Peer-Review comments and authors responses

Reviewer 1

1. **Abstract:** *Consider removing the software information in the Abstract (L73)*

Thank you for your suggestion. We agree that the inclusion of software information in the Abstract is unnecessary and could detract from the focus of the study's key findings. We have removed this detail from the Abstract.

2. **Introduction**: *Well written and depicts a good image of both the investigational gap and current knowledge. I would only advise* ***shortening the overall length a little bit and merging in 2-3 paragraphs maximum.***

Thank you for your thoughtful feedback on the introduction section. We appreciate your recognition of its clarity in depicting the investigational gap and current knowledge. In response to your suggestion, we have revised the section to reduce its length and condensed the content into two (or three) paragraphs for improved readability and focus.

3. **Method**:
   a) L146 – does the NHANES information pool provide any details on how the dust samples were collected? Was it a standardized procedure? Two sentences on this would be of great value for the readers.

Thank you for your insightful comment. The NHANES 2005-2006 dataset includes detailed information on the standardized collection of household dust samples. Trained technicians vacuumed the bed surface and adjacent floor areas in participants' bedrooms using a Sanitaire™ vacuum equipped with a Mitest™ Dust Collector, ensuring consistency across all surveyed households. We have added this information to the manuscript for clarity and to enhance its value to readers.

   b) L157 – in your literature scoping review, did you find any variable with a significant association with sleep outcomes that was non-significant in your bivariate analysis ($p>0.2$). If so, consider previous demonstrated association as a criterion for inclusion in your multivariate model, too. Models based only on significance in the same study, even if raising the threshold to 0.2, can miss some clinically relevant variables.

Thank you for your consideration. We made an effort to include variables that have been previously shown to be associated with sleep outcomes, even if they were not statistically significant in our univariate analysis ($p > 0.2$). Examples of such variables include age, family PIR, asthma, and floor covering type. However, in the multivariate model, only age showed a significant association with sleep outcomes. The other variables did not demonstrate a significant relationship, and therefore, we removed them from the model based on the principle of parsimony. This approach aims to retain only the most relevant variables to ensure model simplicity and avoid overfitting.

c) This somewhat subjective sentence does not make any sense In the Materials and methods and should be removed. Maybe at the end of the discussion… or even suppressing it.

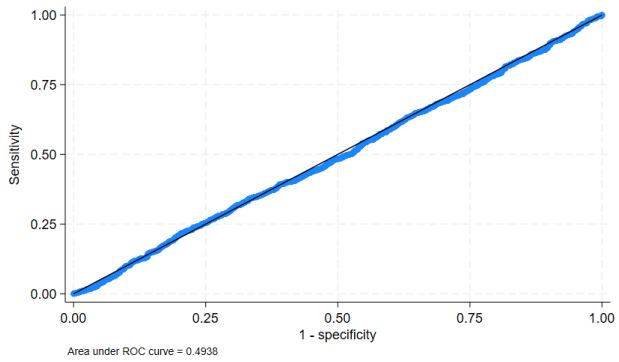
Thank you for your thoughtful comment. The reference to this aspect is mentioned in the Results Section and has been reviewed to improve clarity.

d) I would strongly suggest to add a Receiver Operative Characteristics (ROC) curve analysis to your Methods. Studying the sensitivity/specificity profile of household dust (mg) against the dichotomized sleep outcome (over/under 7 h) could provide not only a suggested cutoff amount of dust (mg) to be considered deleterious on sleep, but also an area under the curve (AUC) as a measure of the predictive capacity. Of course it does not substitute the multivariant analysis (in fact, it is much needed) but in can give an idea of the weakness/strength of the association and discriminative capacity.

Thank you for this excellent suggestion. We agree that adding a Receiver Operating Characteristic (ROC) curve analysis would provide valuable insight into the sensitivity and specificity of household dust levels (mg) in predicting dichotomized sleep outcomes (over/under 7 hours). This approach would help identify a potential cutoff for dust levels that might be considered deleterious to sleep and provide an AUC value as a measure of the model's discriminative capacity.

While this analysis does not replace the multivariate model, it complements it by offering an additional perspective on the strength and predictive capacity of the association.

We have added the ROC curve analysis to the Methods section and updated the Results accordingly.



e) L174 – given your decent sample size, one potential explanation for the weak associations found could be the great heterogeneity (sex, age, sedentarism…) of the analyzed sample. I would consider at least two subgroup analyses, in the two sub-cohorts that you determine to be more meaningful according to your literature review. For example, males/females, age strata (active/retired…). Besides, this great heterogeneity should be adequately accounted for as a limitation.

Thank you for your thoughtful input. We appreciate your observation regarding the potential impact of sample heterogeneity on the associations found in our analysis. While we included "age" as a covariate in our models, it was neither significant in the univariate analysis nor did it improve the multivariate model. Similarly, based on our literature review, we tested "marital status" (categorized as sleeping alone vs. sleeping with a partner) and "annual family income" (categorized as wealthy vs. non-wealthy), but both were insignificant and had negligible impact on the model.

We agree that excessive heterogeneity can reduce the reliability and significance of the results due to the presence of potential confounders. To address this, we verified that the Variance Inflation Factor (VIF) was <5, indicating that multicollinearity is unlikely to affect residuals. Additionally, we will explore subgroup analyses, focusing on cohorts identified as meaningful based on the literature (e.g., stratifying by sex or age groups such as active vs. retired individuals). These analyses may provide deeper insights into subgroup-specific relationships.

Finally, we have acknowledged the sample's heterogeneity as a limitation in the manuscript, emphasizing how it may dilute the observed associations and potentially obscure more nuanced subgroup effects.

f) Table 1 – since multiple variables (Ethnicity, Marital status, Family PIR…) have multiple categories, another possible way to fight heterogeneity is to dichotomize

them and see the influence on the found associations (e. g. Family PIR "near poor or poor" vs. "others")

Thank you for your suggestion regarding dichotomizing variables. While we recognize its potential to simplify analysis, we decided against it to avoid losing valuable information inherent in the original categories. Additionally, retaining the multi-category structure aligns with established conventions in the literature, ensuring comparability with prior studies. Heterogeneity was addressed by including key confounders and verifying that multicollinearity was not a concern (VIF < 5). We have also acknowledged sample heterogeneity as a limitation and highlighted it as an avenue for future research.

4. **Grammar/format**: *Minor Issues.*

a) Pay attention with line numbers colliding with the text

Thank you for bringing this to our attention. We have reviewed the manuscript thoroughly to ensure that line numbers do not collide with the text. This formatting issue has been corrected, and we appreciate your attention to detail in improving the readability of the document.

b) L3.1, throughout the manuscript – there is no linguistic nor stylistic reason to use capital letters for some words in your subtitles.

Thank you for pointing this out. We appreciate your attention to linguistic and stylistic consistency. We have reviewed the manuscript and adjusted the subtitles to ensure that unnecessary capitalization is removed. The revised subtitle now reads: **Impact of household dust on sleep quality: A cross-sectional analysis of NHANES 2005-2006 data**, adhering to proper stylistic conventions. This adjustment has been applied throughout the manuscript for consistency.

5. **Statistics:**

c) L169 – please provide company, city and country for the Stata 18 software

Thank you for this recommendation, we have adjusted this in the text: "All analyses were conducted using Stata 18 (StataCorp LLC, College Station, TX, USA)."

d) L179 – some journals' style books recommend giving the standard deviation with one decimal position less than the mean (makes sense). Besides, with a sample size over 1,000 it also makes sense to give percentages with at least one decimal position.

Thank you for your detailed feedback. We agree that aligning the number of decimal places for the standard deviation to one less than the mean provides better readability and adheres to best

practices. Additionally, for a sample size exceeding 1,000, including percentages with one decimal place offers a more precise representation of the data. We have revised the presentation of these values throughout the manuscript to reflect these conventions, ensuring consistency and adherence to high reporting standards.

Reviewer 2

Please see the attached file with comments to the authors.

1. **Introduction:**
   a) *"...nasal congestion, sneezing, and itchy eyes (Bousquet et al., 2001)."So from this argumentation I get that diseases caused by dust are a mediator between dust and sleep disturbances. Why did you not investigate a potential mediation?*

Thank you for this insightful comment. You are correct that conditions such as allergic rhinitis, triggered by dust exposure, could act as mediators in the relationship between household dust and sleep disturbances. We were particularly interested in including covariates addressing rhinitis symptoms that might influence our model. Unfortunately, after a thorough review of the NHANES 2005–2006 dataset, this information was not available. While we did include asthma and emphysema as variables, they did not significantly improve our model.

b) *more literature needs to directly assess the role of household dust on sleep patterns and outcomes. Why? What is the new thing you want to find?*

Thank you for your comment. While previous studies have explored the impact of environmental factors, including allergens, on sleep, there is limited direct evidence assessing the specific role of household dust on sleep patterns and outcomes. Household dust contains a mixture of particulate matter, allergens, and microbial contaminants that may uniquely influence sleep by triggering conditions such as allergic rhinitis, which can disrupt sleep quality and duration. By focusing on this exposure, our study aims to bridge this gap and provide new insights into the specific impact of indoor air quality on sleep health, potentially identifying modifiable environmental factors for targeted interventions.

2. **Method/statistics:**
   a) *Table 2. Linear regression analyses. Please also report R-square*

Dear reviewer,

Thank you for your insightful question and for emphasizing the importance of transparency and methodology.

In Table 2, we aimed to summarize the most significant findings from our model, selected from over five models and more than 20 numerical outputs generated by Stata. We interpreted the Adjusted R-squared as a more relevant metric than the R-squared for adjusted models. Including all the important information in the table would have resulted in clutter, reducing readability and clarity.

b) *oversampling strategy. That is important regarding the generalizability of results when the study population does not match the general population by certain factors.*

Thank you for highlighting this point. We agree that the oversampling strategy is crucial for ensuring the generalizability of results, particularly when the study population differs from the general population on key factors. In our analysis, we accounted for the NHANES oversampling strategy by applying appropriate sampling weights, which adjust for differences in representation and ensure that our findings are reflective of the broader U.S. adult population. This approach strengthens the validity and applicability of our results to diverse demographic groups.

c) *Collected. In a standardized fashion? It can make a huge difference where and how the samples were collected.*

Thank you for pointing this out. Yes, the household dust samples in NHANES 2005-2006 were collected in a standardized fashion to ensure consistency and reliability. Trained technicians used a Sanitaire™ vacuum with a Mitest™ Dust Collector to vacuum the bed surface and adjacent floor areas in participants' bedrooms, following a uniform protocol across all surveyed households. This standardized methodology minimizes variability in sample collection and enhances the validity of the exposure assessment.

d) *"How much sleep do you get (hours?)"[A1] The hours of factual sleep is very difficult to assess by self-reporting in a valid fashion. From sleep research it becomes clear that participants' subjective perception can differ significantly from objective measures. I would at least discuss this point in the discussion section.*

Thank you for highlighting this important point. We fully agree that the self-reporting approach in NHANES 2005–2006 has limitations in accurately capturing sleep duration and latency, as these were not objectively measured using devices such as chronometers or smartwatches. Consequently, we acknowledge this as a limitation of our findings and have added the following

statement to the discussion section: *"The reliance on self-reported sleep data may introduce reporting bias, as subjective assessments can skew results" as subjective assessments can skew results"*

e) *"How long does it take to fall asleep?" [A1]]Same applies here.*

Thank you for highlighting this important point. We fully agree that the self-reporting approach in NHANES 2005–2006 has limitations in accurately capturing sleep duration and latency, as these were not objectively measured using devices such as chronometers or smartwatches. Consequently, we acknowledge this as a limitation of our findings and have added the following statement to the discussion section: *"The reliance on self-reported sleep data may introduce reporting bias, as subjective assessments can skew results"*

f) *covariates: I believe that the experience of stress is a very relevant factor. As well as the consumption of caffeine and alcohol. Where there any variables available?*

Thank you for raising another relevant point. Alcohol consumption has been linked to sleep duration, as noted in our literature review. However, in our univariate analysis, alcohol intake was assessed and found to have a p-value of 0.572, indicating no significant association. On the other hand, caffeine intake had a p-value of <0.0001 in the univariate analysis but did not significantly improve the model after adjustment. Stress burden was indirectly evaluated through a specific mental disorders domain, which included variables such as "Feeling Down," "Having Someone to Provide Emotional Support," and *PHQ-9* scores. The latter two variables showed significant associations and were included as covariates in our final model.

g) *Linear regression models: Were the assumptions met?*

Thank you for double-checking this crucial statistical step. We strongly believe that our dependent variables, sleep duration, and sleep latency, were measured independently of House Dust Weight. Secondly, the residuals appear to be normally distributed in the histogram, and the residuals' LOWESS plot shows a horizontal line. Finally, the Variance Inflation Factor (VIF) is less than 5, suggesting that residuals are unlikely to be affected by collinear predictors.

h) *secondary analyses categorized sleep outcomes as: Please explain the rationale for why both outcomes, the continuous and the binary are of interest.*

This is an interesting point. The categorization of sleep duration as <7 hours versus ≥7 hours aligns with the American Academy of Sleep Medicine recommendations, as insufficient sleep "is associated with [...] weight gain and obesity, diabetes, hypertension, heart disease and stroke, depression, and increased risk of death." Similarly, we categorized sleep latency as <30 minutes versus ≥30 minutes based on the National Sleep Foundation's recommendations, which associate longer sleep latency with poor sleep quality.

We incorporated this information into the second paragraph of the Methods section:

"Sleep duration was assessed with the question, "How much sleep do you get (hours?)" and was analyzed both continuously and as adequate (≥7 hours) or inadequate (<7 hours) based on American Academy of Sleep Medicine recommendations (Watson et al., 2015). Sleep quality, measured through sleep latency (i.e., the time to fall asleep), was based on responses to "How long does it take to fall asleep?" with latencies of 30 minutes or less considered indicative of good sleep quality (Ohayon et al., 2017)."

Thank you for bringing this up.

i) *Notably, the models analyzing sleep quality were not statistically significant. Please move to the results section.*

Perfect, we agree. We have relocated those non-significant findings to the Results section, specifically under topics 3.1 and 3.2. Thank you for your suggestion.

j) *"This study provides valuable insights into household dust exposure and sleep disturbances in U.S. adults, although limitations in statistical significance for sleep quality outcomes highlight the need for further research." Sounds like a conclusion. This should move to the abstract and/or end of the discussion section.*

Thank you for this very attentive point. You're absolutely right—it doesn't belong in the "Methods" section. Since the same passage is already included in the "Discussion" section, we have deleted it from the "Methods" section to avoid redundancy.

k) *Sleep duration was measured as a continuous variable in hours. (Methods section.)*

We completely agree. As mentioned in the Results, sleep duration was measured both as a continuous variable in hours and as a binary variable with categories of less than 7 hours and more than 7 hours.

l) *Linear regression adjusted for age and emotional support. Please report on which covariates were found to be relevant of those described in the methods section.*

Thank you for bringing this topic. “Age” and “emotional support” covariates were used to adjust household dust to sleep duration, as described in section 3.1. Similarly, “Emphysema” and “PHQ-9” were the covariates to adjust household dust to sleep latency, as commented in section 3.2. We consider it more appropriate to describe it in the Result section than in the Method section.

m) *Emphysema and PHQ-9 score. Same as above.*

Thank you for bringing this topic. “Age” and “emotional support” covariates were used to adjust household dust to sleep duration, as described in section 3.1. Similarly, “Emphysema” and “PHQ-9” were the covariates to adjust household dust to sleep latency, as commented in section 3.2. We consider it more appropriate to describe it in the Result section than in the Method section.

n) *significant associations. In which direction?*

In the sentence, ´significant associations with sleep latency, as shown in Table 2,' we believe the directions of the associations are more clearly reported in the table. Specifically:

(a) Sleep Duration: Age and emotional support show positive beta coefficients, indicating that greater age and support are associated with longer sleep duration.

(b) Sleep Latency: Emphysema and PHQ-9 scores have positive beta coefficients, meaning that higher levels of emphysema and PHQ-9 scores are associated with longer sleep latency, reflecting more time needed to fall asleep.”

This is a tricky point and has to be properly reported. Thank you.

o) *"These findings underscore the nuanced role of household dust in influencing sleep outcomes. Our study observed minor effects on sleep duration but not latency, providing valuable insights into the relationship between household dust and sleep quality". Move to discussion section.*

Thank you for this suggestion. We agree that it should not be in the methods. We deleted this since there was a sentence addressing this properly in the discussion. Thank you.

Discussion:

a) *In general, coefficients for dust weight are very small even if significant. Why do you think that this is still meaningful? Couldn't it be a consequence of a large sample size leading to alpha-error?*

In our interpretation, the small coefficients are a combination of a weak association between the model and small units used in NHANES 2005-2006 (mg of HouseHold Dust). We believed that because we made a univariate analysis according to literature review, added relevant data, and performed and reported the statistical plan, we think that type I error is unlikely.

b) *For age and emotional support. The addition of emotional support drives the dust weight towards significance and is highly significant itself. I would discuss this.*

Thank you for bringing up this interesting topic.

Indeed, the crude model was non-significant, with a high p-value and no evidence of an association between household dust and sleep duration.

When adjusting for **"Age"** and **"Emotional Support,"** the model as a whole became statistically significant ($p<0.001$).

For **"Emotional Support,"** we found a significant p-value ($p=0.001$) and a strong positive coefficient ($\beta=0.44\beta$), suggesting that greater emotional support is associated with increased sleep duration. This contrasts with our primary independent variable, **Household Dust**, which tends to decrease sleep duration, as indicated by its small negative coefficient ($\beta=-0.0001$) and marginal significance ($p=0.047$).

"Age" was not statistically significant ($p=0.463$), but it remained in the model because it is a well-documented covariate in the literature.

Although the overall model was statistically significant, likely due to the strong contribution of emotional support, the effect of adjusting for **Household Dust** and **Emotional Support** is modest. The p-value for Household Dust barely reached significance ($p=0.047$), and the adjusted

R2=0.0135 suggests that the model explains only a small proportion of the variation in sleep duration.

Finally, we added this to the discussion section *"Age and emotional support were positively correlated with sleep duration in the adjusted model, suggesting that older individuals and those receiving greater emotional support tend to have longer sleep durations, as detailed in Table 2"*

c) *Coughing, wheezing, and nasal congestion and were those not available as covariates or potentially mediating factors?*

You are 100% right. Sadly, NHANES 2005-2006 does not provide rhinitis symptoms score and sleep quality score, so we could not assess those important covariates to our model.

Your comment emphasized the need for clarification. Thank you. We added a sentence into the methods section. Finally, we complemented this topic in the limitation section: *"The NHANES 2005-2006 lacks key covariates for our research, particularly rhinitis symptoms and sleep quality metrics (e.g., polysomnography, snoring scores, sleep quality scores), limiting our ability to build a comprehensive model addressing sleep duration."*

d) *Respiratory symptoms due to house dust mites were a common cause of sleep disorders and related medical consultations. I think this interpretation is a rather long stretch. Please also discuss the negative findings.*

Dear reviewer. Thank you for the need for concision and clarification:

*"*The study identified a weak but significant negative association between household dust weight and sleep duration in a multivariate linear regression model adjusted for age and emotional support. This aligns with evidence linking indoor dust to allergens and microbial contaminants that provoke respiratory symptoms (e.g., coughing, wheezing, nasal congestion) and inflammation, disrupting sleep quality and duration (Aggarwal et al., 2023; DeVries et al., 2018; Fujimura et al., 2013). Similar findings by Leger et al. (2017) highlighted house dust mites as a common trigger of sleep disorders and related medical consultations."

The negative findings were highlighted in the next paragraph, in "Strengths and Limitations"

e) *generalizability of these findings to the U.S. adult population. See oversampling point*

Thank you for emphasizing the importance of the NHANES oversampling strategy and its impact on generalizability. While this enhances the dataset's representativeness when sampling weights are applied, it also necessitates careful interpretation of findings. We have explicitly acknowledged this methodological detail in the limitations:

"Although the oversampling strategy limits generalizability, our large sample size increases the external validity beyond the U.S. adult population."

Thank you

f) *unique insights into an underexplored environmental determinant of sleep. These insights being explicitly?*

We are glad for your attentive comments and support. We agree that the words "underexplored" and "unique" seem to inflate the strengths, so we deleted this last part.

We believe that the strengths of NHANES are the generalizability and the plurality of the dataset, so we kept the main ideas of the original paragraph.

Thank you.

g) *"whether dust exposure leads to sleep disturbances or if those with sleep issues engage in behaviors that increase dust accumulation." Yes indeed - very important that it is mentioned here.*

Thank you for your consideration. We appreciate the feedback.

h) *Awareness of these limitations is crucial for a balanced understanding of the study's findings You make it aware to the reader by describing the limitations. This sentence is obsolete.*

Thank you for your valuable feedback. We agree that the sentence is redundant, as the limitations are already explicitly described in the manuscript. We will remove this sentence to ensure clarity and conciseness.

i) *Influence. I would rather stick to the wording of an association to not overinterpret the results.*

Dear reviewer. We totally agree that we should replace the word “influence” with “be associated” for the technical terms and language accuracy between the covariates. We replace it in the text.

Thank you.

j) *Effects. Again wording.*

Perfect.

We also changed ´While the effects are limited´ to ‘While the model has limited association’ for accuracy.

Thank you again.

Reviewer 3

Dear authors,

Thank you for submitting your paper at PPCR journal. It was a pleasure read and assessment this study. I will give some suggestions to improve, please, feel free to consider it or, explaining what not, not.

1. ***Abstract****:* I believe that, since the study is a exploratory study, you are checking household dust may impact the sleep. So, it's a little over the line that the first statement of the abstract already gave this statement "Indoor pollutants, such as household dust, are increasingly recognized as potential contributors to health problems, including sleep disturbances"(line 65-66). Please, could you try to make this sentence more soft to read?

Thank you for the feedback, we changed for: “Indoor pollutants, such as household dust, have been suggested as potential contributors to health problems, including sleep disturbances.”

2. **Title:** *I suggest a little change in the tittle to be more concise and impactful to "Impact of Household Dust on Sleep Quality: A Cross-Sectional Analysis of NHANES 2005–2006 Data";*

Thank you for the feedback, we changed for: "Impact of household dust on sleep quality: a cross-sectional analysis of NHANES 2005–2006 data".

3. **Methods**:
   a) *Please, could you be more precise regarding the variables tested as confounders such as "demographic and socioeconomic factors"? Which variables exactly are?*

Dear Reviewer, as perfectly suggested, we have added the variables we tested as confounders regarding socioeconomic and demographic factors: age, gender, race, marital status, and annual family income. After the adjustment, the text now reads: “To address potential confounders, the analysis included various covariates: demographic and socioeconomic factors (e.g. age, gender, race, marital status, annual family income), behavioral factors (e.g., current smoking), health-related variables (e.g., asthma, chronic bronchitis), and psychosocial characteristics, selected based on their known associations with sleep disturbances.”

   b) *It is not necessary to mention the complete NHANES 2005–2006 dataset (Line 177-179). Suggestion: For this cross-sectional analysis, we included 5,582 adults (aged 18 and older) to assess sleep duration and 4,893 adults to evaluate sleep latency, both sampled from the NHANES 2005–2006 dataset.*

Thank you for the suggestion. We agree that providing the total number of participants included in the analysis is more concise and appropriate. We have revised the text as suggested.

4. **Statistical Analysis**:

a) *Since the logistic regression analysis was entirely non-significant, I suggest focusing solely on the linear regression and exploring these results further. I have not come across a publication that employs both modeling approaches within the same study;*

Thank you for your insightful suggestion regarding focusing on the linear regression results. While we recognize that the logistic regression models yielded non-significant findings, we believe that including both modeling approaches provides a more comprehensive understanding of the relationship between household dust exposure and sleep outcomes. By including both methods, we provide complementary insights that address different facets of the research question, ensuring a fuller data exploration. Furthermore, presenting significant and non-significant results enhances

transparency and completeness, avoiding potential selective reporting and contributing valuable information for future research.

5. **Results**: *For all reported results, please ensure they align with the comments provided in point number 3.*

Thank you for pointing this out. We have reviewed the numbers in lines 78 and 81 and adjusted them to include no more than two decimal places, as suggested.

6. **Discussion**: *I believe the discussion section needs to be strengthened by incorporating literature to explain and support why a physical factor, such as dust exposure, may be associated with emotional support or age.*

Thank you for your thoughtful comment. We agree that the inclusion of age and emotional support in the model warrants clarification. These variables were included based on a priori decisions informed by the literature, as they are consistently recognized as significant factors influencing sleep outcomes. While they may not have a direct relationship with household dust exposure, their inclusion was important to account for their potential role as covariates in the association between dust exposure and sleep outcomes.

7. **Format/Grammar**:
   a) *Could you please check the numbers in lines 78 and 81? I believe it's unnecessary to include more than two decimal places;*

Thank you for noting this, we fixed the extra numbers.

   b) *Regarding line 194, please, could you digest a little for the reader? Suggestion: "[...] Age and emotional support were positively correlated with sleep duration in the adjusted model, suggesting that older individuals and those receiving greater emotional support tend to have longer sleep durations, as detailed in Table 2."*

Dear Reviewer, thank you for this suggestion. We made this change in the text to make the message be more digestible for the reader.

   c) *Line 204 - please, check the punctuation 'not good,'logistic;*

Dear reviewer, thank you for your suggestion. The changes in the punctuation were made.

Reviewer 4:

Dear authors,

The article addresses a novel topic, specifically, the impact of household dust on sleep outcomes. This adds relevant insights to the literature and highlights the potential need for public health interventions

1. **Introduction:** *This introduction is comprehensive and well-organized, effectively setting the stage for the study. It is clear about the importance of sleep for physical and mental health, situating the topic within public health and economic contexts.*

Some suggestions are:

- Include some background on the prevalence or typical concentrations of household dust in different settings.

- Briefly mention why NHANES 2005-2006 data was chosen (e.g., its scope, representation, or particular measurements of interest).

Thank you for your positive feedback on the novelty of our study and the organization of the introduction. We appreciate your suggestions for enhancing the background information and context provided in the introduction. We have added information about the prevalence and typical concentrations of household dust in various settings. This addition provides readers with a better understanding of the environmental exposure under investigation. The revised text includes:

- A brief mention of variations in household dust concentrations and factors influencing them.
- An explanation of why the NHANES 2005–2006 dataset was chosen.

2. **Methods**: *This Methods section is well-structured and informative. The use of NHANES 2005-2006 data is well-justified, indicating a robust and representative sample of the U.S. population. The primary exposure variable and outcome variables (sleep duration and quality) are clearly defined, along with relevant cut-off points and sources for the criteria*

used (e.g., AASM and Ohayon et al.). The use of linear and logistic regression models is appropriate for the analysis, with results explained as beta coefficients and odds ratios, aligning with best practices. The inclusion of various potential confounders demonstrates an understanding of the multifactorial nature of sleep disturbances.

Some suggestions:

a) *While you mention the initial number of NHANES participants (10,348), it would be useful to specify how many participants were ultimately included in the final analysis and why some may have been excluded (e.g., incomplete data).*

Dear reviewer, we appreciate your thorough evaluation of the methods section. Thank you for your thoughtful and detailed feedback on the Methods section. We appreciate your positive assessment and suggestions for improvement.

Final Number of Participants and Exclusions:
We have clarified the final number of participants included in the analysis and the reasons for exclusions in the Results section as follows:
"For this cross-sectional analysis, of the initial 10,348 participants, 5,582 adults (aged 18 and older) were included to assess sleep duration and 4,893 adults to evaluate sleep latency, both sampled from the NHANES 2005–2006 dataset. Participants were excluded from the final analysis due to missing data on key variables, including sleep outcomes, household dust exposure, or covariates. Missing data were addressed using a complete-case analysis approach, ensuring that only participants with complete data on relevant variables were included. Sensitivity analyses confirmed that exclusions did not introduce significant bias."

b) *There is no mention of how missing data were addressed, which is important for readers to assess potential biases.*

Handling of Missing Data:
We have added an explanation of how missing data were addressed to ensure transparency:
"Sensitivity analyses confirmed that exclusions did not introduce significant bias."

c) *You mentioned $p < 0.20$ for univariate analysis inclusion and $p < 0.05$ for multivariate analysis, which might raise questions about the rationale for these thresholds. Clarifying why $p < 0.20$ was chosen would enhance transparency.*

Rationale for $p < 0.20$ Threshold:
We have clarified the rationale for using $p < 0.20$ for univariate analysis inclusion:
"To address potential confounders, the analysis included various covariates: demographic and socioeconomic factors (e.g. age, gender, race, marital status, annual family income),

behavioral factors (e.g., current smoking), health-related variables (e.g., asthma, chronic bronchitis), and psychosocial characteristics, selected based on their known associations with sleep disturbances. Nasal symptom scores and additional sleep data (e.g., polysomnography, snoring scores, and the Epworth Sleepiness Scale) were not available in this dataset. Covariates that showed statistical significance in univariate analysis ($p < 0.20$) were included in multivariate models.For statistical analysis, adult participants with available sleep outcome data were included. Descriptive statistics were presented as means and standard deviations for continuous variables and frequencies for categorical variables. Linear regression models were used to examine sleep duration and latency as continuous variables, with covariates selected based on a literature review and a significance threshold of $p < 0.05$ for multivariate inclusion. Results were reported as beta coefficients (β). Additionally, secondary analyses categorized sleep outcomes as adequate/inadequate and sound/not good, with group differences analyzed using chi-square tests for categorical variables and unpaired t-tests for continuous variables. Logistic regression models were employed to examine associations with categorized sleep outcomes, with results reported as odds ratios (OR) and 95% confidence intervals. Notably, models analyzing sleep quality were not statistically significant. All analyses were conducted using Stata 18 (StataCorp LLC, College Station, TX, USA)."

d) *Expand on what the secondary analyses entailed and why these were considered (e.g., addressing specific hypotheses or further exploring significant findings).*

Secondary analyses: The secondary analyses categorized sleep outcomes (e.g., adequate vs. inadequate, sound vs. not good) to complement the primary analyses. Chi-square tests and unpaired t-tests assessed group differences, while logistic regression models evaluated associations, reporting odds ratios (OR) and confidence intervals. These analyses aimed to explore clinically relevant thresholds and population differences, offering insights that might be missed in continuous measures.

e) *While you note that the models for sleep quality were not statistically significant, briefly explaining potential reasons (e.g., sample size, power issues) could clear questions from readers.*

Thank you for your feedback.

Non-significant sleep quality models: The lack of significance in sleep quality models may be due to

- Sample Size and Power: Limited data on sleep outcomes may have reduced the ability to detect small effects.
- Subjective Measurement: Self-reported sleep quality introduces variability and potential bias.
- Complex Influences: Multiple unmeasured factors, such as stress or comorbidities, likely confounded the associations.
- Exposure Variability: Differences in the exposure across participants may have diluted effects on sleep quality.

These findings highlight areas for refinement, including larger sample sizes, objective measures, and additional covariate adjustments in future studies.

3. **Results**: *The sample characteristics, including mean age, gender distribution, and racial/ethnic breakdown, are well-described, giving context to the reader. The section includes precise values (e.g., β coefficients, odds ratios, p-values, and confidence intervals), which is essential for transparency and replicability. Adjusting for confounding variables like age, emotional support, emphysema, and PHQ-9 scores adds depth to the findings and demonstrates a robust analytical approach.*

Some suggestions:

a) Summarize the main conclusion at the end of each subsection to reinforce whether household dust has practical implications for sleep outcomes.

Dear reviewer, thank you for your assessment of the results section. We have addressed your points as follows:

1. **Summarizing Main Conclusions at the End of Subsections:**
   We have added summary statements at the end of each subsection to reinforce whether household dust has practical implications for sleep outcomes. For example:

- **Section 3.1 (Sleep Duration):**
  "While a slight negative association between dust weight and sleep duration was observed in the adjusted model, the effect size suggests limited practical significance, highlighting the need for further research to determine the clinical implications of this finding."
- **Section 3.2 (Sleep Latency):**
  "No significant association was found between dust weight and sleep latency, even after adjusting for confounders, suggesting that household dust may not play a substantial role in influencing sleep latency."

2. **Clarifying Clinical Relevance of Minor Effects:**
   We have revised the discussion of the adjusted β for sleep duration (-0.104), which corresponds to a reduction of 6.3 minutes per additional gram of dust, to address its clinical relevance:
   "Although statistically significant, the reduction in sleep duration of 6.3 minutes per additional gram of household dust is relatively small and may not translate into clinically meaningful outcomes. This finding underscores the complexity of environmental factors influencing sleep and the need for additional studies to validate these results."
3. **Discussing Practical Implications of Statistically Significant Findings:**
   We have included a discussion on the practical implications of statistically significant findings, emphasizing limitations of small effect sizes:
   "Statistically significant associations, such as the adjusted β for sleep duration and adjusted OR for adequate sleep, suggest potential links between household dust and sleep outcomes. However, the small effect sizes indicate limited real-world impact. These findings highlight the need for broader investigations into environmental and behavioral factors that might compound these effects."

b) The finding that an additional mg of dust reduces sleep by 0.374 seconds may seem trivial to readers. Clarify the clinical relevance or limitations of such minor effects, emphasizing why this finding is noteworthy or not.

c) While p-values are reported accurately, it would be helpful to discuss whether the statistically significant associations (e.g., adjusted β for sleep duration) have any meaningful impact in real-world settings. Mentioning the practical implications or limitations of the small effect sizes can give readers a better perspective on the findings.

Thank you for this interesting topic.

In our interpretation, the small coefficients are a combination of a weak association between the model and small units used in NHANES 2005-2006 (mg of HouseHold Dust).

For a better experience for readers, we transformed **mg** in **g** of HouseHold Dust weight and replaced the numbers through the manuscript and the tables.

We agree that such a small variable is clinically irrelevant and addressed that in the Results and Discussion section.

Thank you.

d) Table References: I recommend to briefly summarize in the text what is found in these tables

Thank you for your insightful suggestions. We have addressed both points in the revised manuscript as follows:

Table References: We agree with your recommendation to briefly summarize the contents of the tables in the text. We have now added concise descriptions of the key findings from each table to the relevant sections of the Results. Specifically, we have clarified what is presented in **Table 1**, which outlines the sample characteristics, **Table 2**, which summarizes the linear regression results for sleep duration and latency, and **Table 3**, which provides the logistic regression results.

e) *If possible, adding figures (e.g., a graph showing the distribution of sleep duration or dust exposure) could help illustrate findings.*

Figures: We appreciate your suggestion to include additional figures to help illustrate our findings. In response, we have added a scatter plot (Figure 1) to visually depict the relationship between sleep duration and dust weight, as well as another scatter plot (Figure 2) showing the correlation between sleep latency and dust weight. We believe these figures will help readers better understand the relationships between sleep outcomes and dust exposure.

We hope these revisions address your concerns and improve the clarity of our presentation.

4. **Discussion**: *This Discussion section is well-articulated and addresses important aspects of the study, including its findings, implications, and limitations. The section effectively summarizes the primary finding—a negative association between household dust weight and sleep duration—and connects it to relevant literature. This provides a cohesive narrative linking your results to existing research.*
   Some suggestions:

a) *While discussing the significant findings, it would be helpful to balance their importance with the overall practical impact. For instance, emphasizing that the statistically significant results were modest (e.g., small beta coefficient) can prevent readers from overestimating the real-world significance.*

Dear reviewer, thank you for your input on the discussion section.

We agree that although the results are significant, they are irrelevant. So, we also agree that we should emphasize this topic, to avoid misinterpretations. We changed our description in the first paragraph.

b) *The mention of "noise exposure" as an unexamined variable is valuable, but you could expand on other potential confounders such as socioeconomic status or the presence of pets, which could affect both dust levels and sleep.*

For the confounders, pets is another variable that should be accounted as another limitation, although it is not included in the formula provided by NHANES. Socioeconomic status was analyzed in the univariate and multivariate analysis and was non-significant.

c) *The discussion could benefit from addressing why the study did not find significant associations with sleep latency and exploring potential reasons for this (e.g., differences in sensitivity to dust exposure or limitations in self-reported sleep latency).*

For the limitations, we agree that the self-reported fashion was a point. We reported this in the limitation section.

d) *Ensure the language used does not imply causation, especially since this is a cross-sectional study (e.g., use "associated with" rather than "leads to").*

Thank you for the wording to avoid causation meaning. We replace "lead to" to "associated with".

5. **Conclusions**: *This conclusion is strong and effectively wraps up the discussion by summarizing the implications of the study and suggesting future research directions. The section does a good job of reiterating that the study provides preliminary evidence on the impact of household dust on sleep, which is concise and clear.*

Some suggestions:

a) *Adding a phrase to emphasize the magnitude of the findings (e.g., "although the observed effects were modest") would help manage reader expectations and highlight that the evidence, while important, is not conclusive.*

b) *Regarding the Public Health Recommendations, a brief example of what public health interventions might look like (e.g., "such as promoting cleaner indoor environments through educational campaigns or air filter use") would make the recommendation more concrete.*

Dear reviewer, we appreciate your evaluation and suggestions for the conclusions. To respond to your comments, we addressed your suggestions like this:

"Although the observed effects were modest, this study offers preliminary evidence that household dust exposure may impact sleep duration and quality. While the model has limited association, the

findings underscore the potential benefits of enhancing indoor air quality as part of a broader strategy for improving sleep health. Future research should clarify the causal pathways between dust exposure and sleep disturbances using longitudinal designs and examine the interaction between environmental, behavioral, and psychosocial factors. Public health initiatives focused on improving indoor air quality, such as promoting cleaner indoor environments through educational campaigns or encouraging air purifiers, could provide practical means to enhance sleep outcomes."