BEYOND ZOONOSIS: THE MENTAL HEALTH IMPACTS OF RAT EXPOSURE ON INNER-CITY RESIDENTS

by

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Summary

Introduction

- Rats are a common problem in cities worldwide, but impoverished, inner-city neighborhoods are disproportionately affected because factors associated with poverty promote rat infestations and rat-human contact.
- Public health has mostly focused on disease transmission associated with rat infestations, but little is known about the non-physical consequences of this environmental exposure.
- Mental health is often neglected but is receiving increasing attention in public health research and practice.

Methods

- A systematic review and narrative synthesis of the published literature was conducted to explore the effect of rat exposure on mental health among inner-city residents.
- Titles and abstracts of articles were first reviewed to determine relevance to the research question; full text of included articles were subsequently reviewed and synthesized for evidence between the exposure and outcome.

Results & Discussion

- Literature addressing this topic was sparse (eight out of seven hundred and fifty-six articles) but the results consistently suggest that rat exposure has a negative impact on mental health.
- These impacts can be direct or indirect and themselves can be exacerbated by external variables.
- Evidence of the mental health impact of other pest infestations have been mixed, suggesting pest-specific factors, such as perception, also play a role in determining the outcome.
- Given the limited literature, many areas for future research remain: how rat infestation elicits stress, if a dose-response relationship exists between rat exposure and poor mental health, if different demographics are disproportionately affected, and possible interventions for the problem.

Conclusion

- By developing a better understanding of potential rat-related health risks, both mental and physical, public health officials can better evaluate, refine, and develop their policies regarding rats.

Introduction

Society has a negative perception of rats (*Rattus* spp.). From a health perspective, they are the source of a number of zoonoses that have caused considerable human morbidity and mortality around the world (1). From a sociological perspective, rats have become symbolic of filth and destitution (2).

Rats thrive in urban centers where human environments provide easy access to harborage and food (3). Aging infrastructure, poor sanitation, high population/housing density, and poverty have been consistently associated with urban rat infestations (1,4). Many of these conditions are characteristic of inner-city neighborhoods even in developed high income countries such as the United States and Canada (1,5). Often the control of these conditions rests in the hands of municipalities or landlords and are beyond that of individual residents. Residents of impoverished neighborhoods may also be ill-equipped to deal with rat infestations because of low education and income, as well as fear of landlord reprisal (5).

Although the majority of concerns regarding urban rat infestations are centered around the risk of disease transmission, the incidence of rat-associated illness among humans in urban cities is relatively low (6,7). In the absence of immediate and obvious public health threats, government bodies can become apathetic and/or reactive to rats and rat-related issues (8,9). The potential non-physical consequences of living with rats, however, have been largely ignored.

The current culture of complacency regarding rat infestations may be inadvertently contributing to a growing incidence and prevalence of mental health issues among already vulnerable populations. Within the context provided by the hygiene paradigm, the lack of recognition, evaluation and control of a potential environmental exposure (i.e., rat infestation) may translate to preventable mental health consequences in the population. Given the ubiquity of rats in the urban environment, and the fact that rat infestations disproportionately affect populations that are already marginalized, it is important to understand the full scope of potential rat-related health risk – both physical and mental. Understanding of this environmental exposure and the related health outcomes may provide the evidence needed to take action: public health officials can better evaluate the problem and implement control measures where appropriate. Thus, the goal of this review is to synthesize the published literature regarding the potential mental health impacts of rat infestations on impoverished, inner-city residents.

Methods

A systematic review was conducted among 6 databases (Appendix A) resulting in seven hundred and fifty-six articles being identified. Titles of these article were first screened, and when necessary, abstracts were reviewed to determine relevancy to the research question. Full text articles were then reviewed to determine if the inclusion criteria were met (Appendix A). Finally, the full texts of the included articles were reviewed and synthesized for evidence of the association between rat infestation and mental/psychological health. The search strategy was

reviewed by U. Ellis (UBC SPPH reference librarian) and C. Himsworth (DVM, MVetSc, Dipl ACVP, Assistant Professor, UBC SPPH) to ensure the search scope was appropriate.

Results

Eight of seven hundred and fifty-six articles fulfilled the inclusion criteria (Appendix B). Six of the included articles (Appendix C) evaluated rat infestations (as part of rodent infestations) as one component of a spectrum of housing and neighborhood factors affecting health, including mental health. Of these six, two were editorial articles, one a literature review, one a book chapter, and two cross-sectional research studies. The remaining two included articles focused on the impact of rat infestations on mental/psychological health outcomes in urban settings. One of the two was a longitudinal research study that examined the psychological consequences of having pest infestations (including rats) within the home, and the other was a cross-sectional study that examined the impact of urban rat exposures as a community stressor.

Evidence Synthesis:

Rat exposure has a negative impact on mental health

In substandard housing, pest infestations have been consistently cited as one of many mental health stressors (5,10,11). Even being cognizant of an infestation in their dwelling without any direct contact can be a source of anxiety for residents (7). A three-year longitudinal study in Waterbury, Connecticut evaluated the effects of residential pest infestations on the mental health of minority women residing in multi-unit dwellings using six psychiatric assessment scales (12). Among household pests (rats, mice, and cockroaches), only rats had a significant impact on mental health, and residents with rat infestations had poorer mental health than those without. In the preceding longitudinal study, rat exposure specifically triggered somatization (headaches, dizziness, and stomach aches), as well as other mental health outcomes such as depression and hostility (12).

Some studies have suggested that inner-city residents may develop passive acceptance of rats as part of their environment (6,12). However, in 2016, researchers examined perceptions of rats and the mental health effects of rat exposure on several impoverished Baltimore neighborhoods (13). Residents reported that in general, rat sightings were bothersome and that the level of disturbance was also proportional to the degree of exposure. Those who self-reported daily rat sightings perceived infestations to be most problematic and experienced greater depressive symptoms, compared to those exposed to rats less frequently. These associations did not vary among demographic characteristics such as ethnicity, age and education. In fact, resident attitudes towards rats were more negative in areas with high rates of infestation compared to areas with lower rates of infestation (13).

Causes of rat-related mental health impacts

The negative mental health impacts of rat infestations can be either directly or indirectly related to rat exposure. Regarding direct impacts, stress can be induced through concern for personal or

family health and safety (10). Those in contact with rat infestations may be fearful of disease exposure and/or physical trauma (3,13). It is of note that numerous cases of rat bites have been documented in substandard housing (3,7).

With regard to indirect impacts, the inaction of landlords to address maintenance issues, such as rat infestations, has been shown to elevate the tenants' stress levels; conflicts arising from the infestations may result in the threat of eviction or verbal abuse directed toward the tenants (10). Further, rat infestations can be one of a constellation of environmental stressors experienced in inner-city neighborhoods. For example, one study found that residents who perceived rat infestations as problematic also lived on blocks that had other indicators of neighborhood disorder, such as vacant properties and unkempt trash. This was after adjusting for socioeconomic factors such as education and number of children (13). Therefore, rats may indeed be a significant and independent environmental risk factor in these neighborhoods.

Discussion

Summary of Findings

The results of this review suggest that exposure to rats and rat infestations can result in negative mental health consequences for impoverished, inner-city residents. This negative effect is associated with both exposures at home (12), or as part of the general neighborhood environment (13). Although rat exposure can trigger stress directly, stress can also be elicited and/or exacerbated by indirect variables such as landlord inaction (5,10), feelings of helplessness (14,15), and concurrent neighborhood disorder (13). Mental health impacts can be compounded by the fact that impoverished residents have limited resources to address rat infestations themselves (14). This helplessness undermines the residents' control over their own lives, which has been recognized as a key parameter for distress (14,15).

Mental Health Impacts of Other Pests – Broader Context

Given the limited research investigating rat infestation and mental health specifically, results from studies on the mental health effects of other urban pests are also discussed here. These other studies provide mixed evidence of the mental health impacts of other pests. Bed bug infestations have been associated with posttraumatic stress disorder (16), and even the development of paranoid schizophrenia due to the social isolation experienced when others distanced themselves for fear of acquiring an infestation (17). Other investigators however, did not find that cockroach infestations had a significant impact on mental health (12). It is likely that the mental health effects of infestations vary among pest species based on factors such as the nature of interaction between that pest and humans, probability of physical disease consequences, the persistency of the infestation, and social perceptions of the pest. Even among pests that have negative mental health impacts, the nature and mechanism of those impacts are likely to be different because of the different characteristics of the pests and associated infestation. For example, compared to rats, bed bugs are inconspicuous, localized to an infestation site, and are not traditionally affiliated with disease transmission (18). In this context, rats may have a more

significant impact on mental health given they are conspicuous, destructive, and affiliated with disease transmission and filth.

Limitations, Knowledge Gaps and Priorities for Future Study

The most significant limitation to the current literature review and synthesis is a very small body of literature. Therefore, the nuances of the relationship between rat infestation and mental/psychological consequences remain unclear. We suggest that the following are the most significant knowledge gaps and should therefore be priorities for future study to inform public health action:

- **Why does rat exposure negatively impact mental health?** The current literature review and synthesis give us some ideas regarding the potential direct and indirect causes of rat-related distress, but a more detailed understanding of why this distress is evoked will be important for efficiently and effectively preventing and addressing that distress. For example, dealing with fears regarding disease transmission would be quite different from dealing with feelings of helplessness related to poverty. Active participation of community members is necessary for implementation of successful rodent control initiatives (19). Understanding the concerns of residents will allow program administrators to better engage communities by appealing to their worries. On the other hand, if the resident concerns are neglected, they can become disenfranchised towards control efforts (20). For example, if distress arises from concern for children's safety, communication can focus on measures that reduce the likelihood of child exposure to rats.
- **How does rat exposure negatively impact mental health?** Specifically, what symptoms and conditions does exposure contribute to and what are the long-term consequences? The existing literature suggests that the non-physical consequences of rat exposure can be highly variable, perhaps as a result of different causes of distress. For example, the manifestations of fears around disease transmission may differ from those stemming from feelings of helplessness. Thus, it will be important to understand the full range of potential mental health effects relative to the intensity and duration of exposure in order to help health care professionals identify and care for people suffering from these effects, and to provide evidence of longer-term and serious consequences as a public health lever for action.
- **Are different demographics affected differently?** There is evidence that impoverished, inner-city residents are likely disproportionately affected by rat-related mental health issues. However, it remains to be determined whether more affluent demographics are similarly affected or whether relative affluence is a protective factor. Also, within disadvantaged communities, specific groups may be at greater risk. For example, people in poor health, the elderly, or parents of young children, may be further sensitized to the negative impacts of rat exposure. This understanding will help to identify groups that should be a priority or focus for interventions.
- **Is there a dose-response relationship between rat exposure and mental health impacts?** If there is a link between the frequency and/or intensity of rat exposure, then rat control campaigns may be effective at reducing mental health impacts. Additionally, if repeated and/or chronic exposure is a risk factor, then this might highlight the need for

prompt action and diligent monitoring for infestation recurrence. Incidentally, methods to assess the rat exposure are also needed in terms of the frequency, density, intensity and duration of exposure. The health impact of community noise exposure is an environmental parallel that is well studied in this regard (21).

- **Are rats an independent risk factor for poor mental health?** Given that rat infestations are often associated with general neighborhood disorder, the potential for confounding must be considered. It may be that the negative mental health impacts are due to associated environmental stressors, such as sub-standard housing or crime, rather than rat exposure itself. If that is the case, then addressing overall neighborhood disorder may be more important than addressing the infestation. Alternatively rats and other neighborhood/environmental factors such as crime and unkempt trash, may have an interactive effect similar to how smoking and radon are synergistic carcinogens when exposed concomitantly (22). This would highlight the need to address rats specifically, even within a disordered neighborhood.
- **Are there interventions that can make people more resilient to rat exposure?** Given that rat infestations are often difficult to fully eliminate or prevent, it will be important to determine whether residents have the ability to adapt to and cope with rat infestations, or whether chronic exposure leads to progressive mental health deterioration. Identifying factors that make residents more resistant to rat-related mental health impacts may help to improve overall public health actions and interventions aimed at reduction the exposure to levels as low as possible.

Conclusion

Mental health has been a neglected problem in the field of environmental health (23). To address this, the World Health Organization has launched the *Comprehensive Mental Health Action Plan 2013 – 2020,* with prevention and research as two of its main objectives (24). Currently, health concerns regarding rat exposure are almost entirely based on the perceived threat of infectious disease. Given the non-physical impacts of rat exposure, this approach may lead to the neglect of a far greater rat-related public health impact. Information on how and why rats evoke mental stress may allow environmental health professionals to develop a better understanding of the full scope of rat-related health risks and impacts. As an environmental exposure, and at least in the inner-city setting, the health impacts of rat infestations should be re-evaluated. On a broader social context, this relationship between rat infestations and overall health impacts may be used as a lever for public health action to improve vulnerable neighborhoods. That is, this understanding may in turn provide a different perspective from which policy makers, urban planners and government officials can develop more effective and holistic public health strategies - ones that encompasses not only the physical, but also the mental and social well-being of the residents (25). However, for the intermediary, officials can consider approaches such as the ALARA (As Low As Reasonably Achievable) principle when it comes to dealing rat infestations. In this regard, existing public health, landlord-tenancy and municipal regulations are existing tools that can be used. In Canada for example, the foundation of public health legislation requires prevention of health hazards. Many landlord-tenancy statutes stipulate that landlords

must uphold the maintenance of their properties, which include pest infestations. At the local level, municipal property use divisions can address rat infestations with their by-laws.

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Appendix A – Search Strategy

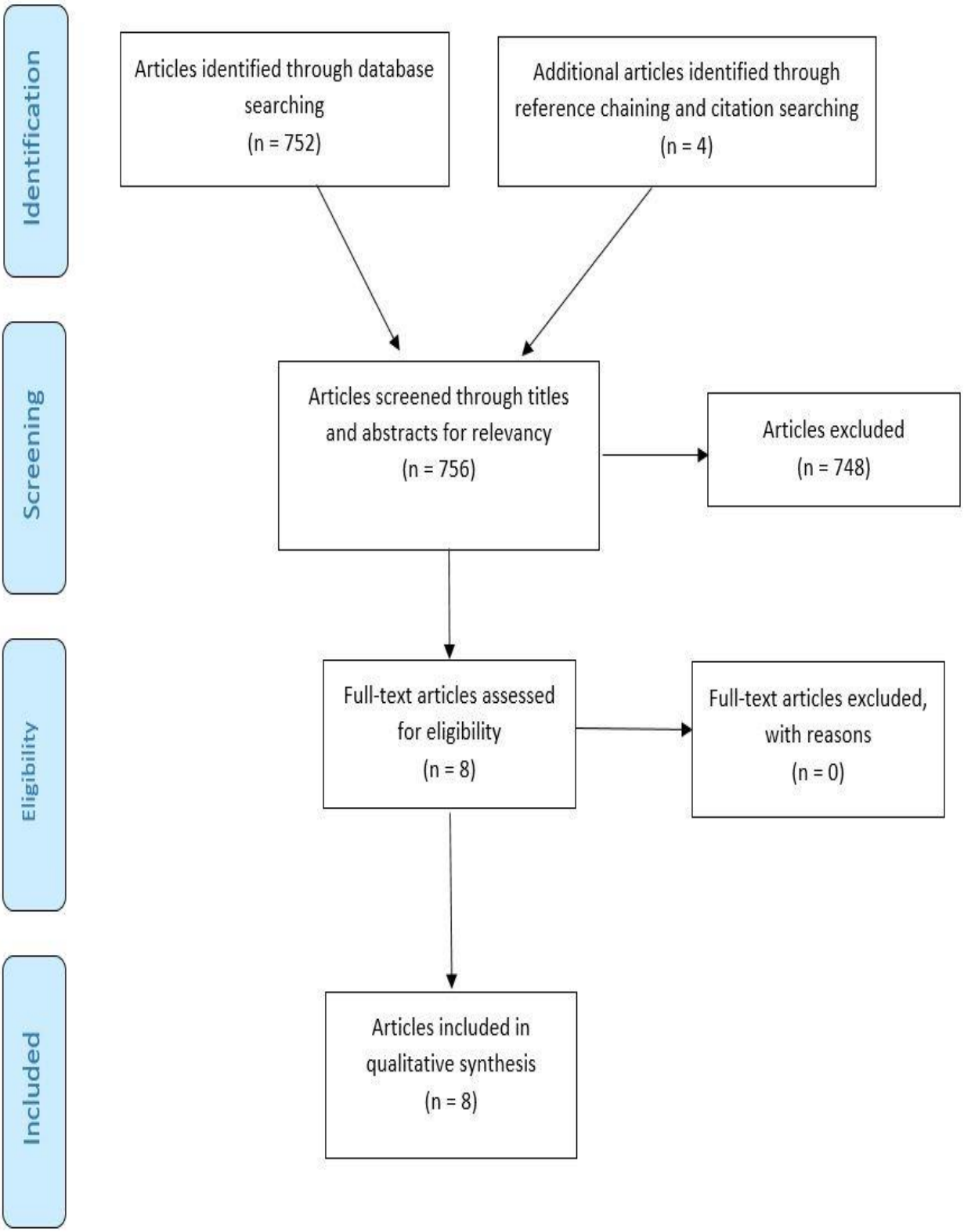
Scope of Search

The systematic search included Medline, Embase, Web of Science, PubMed, PsycINFO and Cinahl. Word searches were conducted using a combination of keywords and Medical Subject Headings (MeSH), pertaining to three main concepts: rats (rats, rodents, rat infestation, rodent infestation, rodentia, *Rattus norvegicus*, *Rattus rattus*, black rat, Norway rat, brown rat), psychological effects (mental health, mental disorder, anxiety, stress, psychological stress) and impoverished urban populations (urban, poor, poverty, poverty areas, socioeconomic factors, slums, social class). The Boolean operators OR and AND were used to combine keywords/MeSH terms within and between concepts, respectively. Reference chaining (manual searching of reference lists) and citation searching (following references that cite relevant articles) were used to supplement results.

Inclusion/Exclusion Criteria

Only articles that discussed the impact of rat infestations (including as part of general rodent infestations) on mental/psychological health in residents of urban neighborhoods were considered. Articles focusing on the mental health impact of other pest species (e.g., mice), studies that did not pertain to urban centers (e.g., rural settings), and articles written in languages other than English, were excluded.

Appendix B – Modified PRISM Diagram of Literature Search



Appendix C – Publication Details of Included Studies

Author, Year	Title	Literature Type	Aim	Relevance to Evidence Synthesis
Clinton, 1969	Rats in urban America	Editorial	Provided an update of increased rat bite incidence in urban America	Editor provided comment on the lasting and adverse psychological effect of having rat-bite mutilated lips
Bashir, 2002	Home is where the harm is: Inadequate housing as a public health crisis	Editorial	Provided overlook of how sub-standard housing affected public health	Cited rodent infestation as one of many household triggers for poor mental health; vulnerability of poor families to sub-standard housing conditions due to concern of eviction
Battersby et al., 2002	Urban rat infestations and the risk to public health	Literature review	Examined the risk to public health from urban rat infestations	Social inertia/exclusion led to underreporting of rat infestations among poor neighborhoods
Battersby et al., 2008	Public health significance of urban pests	Chapter in Peer Reviewed Book (WHO)	Provided main health, economic, disease burdens of common urban pests	Indicated rats are a source of mental anxiety, on top of traditional association with disease
Bachelder et al., 2016	Health complaints associated with poor rental housing conditions in Arkansas: The only state without a landlord's implied warranty of habitability	Cross-sectional survey	Examined how Arkansas landlord-tenant laws contribute to unhealthy housing and poor health	Landlord tenant conflicts arising from maintenance (including rat infestations) caused tenant stress levels to rise

Duvall & Booth, 1978	The housing environment and women's health	Cross-sectional survey	Examined the quality of household environment and its impact on health	Non-structural household deficiencies, including rodent infestations, found to negatively affect mental health
Zahner et al., 1985	Psychological consequences of infestation of the dwelling unit	Longitudinal follow-up survey (multiple)	Investigated the psychological impact of pest) infestations (mice, rats, cockroaches, others on minority women	Rat infestations associated with eliciting somatization
German & Latkin, 2016	Exposure to urban rats as a community stressor among low-income urban residents	Cross-sectional survey	Investigated the impact and perception of rat infestations among impoverished Baltimore neighborhoods	More mental health issues reported in neighborhoods with higher rat prevalence