

PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Factors affecting adherence to non-pharmaceutical interventions for COVID-19 infections in the first year of the pandemic in the UK: Analysis of the repeated household Covid Infection Study (CIS)
AUTHORS	Ding, Xuejie; Brazel, David M.; Mills, Melinda

VERSION 1 – REVIEW

REVIEWER	Sung-il Cho Seoul National University Graduate School of Public Health
REVIEW RETURNED	04-Jul-2021

GENERAL COMMENTS	<p>The paper addresses important research question by a large cohort study. There are some aspects that need to be improved for clarity.</p> <p>1. Measurement of autonomy Since the autonomy variable is essential in this study, the measurement properties need to be more clearly described. In the current manuscript, it is described under Statistical analysis section without a dedicated position. It deserves a separate section as "Measurement of autonomy" before statistical analysis section. Several points need to be described more explicitly about the measurement.</p> <p>1)Time of measurement: Was it measured at the enrollment once for each participant, or each time of multiple visits per individuals? 2)Exact questions: Please list the exact questions asked in the supplementary material. Some of the descriptions in the current text is not clear as to what is being asked, especially they seem different from what's listed in Table S3. 3)Distribution and correlations: Distributions of total score and its correlations with each item should be presented in the results section or supplementary materials to show which item is contributing more to the score. Spearman correlations among the items and with the total score would also show the construct validity of the tool. For example, the item "1)possible to work outside the home" seems unclear in its construction and contribution to the score. Normally it would be "requirement to work outside home" that increases the risk of exposure. 4)Analytic scale and unit of the score: It seems that the score was used as a continuous variable. Please describe it explicitly, with the minimum and maximum possible score by construction to compare with the actual distribution of the score. Also describe how to interpret the unit of the score in the logistic regression. Depending on the obtained range, the OR for one unit score may be too small for practical interpretation, and better scaling may be needed.</p> <p>2. Interaction 1) The results show OR's for the main effect and interaction terms.</p>
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	<p>In such presentation, it is difficult to intuitively interpret the results. For example, in Figure 2 & Table S1, model 2, main effects are both negatively and interaction terms are positively associated significantly with the risk. This pattern usually indicates the significant effects of the individual factors are present, but less than multiplicative when they occur together. However, the interpretation in the text is somewhat misleading because it may sound as if the effect is only significant when they occur together.</p> <p>2) Figure 3 nicely shows the direction of interaction. It would be more informative to have a line for OR=1.</p>
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REVIEWER	Matteo Convertino Tsinghua University
REVIEW RETURNED	27-Jul-2021

GENERAL COMMENTS	<p>I read the paper with interest and it is indeed a novel contribution in the huge COVID-19 literature to date. I believe the paper can be accepted after minor revisions that are mainly targeting the use of Odd Ratios and few comments about how these "individual-scale" statistics may reflect country/population patterns of COVID-19 in relation to NPI. As for OR there is a recognised problem that odds ratios do not approximate well to the relative risk when the initial risk (that is, the prevalence of the outcome of interest) is high. Additionally OR approaches are non-probabilistic approaches, meaning that are built on one probability value for one outcome vs. a whole probability distribution that can be highly non-linear. This is a limitation that should be stated or normality or pseudo-normality of pdfs should be proven.</p> <p>As for NPI at the population scale I think the authors should comment a bit on literature addressing this issues (e.g. see here https://www.nature.com/articles/s41598-021-88309-1 and here https://www.nature.com/articles/s41562-020-01009-0?fbclid=IwAR0KjYTSmexyeQnjyAsPVVriHmxVmTG5oGRgVG6oxlQe9STPLyk152lyJz4) where authors analyzed country scale NPIs and population risk attitudes/behavior. I am wondering if the authors may estimate an optimal trajectory of NPIs vs the adopted one and reconstruct people's behavioral attitude in terms of risk.</p> <p>As for the rest the paper is quite interesting and worth publication.</p>
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VERSION 1 – AUTHOR RESPONSE

Reviewer: 1

Prof. Sung-il Cho, Seoul National University Graduate School of Public Health

Comments to the Author:

The paper addresses important research question by a large cohort study. There are some aspects that need to be improved for clarity.

1. Measurement of autonomy

Since the autonomy variable is essential in this study, the measurement properties need to be more clearly described. In the current manuscript, it is described under Statistical analysis section without a dedicated position. It deserves a separate section as "Measurement of autonomy" before statistical analysis section. Several points need to be described more explicitly about the measurement.

This is an excellent point and we have now added a separate section entitled “Measurement of autonomy” before the statistical analysis section as suggested on Page 4 and included more detail.

“Measurement of autonomy

Autonomy to adhere to NPIs is measured by summing conditions that might limit their ability to comply. Each question was asked at every visit to each participant. We assigned points to these conditions which were then summed into one index that measures autonomy. The measures are that the respondent reports that they: (1) work outside the home at least one day per week (1 point), (2) find it ‘easy to maintain 2 metres’ distance in workplace (0 points), (3) find it ‘relatively easy to maintain 2 metres’ distance in the workplace (1 point), (4) find it ‘difficult to maintain 2 metres, but can be 1 metre’ in the workplace (2 points), (5) ‘very difficult to be more than 1 metre away’ in the workplace (3 points), (6) are at a main working location that is ‘somewhere else (not your home)’ (1 point), (7) find it common to go to and from work/school by bus, coach or minibus (1 point); and, (8) engage in work that involves direct contact with patients, clients, residents, service users or customers on a day-to-day basis (1 point). We included transportation by bus, coach or minibus only since sensitivity analyses that included other means of transportation such as underground, tram or motorbike, scooter, or car all showed a reverse correlation with other autonomy items and reduced the reliability of our autonomy index.

The autonomy index passed the Cronbach’s alpha test with the reliability coefficient of 0.73. Exact questions used for the construction of the measurement of autonomy can be found in the supplementary materials (Table S1). Spearman correlation amongst each item and the final autonomy score is documented in the supplementary materials (Table S2).

To interpret the index we consider an example. A person who reports working outside home for 5 days a week (+1), in a job where it is difficult to maintain 2 metre distancing, but can maintain 1 metre (+2) and whose main work location is not home (+1) and does not take public transportation of a bus (0), but works directly with people (+1) will score 5 in autonomy. After summing the scores, we reverse coded the autonomy variable so that a lower score indicates low autonomy (i.e., more situations that limit the individuals’ ability to comply) and a higher autonomy score indicates a higher ability to comply with NPIs. The range for the autonomy score is from 0-7, with the person described in the previous example scored as 2 given reverse coding.”

- 1) Time of measurement: Was it measured at the enrolment once for each participant, or each time of multiple visits per individuals?

We have clarified the timing of measurement on Page 4, second paragraph:

“Each question was asked at every visit to each participant.”

- 2) Exact questions: Please list the exact questions asked in the supplementary material. Some of the descriptions in the current text is not clear as to what is being asked, especially they seem different from what’s listed in Table S3.

We added the exact questions in the supplementary material, section 1 and Table S1.

- 3) Distribution and correlations: Distributions of total score and its correlations with each item should be presented in the results section or supplementary materials to show which item is contributing more to the score. Spearman correlations among the items and with the total score would also show the construct validity of the tool. For example, the item "1)possible to work outside the

home" seems unclear in its construction and contribution to the score. Normally it would be "requirement to work outside home" that increases the risk of exposure.

We have added a description of the distributions of total score in the Results section (Page 5, Paragraph 4) and a figure of the distributions (Figure 2). Spearman correlations amongst the items are provided in the supplementary materials. We also changed "1) possible to work outside the home" into "1) work outside home at least one day per week" to make it more precise on Page 4 as listed above in relation to our new section 'Measurement of autonomy'.

In the first paragraph of the results (page 5) we also added:

"The autonomy score ranges from 0 to 7 (Mean = 4.21, SD = 1.82), with a higher score indicating more autonomy. The distribution of the autonomy score for the entire sample and by sub-groups is presented in Figure 2. The autonomy score follows a normal distribution. Men, and particularly men above 40 years of age, report more autonomy than women and younger counterparts. "

- 4) Analytic scale and unit of the score: It seems that the score was used as a continuous variable. Please describe it explicitly, with the minimum and maximum possible score by construction to compare with the actual distribution of the score.

The constructed score by default ranges from -7 to 0, with lower score means high autonomy (i.e. -7 means the highest autonomy whereas 0 means the lowest autonomy). To improve readability, we flipped the scale thus the score now ranges from 0-7 with higher score means higher autonomy. The unit of the score did not change. We described the minimum and maximum possible score in the Results section on Page 5, paragraph 4 as listed in the previous response.

- 5) Also describe how to interpret the unit of the score in the logistic regression. Depending on the obtained range, the OR for one unit score may be too small for practical interpretation, and better scaling may be needed.

This is a very good point and we have now added the interpretation of the unit of the score in the Results section on Page 5, paragraph 5. Since the score is essentially the sum of situations that may limit the respondents' ability to adhere to NPIs, keeping its original scale seems to be the most intuitive and easiest way to interpret.

"We find that the level of autonomy to adhere to NPIs does not predict COVID-19 infection alone, rather the risk of infection is lessened when individuals wear face-covering/masks (Figure 3, or Table S3). For example, the main effect model in Figure 3 and Model 1 in Table S3 shows that with one score higher in autonomy (i.e., one more condition that limited the respondents' ability to comply to NPIs), there is a 3% lower likelihood of testing positive for SARS-CoV-2 (OR: 0.97; 95% CI 0.95 to 0.99)."

2. Interaction

1) The results show OR's for the main effect and interaction terms. In such presentation, it is difficult to intuitively interpret the results. For example, in Figure 2 & Table S1, model 2, main effects are both negatively and interaction terms are positively associated significantly with the risk. This pattern usually indicates the significant effects of the individual factors are present, but less than

multiplicative when they occur together. However, the interpretation in the text is somewhat misleading because it may sound as if the effect is only significant when they occur together.

We fully agree with the comment and we have revised the interpretation in the text to make it clearer on Page 5, paragraph 6.

“In Figure 2 (also see supplementary materials, Table S3, Model 2), we add interaction terms between autonomy and compliance of wearing a face covering/mask. We found that the protective effect of wearing a face covering/mask is stronger when autonomy is low. We visualise this interaction effect based on model 3 in Figure 4. The interaction effect is the most pronounced amongst females.”

2) Figure 3 nicely shows the direction of interaction. It would be more informative to have a line for $OR=1$.

We have added a line $OR=1$ in the Figure. See Figure 4.

Reviewer: 2

Dr. Matteo Convertino, Tsinghua University

Comments to the Author:

I read the paper with interest and it is indeed a novel contribution in the huge COVID-19 literature to date. I believe the paper can be accepted after minor revisions that are mainly targeting the use of Odds Ratios and few comments about how these "individual-scale" statistics may reflect country/population patterns of COVID-19 in relation to NPI. As for OR there is a recognised problem that odds ratios do not approximate well to the relative risk when the initial risk (that is, the prevalence of the outcome of interest) is high. Additionally OR approaches are non-probabilistic approaches, meaning that are built on one probability value for one outcome vs. a whole probability distribution that can be highly non-linear. This is a limitation that should be stated or normality or pseudo-normality of pdfs should be proven.

We agree with the reviewer that the OR approach suffers from the above mentioned limitations. To address the problem that odds ratios do not approximate well to the relative risk when the initial risk is high, our test positive rate (Positive test/Total number of tests) by the time this study was conducted was around 1%. For this reason, we believe that the limitation is not a serious concern in our study. We also agree that the limitation of non-linearity may harm the accuracy of our results. We added this limitation to our manuscript on Page 7, paragraph 4.

“Finally, the mixed logit models assume linearity between the continuous predictors and the log odds of the outcome of interest. Violating linearity can affect prediction and inference. Since most of our predictors are categorical/binary and we only include three continuous predictors – visit date, autonomy, and household size – in the analyses, it is unlikely that the linearity assumption is severely violated. The plot of the logit for continuous predictors (Supplementary materials, Figure S2) also alleviates the concern.”

As for NPI at the population scale I think the authors should comment a bit on literature addressing this issues (e.g. see here <https://www.nature.com/articles/s41598-021-88309-1> and here <https://www.nature.com/articles/s41562-020-01009-0?fbclid=IwAR0KjYTSmexyeQnjyAsPVVriHmxVmTG5oGRgVG6oxIQe9STPLyk152lyJz4>) where authors analysed country scale NPIs and population risk attitudes/behavior. I am wondering if the authors may estimate an optimal trajectory of NPIs vs the adopted one and reconstruct people's behavioural attitude in terms of risk.

As for the rest the paper is quite interesting and worth publication.

Thank you very much for directing us to these two excellent inspiring papers. We have added in the text our suggestion for future work to incorporate our individual level approach with the approach used in these paper for better analysing population scale NPIs and risk attitudes/behaviours on Page 7, paragraph 5.

“Future work may incorporate our individual- and household- level approach with the aggregate level approach, [16, 17] together to analyse population scale NPIs and risk attitudes/behaviours.”