

PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form ([see an example](#)) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below. Some articles will have been accepted based in part or entirely on reviews undertaken for other BMJ Group journals. These will be reproduced where possible.

ARTICLE DETAILS

TITLE (PROVISIONAL)	Mental health effects from urban bed bug infestation (<i>Cimex lectularius</i> L.): a cross sectional study
AUTHORS	Perron, Stéphane ; Susser, Stephanie; Fournier, Michel; Jacques, Louis; Denis, Geoffroy; Tessier, François; Roberge, Pasquale

VERSION 1 - REVIEW

REVIEWER	<p>Jerome Goddard, Ph.D. Associate Extension Professor of Medical Entomology Department of Biochemistry, Molecular Biology, Entomology, and Plant Pathology Mississippi State University</p> <p>This reviewer has no real or perceived conflicts of interests.</p>
REVIEW RETURNED	27-Feb-2012

THE STUDY	<p>This study, while admirable and certainly useful for highlighting the emotional effects of bed bug infestations, might be flawed in some ways by the selection of participants. The tenants who were assessed for emotional distress from bed bugs were recruited from two Montreal apartment complexes who participated in public health interventions targeting unfit housing conditions. It is impossible to know how many participants may have believed that self-reporting of mental and emotional stress from bed bugs might perhaps lead to better housing conditions.</p>
RESULTS & CONCLUSIONS	<p>Although perhaps flawed in participant selection, the authors clearly disclose those limitations and the results and conclusions are still worthy of publication as a basis for further research.</p>

REVIEWER	<p>Nancy Low McGill University</p>
REVIEW RETURNED	29-Mar-2012

THE STUDY	<p>This report examines the association between bed-bug exposure and several psychiatric symptoms (sleep disturbance, anxiety, depression) in a cross-sectional case control study of a convenience sample to low-cost housing tenants.</p> <p>The major limitation of the report is that the psychiatric symptoms can be explained by a medical cause, that is the bed-bug exposure, and therefore are not primary in their origin or nature. According to</p>
------------------	---

	<p>the DSM psychiatric symptoms are considered classified as such when a medical condition has been ruled out. In this study, all subjects believe they have bed bug exposure. Even those in the control group seem to believe it even though they have been classified as not having exposure for 30 days due to lack of objective evidence. Therefore the symptoms of disturbed sleep, anxiety and possible depression in all subjects would seem like an appropriate given the medical cause.</p> <p>Could these symptoms be in excess of what would be a 'normal' reaction to bed-bug manifestation? The background does not provide this information as it seems to have to have assumed these symptoms are primary in nature. Notably, following these subjects longitudinally with proof with there is no more bed-bug exposure could make the case that the symptoms are psychiatric in nature as the bed-bug (medical cause) infestation can no longer explain the symptoms.</p> <p>Introduction More information is needed as to the medical nature and natural course of the bed-bug infestation. Bed-bug infestation can cause sleep disturbance. Those with infestations have legitimate worry about their consequences (would appears like GAD). What happens to the symptoms after people are treated? Or after people move to a non-bed-bug location? The states it is original in publishing this epidemiologic data, but what was the nature of the studies in the previous reports? It does not appear as if they were from clinical settings?</p> <p>Methods How were the apartment complexes selected? Why is the control group those who report subjective bed-bug exposure but do not have objective evidence of it? Controls are those who are at risk to have the exposure, but do not. Controls should ideally then be tenants of the same apt complexes who do not report bed-bug exposure. The figure require numbered boxed and arrows to be more clear. Given there are only 39 people who have bed-bugs, there are a lot of co-variates. The general rule of 10 cases per covariate seems to be violated. And wouldn't a bed-bug infestation be considered a 'particularly stressful event'? This many in the causal pathway and therefore reconsidered as a covariate. Given the N's are so small, a justification for missing value imputation should be made.</p>
<p>RESULTS & CONCLUSIONS</p>	<p>Results Table 1 should report the N's. What does the final column N represent? Since all variables are dichotomized why is necessary to report the complementary % in the second row of every variable? The rationale for included no of inhabitants and cockroach dwelling in the various models is unclear.</p> <p>Discussion Not specific enough. Too general. Is it the authors' position that the symptoms they are investigating are truly psychiatric in nature? That they cannot be considered as part of the symptom clusters related to having an infection? Is the literature they reference related to excessive reactions despite the medical infection being treated? What are the specific implications of this study? It would be helpful to know if they subjects were treated or not for the infestation and if they have had infestation in the past and how they managed that (medically and psychologically).</p>

VERSION 1 – AUTHOR RESPONSE

Comment by reviewer 1 JG

This study, while admirable and certainly useful for highlighting the emotional effects of bed bug infestations, might be flawed in some ways by the selection of participants. The tenants who were assessed for emotional distress from bed bugs were recruited from two Montreal apartment complexes who participated in public health interventions targeting unfit housing conditions. It is impossible to know how many participants may have believed that self-reporting of mental and emotional stress from bed bugs might perhaps lead to better housing conditions.

Reply by authors: The goal of these interventions was to document the unfit housing conditions so that municipal authorities and the owner could then intervene to improve housing conditions. The only situation where individuals could be moved to other housing units in the context of this intervention was if they showed signs of disease linked to water infiltration and humidity – thus signs of respiratory disease. It was very clear that individuals could not be displaced due to the presence of bed bugs in the dwelling.. Thus we do not think that hope of relocating to better housing conditions was an issue related to differential self reporting of infestation to have better housing conditions. We added a comment with respect to this issue in first paragraph of the method section.

Comment by reviewer 1 JG

Although perhaps flawed in participant selection, the authors clearly disclose those limitations and the results and conclusions are still worthy of publication as a basis for further research.

Reply by authors: Some precisions were added in the discussion to discuss the issue of selection bias.

Comment by reviewer 2 NL

The major limitation of the report is that the psychiatric symptoms can be explained by a medical cause, that is the bed-bug exposure, and therefore are not primary in their origin or nature. According to the DSM psychiatric symptoms are considered classified as such when a medical condition has been ruled out.

Reply by authors:

This remark is important. We added an introductory paragraph to explain that bed bugs are not an infection like syphilis and do not transmit blood borne pathogens. The only physical reaction that they cause is local swelling due to an allergic reaction following a bite. Hence they will not affect the nervous system directly like syphilis and will not affect it indirectly either (through endocrine changes). Bed bug exposure as being more similar to exposure to mosquitoes or black flies – ecologically, they are micro-predators, they take a meal of blood, then leave. Hence they will not cause psychological symptoms that are medical in nature. We consider bed bugs to be an environmental stressor.

Comment by reviewer 2 NL

In this study, all subjects believe they have bed bug exposure. Even those in the control group seem to believe it even though they have been classified as not having exposure for 30 days due to lack of objective evidence.

Reply by authors:

We investigated each home. Individuals who did not experience bed bug exposure within the last 30 days were considered unexposed. This point was made clearer in the text. Some individuals had past bed bug exposure, but did not report having exposure in the past 30 days. These individuals were also classified as unexposed. We do not have objective evidence of past bed bug exposure. If there

was any misclassification bias due to this issue, it would only decrease the strength of the association.

Comment by reviewer 2 NL

Therefore the symptoms of disturbed sleep, anxiety and possible depression in all subjects would seem like an appropriate given the medical cause.

Reply by authors:

We agree that these symptoms may occur because of the bed bug exposure. However, we still do not consider this exposure as medical, but rather environmental.

Comment by reviewer 2 NL

Could these symptoms be in excess of what would be a 'normal' reaction to bed-bug manifestation?

Reply by authors:

We cannot answer this question with our data. More research is needed to qualify what is a normal reaction versus an abnormal reaction.

Comment by reviewer 2 NL

The background does not provide this information as it seems to have to have assumed these symptoms are primary in nature. Notably, following these subjects longitudinally with proof with there is no more bed-bug exposure could make the case that the symptoms are psychiatric in nature as the bed-bug (medical cause) infestation can no longer explain the symptom

Reply by authors:

The goal of the study is not to evaluate whether the symptoms are primary in nature, but rather to evaluate the association between environmental exposure to bed bugs and the presence of sleep disturbance, anxiety and depressive symptoms.

Introduction

Comment by reviewer 2 NL

More information is needed as to the medical nature and natural course of the bed-bug infestation.

Reply by authors:

Clarifications were inserted in the introductory paragraph.

Comment by reviewer 2 NL

Bed-bug infestation can cause sleep disturbance. Those with infestations have legitimate worry about their consequences (would appear like GAD).

Reply by authors:

We agree with the sentence, however the goal was not to diagnose GAD or depression with the use of the GAD-7 and PHQ-9, respectively, but rather to use these tools to evaluate symptoms.

Comment by reviewer 2 NL

What happens to the symptoms after people are treated? Or after people move to a non-bed-bug location?

Reply by authors:

These are questions for future studies. We clarified this point in the discussion section.

Comment by reviewer 2 NL

The states it is original in publishing this epidemiologic data, but what was the nature of the studies in the previous reports? It does not appear as if they were from clinical settings?

Reply by authors:

We added the fact that none of the studies were performed in a clinical setting in the introduction

Methods

Comment by reviewer 2 NL

How were the apartment complexes selected?

Reply by authors:

Clarifications were made in the first paragraph of the 'data collection and measures'

Comment by reviewer 2 NL

Why is the control group those who report subjective bed-bug exposure but do not have objective evidence of it?

Reply by authors:

As we only wanted to evaluate those with exposure in the last 30 days, individuals who had experienced bed bug exposure in the past, but not within the last thirty days were classified as unexposed.

Comment by reviewer 2 NL

Controls are those who are at risk to have the exposure, but do not. Controls should ideally then be tenants of the same apt complexes who do not report bed-bug exposure.

Reply by authors:

Indeed, and this was the case. We added a sentence in the result section where we explain that both exposed and unexposed individuals were selected from the same two apartment complexes.

Comment by reviewer 2 NL

The figure require numbered boxed and arrows to be more clear.

Reply by authors:

It is not clear for us to which figure this comment refer to.

Comment by reviewer 2 NL

Given there are only 39 people who have bed-bugs, there are a lot of co-variates. The general rule of 10 cases per covariate seems to be violated..

Reply by authors:

We agree that the number of cases per covariate rule of thumb is slightly violated in our fully adjusted models. In this case, we chose to risk a little overfitting instead of leaving out an important confounder. Note, however, that the results are in agreement with the non-adjusted models, which respect the rule of thumb.

Comment by reviewer 2 NL

And wouldn't a bed-bug infestation be considered a 'particularly stressful event'? This many in the causal pathway and therefore reconsidered as a covariate.

Reply by authors:

We wanted to evaluate the association between bed bug exposure (which is a stressor) and various symptoms. We wanted to control for other particularly stressful events because these represent important confounders.

Comment by reviewer 2 NL

Given the N's are so small, a justification for missing value imputation should be made

Reply by authors:

The procedure that we used is standard when there are a limited number of missing value in a scale. (see end of first paragraph of the statistical analysis section)

Results

Comment by reviewer 2 NL

Table 1 should report the N's. What does the final column N represent? Since all variables are dichotomized why is necessary to report the complementary % in the second row of every variable?

Reply by authors:

The N is given (3rd column). The unexposed % column is indeed redundant. We deleted this column

Comment by reviewer 2 NL

The rationale for included no of inhabitants and cockroach dwelling in the various models is unclear.

Reply by authors:

Crowded conditions can be stressful and when there are more people in a dwelling, there are more possible hosts for bed bugs, thus increasing the chance that someone will be exposed. When there are more people in a dwelling there is also an increased risk that visitors (of whom there are more likely to be numerous) will bring in bed bugs. We added the presence of cockroaches in the dwelling as it may be perceived by many individuals as being a stressor.

Discussion

Comment by reviewer 2 NL

Not specific enough. Too general.

Reply by authors:

In the discussion we replaced mental health outcomes with anxiety and depressive symptoms and sleep disturbance.

Comment by reviewer 2 NL

Is it the authors' position that the symptoms they are investigating are truly psychiatric in nature?

Reply by authors:

We were not trying to diagnose depression or any anxiety disorder. We only wanted to know if the stress caused by the presence of bed bugs would be associated with more depressive or anxious symptoms (or sleep disturbance). If a diagnosis would have to be made, we would have to do a thorough psychiatric evaluation. Thorough psychiatric evaluations were not performed.

Comment by reviewer 2 NL

That they cannot be considered as part of the symptom clusters related to having an infection?

Reply by authors:

Bed bugs are not parasites nor infectious diseases. They do not stay on the body after biting. We cannot consider them as being infectious. There is no evidence that bed bugs transmit infectious disease. This was clarified in the introduction.

Comment by reviewer 2 NL

Is the literature they reference related to excessive reactions despite the medical infection being treated?

Reply by authors:

We refer to environmental exposure to fleas and an infestation of head lice which are both not infections. Since the reports are from a survey or case reports, and since there is not much research in this field, it is difficult to say if the reaction are excessive.

Comment by reviewer 2 NL

What are the specific implications of this study?

Reply by authors:

As stated in the article summary, the implication of this study is that individuals exposed to bed bugs may be at risk of experiencing sleep disturbance and of developing anxious and possibly depressive symptoms.

Comment by reviewer 2 NL

It would be helpful to know if they subjects were treated or not for the infestation and if they have had infestation in the past and how they managed that (medically and psychologically).

Reply by authors:

Appropriate recommendations were made following the data collection phase of the intervention. We agree that all these questions are highly relevant. However, they are questions that go beyond the objectives of our study, which is exploratory in nature. Those are questions for future research.

VERSION 2 – REVIEW

REVIEWER	Nancy Low Assistant Professor McGill University Canada I have no competing interests.
REVIEW RETURNED	10-Jul-2012

GENERAL COMMENTS	I'm satisfied with all the revisions. I was referring to Figure 2 in my initial comments. This was a question from the authors to clarify it.
-------------------------	--