Author's response to reviews

Title: Household vacuum cleaners vs. the high-volume surface sampler for collection of carpet dust samples in epidemiologic studies of children

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To the Environmental Health Editorial Team:

Please thank the reviewers for their thoughtful comments on our manuscript, "Used vacuum cleaner bags vs. the high-volume surface sampler for collection of carpet dust samples in epidemiologic studies of children," MS 8642899271589061. Our response to each comment is provided below.

Reviewer: Joseph Allen

Minor Essential Revisions

Page 6-7: References 15 and 16 (and the preceding sentence) refer to surface loading being a better indicator of dose than concentration for lead. Does this hold true for PCBs and the other compounds in this study? If so, need to add a reference. If not, add clarifying sentence or statement (e.g., "There is some evidence that loading is a better indication of dose than is concentration for some metals; in studies of..."").

Response: We agree with this comment and have edited the text as suggested.

Page 8: "In addition, because children spend most of their floor time in one room..." Not sure this is true. Need to add reference.

Response: We do not know of a reference supporting our statement, so we have replaced it with alternative language.

Page 9: Please describe the method for choosing 45 of the 150 households with available HVS3 and used bag samples. The only exclusion criteria listed was
for insufficient dust but that isn’t likely to have been the sole reason for excluding over 2/3 of the samples. The results of this study are strong but rely on the 45 homes being representative of a random sample and not selected because they had a higher percent agreement.

Response: We have added more detail to the paragraph describing how we selected the sample.

Page 9: We ruled out households. Need clarifying statement here -- were homes ruled out more often for insufficient dust from the HVS3 or used bag? If it was consistently because the used bad did not have sufficient dust, this would have implications for how well the used bag method could work in actual epidemiologic settings.

Response: We have clarified that insufficient dust pertains to the HVS3 samples.

Page 11: Provide more detail on how the 1 sq. meter area was chosen (e.g., center of room? Standardized selection? Excluded area near doorways?)

Response: We have provided the requested detail.

Page 11: The goal of the paper was to compare HVS3 with used bag methods. On page 8, the authors state that, in practice, rarely is the HVS3 used in more than one room. However, in the methods section the authors describe using the HVS3 in more than one room to collect the necessary dust. This gives the impression that the conclusions being drawn about the efficacy of using the used bag compared with the HVS3 may not be valid; the comparison being done is using an HVS3 method that more closely resembles the used bag method in that it is used in more than one room, contrary to how the HVS3 is normally used in practice. The authors need to address this issue.

Response: The HVS3 was never used in more than one room. If there was insufficient dust in one area of the room, the interviewers vacuumed in another area of the same room. The text has been modified accordingly.

Page 16: Please justify substituting ½ the detection limit for compounds not detected, but not doing so for values that were below the detection limit. Because a large part of the results compares the % detection by each method, the inconsistency in the handling of values below LOD is a concern.

Response: We have reconsidered our approach for handling detections below the detection limit and agree with the reviewer that the more consistent approach is to consider them non-detects and assign them ½ of the detection limit. We have revised the table and text accordingly. Bromoxynil was the only compound affected in a meaningful way by this change, because there were a small number of detected values and one of them was considerably below the detection limit. Other compounds for which some of the statistical measures changed, but only by a small amount, were methoxychlor, diazinon, phosmet, carbaryl, cypermethins, cyfluthrin 2, dacthal, simazine, methoprene, coronene, PCB 118,
and PCB 180.

Page 18: Authors should address results if the true relative risk is 1.5. Do the same results hold, or do a much greater % become unity? This has implications for the generalizability of their findings and the sensitivity of the used bag method as an exposure metric. Is the used bag a suitable surrogate for HVS3 only for studies with a true relative risk of 2.0 or greater?

Response: Taken as a percentage of the true relative risk, the observed relative risk actually increases as the true relative risk decreases. For example, if the true relative risk is 2.0 and the correlation coefficient is 0.85, the observed relative risk is 1.8025, which is 90% of 2.0. If the true relative risk is 1.5 and the correlation coefficient is 0.85, the observed relative risk is 1.4115, which is 94% of 1.5. So, the effect of the measurement error on the risk estimate is less at 1.5 than it is at 2.0. This is true for all methods of calculating relative risk. In terms of the manuscript, we chose 2.0 as a reasonable example for our paper, but the reader can easily go back to the De Klerk paper to observe the effect at other values.

Discretionary Revisions

Page 3: HVS3 samples were collected in one room. Authors need to identify which room the HVS3 sample was taken in order to understand the comparison to household vacuum.

Response: The room in which the HVS3 sample was collected is discussed in the Methods section. In the authors' opinions, it is not necessary to discuss this in the Abstract.

Page 4: Would prefer the mean or median % agreement with the range in parentheses to assess if agreement was closer to 100% or 75%.

Response: We agree with this comment and have added the median % agreement (95%) to both the Abstract and the Results.

Page 4: Present p-values with Spearman correlation coefficients.

Response: We believe that adding the p-values would clutter the table without adding anything meaningful. All of the p-values are highly significant except for malathion and allethrin, which perform poorly by other measures already on the table.

Page 6: Reference 4 is for pesticides but sentence refers to pesticides and other compounds. Add references for the other compounds in study.

Response: We removed pesticides and other compounds from this sentence.

Page 6: The HVS3 is designed to achieve constant dust removal efficiency across different surfaces. It is unclear if the HVS3 was used for only carpet dust sampling or if it was used across different surfaces. The interest is whether or not the household vacuum bag is related to carpet dust or room dust,
in general.
Response: The HVS3 was used only for carpet dust collection. This has been clarified in the text.

Page 11: Were field duplicates taken with the HVS3 to compare intra-room variability? If not, the reason for not conducting a field duplicate should be stated. If duplicate samples were taken, report the comparability.
Response: Interviewers were trained to collect the HVS3 samples in accordance with the protocol for the California Childhood Leukemia and Fresno studies, which was not designed to assess intra-room variability and did not include collection of field duplicates.

Page 11: Add sample storage temperature.
Response: We have added the sample storage temperatures.

Page 12: Were field blanks used for the HVS3 or only a solvent blank? Also, change ¿a duplicate¿ to ¿a lab duplicate¿ as this is not a field duplicate.
Response: We have changed ¿a duplicate¿ to ¿a lab duplicate.¿ There were no field blanks, which would be a difficult thing to collect.

Page 18: ¿Paired t-tests showed no significant differences in concentrations¿ ¿Should be ¿log concentrations.¿
Response: We do not believe that this change is necessary as it is clear that the analyses were conducted on log-transformed values.

Page 18: For compounds with low Spearman correlations, the authors re-state that they were ¿detected infrequently.¿ As they were detected infrequently, and values below the LOD are given the value of ½ LOD, then this would increase the correlation coefficient as both methods would yield a higher number of perfectly correlated values. If only detected values were analyzed for Spearman correlations, then the ¿detected infrequently¿ statement is less informative than a p-value.
Response: We deleted the sentence about their being detected in only a few homes.

Page 20: ¿8 to 9 of 15 samples)¿ Unclear what is meant by ¿8 to 9.¿
Response: In the earlier study, 2,4-D was detected in 9 HVS3 samples and 8 used bag samples. We have edited the text to clarify this.

Table 1: Include ¿n¿ for number of samples in correlation analysis. It is unclear if all samples were included or only if detected in both HVS3 and used bag.
Response: Footnote (c) has been edited for clarification.

Reviewer: Susan Teitelbaum
Although the authors mention the protocol for collecting dust from vacuum cleaners with and without bags, it would be very informative to provide information on whether any difference in agreement was observed between each of the vacuum cleaner types and the HVS3. The numbers may be too small to evaluate this difference statistically, but including at least a comment on whether there were differences is important.

Response: This is an excellent comment. We re-calculated the statistics after deleting 10 homes for which dust samples were collected from vacuums without bags and found that the correlations were generally improved. We have added paragraphs to the Results and Discussion sections to reflect this. In addition, given that 22% of the homes in our sample did not have vacuums with removable bags, we changed the name of the method from the “used bag” method to the “household vacuum cleaner” method.

Also, what percent of the homes (if any) did not have vacuum cleaners -- this is an important point for researchers who may be planning studies that will include dust collection through home vacuum cleaners.

Response: In the California Childhood Leukemia Study, among 342 households for which we tracked this information, 313 had vacuum cleaners and agreed to the collection of vacuum dust (92%), 18 (5%) presumably had vacuums but refused the interviewer’s request to collect vacuum dust, and 11 (3%) did not have a vacuum cleaner. However, we hesitate to put this in the manuscript because the proportion of households without vacuum cleaners can vary considerably in different geographic areas.

Rather than presenting % agreement, the authors should present Kappas which accounts for the agreement solely due to chance.

Response: There are many different ways of measuring agreement in these types of studies. The kappa statistic measures agreement beyond that expected by chance alone. However, it does not always realistically reflect the degree of agreement. For example, in our study, coronene was detected in 40 of 40 HVS3 samples and 39 of 40 vacuum bag samples. The percent agreement is 95%, but the kappa statistic is -0.0256. We do not agree that the percent agreement statistics should be replaced with kappas. An option would be to add the kappas to Table 1, along with additional text explaining the results, which would lengthen the manuscript. Another option would be to present the kappas in a supplementary on-line table (if the journal allows supplementary material). If supplementary material is an option, we would suggest presenting both the kappas and the 2 x 2 tables for all compounds. Please advise.

Reviewer: Ruthann Rudel

Minor Essential Revisions

The last sentence of the abstract was unclear. I would suggest “the extent to which the vacuum bag method will reduce relative risk estimates by increasing...”
random measurement error will vary by compound."

Response: We agree with the comment and have edited the text accordingly.

Statistical analysis. It appears the analyses of HVS3 data were conducted using the mass chemical per gram dust, rather than the mass per surface area sampled. Did the authors also evaluate rank correlation between the HVS3 and vacuum bags using surface area- rather than mass-based concentrations for the HVS3 data? If so, it would be interesting to know the outcome. If not, perhaps they could explain why not.

Response: We were concerned that adding such an analysis to this manuscript would make it too long, especially considering the level of detail required in this first presentation of the laboratory methods. Discussing the factors that could affect chemical loadings in carpets, and the correlation of loadings with concentrations, would be lengthy. We are planning another manuscript down the road that will compare HVS3 concentrations and HVS3 loadings using a much larger sample size. We are planning to include the comparison of vacuum bag concentrations and HVS3 loadings in that manuscript.

Statistical analysis, and p. 20. Sometimes correlation estimates can be influenced by treatment of below detection limit values (see for example Newton and Rudel. (2007). Estimating correlation with multiply censored data. Environmental Science & Technology. 41: 221-228). Authors should review scatter plots of each correlation to assess how <DL values are affecting correlation estimates. Authors might consider using an alternative correlation estimator -- Kendalls tau, adjusted for ties (see Newton and Rudel 2007 for a description and additional references).

Response: We calculated the Kendall’s tau-b for each analyte and compared these values to the Spearman correlation coefficients. As expected, the Kendall’s tau-b values were lower than the Spearman coefficients, but not drastically so. For 31% of the analytes, the Kendall’s values were 71-79% of the Spearman’s; for 22% of the analytes, the Kendall’s values were 80-89% of the Spearman’s; and for 47% of the analytes the Kendall’s values were 90-100% of the Spearman’s. We believe that for the purposes of this analysis, the Spearman coefficients are the more meaningful measure of correlation. In an epidemiologic study, we want our exposure assessment tool to rank people properly, and that is what the Spearman correlation coefficient measures. There is no well-defined intuitive meaning for Kendall’s tau-b.

Page 18 and elsewhere, I suggest using quotation marks around the term ‘gold standard’ to indicate that the assignment of HVS3 to this status is hypothetical. I think it is important to elaborate on this issue in text as well. For example, it is important for readers to keep in mind that the real ‘gold standard’ is the measure most predictive of the exposure of interest in a particular study. It is possible that vacuum bag would be better than HVS3 because it integrates more of the house, for example, or perhaps some combination of the two is most predictive.
Response: We agree with this comment and have edited the text accordingly.

Conclusion: The second sentence is unclear. The introduction of dust loading issues at this point in the paper lacks context and meaning. Please clarify.

Response: We agree with this comment and have deleted the second sentence from the Conclusions.

Discretionary Revisions

Page 6, the paper says the HVS3 collects particles >5 microns. It would be interesting to know (a) whether there is also a high-end cutoff (other than the 100-mesh sieve in the laboratory sample preparation) and (b) whether/how the distribution of particle sizes between the two methods (David Camann at SwRI may have some of this information).

Response: We believe that this information is extraneous to the paper. Given that the fine fraction is the one of interest for exposure assessment, the high-end cutoff is not relevant. The distribution of particle sizes would likely differ depending on the characteristics of the dust being vacuumed and the type of vacuum cleaner used.

Page 9, the paper says 150 homes were sampled using both methods. Have any chemicals been analyzed in both samples in all 150 homes? If not, what was the purpose of collecting those samples? Some context would be informative.

Response: Because the vacuum bags were easy to obtain, we collected them as a back up if the desired amount of HVS3 dust was difficult to obtain, and also for archiving for possible future analyses. At this time, the only homes for which both types of samples have been analyzed are the ones included in the manuscript.

Method section - the description of analytical methods is very detailed. Is this the first report of those methods, or could other papers be referenced and the description condensed?

Response: Unfortunately, these methods have not been published previously.

Sincerely,

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