 44% (95%CI: 36-52%) [Marziano et al, PNAS, 2021]. In both panels, the red dotted line corresponds to the value of the basic reproduction number estimated for H1N1 in Italy [Merler et al, PloS One, 2013] and the black dotted line denotes the epidemic threshold of 1.

In the case of SARS-CoV-2, we considered a basic reproduction number of 3. As anticipated above, we assumed a 44% (95%CI: 36–52%) reduction in transmissibility associated with infection-prevention measures. In addition, we considered a 90% reduction in "other" community contacts (including leisure activities, public transport, and other social settings), as estimated for Italy during the first months of the pandemic [Marziano et al, PNAS, 2021]. Under these assumptions, model results indicate that the SARS-CoV-2 epidemic would likely not have been controlled without strong reductions in in-person work and the implementation of extensive school closures (Figure SI16).

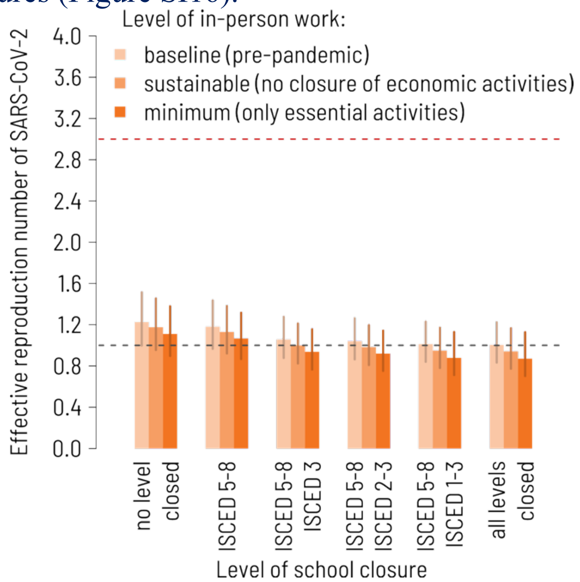


Figure SI16. Effective reproduction number of SARS-CoV-2 associated with intervention scenarios combining different levels of school closures and in-person work, considering a 44% (95%CI: 36–52%) reduction in transmissibiity due to infection-prevention measures, and an additional 90% reduction in "other" community contacts [Marziano et al, PNAS, 2021]. The red dotted line corresponds to the value of the basic reproduction number for SARS-CoV-2 [Guzzetta et al, EID, 2021] and the black dotted line denotes the epidemic threshold of 1.

R1.2 - Although the next generation matrix approach is quite established in literature and the reference model is specified, the authors may want to include a section in the supporting information where they detail the computation of the next generation matrix in the block form at the beginning of page 9.

We thank the reviewer for this suggestion. We have now added a new section to the Supplementary Information (Section 1.5) detailing the computation of the Next Generation Matrix for the main analysis which assumes homogeneous susceptibility. Moreover, we describe how the structure of the NGM changes when heterogeneous susceptibility to infection across age groups is considered.

In conclusion, this manuscript has a high level of maturity and should be considered for publication, once my suggestions have been considered/discussed.

We thank the reviewer for their positive feedback. We believe it contributed to increasing the entire manuscript robustness and clarity.

Reviewer #2 (Remarks to the Author):

This work examines patterns of post-pandemic social contact over two waves of data in March 2022 and 2023 in Italy. Data are collected online from nationally representative (by age, sex and region) participants recruited via email. Surveys include demographic information such as level of income, household size and level of education, providing an important opportunity to understand drivers of heterogeneity in contact behavior. Contact surveys enquire about both close and incidental contacts from the previous data, an extension from many pre-pandemic surveys recognising the potential for airborne transmission, and collecting age data regarding close contacts as is common for contact surveys of this type.

While many participants are represented in both waves of data collection, the analysis focuses on aggregate data. The authors fit a multi-variate generalised linear model in order to understand which attributes are associated with the number of contacts. Sensitivity analyses including regarding the assumptions of the age of indirect contacts are presented. The results are used to compute the relative transmission potential of a virus under various school closure and work from home strategies assuming contact numbers are linearly related to transmission potential.

Overall, the emerging data sets, and the analysis, are very important for building representative epidemic models in the post-covid era, and understanding the benefit of NPIs in epidemic and pandemic scenarios. My opinion is that this is an important and thorough piece of work. I have some (minor) comments that may aid the clarity of this work.

We thank the reviewer for their positive feedback and constructive comments. Below, we report a structured letter with point-by-point responses to your suggestions.

R2.1 - In the abstract, the claim "They support a nuanced approach to social distancing policies, balancing public health benefits with economic and social considerations." seems a bit vague, and though likely true, unclear how it relates to the findings -- consider making this more precise.

We thank the reviewer for this valuable suggestion. As recommended, we have revised the abstract to strengthen the connection between our findings and their implications for policy. Specifically, we replaced the previous generic statement with a more precise conclusion highlighting how our results provide quantitative evidence on the impact of targeted distancing measures, thereby supporting the design of interventions. Please note that the abstract has been modified to implement other reviewers' comments and has been restructured into sections (Background, Methods, Results, Conclusions) to meet journal formatting requirements:

> ***"Background***
>
> *The collection of updated post-COVID-19 data on social contact patterns is critical for future epidemiological assessment and evaluation of non-pharmaceutical interventions.*
>
> ***Methods***
>
> *We conducted two waves of an online survey in Italy (March 2022 and March 2023), collecting representative data on direct (verbal/physical) and indirect (indoor co-location) contacts. Using a generalised linear mixed model, we analysed social contact determinants and the impact of work-from-home and distance learning on the reduction of a pathogen's reproduction number (R). Additionally, we calibrated an age-structured SEIR model to the 2023–2024 influenza A epidemic in Italy to explore the impact of alternative scenarios of in-person school/work attendance on overall and age-specific attack rates.*

Results

In-person attendance significantly increased contacts: compared to those staying home, adults attending in person had 1.69 times (95%CI: 1.55-1.83) more contacts, while children/adolescents 2.36 (95%CI: 1.96-2.84). Limiting in-person work alone had a marginal effect on R, whereas combining work-from-home with distance learning (from primary school onwards) could reduce R by up to 23.2% (95%CI: 13.7-30.1%), with minimal additional benefit from suspending early childcare. In the influenza A case study, overall seasonal infection attack rates ranged from 14.7% (95%PI: 12.8–16.5%) under full in-person attendance to <0.2% under the most restrictive scenario. Moderate interventions (suspension of tertiary education and work-from-home) reduced attack rates by up to one fourth among adults (15-64 years) and one sixth among older individuals.

Conclusions

This study provides updated, post-pandemic contact matrices for Italy that are essential for modelling transmission of respiratory pathogens and provides quantitative evidence on the epidemiological impact of targeted physical distancing measures, thereby supporting future policy design."

R2.2 - The authors have attempted to generate representative samples across a number of factors. Potential bias in recruitment of children is noted, are there additional concerns due to the method of contact, in particular with regard to the elderly, despite them being overrepresented in your sample?

We agree with the reviewer that the adopted participant recruitment method can introduce age-specific biases in representativeness, yielding lower participation from the youngest and the elderly. When comparing our data with nationally representative age distributions, we observed an acceptable degree of underrepresentation among younger respondents, with an average population-to-sample weight of 1.47 for the 0-29 group. By contrast, the underrepresentation was much stronger among the 80+ respondents, with a population-to-sample weight of 4.98 (see Figure below).

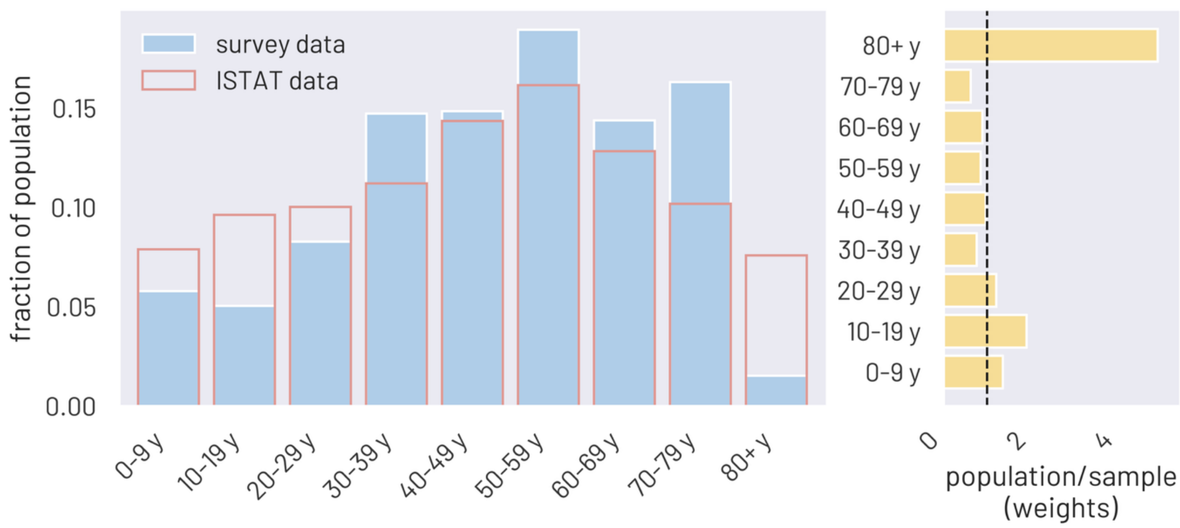


Figure: On the left, we report the fraction of population within each age-group, similar to Figure SI2 but explicitly showing a separate bar for the 80+ age-group. Filled bars show the fraction of responses collected in the survey, while the empty, red-edged bars report the fraction of the population within the different age groups as reported by the Italian statistical office. On the right, we report the population to sample ratios (response weights) showing the 80+ age-group as the most underrepresented one.

The difficulty in reaching participants in the 80+ age group was already known to the survey company, which, during the data collection design phase, informed us that it could ensure representativeness of the sample by 10-year age groups up to a single "70+" category. This is the reason why we did not consider a separate 80+ group.

We now highlight these aspects more clearly, specifying the representativeness groups adopted in the Materials and Methods section and including a new panel to Figure SI2 showing that the population-to-sample size ratio for the designed age groups is always maintained below 2. In addition, we explicitly acknowledge the underrepresentation of the 80+ population group in the Discussion among the study limitations.

The revised Figure SI2 is reported below for the reviewer's convenience along with the new paragraphs added to the main text.

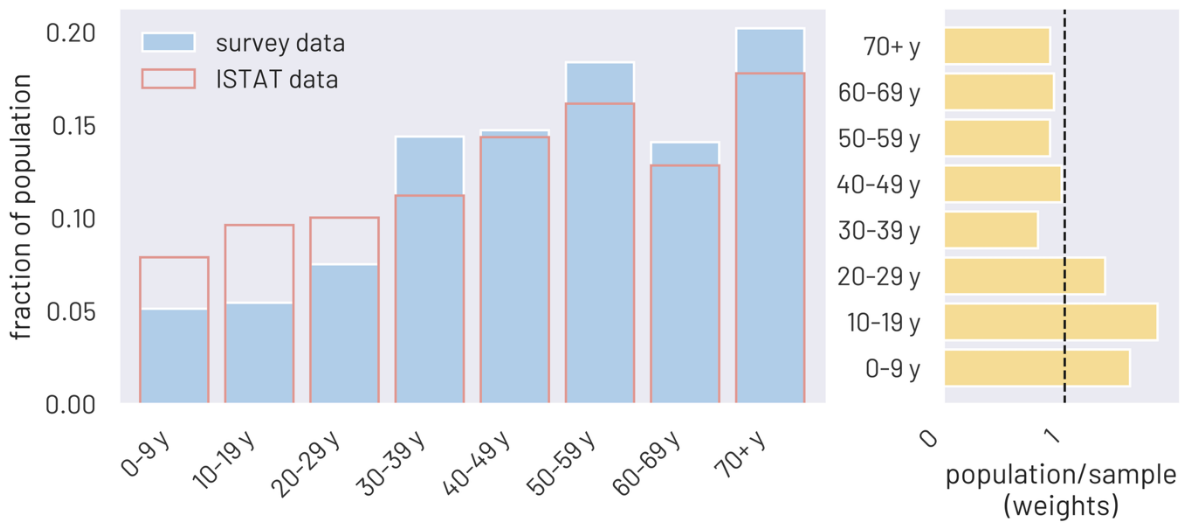


Figure SI2: *Survey respondents by age against the Italian population.* Left: Light blue bars report the distribution of respondents by age group. Darker blue bars show the distribution by age of the respondents' reported contacts. The overlayed red bars report the fraction of the population by age group reported for 2022 by the Statistical Office of the European Union. Right: population-to-sample weights obtained as the ratio between red and light blue bars in the right panel.

Materials and Methods:

> *"This work is based on a new sample of data collected online in two waves at the end of March 2022 and 2023, from a nationally representative panel of the Italian population in terms of age, (based on 10-year age groups up to a single 70+ group), sex, and area of residence (based on NUTS1 geographic level). Representativeness was maintained within a population-to-sample ratio below 2 for all targeted demographic groups (see Figures SI2 and SI3)."*

Discussion:

> *"For a more comprehensive assessment of age-specific reductions in transmissibility, it would have been valuable to explicitly disaggregate the 80+ age group, as this population is often the most vulnerable to severe disease outcomes. In our dataset, however, the number of respondents for this population strata was insufficient (fewer than 50 survey responses) for robust separate estimates."*

R2.3 - Perhaps this is another paper, but it would be very interesting to see how/if individuals are changing their behavior over the waves, and if this varies with social and demographic factors?

We thank the reviewer for their comment. While including a longitudinal sample, the data collection was not specifically designed for an individual-level fully paired analysis, as it falls short in some key respects. In particular, we did not require specific individual variables to remain constant, e.g., survey completion on the same day of the week (being the same for only

17% of respondents) and household composition (which changed for almost 10% of respondents). In our opinion, focusing on a full paired analysis would require a very careful consideration of all these individual-level variations across waves making it beyond the scope of the present work.
Nevertheless, we believe that the statistical analysis performed in this study goes in a similar direction, as it accounts for the main sociodemographic dimensions potentially associated with respondents' number of contacts and includes a random intercept to account for within-individual correlations. In this respect, we have expanded the discussion of the results of our statistical analysis to better highlight that, albeit limited, we detect a significant association of the number of contacts with the survey wave, which is not explained by the other variables included in the model, as follows:

> *"When comparing responses across waves, we find a small but significant increase in the number of reported contacts, with the second wave showing 1.12 (95%CI: 1.06-1.17) times more contacts than the first wave (see also Table SI7-10 for a more detailed breakdown of the number of contacts by wave)."*

In addition, we have added a new Table SI10 (reported below), analogous to Table 1 in the main text, presenting the number of contacts further stratified by respondent type (i.e., panel vs. longitudinal participants).

Table SI10: *Survey average contacts by wave and respondent type*. The table reports the average number of total social contacts (95% Confidence Intervals are reported in parenthesis) stratified by different respondent characteristics: age, sex, household income, household size, NUTS1 region, and COVID-19 vaccination status.

Variables	Panel respondents		Longitudinal respondents	
	March 2022 wave	**March 2023 wave**	**March 2022 wave**	**March 2023 wave**
Age Group				
0-9 y	10.2 (8.6 - 11.9)	12.5 (9.8 - 15.4)	13.6 (10.3 - 17.2)	12.8 (9.7 - 16.1)
10-19 y	13.6 (11.4 - 16)	16.7 (13.2 - 20.5)	10 (7.9 - 12.3)	12.8 (9.1 - 16.9)
20-29 y	11.3 (8.8 - 14.1)	11.1 (8.6 - 14.2)	8.7 (6 - 12.5)	10.2 (7.2 - 13.9)
30-39 y	7.9 (6.5 - 9.7)	9.1 (7.6 - 10.7)	8.1 (6.5 - 10)	8.5 (6.7 - 10.6)
40-49 y	5.7 (4.6 - 7.1)	6.1 (5 - 7.4)	6.4 (5.1 - 8.3)	7.2 (5.9 - 8.8)
50-59 y	7.1 (5.6 - 8.8)	7.8 (6.4 - 9.3)	5.7 (4.7 - 6.8)	6.9 (5.8 - 8.2)
60-69 y	6.5 (4.7 - 8.6)	6.8 (5 - 9.1)	6.5 (5.2 - 8)	5.9 (4.9 - 7.2)
70+ y	5.3 (4 - 6.8)	5.5 (4.6 - 6.6)	4.5 (3.9 - 5.3)	5.9 (4.8 - 7.1)
Sex				
Male	7.9 (7.1 - 8.8)	8.8 (7.8 - 9.9)	7.1 (6.3 - 8)	7.7 (6.9 - 8.6)
Female	8.3 (7.4 - 9.3)	7.7 (7 - 8.5)	5.9 (5.3 - 6.6)	6.9 (6.1 - 7.7)
Net household income (euros per month)				
<1,500 euro	7.3 (5.8 - 8.9)	6.4 (5.3 - 7.6)	4.6 (4 - 5.2)	6.3 (5.1 - 7.6)
1,500-2,999 euro	7.8 (6.9 - 8.7)	8 (7.2 - 8.9)	7.2 (6.2 - 8.2)	7.2 (6.5 - 8.1)
>3,000 euro	9.9 (8.5 - 11.4)	11.4 (9.6 - 13.4)	8 (6.8 - 9.4)	9 (7.6 - 10.5)
Undisclosed	8 (6.6 - 9.6)	6.8 (5.6 - 8.1)	5.9 (4.9 - 7.1)	6.7 (5.3 - 8.4)
Household size				
1	5.3 (4.2 - 6.6)	4.7 (3.8 - 5.7)	5.2 (4.2 - 6.2)	7 (5.4 - 9)
2	6 (4.9 - 7.2)	6.8 (5.7 - 8.1)	5.5 (4.7 - 6.5)	6.1 (5.2 - 7.1)
3	9.2 (8 - 10.6)	9.1 (7.9 - 10.5)	6.9 (5.9 - 8.2)	7.7 (6.7 - 8.9)
4	9.6 (8.3 - 10.9)	10.4 (9 - 11.8)	8.6 (7.3 - 10)	8.7 (7.5 - 10)
5+	11.8 (9.1 - 15)	11.8 (9.2 - 14.8)	8.2 (6.6 - 9.8)	9.8 (7.8 - 12)
NUTS1 region				

North-West	9.6 (8.2 - 11.2)	7.9 (6.7 - 9.2)	7 (5.9 - 8.2)	7.3 (6.2 - 8.6)
North-East	8 (6.8 - 9.3)	8.1 (6.8 - 9.7)	7.1 (5.9 - 8.6)	7.9 (6.7 - 9.2)
Center	6.5 (5.6 - 7.5)	8.8 (7.5 - 10.3)	6.5 (5.6 - 7.4)	7.8 (6.5 - 9.2)
South	8.1 (6.7 - 9.7)	8.1 (7 - 9.4)	5.8 (4.9 - 7)	7.1 (5.9 - 8.5)
Islands	7.8 (5.9 - 10)	8.3 (6.1 - 11)	5.7 (4.3 - 7.5)	5.8 (4.6 - 7.2)
COVID-19 vaccination status				
No doses	8 (6.2 - 10.1)	7.6 (5.9 - 9.6)	5.4 (4.2 - 6.8)	5.1 (4 - 6.3)
One dose	7.1 (4.1 - 10.1)	8.9 (4.5 - 14.1)	7.5 (2.8 - 14.5)	6.9 (3.9 - 10.1)
Two doses	9.5 (8 - 11.2)	9.2 (7.4 - 11.3)	7.5 (5.3 - 10.3)	7.8 (6.2 - 9.6)
Three doses or more	7.8 (7 - 8.6)	7.9 (7.2 - 8.6)	6.4 (5.9 - 7)	7.3 (6.7 - 8)
Exempt	9.3 (7.3 - 11.8)	12.7 (8.5 - 17.9)	9.3 (6.2 - 12.7)	13.6 (9.6 - 17.9)

R2.4 - Sometimes there are slips where the authors use "transmission" rather than "transmission potential" when discussing the role of contacts of viral spread. Of course, contacts may not map linearly to transmissibility; there may be age and environmental impacts that modify how contacts relate to transmission. This could potentially be addressed by emphasising assumptions about transmissibility in lines 310-328 of the supplementary material.

We apologize for this oversight. We have corrected the terminology throughout the manuscript to consistently refer to transmissibility rather than transmission where appropriate. Please note that, in response to another reviewer's comment, we have removed all references to 'transmission potential' and now refer to the reproduction number R as a measure of the pathogen's transmissibility.
In addition, we have expanded the Supplementary Information to provide further details on the computation of the Next-Generation Matrix (NGM), as also requested by Reviewer #1 (section SI1.5). In this section, we explicitly describe the model equations underlying the NGM computation, including the assumption that the rate at which new infections appear is obtained by multiplying the contact matrices by a scaling factor (β) shaping how contacts relate to transmission of the pathogen. Moreover, we describe how the structure of the NGM, and consequently the relationship between contacts and transmissibility, changes when assuming heterogeneous susceptibility to infection across age groups.

R2.5 - It seems that the only mention of contact duration in the online survey is when defining indirect contact. Is this correct, and should the limited data on contact duration when defining the transmission potential be considered?

We thank the reviewer for pointing out this unclear passage. We did not collect any information on duration for the direct contacts. Previous studies, which collected this information for direct contacts did not use them to define contact matrices, probably because even if contact duration may have a role in the likelihood of transmission, it is not trivial to quantify their relationship. On the other hand, we set a minimum duration of 30 minutes for indirect contacts. These contacts were defined following the idea that transmission-relevant contacts not involving face-to-face interaction but sharing a closed environment for a minimum amount of time.
We now added a sentence to the main text spelling explicitly that no information on contact duration was requested for direct contacts:

> *"Participants were asked to provide details on each of their direct contacts, such as their age, sex, or the setting in which the interaction occurred. No information about the duration of these contacts was requested.*
> *[…]*

An indirect contact was defined as a person with whom the respondent was co-located in a closed environment for at least 30 minutes (e.g., classmates at school or colleagues at work). This definition was specifically designed to make respondents report only transmission-relevant contacts."

R2.6 - From my reading of the scenarios analysis with workplace and school closure, it seems that the behaviour of adults and children are considered to be independent? In reality for adults who are care providers this is not the case (e.g. if young children are at home, at least one adult needs to provide care) and so if this limitation exists I think it is worth highlighting when discussing these NPIs.

We thank the reviewer for this insightful comment. As correctly highlighted, our scenario analysis assumes that the levels of in-person school and workplace attendance can vary independently. This represents a simplification of real-world social dynamics, as younger children typically require adult supervision. We have now made this assumption explicit in the Methods:

"We considered different scenarios combining various levels of in-person work and school attendance, assuming that these two dimensions could vary independently, and we quantified the relative change in reproduction numbers compared to a baseline scenario with full in-person attendance."

and further discussed it as a limitation in the Discussion section, as follows:

"Moreover, the scenario analysis considered in this study simplifies the complex interdependencies between social settings. In particular, the assumption that schools and workplace in-person attendance can vary independently represents a limitation. In reality, closures of early education levels (e.g., kindergartens or primary schools) would likely entail a concurrent reduction in workplace attendance, as parents or other caregivers need to provide childcare. As a consequence, the reduction in transmissibility estimated under scenarios assuming the closure of all school levels likely represents a lower bound of the effect achievable in real-world conditions."

R2.7 - The comparison to POLYMOD work is very interesting and appears to suggest substantial changes from pre-pandemic behaviour even in 2022. I understand there are methodological differences between surveys (e.g. paper versus online) but I think this is also an important finding that could be further highlighted (e.g. in the main text).

Following the reviewer's suggestion, we have included a direct comparison of our results with those obtained in the POLYMOD study in the "Results" section of the main text:

"Overall, this study shows a higher number of reported contacts with respect to the CoMix study [Gimma et al, 2021], which estimated for Italy an average number of contacts of 3.6 (95%CI: 3.3-3.9) during February-April 2021. However, it also reveals a substantially lower number of reported contacts with respect to POLYMOD data [Mossong et al, PLOS Medicine, 2008], which estimated for Italy an average number of contacts of 19.8 (95%CI: 19.0-20.6). In this case, data were collected through paper surveys during April 2006 (see Table SI4 for a more detailed comparison)."

Additionally, in the "Discussion" section, we have included some considerations about the possible reasons underlying the lower number of reported contacts with respect to the POLYMOD data collection:

"We also note that, compared to the pre-pandemic POLYMOD collection (run in April 2006) [Mossong et al, PLOS Medicine, 2008], respondents reported fewer social contacts. However, it is not trivial to understand whether this difference reveals a change in social behaviour (number of interactions, contact

characteristics such as the amount of face-to-face communication), or methodology-induced differences (e.g., online vs paper data collections [Leung et al., Scientific Reports, 2017]; see also Table SI3 for a detailed methodological comparison between surveys)."

A comparison across the three main contact data collection methods in Italy has also been added in Table SI3 (reported below). Please note that in the table below, we refer to our survey as "MixIT", while we refer to "POLYMOD" and "CoMix" as the contact studies conducted by Mossong et al., 2008, and Coletti et al., 2020, respectively.

Table SI3: *Methodological aspects of the three main data collection run in Italy:* POLYMOD, CoMix, and MixIT (this study).

	POLYMOD	**CoMix**	**MixIT**
Recruitment method	Random digit dialling on fixed telephone lines	Combination of social media, web advertising, email campaigns	Representative survey company panel
Survey field work conducted by	CRA Research, www.cra-research.com	Ipsos Mori, www.ipsos.com/it-it	YouGov, it.yougov.com
Financial Incentives	None	Yes	Yes
Sampling method	Quota by age, sex, geographical region, rural/urban and day of the week	Quota by age, gender, geographic region, socioeconomic status	Quota by age, gender, geographical region, and weekday/weekend
Diaries delivered and collected by...	Paper/Mail	Online platform	Online platform
Time period of the survey and number of waves	May 2006	December 2020 – April 2021; 7 adult waves + 2 children waves, approximately every two weeks	2 waves: March 2022; March-April 2023
Respondent types – age groups	0-8 parental proxy reporting, 9-17 self-reporting children and teenagers, 18+ self reporting adults	0-17 parental proxy reporting, 18+ self-reporting adults	0-13 parental proxy reporting, 14-17 self-reporting with parental support, 18+ self-reporting adults
Maximum number of contact entries	45	100	150
Asked about duration of contacts	Yes	Yes	No
Definition of contact	*Direct contact*: a skin-to-skin contact (a physical contact), or a two-way conversation with three or more words in the physical presence of another person but no skin-to-skin contact (a nonphysical contact)	*Direct contact* but with the exchange of "at least a few words"	*Direct contact* but with the exchange of "at least 5 words"
Additional aggregate contact information	Yes: by physical/non physical distinction	Yes: by age group and setting	Yes: indoor prolonged contacts (>30 minutes)

R2.8 - I understand that the baseline scenario assumes pre-pandemic rate of home working but after looking at the supplementary material I'm still not 100% certain that the authors use their contract matrices rather than the POLYMOD data for the baseline scenario, consider clarifying this.

We apologize for the lack of clarity on this important point and confirm that our baseline scenario was defined using our survey data. The point was clarified in the main text as follows:

"Leveraging our survey data, we constructed contact matrices disaggregated by respondent attendance to work/school: in-person or remote/no-attendance. These matrices were used to assess the impact of work-from-home and distance learning in reducing the reproduction number (R) of a generic respiratory virus.

Reviewer #3 (Remarks to the Author):

Review of the manuscript 'Post-pandemic social contacts in Italy: implications for distancing 1 measures on in-person school and work attendance' by Lorenzo Lucchini and colleagues, submitted to Communications in Medicine.
Summary: In this manuscript, the authors provide results on an online social contacts study performed in Italty in early 2022 and early 2023 to help gauge the impact of non-pharmaceutical interventions. The authors stratify data by direct contacts (verbal/physical contact) and indirect contacts (presence in same indoor environment). The authors show that presence at work and at school increased the number of contacts considerably. Based on the inferred contact matrices. the authors provide some simulations of non-pharmaceutical interventions, and conclude that combining working from home combined distance learning (by schoolchildren) could reduce transmissibility by more than 20%.

Evaluation: The manuscript contains interesting information on contact patterns in Italy during various stages of the SARs-CoV-2 pandemic. Further, as far as I can judge the data and analyses are sound. I believe that the intervention scenarios could have been developed further and presented better. Data and code should be made available.

We thank the reviewer for their positive feedback and constructive comments. Below, we report a structured letter with point-by-point responses to your suggestions.

Major comments:
R3.1 - Data and code availability. The paper will have a much longer shelf-life if the underlying material is openly shared. Could you please deposit the raw, de-identified contact diaries, the processed age-specific contact matrices (e,.g., plain CSV), the full analysis and plotting code, and a public repository (zenodo and else github will probably suffice).

We agree with the reviewer that sharing data and code is essential. We have made the data used to construct the contact matrices and the code for the entire analysis publicly available. The code is now shared in a public GitHub repository (https://github.com/LLucchini/MixIT-social-contact-data-Italy), while the data are now accessible, under the name "MixIT: Post-pandemic social contacts in Italy" as part of the 'Social contact data' collection on Zenodo (https://zenodo.org/records/17579537). Both resources are now referenced in the main manuscript (see section "Data and Code availability").

> *"**Data availability***
>
> *Social contact data collected in this study have been prepared in a format suitable for public release and are available on the Social Contact Data website (https://www.socialcontactdata.org) and in a dedicated repository on Zenodo (https://zenodo.org/records/17579537).*
>
> *The code used to perform the statistical and modelling analyses, as well as to generate all figures presented in the main text and Supplementary Information, is available in a public GitHub repository (https://github.com/LLucchini/MixIT-social-contact-data-Italy)."*

R3.2 - Scenario analyses and Figure 3. The intervention analysis section feels a bit underdeveloped and untethered from reality, as you do not calibrate or fit the baseline model to the observed epidemic curve. I certainly would applaud such an undertaking and believe it could substantially strengthen the ms, ie fit first, extrapolate second. Even a quick back-of-the-envelope calibration to the January-March 2022 COVID notification curve for Italy (or, better, a sero-attack-rate) would anchor the R0 that drives your simulations. Additionally, could you show more relevant quantities ie replace or complement panel C with infection attack rates under each scenario. Additionally, as age is such an important determinant of severity I strongly suggest to disaggregate the infection attack rates by age.

We thank the reviewer for this insightful comment. As correctly noted, the reductions in transmissibility shown in Figure 3 were derived from the computation of the Next Generation Matrix at a specific time point (i.e., the start of the epidemic), rather than from a dynamic simulation model. This approach allowed us to derive impact measures that are generalizable to different pathogens across different epidemiological conditions, in a preparedness perspective.

To address the reviewer's suggestion and illustrate the potential impact under realistic epidemiological conditions, we have now added a modeling application based on a representative case study on seasonal influenza A. We preferred to focus on influenza A rather than SARS-CoV-2, primarily because of the limits in reliably initializing the immunity profile of the Italian population between 2022 and 2023. In that period, population immunity was likely high due to prior infections and multiple vaccine doses, but precise quantification is difficult also due to the lack of seroprevalence data for this period. In addition, the rise of the Omicron variant in early 2022 and of its subvariants in the following months likely induced changes in testing policies and individual testing behavior, leading to substantial temporal variations in reporting ratios and making calibration of a model based on notified cases highly challenging.

In addition to this modelling analysis, and in the spirit of making our work more closely aligned with real-world conditions, we complemented the main analysis based on NGM computation (Figure 3C), by adding two sensitivity analyses that incorporate more realistic assumptions on age-specific susceptibility to infection. Specifically, we assessed how heterogeneities in age-specific susceptibility, as estimated for the 2009 influenza A(H1N1) pandemic virus and for SARS-CoV-2 ancestral lineages, may affect the reductions in transmissibility associated with the different in-person attendance scenarios.

Regarding the new modelling application, we simulated the 2023–2024 seasonal influenza epidemic in Italy, focusing on influenza type A, the dominant circulating type during that season, using a deterministic age-structured SEIR model. In this model, the Italian population was stratified into two subgroups based on attendance status ("in-person" and "not-in-person"), with mixing patterns informed by the contact matrices estimated in this study.

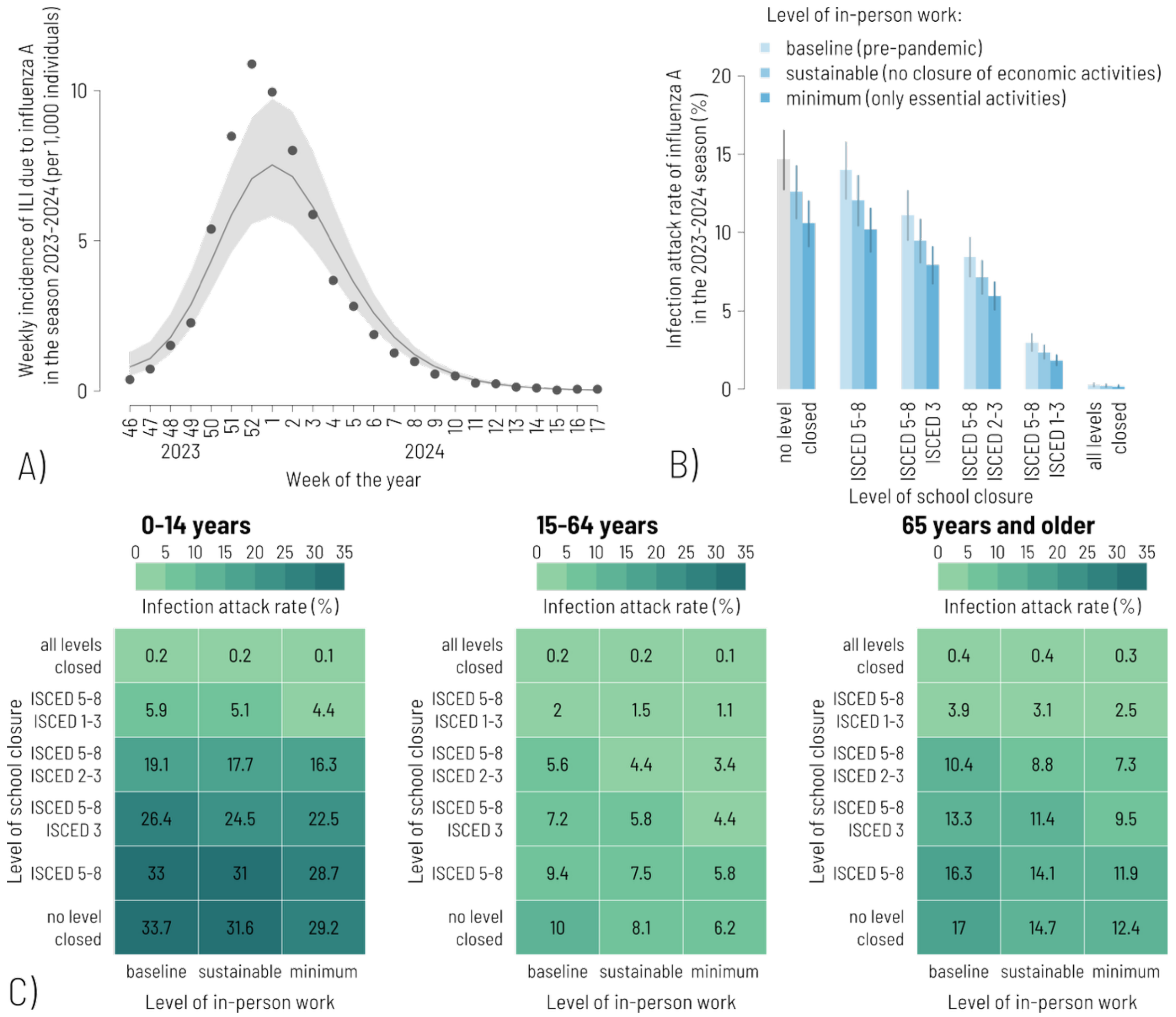
The considered SEIR model incorporated epidemiological parameters specific to influenza A, i.e. latent and infectious periods, as well as age-specific susceptibility to infection estimated in the literature [Trentini et al, BMC Public Health, 2022].

Model calibration was performed against the weekly incidence of influenza A during the 2023–2024 season (from week 46 of 2023 to week 17 of 2024) using a Metropolis–Hastings MCMC algorithm with a negative binomial likelihood to account for overdispersion in the data. Calibration was conducted under the assumption of full in-person attendance, since no interventions were in place in the considered period. The model has four free parameters: the scaling factor for transmissibility, the reporting ratio, the number of infectious individuals at the start of the simulations, and the overdispersion parameter of the negative binomial distribution which we use to compute the likelihood of observing the weekly incidence given the simulated one likelihood. Posterior distributions of the estimated parameters (Figure SI4) were then used to simulate alternative attendance scenarios.

Model outcomes under different scenarios were compared in terms of both overall and age-specific infection attack rates. In the revised version of the manuscript, we have dedicated a new Figure in the main text (Figure 4, shown below) to this analysis, presenting the model fit together with the overall and age-specific infection attack rates across scenarios. Further details on model formulation and calibration have been added to the Methods section and the Supplementary Information.

Finally, we have expanded the Results section to comment on the findings from this case-specific analysis as follows:

> *"We calibrated an age-structured SEIR model to the 2023–2024 epidemic of seasonal influenza A in Italy and used it to project the impact of alternative school and workplace attendance scenarios on infection attack rates at the end of the season (Figure 4). The model was calibrated to weekly influenza A incidence, assuming full-in person work and school attendance (Figure 4A). Overall infection attack rates varied substantially across the scenarios considered, ranging from 14.7% (95% Prediction Intervals, PI: 12.8-16.5%) under full in-person attendance to less than 0.2% when all education levels were suspended and in-person work was restricted to its minimum level (Figure 4B).*
>
> *In the scenario of full in-person attendance, we estimated infection attack rates of 33.7% (95%PI: 30.2–36.9%) among individuals aged 0–14 years, 10.0% (95%PI: 8.6–11.4%) among those aged 15–64 years, and 17.0% (95%PI: 14.6–19.2%) among adults aged 65 years and older.*
>
> *Considering moderate intervention scenarios, suspending in-person tertiary education alone had a limited effect on infection attack rates across all age groups compared with the full in-person attendance scenario. Specifically, infection attack rates were estimated to decrease to 33.0% (95%PI: 29.5-36.2%) in 0-14 years, to 9.4% (95%PI: 8.0-10.6%) among those aged 15-64 years, and to 16.3% (95%PI: 14.0-18.4%) in those aged 65 years and older (Figure 4C). Combining the suspension of in-person tertiary education with a "sustainable work" limitation led to stronger reductions, particularly in the 15-64-year age group, which includes the majority of workers, where infection attack rates decreased to 7.5% (95%PI: 6.4-8.6%).*
>
> *When exploring more stringent scenarios, infection attack rates decreased to 12.4% (95%PI: 10.5-14.1%) in the ≥65-year age group when in-person work was kept at its minimum without school closures, and to 11.9% (95%PI: 10.2-13.6%) when in-person tertiary education was also suspended. Comparable reductions among school-aged children (0–14 years) could instead be achieved only by suspending in-person attendance from upper secondary education upward, combined with at least a "sustainable" reduction in workplace attendance. Finally, combined interventions involving school closures from the primary level upward resulted in infection attack rates reduced by two thirds in all age groups compared to the full-attendance scenario, regardless of the level of in-person work considered (Figure 4C)."*



0-14 years	baseline	sustainable	minimum
all levels closed	0.2	0.2	0.1
ISCED 5-8 ISCED 1-3	5.9	5.1	4.4
ISCED 5-8 ISCED 2-3	19.1	17.7	16.3
ISCED 5-8 ISCED 3	26.4	24.5	22.5
ISCED 5-8	33	31	28.7
no level closed	33.7	31.6	29.2

15-64 years	baseline	sustainable	minimum
all levels closed	0.2	0.2	0.1
ISCED 5-8 ISCED 1-3	2	1.5	1.1
ISCED 5-8 ISCED 2-3	5.6	4.4	3.4
ISCED 5-8 ISCED 3	7.2	5.8	4.4
ISCED 5-8	9.4	7.5	5.8
no level closed	10	8.1	6.2

65 years and older	baseline	sustainable	minimum
all levels closed	0.4	0.4	0.3
ISCED 5-8 ISCED 1-3	3.9	3.1	2.5
ISCED 5-8 ISCED 2-3	10.4	8.8	7.3
ISCED 5-8 ISCED 3	13.3	11.4	9.5
ISCED 5-8	16.3	14.1	11.9
no level closed	17	14.7	12.4

Figure 4. *Impact of school and workplace attendance scenarios on influenza A transmission in Italy, 2023–2024.* A) Weekly incidence of influenza-like illness (ILI) attributable to influenza A during the 2023–2024 season (per 1,000 individuals), as reported by the InfluCast web platform [https://influcast.org/] (dark grey points), and mean weekly incidence estimated by the model (solid line). Shaded areas represent 95% prediction intervals (PIs) of model estimates. B) Overall infection attack rate (%) of influenza A in the 2023–2024 season under alternative intervention scenarios combining different levels of school closures (including distance-learning mandates) and in-person work. The grey bar corresponds to the baseline full in-person attendance scenario (used for model calibration), in which the proportion of in-person workers is set to pre-pandemic levels and students at all education levels attend in person. C) Mean age-specific infection attack rates under intervention scenarios combining different levels of school closures and in-person work. Age groups are defined as 0–14 years, 15–64 years, and ≥65 years.

In addition to the above analysis, we have performed two sensitivity analyses on the impact of interventions on transmissibility, by considering two age-specific susceptibility profiles, as estimated for the influenza A(H1N1) 2009 pandemic virus and for SARS-CoV-2 ancestral lineages. Using H1N1 estimates, showing higher susceptibility in children compared to adults and the elderly [Merler et al., PLoS One, 2013], we found that interventions targeting only in-person work were much less effective, whereas measures affecting school attendance had a substantially stronger impact compared with to results from the main analysis (Figure SI14A, reported below). Specifically, in the absence of school closures, limiting in-person work to essential workers reduced transmissibility by less than 1% (vs. 5.5% in the main analysis). In contrast, combining full school closure with in-person attendance restricted to essential workers work yielded an average reduction of 62.0% (95%CI: 52.1–69.8%), nearly twice the effect estimated under the homogeneous susceptibility assumption (about 30%). Conversely, when adopting SARS-CoV-2 susceptibility estimates, where the elderly are more susceptible compared to adults and children (Hu et al, Nature Communications, 2021), interventions targeting workers produced more pronounced effect compared with the main analysis (Figure SI14B, reported below). Without school closures, limiting in-person work to essential workers reduced transmissibility by 8.8% (95%CI: 6.5–10.8%), higher than the 5.5% estimated in the main analysis. However, combining full school closure with the minimum level of in-person work resulted in a transmissibility reduction of 20.3% (95%CI: 9.5–27.9%), smaller than the 29.1% obtained under homogeneous susceptibility. Methods and results from these new sensitivity analyses are now presented in Section 2.5 of the revised Supplementary Information.

To describe these findings, we have also added the following paragraphs to the Results and the Discussion sections, respectively:

> *"To assess the robustness of our results to alternative assumptions on age-specific susceptibility, we conducted two sensitivity analyses using susceptibility estimates from the 2009 H1N1 pandemic virus and from SARS-CoV-2 ancestral lineages [Merler et al, PLoS One 2013, Hu et al, Nature Communications 2021]. Under the H1N1 estimates, where susceptibility is higher in children compared to adults and the elderly, interventions targeting work attendance alone were markedly less effective in reducing the transmissibility than in the main analysis, which assumed homogeneous susceptibility across ages (see Figure SI14A). We estimated that limiting in-person work to essential workers reduced the reproduction number by 0.33% (95%CI: 0.16–0.56%), compared with 5.5% (95%CI: 3.0–7.8%) in the main analysis. In contrast, combining full school closure with the maximum level of work restrictions resulted in an average reduction of 62.0% (95%CI: 52.1–69.8%), nearly twice the effect obtained in the main analysis (29.1%). By contrast, when adopting the SARS-CoV-2 estimates, where susceptibility is higher in the elderly compared to adults and children, interventions targeting work attendance were estimated to be more effective than in the main analysis (see Figure SI14B). Without school closure, restricting in-person work to essential workers yielded an 8.8% transmissibility reduction (95%CI: 6.5–10.8%), slightly higher than in the main analysis. Conversely, the maximum combined effect of full school closure and work restrictions was weaker, resulting in a 20.3% reduction (95%CI: 9.5–27.9%), compared with 29.1% in the main analysis."*

> *"Our findings suggest that the impact of work-from-home and distance learning measures on the reproduction number may depend on the epidemiological characteristics of the pathogen considered, such as the age-specific susceptibility to infection. In particular, interventions targeting schools tend to be more effective for pathogens with higher susceptibility among younger age groups, while measures acting on in-person work attendance have a more limited effect."*

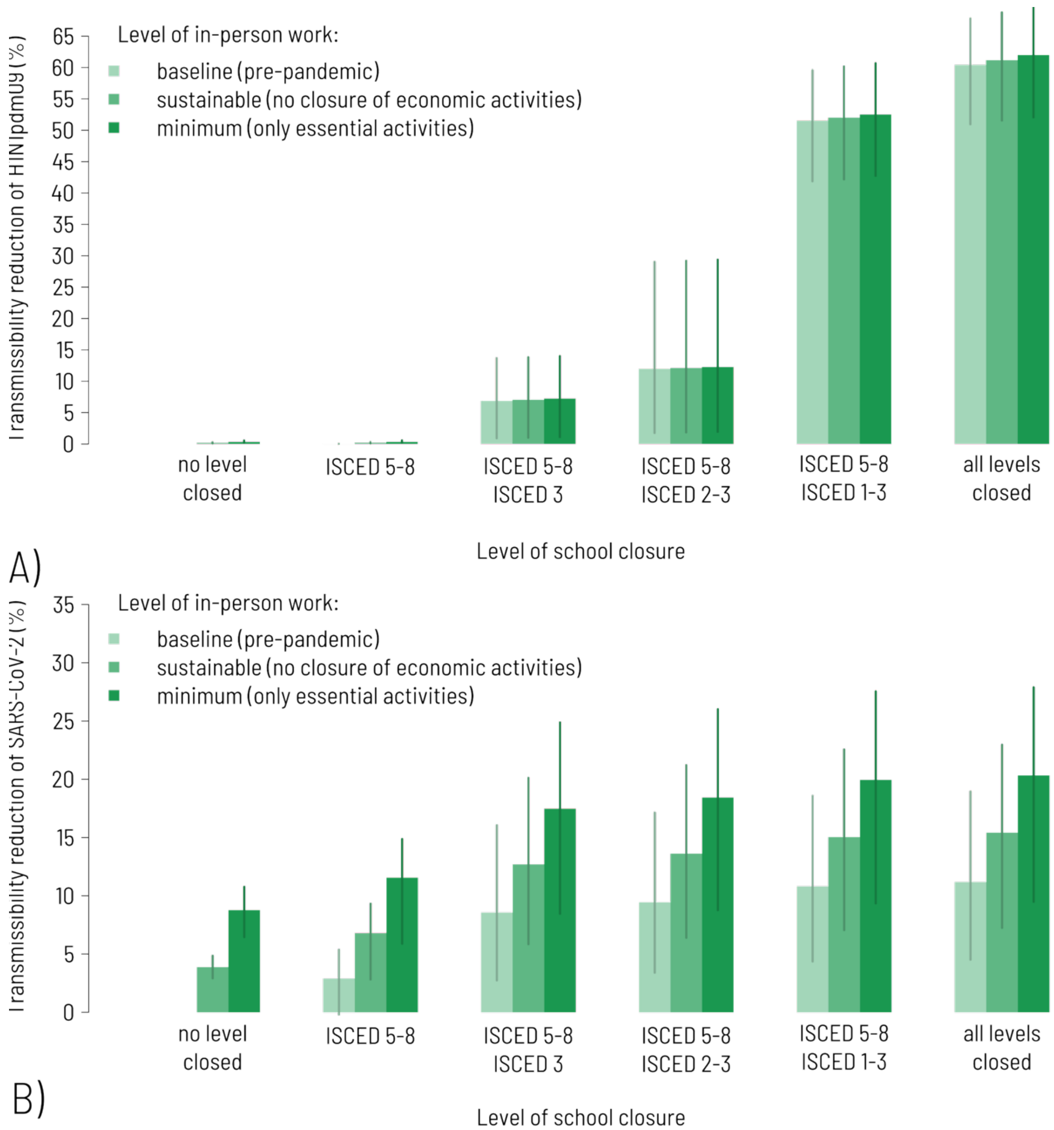


Figure SI14. *Transmissibility reduction under different scenarios of work/school attendance considering age-specific susceptibility* A) Transmissibility reduction of H1N1pdm09 associated with intervention scenarios combining different levels of school closures (including distance-learning mandates) and in-person work, compared to a baseline scenario where the in-person workers are set at pre-pandemic levels and students across all education levels attend in person. B) As A) but for SARS-CoV-2

Specific comments

R3.3 - Abstract. Spell out "transmissibility": we quantify the percentage reduction in the basic reproduction number R0. Even better, also report the resulting overall infection attack rate for the most extreme scenario so readers get a more direct impact figure.

We thank the reviewer for the suggestion. We have replaced "transmissibility" with "reproduction number (R)" in the Abstract. Since the reported reductions refer to interventions that limit the number of contacts, we preferred to use the more general term reproduction number, avoiding the specific notation R_0. In addition, these reductions can also apply to situations in which the reproduction number in the absence of interventions already deviates from the ideal conditions assumed in the definition of R_0.

We also included in the Abstract a summary on results on overall and age-specific infection attack rates from the new modeling analysis on seasonal influenza A. Please note that the abstract has also been slightly revised to incorporate other reviewers' comments and has been restructured into sections (Background, Methods, Results, Conclusions) in accordance with the journal's formatting requirements. The new version is reported below:

> ***"Background***
>
> *The collection of updated post-COVID-19 data on social contact patterns is critical for future epidemiological assessment and evaluation of non-pharmaceutical interventions.*
>
> ***Methods***
>
> *We conducted two waves of an online survey in Italy (March 2022 and March 2023), collecting representative data on direct (verbal/physical) and indirect (indoor co-location) contacts. Using a generalised linear mixed model, we analysed social contact determinants and the impact of work-from-home and distance learning on the reduction of a pathogen's reproduction number (R). Additionally, we calibrated an age-structured SEIR model to the 2023–2024 influenza A epidemic in Italy to explore the impact of alternative scenarios of in-person school/work attendance on overall and age-specific attack rates.*
>
> ***Results***
>
> *In-person attendance significantly increased contacts: compared to those staying home, adults attending in person had 1.69 times (95%CI: 1.55-1.83) more contacts, while children/adolescents 2.36 (95%CI: 1.96-2.84). Limiting in-person work alone had a marginal effect on R, whereas combining work-from-home with distance learning (from primary school onwards) could reduce R by up to 23.2% (95%CI: 13.7-30.1%), with minimal additional benefit from suspending early childcare. In the influenza A case study, overall seasonal infection attack rates ranged from 14.7% (95%PI: 12.8–16.5%) under full in-person attendance to <0.2% under the most restrictive scenario. Moderate interventions (suspension of tertiary education and work-from-home) reduced attack rates by up to one fourth among adults (15-64 years) and one sixth among older individuals.*
>
> ***Conclusions***
>
> *This study provides updated, post-pandemic contact matrices for Italy that are essential for modelling transmission of respiratory pathogens and provides quantitative evidence on the epidemiological impact of targeted physical distancing measures, thereby supporting future policy design."*

R3.4 - Data stratification. Could you split the 70–79 y and = 80 y groups? Italy's demographic pyramid is heavily skewed towards the elderly and they bear the brunt of severe outcomes.

We thank the reviewer for pointing this out. In line with our agreement with the survey company, population representativeness was ensured only for those age groups for which the company was confident that sufficient participation could be achieved.

We acknowledge that this limitation was not adequately described in the original version of the manuscript, and we apologize for the lack of clarity. We now explicitly state the groups for which representativeness was ensured. In particular, we report that representativeness was targeted for 10-year classes up to a single aggregated "70+" category.
In designing our analysis, we also considered the inclusion of a finer age group for the older population (a separate 80+ group). However, this group showed a strong underrepresentation in our sample of respondents, potentially making the resulting estimates statistically unreliable. The reasoning behind our choice of retaining a single 70+ group was based on two main motivations: i) the 80+ population represents a relatively small share of Italy's population (6.7%), compared with 9.9% for the 70–79 group, and correspondingly accounted for three times fewer survey responses than any other age group (only 34 responses in both the first and second survey waves); and ii) the 80+ group was substantially underrepresented in our respondent sample relative to national population benchmarks. When comparing our data with

nationally representative age distributions, we observed an acceptable degree of underrepresentation among younger respondents, with an average population-to-sample weight of 1.47 for the 0-29 group. By contrast, the underrepresentation was much stronger among the 80+ respondents, with a population-to-sample weight of 4.98 (see Figure below).

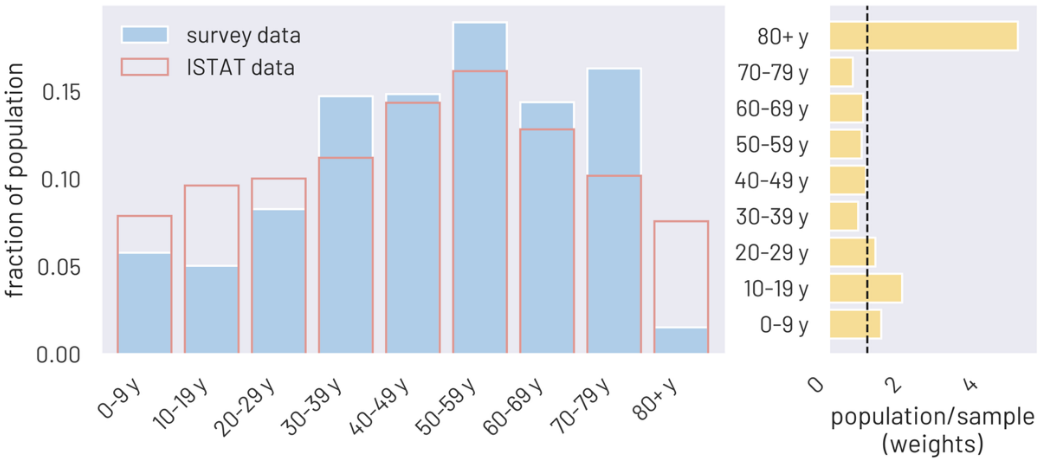


Figure: On the left, we report the fraction of population within each age-group, similar to Figure SI2 but explicitly showing a separate bar for the 80+ age-group. Filled bars show the fraction of responses collected in the survey, while the empty, red-edged bars report the fraction of the population within the different age groups as reported by the Italian statistical office. On the right, we report the population to sample ratios (response weights) showing the 80+ age-group as the most underrepresented one.

We now highlight these aspects more clearly, specifying the representativeness groups adopted in the Materials and Methods section and including a new panel to Figure SI2 showing that the population-to-sample size ratio for the designed age groups is always maintained below 2. In addition, we explicitly acknowledge the underrepresentation of the 80+ population group in the Discussion among the study limitations.

The revised Figure SI2 is reported below for the reviewer's convenience along with the new paragraphs added to the main text.

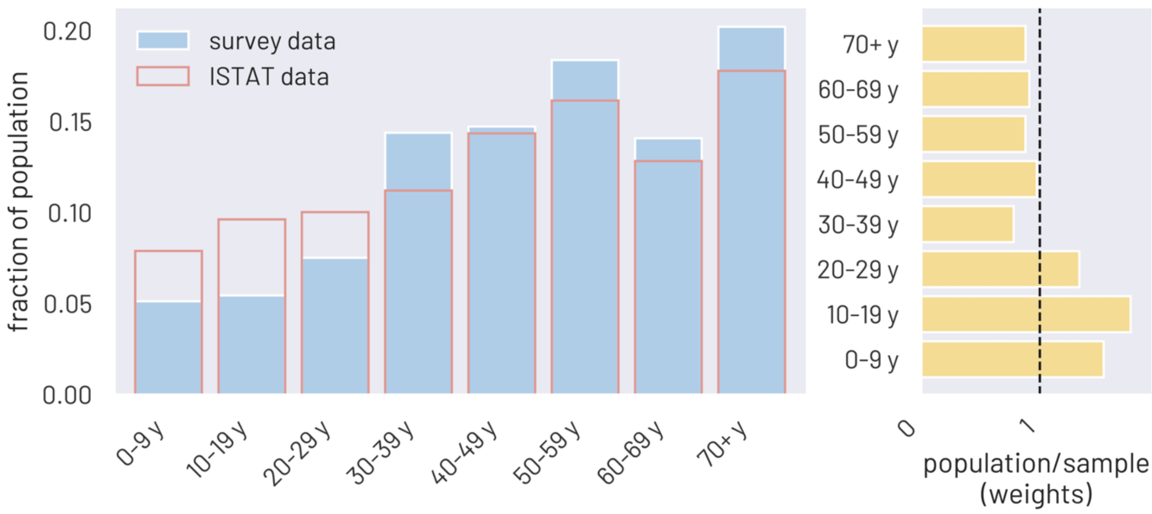


Figure SI2: *Survey respondents by age against the Italian population.* Left: Light blue bars report the distribution of respondents by age group. Darker blue bars show the distribution by age of the respondents' reported contacts. The overlayed red bars report the fraction of the population by age group reported for 2022 by the Statistical Office of the European Union. Right: population-to-sample weights obtained as the ratio between red and light blue bars in the right panel.

Materials and Methods:

> *"This work is based on a new sample of data collected online in two waves at the end of March 2022 and 2023, from a nationally representative panel of the Italian population in terms of age, (based on 10-year age groups up to a single 70+ group), sex, and area of residence (based on NUTS1 geographic level). Representativeness was maintained within a population-to-sample ratio below 2 for all targeted demographic groups (see Figures SI2 and SI3)."*

Discussion:

> *"For a more comprehensive assessment of age-specific reductions in transmissibility, it would have been valuable to explicitly disaggregate the 80+ age group, as this population is often the most vulnerable to severe disease outcomes. In our dataset, however, the number of respondents for this population strata was insufficient (fewer than 50 survey responses) for robust separate estimates."*

R3.5 - "Social distancing" vs "physical distancing". Pick one term and stick to it (WHO now prefers physical distancing).

We thank the reviewer for pointing out this inconsistency. We have adopted in the entire manuscript the "physical distancing" nomenclature.

R3.6 - Introduction—what is new? You say updated post-pandemic contact data are "still missing", but you then cite CoMix, Jarvis et al., Jeong et al. and others. Clarify that no nation-wide Italian data covering BOTH direct and indoor co-location contacts after all mandates were lifted have been published—that is your unique contribution (or anything else, but make sure that you make it very specific what you add specifically).

Following the reviewer's suggestion, we have included more details in the introduction section when introducing our contributions. The paragraph now reads:

> *"Here, we provide updated evidence on nationwide Italian contact data covering both direct social contacts and indoor co-location contacts after all mandates were lifted. Contact diaries were collected through internet-based surveys conducted in March 2022 and March 2023."*

R3.7 - 30-minute colocation threshold. Earlier studies used anything from 5 min to 15 min as a cut-off (if I recall this correctly). Justify the 30 min choice and discuss.

We thank the reviewer for this comment. The motivation behind setting 30 minutes of shared indoor co-location as the threshold for recording "indirect" (or "group") contacts was to capture sustained co-presence typical of co-workers/classmates while excluding numerous very brief co-locations (e.g., on public transport or in outdoor environments) that typically contribute less to transmission risk[1] and are more difficult to recall.

While in POLYMOD [Mossong et al., Plos Medicine 2008] the reporting of group contacts was possible, although intended as a "fallback" option due to diary space constraints, they were always referring to a face-to-face conversation or skin-to-skin touch. Similarly, in the CoMix surveys (which we used as a contemporary reference), group contacts were asked as a separate question and for selected settings by age classes, requesting the reporting of the average time spent [Mossong et al., Plos Medicine 2008, Gimma et al., Zenodo 2021].

Aiming at reducing the completion burden and recall biases that could skew contact distributions for specific respondent categories, we leverage the concept of "group contacts" to

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[1] https://archive.cdc.gov/www_cdc_gov/coronavirus/2019-ncov/science/science-briefs/sars-cov-2-transmission.html

specifically capture epidemiologically relevant encounters [Smieszek et al., Epidemiology and Infection 2011, Smieszek et al., BMC Infectious Diseases 2014].

To develop the "indirect contacts" definition, we considered two different aspects: i) contact duration, and ii) environment. Regarding the contact duration, public-health guidance and high-resolution sensing studies frequently use ≥15 minutes as a minimum for "close contact," often in conjunction with distance requirements; institutions such as WHO and ECDC also note the arbitrariness of that limit and the monotonic increase of risk with duration. Typical definitions require a face-to-face interaction within ~1–2 m for at least 15 min[2,3].

In particular, public health institutions have shared evidence that infection risk decreases with increasing distance but increases with time of shared air, especially indoors with limited ventilation. Our 30-minute choice is therefore a conservative rule following a similar reasoning. The conservative approach stems from the need to compensate for longer distances in colocations that might still be relevant for airborne transmission events (e.g., co-presence in open-plan offices, co-working areas, and classrooms)[4].

Similar considerations are also expressed in the literature on high-resolution event networks, which typically operationalize "close contact" using cumulative duration rules (e.g., more than 15 minutes of interaction), only saturating network weights after multi-hour exposure. This underscores that risk is duration-graded with our 30-minute co-location threshold sitting between these two anchors: stricter than the minimal 15-minute criterion, yet far below multi-hour saturation [Pung et al., Nature Communications 2022].

In summary, we chose 30 minutes to i) focus aggregate colocation on sustained indoor presence in work/school settings, ii) maintain comparability with diary-based "long-duration" categories used in the contact-matrix literature, and iii) reduce duration- and distance-related recall error for group exposures, while remaining consistent with public-health practice that treats ≥15 minutes as a minimal threshold for close contact.

To make the reasoning behind this choice clearer, we have added a paragraph in the supplementary material ("Survey methodology" section) to clearly report the elements taken into consideration:

> *"In the last part of the questionnaire, participants were also asked to report the overall number of persons with whom they shared an indoor space for a period of more than 30 minutes (indirect contacts, e.g., schoolmates, co-workers, people in public transport means), including in the number people already reported as direct contacts. The 30-minute threshold used to define indirect contacts was chosen to capture sustained indoor co-presence typical of work and school environments while excluding numerous brief or incidental co-locations (e.g., on public transport or in transient settings) that are either less relevant for airborne transmission or more difficult to recall and which might increase completion burden and recall bias [Smieszek et al, Epidemiology & Infection, 2012; Smieszek et al, BMC Infectious Diseases, 2014] . This duration criterion aligns with public-health guidance identifying ≥15 minutes of close contact as a minimal exposure threshold, while adopting a more conservative cut-off to account for longer-distance co-presence in shared indoor spaces. The approach follows practices in contact-survey and high-resolution sensing studies that operationalize infection-relevant exposure through cumulative time thresholds [WHO; ECDC; CDC; Pung et al, Nature Communications, 2022]."*

[2] https://www.who.int/publications/i/item/WHO-2019-nCoV-Contact_tracing_and_quarantine-2022.1
[3] https://www.ecdc.europa.eu/sites/default/files/documents/covid-19-public-health-management-contact-novel-coronavirus-cases-EU.pdf
[4] https://archive.cdc.gov/www_cdc_gov/coronavirus/2019-ncov/science/science-briefs/sars-cov-2-transmission.html

R3.8 - Lines 79-80—paired analysis. You actually have 1,236 repeat respondents. A quick within-subject comparison would show whether the mean contact increase from 2022 to 2023 is driven by behavioural change rather than sample composition. Also, have you considered a full paired analysis? If not, can you discuss the options?

We thank the reviewer for their comment. While including a longitudinal sample, the data collection was not specifically designed for an individual-level fully paired analysis, as it falls short in some key respects. In particular, we did not require specific individual variables to remain constant, e.g., survey completion on the same day of the week (being the same for only 17% of respondents) and household composition (which changed for almost 10% of respondents). In our opinion, focusing on a full paired analysis would require a very careful consideration of all these individual-level variations across waves, making it beyond the scope of the present work.

Nevertheless, we believe that the statistical analysis performed in this study goes in a similar direction as it accounts for the main sociodemographic dimensions potentially associated with a respondent's number of contacts and includes a random intercept to account for within-individual correlations. In this respect, we have expanded the discussion of the results of our statistical analysis to better highlight that, albeit limited, we detect a significant association of the number of contacts with the survey wave, which is not explained by the other variables included in the model, as follows:

> *"When comparing responses across waves, we find a small but significant increase in the number of reported contacts, with the second wave showing 1.12 (95%CI: 1.06-1.17) times more contacts than the first wave (see also Table SI7-10 for a more detailed breakdown of the number of contacts by wave)."*

In addition, we have added a new Table SI10 (also reported below), analogous to Table 1 in the main text, presenting the number of contacts further stratified by respondent type (i.e., panel vs. longitudinal participants).

Table SI10: *Survey average contacts by wave and respondent type*. The table reports the average number of total social contacts (95% Confidence Intervals are reported in parenthesis) stratified by different respondent characteristics: age, sex, household income, household size, NUTS1 region, and COVID-19 vaccination status.

Variables	**Panel respondents**		**Longitudinal respondents**	
	March 2022 wave	**March 2023 wave**	**March 2022 wave**	**March 2023 wave**
Age Group				
0-9 y	10.2 (8.6 - 11.9)	12.5 (9.8 - 15.4)	13.6 (10.3 - 17.2)	12.8 (9.7 - 16.1)
10-19 y	13.6 (11.4 - 16)	16.7 (13.2 - 20.5)	10 (7.9 - 12.3)	12.8 (9.1 - 16.9)
20-29 y	11.3 (8.8 - 14.1)	11.1 (8.6 - 14.2)	8.7 (6 - 12.5)	10.2 (7.2 - 13.9)
30-39 y	7.9 (6.5 - 9.7)	9.1 (7.6 - 10.7)	8.1 (6.5 - 10)	8.5 (6.7 - 10.6)
40-49 y	5.7 (4.6 - 7.1)	6.1 (5 - 7.4)	6.4 (5.1 - 8.3)	7.2 (5.9 - 8.8)
50-59 y	7.1 (5.6 - 8.8)	7.8 (6.4 - 9.3)	5.7 (4.7 - 6.8)	6.9 (5.8 - 8.2)
60-69 y	6.5 (4.7 - 8.6)	6.8 (5 - 9.1)	6.5 (5.2 - 8)	5.9 (4.9 - 7.2)
70+ y	5.3 (4 - 6.8)	5.5 (4.6 - 6.6)	4.5 (3.9 - 5.3)	5.9 (4.8 - 7.1)
Sex				
Male	7.9 (7.1 - 8.8)	8.8 (7.8 - 9.9)	7.1 (6.3 - 8)	7.7 (6.9 - 8.6)
Female	8.3 (7.4 - 9.3)	7.7 (7 - 8.5)	5.9 (5.3 - 6.6)	6.9 (6.1 - 7.7)
Net household income (euros per month)				
<1,500 euro	7.3 (5.8 - 8.9)	6.4 (5.3 - 7.6)	4.6 (4 - 5.2)	6.3 (5.1 - 7.6)
1,500-2,999 euro	7.8 (6.9 - 8.7)	8 (7.2 - 8.9)	7.2 (6.2 - 8.2)	7.2 (6.5 - 8.1)

>3,000 euro	9.9 (8.5 - 11.4)	11.4 (9.6 - 13.4)	8 (6.8 - 9.4)	9 (7.6 - 10.5)
Undisclosed	8 (6.6 - 9.6)	6.8 (5.6 - 8.1)	5.9 (4.9 - 7.1)	6.7 (5.3 - 8.4)
Household size				
1	5.3 (4.2 - 6.6)	4.7 (3.8 - 5.7)	5.2 (4.2 - 6.2)	7 (5.4 - 9)
2	6 (4.9 - 7.2)	6.8 (5.7 - 8.1)	5.5 (4.7 - 6.5)	6.1 (5.2 - 7.1)
3	9.2 (8 - 10.6)	9.1 (7.9 - 10.5)	6.9 (5.9 - 8.2)	7.7 (6.7 - 8.9)
4	9.6 (8.3 - 10.9)	10.4 (9 - 11.8)	8.6 (7.3 - 10)	8.7 (7.5 - 10)
5+	11.8 (9.1 - 15)	11.8 (9.2 - 14.8)	8.2 (6.6 - 9.8)	9.8 (7.8 - 12)
NUTS1 region				
North-West	9.6 (8.2 - 11.2)	7.9 (6.7 - 9.2)	7 (5.9 - 8.2)	7.3 (6.2 - 8.6)
North-East	8 (6.8 - 9.3)	8.1 (6.8 - 9.7)	7.1 (5.9 - 8.6)	7.9 (6.7 - 9.2)
Center	6.5 (5.6 - 7.5)	8.8 (7.5 - 10.3)	6.5 (5.6 - 7.4)	7.8 (6.5 - 9.2)
South	8.1 (6.7 - 9.7)	8.1 (7 - 9.4)	5.8 (4.9 - 7)	7.1 (5.9 - 8.5)
Islands	7.8 (5.9 - 10)	8.3 (6.1 - 11)	5.7 (4.3 - 7.5)	5.8 (4.6 - 7.2)
COVID-19 vaccination status				
No doses	8 (6.2 - 10.1)	7.6 (5.9 - 9.6)	5.4 (4.2 - 6.8)	5.1 (4 - 6.3)
One dose	7.1 (4.1 - 10.1)	8.9 (4.5 - 14.1)	7.5 (2.8 - 14.5)	6.9 (3.9 - 10.1)
Two doses	9.5 (8 - 11.2)	9.2 (7.4 - 11.3)	7.5 (5.3 - 10.3)	7.8 (6.2 - 9.6)
Three doses or more	7.8 (7 - 8.6)	7.9 (7.2 - 8.6)	6.4 (5.9 - 7)	7.3 (6.7 - 8)
Exempt	9.3 (7.3 - 11.8)	12.7 (8.5 - 17.9)	9.3 (6.2 - 12.7)	13.6 (9.6 - 17.9)

R3.9 - Regional heterogeneity. Italy's North-South gradient in both demography and pandemic impact well known. Even a simple stratified analysis ie North-West/North-East/Centre/South would be valuable.

Following the reviewer's suggestion we have added to the revised Table 1 the average number of social contacts stratified by NUTS1-level areas (reported below for the reviewer's convenience).

Variables	**March 2022 wave**		**March 2023 wave**		**Both waves**	
	Sample size	**Avg. Contacts (95% CI)**	**Sample size**	**Avg. Contacts (95% CI)**	**Sample size**	**Avg. Contacts (95% CI)**
Total	2474	7.3 (6.9 - 7.7)	2505	7.8 (7.3 - 8.2)	4979	7.5 (7.2 - 7.9)
…	…	…	…	…	…	…
NUTS1 regions						
North-West	683 (27.6%)	8.3 (7.4 - 9.3)	691 (27.6%)	7.6 (6.8 - 8.5)	1374 (27.6%)	8 (7.3 - 8.6)
North-East	473 (19.1%)	7.5 (6.7 - 8.5)	492 (19.6%)	8 (7.1 - 9)	965 (19.4%)	7.8 (7.1 - 8.5)
Centre	500 (20.2%)	6.5 (5.9 - 7.2)	492 (19.6%)	8.3 (7.4 - 9.4)	992 (19.9%)	7.4 (6.8 - 8)
South	561 (22.7%)	7 (6.1 - 7.9)	569 (22.7%)	7.6 (6.8 - 8.6)	1130 (22.7%)	7.3 (6.7 - 8)
Islands	257 (10.4%)	6.7 (5.5 - 8.1)	261 (10.4%)	7 (5.7 - 8.5)	518 (10.4%)	6.8 (5.9 - 7.8)

Please note that, in our statistical analysis, we screened whether geographical information (NUTS1 region of residence) was associated with a significant change in the number of social contacts. However, our analysis failed to find a significant association and, as a consequence,

the respondent's NUTS1 region of residence was not included in the final version of the statistical model.
To better highlight this relevant point, in the revised manuscript, we explicitly state that the region of residence was screened among other potentially relevant covariates:

> *"We built these models using as independent variables each individual covariate, an intercept, and a term accounting for the different data collection waves (2022 or 2023). Covariates that were not significant in the multivariate model were subsequently filtered out. These included, among others, the NUTS1-level region of residence, presence in the household of cohabitants of specific age-groups (children excluded), and whether the respondent knew someone who was hospitalized or died due to COVID-19 (see Table SI6 for a full list of the screened covariates)."*

R3.10 - Line 454—"credible interval". You use a frequentist bootstrap, and I think this should read CI.

We thank the reviewer for pointing out this inconsistency. We have corrected the error in line 454.

R3.11 - SI 1.3. Make vectors and matrices boldface to prevent confusion.
Addressed.

R3.12 - Table SI3. Great table, but please discuss it! Why are your mean contacts still well below pre-pandemic POLYMOD?

Following the reviewers' suggestion, we have included a direct comparison of our contact results with other contact data collection in Italy. Specifically, we have added to the "Results" section of the main manuscript the following paragraph:

> *"Overall, this study shows a higher number of reported contacts with respect to the CoMix study [Gimma et al, 2021], which estimated for Italy an average number of contacts of 3.6 (95%CI: 3.3-3.9) during February-April 2021. However, it also reveals a substantially lower number of reported contacts with respect to POLYMOD data [Mossong et al, PLOS Medicine, 2008], which estimated for Italy an average number of contacts of 19.8 (95%CI: 19.0-20.6). In this case, data were collected through paper surveys during April 2006 (see Table SI4 for a more detailed comparison)."*

Additionally, in the "Discussion" section, we have included some considerations about the possible reasons underlying the lower number of reported contacts with respect to the POLYMOD data collection:

> *"We also note that, compared to the pre-pandemic POLYMOD collection (run in April 2006) [Mossong et al, PLOS Med, 2008], respondents reported fewer social contacts. However, it is not trivial to understand whether this difference reveals a change in social behaviour (number of interactions, contact characteristics such as the amount of face-to-face communication), or methodology-induced differences (e.g., online vs paper data collections [Leung et al, Scientific Reports, 2017]; see also Table SI3 for a detailed methodological comparison between surveys)."*

Finally, a comparison across the three main contact data collection methodologies that were run in Italy has also been added in Table SI3 (reported below). Please note that in the table below, we refer to our survey as "MixIT", while we refer to "POLYMOD" and "CoMix" as the contact studies conducted by Mossong et al., 2008, and Coletti et al., 2020, respectively.

Table SI3: *Methodological aspects of the three main data collection run in Italy*: POLYMOD, CoMix, and MixIT (this study).

	POLYMOD	**CoMix**	**MixIT**
Recruitment method	Random digit dialling on fixed telephone lines	Combination of social media, web advertising, email campaigns	Representative survey company panel

Survey field work conducted by	CRA Research, www.cra-research.com	Ipsos Mori, www.ipsos.com/it-it	YouGov, it.yougov.com
Financial Incentives	None	Yes	Yes
Sampling method	Quota by age, sex, geographical region, rural/urban and day of the week	Quota by age, gender, geographic region, socioeconomic status	Quota by age, gender, geographical region, and weekday/weekend
Diaries delivered and collected by...	Paper/Mail	Online platform	Online platform
Time period of the survey and number of waves	May 2006	December 2020 – April 2021; 7 adult waves + 2 children waves, approximately every two weeks	2 waves: March 2022; March-April 2023
Respondent types – age groups	0-8 parental proxy reporting, 9-17 self-reporting children and teenagers, 18+ self reporting adults	0-17 parental proxy reporting, 18+ self-reporting adults	0-13 parental proxy reporting, 14-17 self-reporting with parental support, 18+ self-reporting adults
Maximum number of contact entries	45	100	150
Asked about duration of contacts	Yes	Yes	No
Definition of contact	*Direct contact*: a skin-to-skin contact (a physical contact), or a two-way conversation with three or more words in the physical presence of another person but no skin-to-skin contact (a nonphysical contact)	*Direct contact* but with the exchange of "at least a few words"	*Direct contact* but with the exchange of "at least 5 words"
Additional aggregate contact information	Yes: by physical/non physical distinction	Yes: by age group and setting	Yes: indoor prolonged contacts (>30 minutes)

Recommendation: Based on the above evaluation that is largely positive I recommend a revision of the manuscript by Lucchini and colleagues that addresses the above points. I do think that making the data and results publicly available is imperative.

We thank the reviewer for their positive feedback and constructive comments, which helped strengthen the analysis, improve the manuscript quality, and potential impact. We confirm that the data and code used in our analysis have been made publicly available (see the Data and Code Availability statement provided in response to comment #R3.1).

Reviewers' comments:

Reviewer #1 (Remarks to the Author):
The authors have addressed all my previous comments. I think that the manuscript is ready for publication.

Reviewer #2 (Remarks to the Author):
Thank you to the authors for thoroughly responding to my comments, I am very happy to recommend this manuscript for acceptance.

We sincerely thank both reviewers for their positive feedback and for recommending our manuscript for acceptance.

We truly appreciate the time and effort dedicated to the evaluation of our work and the constructive comments provided throughout the review process, which have helped us improve the manuscript.