Author's response to reviews

Title: Impacts of highway traffic exhaust in alpine valleys on the respiratory health in adults: a cross-sectional study

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Author's response to reviews: see over
Dear Editors,

on behalf of our entire author team, I would like to thank you for having given us the opportunity of submitting a revised version of our manuscript "Impacts of highway traffic exhaust in alpine valleys on the respiratory health in adults: a cross-sectional study". In our revision, we have tried to best possibly follow the suggestions of the reviewers. In particular, we have shortened the introduction and provided some more results in the on-line appendix (additional files).

All revisions made are marked in the according document and most of them are also listed in the responses to the reviewers and quoted in italics. Our detailed responses to the comments of the two reviewers follow underneath.

We hope that the revised version will find your approval and the approval of the reviewers.

Sincerely yours,

C. Schindler
Reviewer 1

1.1. I was unable to read any comment about the migrants (in/out) which could be essential in a cross-sectional study. I suggest: a) do a sensitivity analysis after excluding the migrants; b) comment on that in the Discussion.

Response: We had considered a variable for non-Swiss citizenship before but found that the inclusion of this variable had almost no influence on the effect estimates. So, in order to keep the number of degrees of freedom of the model in reasonable proportion to the number of cases which (for some outcomes were quite low), we decided to drop this variable from the model. However, taking up the suggestion of the reviewer, we now conducted an analysis restricted to Swiss citizens, which reduced the total by 13%. This led to a slight reduction in the effect estimates for wheezing but to a slight increase in the effect estimates for chronic cough and chronic bronchitis. We have now also included a table (A5) with these results in the on-line appendix.

1.2. Given that less than 5% in all exposure groups had low education, they could adjust for more categories of the variable education in order to avoid residual confounding by social class. One idea is to use education in years, another education in several categories, not only as a dichotomous variable.

Response: We had conducted analyses with a 6-level variable for education before but had found education to be of low influence altogether. Again, in order to keep the number of degrees of freedom in reasonable proportion to the number of cases, we decided to simplify the education variable. In fact the results with the 6-level variable are very similar to the ones with the 2-level variable (with odds ratios differing by at most 0.01 for all outcomes other than regular cough, where the odds ratio with the 6-level variable was 1.42 while it was 1.36 with the two-level variable).

1.3. Introduction is too long and could be reduced.

Response: We have shortened the introduction

1.4. Table 2 and Figure 3 could include a legend indicating the variables included in the multivariate model.

Response: Such a legend was added at both places.
Reviewer 2

The authors conducted an interview-based cross-sectional study to investigate if residence near Swiss Alpine highways is associated with respiratory symptoms in 15-70 year old adults. 3'287 inhabitants were selected from 10 trans-alpine rural communities and phoned for interviews. It was hypothesized that the harming effect of traffic exhausts is more accentuated by focusing on rural communities because background air pollution is less likely to dilute an effect as could be the case in an urban setting. 1'839 (56%) of the contacted persons completed the interview which asked about respiratory symptoms, risk factors/potential confounding variables and residential address. Results showed that participants who lived within 200m of a highway were more likely to suffer from wheezing without cold and chronic cough than participants living farther away.

A particular strength of the present study are the two approaches for traffic exposure, with a dichotomous variable (place of residence <200m away from highway vs. #200m) and a continuous variable using a bell-shaped function of the distance between place of residence and highway, respectively. The authors convincingly argue that a distance-based approach to approximate traffic-related pollution might be more precise in a rural compared to an urban setting with high levels of background pollution. Overall, this clearly written paper is a welcome contribution to the existing literature and no major revisions are needed. Minor revisions are detailed below:

Minor Essential Revisions

2.1. P 4, line 6-8: Please give some references, that distance-based pollution estimates are working well in rural settings. Are there any validation studies which can be cited?

Response: The distance-based concept applies to all settings for physical reasons related to the fate of freshly emitted pollutants. The key mechanisms involved relate to dispersion (in case of gases) and - probably most importantly - coagulation and accumulation in case of ultrafine particles. While the decay function is generalizable (apart from local influences such as wind, which are well discussed in the paper) the reviewer points to a relevant general issue, namely the question about the absolute differences in pollution concentrations between proximal and more distant locations. This is an inherent limitation of the distance approach - as discussed. The more diverse the traffic density, the weaker is the purely distance-based approach. This diversity is driven by the complexity of the traffic network rather than by urban or rural characteristics. The present project fortunately relies on rather stable settings where both rural and less rural communities were lined up along the highly trafficked North-South transit axes of Switzerland. A review on proximity measures and its influential factors, strength and weaknesses is given the HEI Special Report on traffic-related health effects (our reference # 11). This report is referred to in the introduction in the following sentences (which we have slightly adapted in the revised version):

As most urban study areas are characterized by both heavy traffic and high or complex background air pollution [2, 3, 16], the distance to the closest major road has been
identified as an imprecise measure of exposure in complex urban settings [11]. However, in the simple case of a single dominant traffic artery, distance from this artery and wind direction become the primary determinants of local spatial contrasts in traffic-related pollutants. Gaussian dispersion theory suggests that, in such cases, exposure to traffic pollutants can be approximately described by a bell-shaped function of distance to the predominant traffic line source [24, 25].

2.2. Study population: Could you explain in more detail how the 10 communities were selected? As it is written now, one might think that the 10 selected communities were the ones that agreed to provide addresses of all residents.

Response: The 10 communities were selected based on their location near one of the Alpine transit highways. A further criterion was the availability of an air pollutant monitoring station.

2.3. Were the study participants aware of the main aims and hypotheses of the study? This might be relevant as outcomes were self-reported and might therefore be biased.

Response: The study had originally been conceived as a socio-demographic survey and was declared as such. The health questionnaire was added afterwards. Thus, participants were not attracted to the survey because of a health focus. To make this clearer we changed the respective sentence in the method section:

The telephone interview was conducted for a socio-demographic survey in the first place but also included a condensed version of a questionnaire previously established in a Swiss air pollution cohort study [29].

2.4. Page 5. Study population: Were the telephone numbers provided by the communities or were they extracted from phone books? In the latter case, the study population would consist only of participants with a phone book entry.

Response: Subjects were recruited through random samples from the local population registries and their telephone numbers were provided by these registries.
We have clarified this in the methods section.

Authorities of the communities provided the addresses and telephone numbers of residents aged between 15 and 70 years and a list of streets mostly affected by traffic.

2.5. Could the questionnaire used during telephone interviews be included in the online appendix?

Response: We have included this questionnaire in the online appendix.
2.6. P 7, second paragraph: It would be helpful to describe in more detail how the parameters for the bell-shaped function were estimated. Currently, it is difficult for the average reader to really understand how it was done.

Response: The parameters of the bell-shaped curve were determined by iteratively fitting logistic regression models with stepwise improved values of the dispersion parameter $\sigma_d$ until a minimum of the likelihood function was reached. We changed the respective sentence in the methods section accordingly.

Assuming the logit of the prevalence of a given respiratory symptom to be proportional to $C(d)$, the parameter $\sigma_d$ can be estimated by iteratively fitting logistic regression models with stepwise improved values of $\sigma_d$ until a minimum of the likelihood function is reached.

2.7. P8, line 7: Please explain the definition of “low education”. This potential confounder seems important because low education might be associated with proximity of residence to highways and with respiratory symptoms.

Response: “Low education” was defined as “only having primary school education”. We have also run models with education as a 6-level factor. However, results very similar to the ones with the present two-level factor. The respective odds ratios differed by less than 0.01 for all outcomes other than regular cough. We replaced the term “low education” with “primary school education only” in the text and in the tables.

2.8. Please explain more explicitly why subjects were divided into the subgroups “with and without allergic rhinitis”, and why this might be relevant for the results.

Response: While not conclusive, there is both an experimental and epidemiological literature indicating that exposure to local traffic-related pollutants (in experimental settings usually diesel particles) increases the risk for sensitization, possibly more so to outdoor allergens. Cross-sectional proxy measures of the longitudinal risk to develop atopic diseases - such as reporting allergic rhinitis - are a useful approach to address such biologic interactions. We have added a respective sentence in the methods section.

Based on published results indicating particular susceptibility to air pollution among persons with respiratory allergies [31-33], we also examined whether associations with traffic exposure differed between subjects with and without allergic rhinitis by introducing an interaction term between allergic rhinitis and traffic exposure.

2.9. P8, line 16: As said before, the bell-shaped curve which is pointed out as a major strength of the study should be explained in more detail and supported, if possible, by references (1). If space is a problem, then in the online document.

Response: The bell-shaped curve is motivated from atmospheric physics where a Gaussian plume model is often used to describe the dispersion of pollutants

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away from a line or a point source. We have added two according sentences with references in the background section (cf. also response to point 2.1):

However, in the simple case of a single dominant traffic artery, distance from this artery and wind direction become the primary determinants of local spatial contrasts in traffic-related pollutants. Gaussian dispersion theory suggests that, in such cases, exposure to traffic pollutants can be approximately described by a bell-shaped function of distance to the predominant traffic line source [24, 25].

2.10. Table 1: Please always add the actual number of persons (n) in addition to the percentages.

Response: After some discussion, we have decided not to add these numbers in the table of the main text because this would have made the table extremely busy and unpleasant. However, we give a complete table in the on-line supplement and added a reference to this table in the legend of Table 1.

2.11. It would be interesting to see the results stratified by distance to major roads (as cited on page, 10 lines 1 to 5. Could they be included in the online document?)

Response: We have added a respective table to the on-line appendix (A6). It gives the results for subjects living more than 50 m away from the major main road through their community. However, we have not included the results for subjects living within 50 m of this road since these are extremely imprecise due to the very small number (i.e., n=27) of such persons living also within 200 m of the high way.

2.12. Please discuss in some more detail shortly why persons with nasal allergies might be more vulnerable to road traffic pollution.

Response: We extended the respective sentence in the discussion as follows:

This is consistent with subgroup results from other observational studies in children [33] and adults [31, 32] and from experimental studies [36] that exposed subjects to diesel particles and it adds to the evidence that persons with respiratory allergies are more susceptible to the effects of air pollution.

2.13. P 14, line 8: delete “on the”

Response: We have done this. We thank the reviewer for the careful reading!

2.14. The limitations of the study are totally discussed away. Just list them, together with the strenghts, so that the reader can make his own opinion.

Response: We have omitted the sentence discussing away the limitations.