REPLY

Reply to 'Letter to the editor: Don't forget survey data: "healthy cohorts" are "real world" relevant if missing data are handled appropriately' by Richard Silverwood et al

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We would like to thank you for the opportunity to respond to the issues raised in Silverwood et al's (2022) letter and to clarify our perspective in relation to their concerns.

In their letter, Silverwood et al (2022) note that our findings may be 'open to clear misinterpretation by readers that there is nothing to be done to restore representativeness in NCDS [1958 National Child Development Study]' and suggest that we have omitted to mention 'that even without administrative data there are already methods available to researchers to restore sample representativeness using survey information alone that have been shown to be highly effective'.

We were surprised by this interpretation of our paper and can assure Silverwood et al and others working with survey data that this was not our intention. On the contrary, in our paper we highlighted that *even though* a national sample may not be wholly representative of the target population, the associations between exposure and outcome variables were still generalisable to that population. We chose to compare the NCDS and Office for National Statistics Longitudinal Study (ONS LS; nationally representative linked census data) as they contained similar

variables at comparable timepoints and, to our knowledge, had not been compared previously. Given that attrition and non-response bias are usually inherent in longitudinal surveys, it did not seem contentious for us to find that raw NCDS data obtained in 2004 and 2013 (almost five decades after the study's inception) was mostly unrepresentative of age-matched ONS LS data. Likewise, most longitudinal researchers are arguably already aware of the need to address missingness in their data and of different ways to handle this; however, we acknowledge that a discussion of existing methods to restore sample representativeness would have been useful to avoid any misunderstanding.

It would have been helpful to compare to what extent multiple imputation, and other methods of missing data handling could be used to improve the comparability between the NCDS and LS samples and in turn, exposure–outcome associations; however, this was beyond the scope of our study. We therefore welcomed the demonstration by Silverwood et al (2022) that multiply imputed survey data with auxiliary variables could be used to quite effectively restore sample representativeness in the NCDS with respect to the ONS LS. As might be expected, overall, the imputed NCDS estimates better reflect the ONS LS sample, particularly for long-standing limiting illness (Figure 1) and employment status; however, there are instances where the raw NCDS data demonstrate a closer match; for example, for sex and marital status in 2013. It is likely that restoring sample representativeness will become increasingly challenging over time as attrition increases and greater reliance is placed on the assumptions of missing data methodology. In our paper, we noted that restoring representativeness may also become problematic if the target population is fluid compared to the study's original sample, for example, due to emigration and immigration (13.7% of the UK population was foreign-born in 2020; Office for National Statistics, 2020). We should underscore that there is little evidence to suggest that this is an issue for the NCDS, as demonstrated by Silverwood et al (2022) and others (Archer et al, 2020; Mostafa et al, 2021). We stand by our concluding remark that administrative data could plausibly be used to enhance the accuracy of estimates intended to approximate national populations (as other research is demonstrating, Douglas et al, 2018; Eggleston and Westra, 2020; Büttner et al, 2021), but agree the extent of which is yet to be established.

We believe that demonstrating the similarity of exposure–outcome associations between a raw (and therefore potentially biased) NCDS sample and the nationally representative ONS LS would have acted to bolster the importance and generalisability of NCDS findings, and possibly those from similar studies. We hope our findings inspire future cohort study comparisons with the ONS LS, even if their target populations have never been nationally representative.

We would like to thank Silverwood et al (2022) for their comments and for taking time to consider our paper, which will hopefully create further discussion surrounding sample representativeness and the generalisability of findings (Goldstein et al, 2015). We would also like to reassure Silverwood et al that we agree that the NCDS is a unique and valuable resource relevant to public health policy, and hope to have clarified that we did not intend to suggest otherwise. We look forward to seeing how administrative data might be utilised in the creation of nationally representative estimates.

Conflict of interest

The authors declare that there is no conflict of interest.

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