

Psychological Consequences of Infestation of the Dwelling Unit

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Abstract: Interview data from a three-wave panel study of the impact of the residential environment upon the psychological well-being of 337 minority women were used to examine the effects of household infestation upon self-reported depression, phobic anxiety, somatization, hostility, and anomia. The findings of cross-sectional

and change analyses over the three waves of data point to a stable relationship between rat infestation and a single dimension of psychological well-being, somatization. (*Am J Public Health* 1985; 75:1303-1307.)

Introduction

Infestation remains an important housing problem in the 1980s. A recent report prepared for the US Environmental Protection Agency by the National Research Council's Committee on Urban Pest Management¹ noted that infestation of the dwelling unit by vermin is ranked second among 18 household problems cited in the Annual Housing Survey and is the only housing defect that has increased in prevalence over the last decade. The Committee called for empirical research on social factors related to management of urban pests and for studies of individual perceptions of pests and the impact of infestation on well-being, arguing that improved pest management cannot take place without better scientific understanding of behavioral and psychological responses to infestation. The increase in infestation observed in inner-city housing units of the poor and disadvantaged was felt to be due in part to a negative emotional response to infestation, where residents have resigned themselves with passive acceptance to the presence of these domestic intruders. The Committee also expressed concern that the presence of certain pests may "cause people to perceive themselves as being in a degraded environment and that this may in turn affect their ability to cope with life in general."¹

Despite interest in the relationship between psychosocial mechanisms and household infestation among urban planners and policy makers, a literature review yielded only one study that had quantitatively assessed the impact of housing pests upon mental health, a sub-study of the Toronto housing study.² This investigation detected no relationship between the number of types of household pests and scores on the Langner scale in a sample of Canadian women. The Toronto study's failure to detect the type of strong, deleterious effects suggested by early observers of slum conditions has been a commonplace outcome of studies examining many other dimensions of the residential environment; viz. the absence of strong negative effects of crowding³⁻⁶ or strong benefits of improved housing quality.⁷

The purpose of this report is to present empirical findings relating presence of vermin to diminished psychological well-being. Our investigation of the relationship between infestation and psychological well-being involves a three-wave panel study of the impact of the residential environment

upon the mental health and well-being of minority women. In addition to exploring the simple (zero-order) effects of infestation upon psychological well-being, we will look at the strength of the association uniquely attributable to infestation after removing the concurrent influences of other housing conditions and socioeconomic factors related to poverty. These relationships will also be examined in the three waves of interview data both cross-sectionally and as changes over time.

Methods

The Waterbury housing study is a longitudinal, three-year panel study, with interviews conducted at annual intervals following the initial (TI) data collection in June-August 1977. The data reported here are a limited portion of the residential, social, psychological and demographic variables collected in this study, which was designed primarily to test for social and psychological benefits among residents of an innovative Housing and Urban Development (HUD) housing project. Detailed descriptions of the study methodology and preliminary study findings are reported elsewhere.⁸

Subjects

The panel of study participants were 337 Black and Latino women residing in Waterbury, Connecticut, an industrial city of approximately 105,000 in the central region of the state. Subjects were sampled from five primary residential locations across Waterbury and comprise a reasonably representative sample of Black and Latino women at these sites. Although the selected study subjects cannot strictly be considered a representative sample of all minority women in Waterbury, the sampling procedures did identify residents of housing that represented a spectrum of housing quality and neighborhood locations. One special restriction imposed by the subject selection procedures is the virtual absence of owner-occupied or single unit dwellings in our sample. The response rate to the initial interview was 90 per cent of all eligible subjects. A modest attrition of 11 per cent occurred in panel members from the first to the third wave of interviews.

Data Collection Procedures and Study Measures

At each data collection wave, structured in-person interviews were conducted in the respondent's home. All interviewers were Black or Latino, and an effort was made to match interviewers to the respondent's racial and ethnic status. Many of the interview items were combined into larger, summary measures of particular dimensions of the residential environment and psychological well-being. A

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brief description of the pertinent scales used in this infestation report is provided below.

Infestation—Respondents were asked to report on presence of rats, mice, cockroaches, and other pests in their households. The format of questions on infestation was identical to that used in the American Public Health Association's (APHA) Appraisal Method for Measuring the Quality of Housing⁹ and the Annual Housing Survey.¹⁰ As in these documents, answers were restricted to the presence or absence of infestation, and no information was obtained on frequency or intensity of infestation, or on how much the infestation bothered the respondent. For purposes of analysis, a five-point pests index was developed using the following scoring: 1) no pests; 2) cockroaches only; 3) mice only; 4) mice and cockroaches; 5) rats (with or without other pests present in the household). This typology permitted flexible handling of the infestation index in data analysis, where it could be treated either as a nominal classification variable or as an ordinal or interval measure of intuitively ranked "severity" among the different forms of infestation.

Housing Quality—This index was comprised of 28 items selected from the more extensive APHA Appraisal Method and covers conditions in five areas: 1) plumbing and heating; 2) unit maintenance; 3) location of unit; 4) crowding; and 5) deficiencies in the exterior and interior structure. The respondent provides information on the first four areas while the interviewer evaluates the fifth area. Each item is scored on a five-point scale, with high scores indicating poor housing quality; the items are not weighted differentially in arriving at a total score. This scale contains many items found in the Annual Housing Survey and it is also similar to the Shortened Version of the Appraisal Method used by Wilner, *et al.*⁷ One feature distinguishing the Housing Quality index used here from the scale used in the Wilner study (as well as versions used in our other reports of Waterbury findings) is the exclusion of any information pertaining to infestation from the index. In this way we can examine separately the correlates of infestation and of the remaining aspects of housing quality.

Psychological Well-being—The respondent's report on her own mental health and well-being was measured by six scales. Four of these represent factors from the 90-item version of the Hopkins Symptom Check List (HSLC-90),¹¹ a self-report symptom inventory: 1) Agitated Depression (symptoms such as trembling, poor appetite, crying easily); 2) Phobic Anxiety (being afraid of open spaces, uneasy in crowds, sudden fears); 3) Somatization (psycho-physiological symptoms, many associated with anxiety, such as headaches, dizziness, upset stomach, pains or weakness in parts of the body); 4) Hostility (items denoting irritation, temper outbursts, urgency to smash things). Two additional scales in this group included: 5) the Zung Depression¹² scale; and 6) the Srole Anomia¹³ scale. The Zung Depression scale consists of 20 items assessing common features of depression, including depressive affect (e.g., feeling sad, pessimistic, or irritable), physiologic concomitants (e.g., sleep disturbance, weight loss), and cognitive symptoms (e.g., impaired decision making). The Srole Anomia scale includes questions concerning the role of fate or luck in life circumstances and whether others are unsympathetic, cannot be trusted, or are to blame for problems.

Analysis

All statistical analyses were conducted using Statistical Analysis System General Linear Models programming pro-

cedure.¹⁴ The infestation index was routinely entered into these models as a nominal classification variable with four degrees of freedom. Adjustment for covariates was made by entering relevant variables into the model before the infestation index. Adjusted mental health score means were computed for the infestation sub-groups in all models. More detailed descriptions of the specific models tested will be provided at appropriate points in the results section.

Results

Profile of Infestation in the Study Sample

The three major forms of infestation on which respondents were asked to report—rats, mice, and cockroaches—appeared to encompass all principal types of infestation in our study population. Fewer than 5 per cent of our sample reported other forms of infestation (e.g., flies, ants) at any time period, and therefore these additional but infrequent types of household pests were disregarded in analysis.

At all data collection periods, approximately 40 per cent of the sample reported some form of infestation, with a slight decrease in infestation levels over time (T1 = 41 per cent, T2 = 37 per cent, and T3 = 35 per cent). Cockroaches were the most prevalent form of housing pest reported by study participants, although their levels decreased from 34 per cent at T1 to 26 per cent and 28 per cent at T2 and T3, respectively. Seventeen per cent of the sample reported mice at T1, dropping to 13 per cent at the two subsequent data collection periods. There was considerable overlap between presence of cockroaches and mice: approximately half of the households with mice were also infested with cockroaches, and 7 per cent of all households surveyed reported presence of these two pests. The prevalence of rats ranged from 3 to 5 per cent during the study period.

Comparisons with Annual Housing Survey^{15,16} estimates of rat and mouse infestation suggest that infestation levels in our sample are comparable to the nation as a whole, but are significantly lower than those found in most Black or Latino households, nationally or locally. Apparently this discrepancy can be explained by the heavy sampling of recently constructed government-sponsored project housing in our study. Project housing units included in the study have relatively little rodent infestation (8.5 per cent), whereas the prevalence of rats and mice in Waterbury non-project housing is 27 per cent, a level comparable to the Springfield, MA rates. No national data are available to determine whether the level of cockroach infestation in the study sample deviates significantly from national or regional norms.

Impact of Infestation on Women's Psychological Well-being

Cross-sectional Analysis—Two principal objectives were pursued. First, we were interested in determining whether a stable, replicable relationship between infestation and mental health measures existed in the Waterbury data. Second, we attempted to evaluate whether the observable impact of infestation on psychological well-being withstood a sequence of stringent statistical controls, adjusting for a subset of demographic variables associated with the psychological measures and removing effects due to other adverse housing conditions that may explain the infestation relationship.

Table 1 summarizes the findings from the cross-sectional analyses at three points in time.

The upper portion of the Table indicates the standardized mean psychological ratings for each of the pests categories at the first interview period (1977). Means displayed in

TABLE 1—Cross-sectional Analyses of the Influence of Infestation on Women's Mental Health and Well-being

A. Standardized T1 Mental Health Means for Infestation Subgroups, Adjusted for Demographic Factors and Housing Quality ^a					
	No. Pests	Cockroaches Only	Mice Only	Cockroaches and Mice	Rats
HSCL-90 Agitated Depression	-.08	.08	.21	.21	.36
HSCL-90 Phobic Anxiety	-.10	.15	.09	.04	-.04
HSCL-90 Somatization	-.11	.18	.31	.08	.87
HSCL-90 Hostility	-.09	.11	-.07	.06	.27
Zung Depression	-.26	-.02	-.31	.16	-.03
Srole Anomia	-.28	.09	-.31	.08	.00

B. Percentage of Variance in Mental Health Measures Explained by Infestation Index, with Covariance Adjustments for Housing Quality and Demographics ^b			
Scale	T1	T2	T3
HSCL-90 Agitated Depression	(1.4%)	6.3%	— ^c
HSCL-90 Phobic Anxiety	(1.2%)	(3.0%)	(1.4%)
HSCL-90 Somatization	4.8%	10.1%	4.2%
HSCL-90 Hostility	(1.1%)	(2.3%)	(2.7%)
Zung Depression	(2.1%)	(1.8%)	(1.3%)
Srole Anomia	3.0%	(2.0%)	(3.1%)

^aUsing standard scores; $\bar{X} = 0$, S.D. = 1.0.

^bPercentages are given in parentheses when $p > .05$.

^cInformation on HSCL-90 Agitated Depression not collected at T3.

this Table have received least squares adjustment for differences between infestation groups attributable to other residential conditions and demographics. "Rats" were consistently associated with the poorest mental health, but the cockroach and mice categories revealed an uneven pattern of mental health scores. The pattern observed at T1 is replicated at T2 and T3, although the data are not presented in the Table.

The lower portion of the Table presents the per cent of variance in the psychological well-being measures at times 1 through 3 explained by our five infestation groups, adjusted to remove the effects of demographic factors and housing quality. A subset of potentially confounding demographic factors had been identified for each mental health scale by a stepwise, backward elimination regression of the following variables: family income, employment status, marital status, age of respondent, education, race (Black or Latino), and number of children in the family. The relevant subset of demographics for each scale was then entered together with the Housing Quality index before the infestation term in a linear regression model. The variance explained by the infestation categories computed from the sequential (Type 1) sums of squares therefore represents the additional variance explained by infestation after the effects due to demographic factors have been removed.

Only Somatization persists as a fully replicated outcome over the study period. The "unique" contribution of infestation in explaining Somatization variation using our most stringent set of controls ranges from 4 to 10 per cent over time.

Analysis of Change Over Time—A second series of analyses of the impact of infestation on women's psychological well-being capitalized on the longitudinal nature of our study design, examining changes in infestation and mental health over time. Changes in infestation levels over each annual wave (i.e., between T1 and T2, "T1-2" and between T2 and T3 "T2-3") were classified into four groups: 1) infestation conditions worsened; 2) infestation conditions present with no change in levels over time; 3) no household infestation; and 4) infestation conditions improved. The four level index of change in infestation from T1 to T2 was used

to predict psychological well-being at T2 in linear regression models, and the T2-3 Infestation Change index was used in predicting psychological well-being at T3. The strength of the association between the T1-2 Infestation Change index and psychological well-being was tested by entering the index in three types of regression models: 1) in models without covariates; 2) models where Infestation Change index is entered after T1 psychological well-being; and 3) in models where the Infestation Change index is entered after T1 psychological well-being and a measure of change in housing quality from T1 to T2. The models in which T1 mental health effects are removed provide tests of the association between the Infestation Change index and changes in psychological well-being over time. A parallel series of analyses was conducted for the T2-3 period.

Table 2 summarizes the results of change analysis for the T1-2 period. The amount of variation in the mental health measures at T2 explained by the Infestation Change index above and beyond the covariates in each model is listed for all associations at the $p < .05$ level. In addition, estimates of standardized scores for the psychological scales adjusted for covariates are provided for each of the four change groups. Table 3 provides the results for the change analysis of the T2-3 period.

The information supplied in these Tables again points to Somatization as a principal psychological response to infestation. The Infestation Change index remained a significant predictor of this mental health outcome after controlling for initial psychological status and housing changes over both one-year periods, and accounted for approximately 3 per cent of the variance in the change in somatization levels. The HSCL-90 Agitated Depression factor also emerged as a related psychological outcome in the T1-2 period, but since this measure was not obtained at T3, this finding could not be replicated. The Infestation Change index again explained about 3 per cent of the variance in the change in HSCL-90 Agitated Depression levels after the effects of concurrent changes in housing quality were removed.

Inspection of the subgroup means revealed a number of emerging patterns among the pests change categories. In the

TABLE 2—The Association between Change in Level of Infestation and Respondent's Mental Health: Change in Pests between Waves 1 and 2, Predicting Mental Health at Wave 2

Scale	% Variance Accounted for by Change in Pests ^a			Mean Mental Health Score for Pests Subgroups ^{b,c}			
	Controlling for:			A Pests Conditions Worsened	B Pests Present, No Change in Conditions	C No Pests Present	D Pests Conditions Improved
	No Controls %	Wave 1 Mental Health %	Wave 1 Mental Health and Changes in Housing Quality, Waves 1–2 %				
HSCL-90 Agitated Depression	5.3	4.5	3.1	.41	.06	-.01	-.18
HSCL-90 Phobic Anxiety	(1.7)	(1.5)	(<1.0)	.20	.02	.02	-.12
HSCL-90 Somatization	5.6	4.3	2.9	.31	.23	-.04	-.20
HSCL-90 Hostility	(2.8)	3.2	(2.5)	.37	-.12	-.06	.00
Zung Depression	(1.6)	(<1.0)	(<1.0)	.11	.04	.03	-.16
Srole Anomia	5.5	(2.3)	(2.3)	.22	-.02	-.17	.14

^aPercentages are given in parentheses when $p > .05$.

^bUsing standard scores; $\bar{X} = 0$, S.D. = 1.0.

^cMental health scale means are adjusted for differences in initial mental health and housing quality changes among subgroups.

TABLE 3—The Association between Change in Level of Infestation and Respondent's Mental Health: Change in Pests between Waves 2 and 3, Predicting Mental Health at Wave 3

Scale ^a	% Variance Accounted for by Change in Pests ^b			Mean Mental Health Score for Pests Subgroups ^{c,d}			
	Controlling for:			A Pests Conditions Worsened	B Pests Present, No Changes in Conditions	C No Pests Present	D Pests Conditions Improved
	No. Controls	Wave 2 Mental Health	Wave 2 Mental Health and Changes in Housing Quality, Waves 2–3				
HSCL-90 Phobic Anxiety	(<1.0%)	(<1.0%)	(<1.0%)	.26	.16	.12	-.09
HSCL-90 Somatization	5.2%	4.3%	3.6%	.33	.42	.10	-.32
HSCL-90 Hostility	4.2%	2.8%	(2.4%)	-.07	.32	.12	-.20
Zung Depression	(1.6%)	(<1.0%)	(<1.0%)	-.05	.16	.02	.05
Srole Anomia	2.6%	(<1.0%)	(<1.0%)	.03	.13	-.04	-.16

^aHSCL-90 Agitated Depression not assessed at Wave 3.

^bPercentages are given in parentheses when $p > .05$.

^cUsing standard scores; $\bar{X} = 0$, S.D. = 1.0.

^dMental health scale means are adjusted for differences in initial mental health and housing quality changes among subgroups.

unadjusted means, individuals in households where pests were present and either *worsened* or showed *no change* tended to have poorer mental health than individuals in homes *without pests* or where infestation conditions *improved*. After adjustment for baseline levels in psychological status, the residual changes in psychological well-being over time were found most often in subgroups experiencing a change in infestation, either for the better or worse. Individuals with stable but persistent levels of infestation also showed a slight elevation in Somatization scores. We also examined whether a change in a particular form of infestation (e.g., rats) was especially stressful. No differences among types of pests were observed, but the numbers involved in these analyses were small.

Discussion

Infestation appeared to evoke a highly specific, targeted type of psychological reaction in the women in our sample: psychophysiological symptoms often associated with anxiety (dizziness, palms sweating, headaches, etc.), which have been labeled as "somatization." In cross sectional analyses of our panel data, the HSCL-90 Somatization factor was the only psychological measure associated with infestation over all three time periods after the effects due to background demographic and housing quality were removed. A change in

infestation was also associated with a corresponding change in level of somatization, and individuals with chronic, stable pests conditions over time showed slight increases in somatization scores. The HSCL-90 Agitated Depression factor, which was also associated with changing levels of infestation over time, is another measure heavily weighted with physical symptoms of anxiety (shakiness, trembling, feelings of tension, restlessness). As further evidence of specificity, there was little suggestion of risks associated with cockroach or mouse infestation. Rats appear to be the principal culprits in our study.

In spite of our efforts to remove the effects of confounding factors and our use of a longitudinal study design, a number of competing explanations for the observed association between infestation and psychological distress cannot be readily dismissed. First, both our infestation and mental health indices were based on self-reported information. It is conceivable that respondents reporting psychological problems are more likely to report excessive levels of other problems, including infestation. Although our ratings of infestation were subjective, the pattern of association between the infestation reports and other housing measures suggest that the infestation index has some level of validity. Reports of infestation were equally strongly related to more "objective" ratings of other housing problems made by

interviewers as to housing deficiencies reported by study subjects. Also, the types of infestation most likely to be found within the dwelling unit (e.g., cockroaches, mice) were reported with greatest frequency by respondents living in households where garbage disposal took place within the dwelling unit (e.g., by use of compactors, sink disposals, and trash chutes). By comparison, rat infestation was reported by individuals using garbage cans located outside the household, especially when the lids were loose fitting or garbage overflowed from the cans.

A second limitation of our findings is that despite the longitudinal study design, our measures of changing housing conditions and psychological state were not fully capable of delineating a causal sequence of events since our observations were only made at annual intervals. We are unable to rule out the possibility of "reverse causation", that women who become more distressed take less care of their homes, creating an environment conducive to infestation by bugs and vermin. However, there are a number of conditions of the Waterbury population and residential setting (e.g., multi-family dwelling units, upkeep by a management corporation, insufficient income to invest in professional extermination or repairs of holes or cracks in walls), suggesting that infestation is linked to housing and social conditions effectively beyond the control of the women we studied.

The specificity of the relationship between psychological outcome and type of infestation observed in our analyses can be also offered as a defense in support of a causal directionality. If women are reporting more pests because their psychological problems confine them to their homes or interfere with their upkeep of the household, there is little reason to believe that they would not report more cockroaches and mice as well as rats. Furthermore, symptoms of somatic anxiety measured by the Somatization factor are less likely to have a debilitating effect upon social or work functioning than, say, depression involving psychomotor retardation.

We feel that the impact of infestation will be dependent on contextual factors and that our Waterbury sample may have heightened sensitivity to the effects of infestation. The women we interviewed were, for the most part, economically disadvantaged, and their aspirations for improved housing conditions were limited. They lived in multi-unit dwellings and were dependent on the cooperation of neighbors and apartment management to effectively reduce levels of infestation. Many had young children, and a substantial number were raising their children without the assistance of a spouse. For these women, housing pests, and rat infestation in particular, may have represented a substantial threat or danger to themselves and their dependents that they were unable to combat. It is less likely that household infestation would take a similar toll in middle class families or among graduate students temporarily living in substandard housing.

There is a general consensus among the reviewers of the housing literature that the relationship between the physical environment and well-being is a complex one, and that we must concentrate our efforts on identifying mediating mechanisms and modifying variables. This certainly seems an unavoidable next step for studies of crowding and population density. We would tentatively like to propose on the basis of our present findings that there may also exist other environmental stressors involving less complex cognitive, social, and

behavioral responses, ones whose effects upon psychological well-being may be easier to detect because they are relatively simple and direct. A number of characteristics of the stressor identified in the present study may be central features of a simplified stress-response paradigm. Rat infestation may be an environmental factor that is uniformly regarded as a potential threat or personal danger and to which there appears to be little emotional adaptation with continued exposure. Additionally, the impact of this stressor may have been strengthened in the present study because it was experienced in a setting in which there was limited opportunity to control or remove the source of danger. A useful strategy for identifying additional components of the residential environment with significant impact on psychological well-being may be to target particular settings or other housing conditions in which these general features are combined.

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