

Environmental and Health Impact of Energy and Water Saving Renovations in Public Housing

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Note: This paper represents the conclusions and views of the authors. It does not reflect the official view of the World Health Organization.

Abstract

Four distinct analyses of data from two public housing developments in Boston, Massachusetts, US, were examined to investigate the environmental and health impact associated with energy and water saving upgrades. We assessed resident responses to a survey asking about housing problems and health symptoms as well as requests for repairs before and after energy and water upgrades. We tested variation in resident responses between renovated and un-renovated developments. And we examined associations between measured gas and water consumption and resident survey responses with respect to housing problems and health symptoms. With only a few exceptions, our analyses suggest that energy and water saving upgrades in this housing are compatible with improved living conditions and reduced reports of health symptoms. We conclude that we have begun to develop an approach to studying the impact of renovations on housing and health, but that future studies are needed.

Introduction

Growing asthma rates are an illustration of the mounting environmental health problems that we face today. Over the past twenty-one years, asthma rates in the United States have grown to 31.3 million people in 2001 (Brugge et al, 2004).

Asthma affects people of all age, racial and ethnic groups; however, low income and minority populations are disproportionately affected and experience substantially higher rates of hospital admissions, emergency room visits, and fatalities due to asthma. Data from New England in 2001 showed that Black and Hispanic children and also low-income populations have higher prevalence of asthma (Asthma Regional Council, 2004). In Boston in 2002 there were 11.0 asthma hospitalizations per 1,000 Latinos in the population and 10.7 asthma hospitalizations per 1,000 Blacks in the population (Health of Boston, 2001)

Inroads to the Healthy Public Housing Initiatives (HPHI) were laid in 1997 as a response to the increasing asthma rates in the inner city neighborhoods in Boston. The pilot survey conducted in South Boston public housing showed building related structural problems, such as leaks, moisture, overheating, lack of ventilation and condition of cleanliness as the main causes of poor indoor air quality (Hynes et al., 2000).

The coalition which started as a community – university partnership with the aim of understanding and documenting the public health status in Boston Public Housing grew into HPHI, a broad community- university – city collaborative with the goal of improving community environmental health in public housing in 2000 (Hynes et al., 2003). HPHI focused on the renovated West Broadway Public Housing Development in South Boston and the un-renovated Franklin Hill Public Housing Development in North Dorchester. The goal was to better understand the relationship between housing and health and to generate practical recommendations.

Renovations at West Broadway included roof, wall, and piping repairs in 1984, 1987 and 1990. About 100 bathroom fans were installed across the development. All the interior sections were rehabilitated, and reconfigured, some exterior walls were insulated, and other cosmetic remodeling was done such as repointing of bricks, sealing of seams, and addition of small bump outs around window areas. In 2001, the Boston Housing Authority (BHA) installed energy and water efficiency upgrades at the West Broadway Development. The energy efficiency upgrades included changing from a central steam heating system to distributed forced hot water heating system, with one heating system per building. The water efficiency upgrades included new low flow faucet aerators and showerheads, and low volume toilets (Brugge et al., 2003). Table 1 compares the West Broadway and Franklin Hill developments.

This paper summarizes key research findings from four analyses related to energy savings and health benefits.

Analysis # 1

West Broadway comparisons before and after the renovation

(Brugge et al., 2003)

This analysis explores the effects of energy and water upgrades on self-reported building environment and the resident health. Survey responses gathered from West Broadway before the renovation in 1998 (N=50; Hynes et al., 2000) were compared to survey responses collected after the renovation in 2002 (N=132; Brugge et al., 2003). There were statistically significant increased reports of too cold and enough fresh air after the energy and water upgrades (all ORs adjusted for sex, age, ethnicity and years in public housing). Reports of overheating, stuffy apartments, opening windows in the winter, using the oven for heat, using the air conditioner during the winter and water leaks showed trends toward decreasing after the renovations. Reports of condensation increased after the renovations (Figure 1a).

Comparison of health symptoms before and after heating and water upgrades showed that while there were reductions in reports of some symptoms, none of the changes were statistically significant (Figure 1b).

Analysis # 2

Cross sectional Comparison between West Broadway and Franklin Hill (Brugge et al., 2003)

In this analysis surveys gathered from Franklin Hill (not renovated; N=106) and West Broadway (renovated; N=132) in 2002 were compared to identify self reported housing conditions and chronic health conditions and symptoms in the preceding month. Numerous statistically significant differences in reported indoor environmental problems and resident symptoms were seen between Franklin Hill and West Broadway resident responses. There were a statistically significant increases in reports of over heating, stuffy apartments, opening windows in the winter, wearing light clothes in the winter, using air conditioners in the winter, water leaks, condensation, and smelling mold in the apartment in Franklin hill. There was a trend toward more reports of being too cold and a statistically significant increase in reporting that there was enough fresh air in the apartment at West Broadway (Figure 2a).

Most health symptoms did not differ statistically between the two developments after adjustment for potential demographic confounders. However, reports of ear infection, skin rashes and sneezing remained statistically elevated at Franklin Hill relative to West Broadway (Figure 2b).

The Franklin Hill/West Broadway analysis also looked into environmental factors less likely to be associated with heating systems such as cleanliness, cockroaches, mice, bathroom fans, adults and children with asthma. West Broadway showed a statistically significant increase in cleanliness compared to Franklin Hill. The results also showed statistically significant increase in cockroaches, mice, working bathroom fans and children with asthma in Franklin Hill. Though not statistically significant, West Broadway residents reported 50 percent less adult asthma (data not shown).

Analysis # 3

West Broadway work order comparison before and after renovation (Preliminary report of work in progress)

Work order reports are requests to the housing authority for repairs of apartment level problems, in our case, those for heating and hot water. In this analysis West Broadway work order complaints were compared before and after the energy and water upgrades in 2001. The longitudinal comparison of work order reports for worker order complaints for heating and hot water before (1999 – 2000) and after the renovation (2001 – 2002) showed that the heating and hot water complaints declined following the renovations (Figure 3).

Analysis # 4

West Broadway energy and water consumption savings analysis (Preliminary report of work in progress)

In this analysis, gas and water consumption in each building at West Broadway were measured to attempt to understand their relationship to resident-reported building environment, living conditions, and health. In this analysis we used indices created from multiple, related individual questions to represent water leaks, mold, condensation, asthma/allergy symptoms, and building related symptoms. Associations between gas and water consumption and the indices were tested.

A statistically significant association was found between greater daily water consumption and the asthma/allergy index. Two-fold increases (not statistically significant) were seen for reports of inside water leaks, condensation and building related symptoms with increasing water consumption (Figure 4a). There was a two-fold increase in inside water leaks with increasing nighttime water consumption. Also a statistically significant relationship was found between nighttime water consumption and condensation. No associations were found between nighttime water consumption and symptom indices (Figure 4b).

Measured gas consumption showed no significant association with resident reported thermal conditions in the apartment. A non-statistically significant relationship was observed between increased gas consumption and less reports of cold and fewer building related symptoms (Figure 4c).

Limitations

The analyses reported here are first-stage attempts to understand the relationship between renovations, and more specifically, renovations intended to save energy, and apartment level housing conditions and health. Our small sample sizes, various problems with the gas and water consumption data (to be reported elsewhere), and the self-reported nature of the survey responses limit the confidence with which we can draw conclusions. Furthermore, these analyses took advantage of “natural experiments” where our data was relevant. The fact that these analyses were not planned in advance severely limited the type of data with which we had to work.

Discussion

We believe that the analyses summarized here, some of which have been previously reported in detail (Brugge et al., 2003) and some of which are anticipated to be published in the future, begin to lay the basis for a framework for studying the relationship of energy and water saving renovations to housing conditions and resident health. In particular, the methods that we have piloted point toward ways to investigate such relationships at the micro-level of one or a few housing developments. The beginning of the development of methodology is the primary outcome of our investigation to date.

Despite the limitations of our data and the preliminary nature of our investigation, we feel that there are some suggestive findings in our analysis. The comparison of the West Broadway (renovated) and the Franklin Hill (un-renovated) developments produced striking differences in resident reported housing conditions and more modest differences in symptoms in the preceding month. These differences held up to statistical adjustment for demographic factors and thus may represent a measure of the ability of renovations to improve housing conditions and health.

Comparing survey responses and work order requests before and after the energy and water upgrades at West Broadway showed changes in housing conditions that were mostly, but not entirely positive. While overheating complaints and leaks declined, reports of cold apartments and of condensation increased. We think that it will be important to follow other heating system renovations that reduce overheating to see whether they are leading to cooler, damper apartment that may suffer from greater mold growth.

We tested associations between water and gas consumption (low, medium, high by building) and resident survey responses for housing conditions and health symptoms in the preceding month. While only a few of the associations were statistically significant, many showed trends toward higher condensation, leaks and mold with higher water consumption. Health symptoms also tended to increase with greater water and gas consumption.

Overall, our findings are consistent with a hypothesis that renovations, and in particular renovations aimed at saving water and gas, are compatible with improvements in housing conditions and in health of residents. Our study was set in two low-income public housing developments in one city in the US. Thus the findings are not easily generalizable. Still they should encourage further research and investigation to either confirm or rebut and to expand upon what we believe to be among the first of such investigations of this kind.

Acknowledgements

The work described in this paper was completed as part of the Healthy Public Housing Initiative (HPHI). HPHI partners are Boston Housing Authority, Boston Public Health Commission, Boston University School of Public Health, Committee for Boston Public Housing, Franklin Hill Tenant Task Force, Inc., Harvard University School of Public Health, Peregrine Energy Group, Tufts University School of Medicine, Urban Habitat Initiatives and West Broadway Tenant Task Force, Inc. Major funding for HPHI is

provided by the U.S. Department of Housing and Urban Development, W. K. Kellogg Foundation, Jessie B. Cox Family Trust and The Boston Foundation.

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Table 1: Comparison of the West Broadway and Franklin Hill developments with respect to renovation history.

	WB <2001	WB>2001	FH
Piping	Original	New	Original
Heating	Steam	Hot water	Steam
Ventilation	None	None	None
Stoves	Gas	Gas	Gas
Dryer vents	Built in	Built in	Via window
Ext. walls	Insulated	Insulated	Un-insulated

Figure 1a: Comparison of survey responses about housing conditions from the West Broadway development before and after energy and water upgrades (1998 vs. 2002). Based on Brugge et al., 2003.

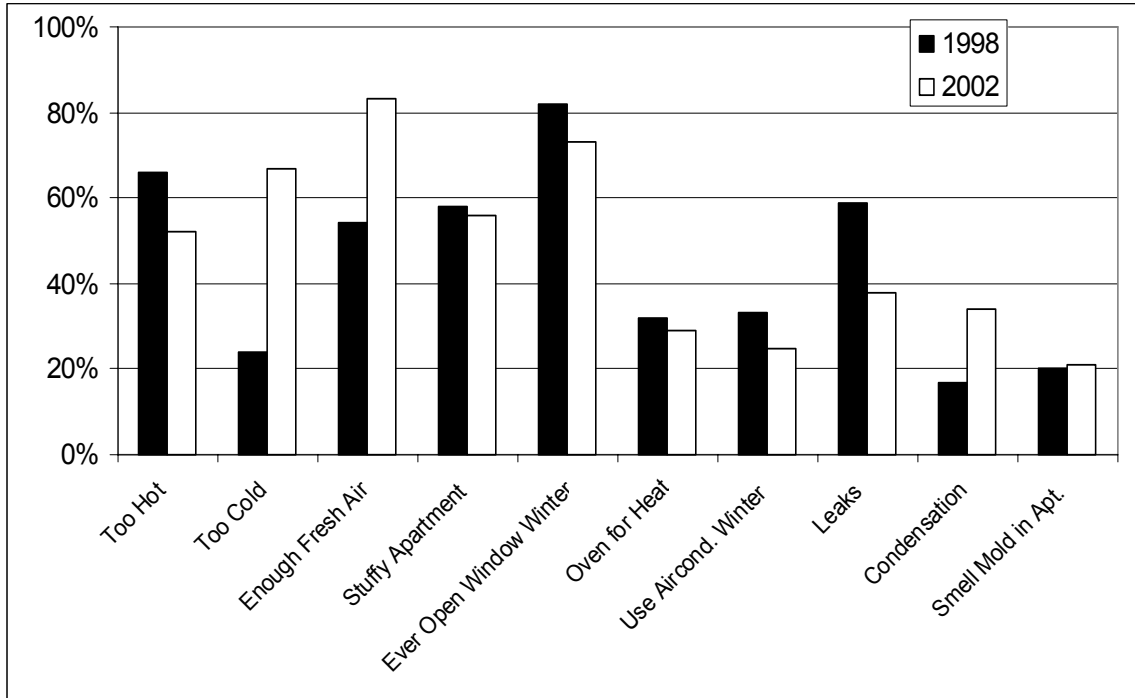


Figure 1b: Comparison of survey responses about symptoms in the preceding month from the West Broadway development before and after energy and water upgrades (1998 vs. 2002). Based on Brugge et al., 2003.

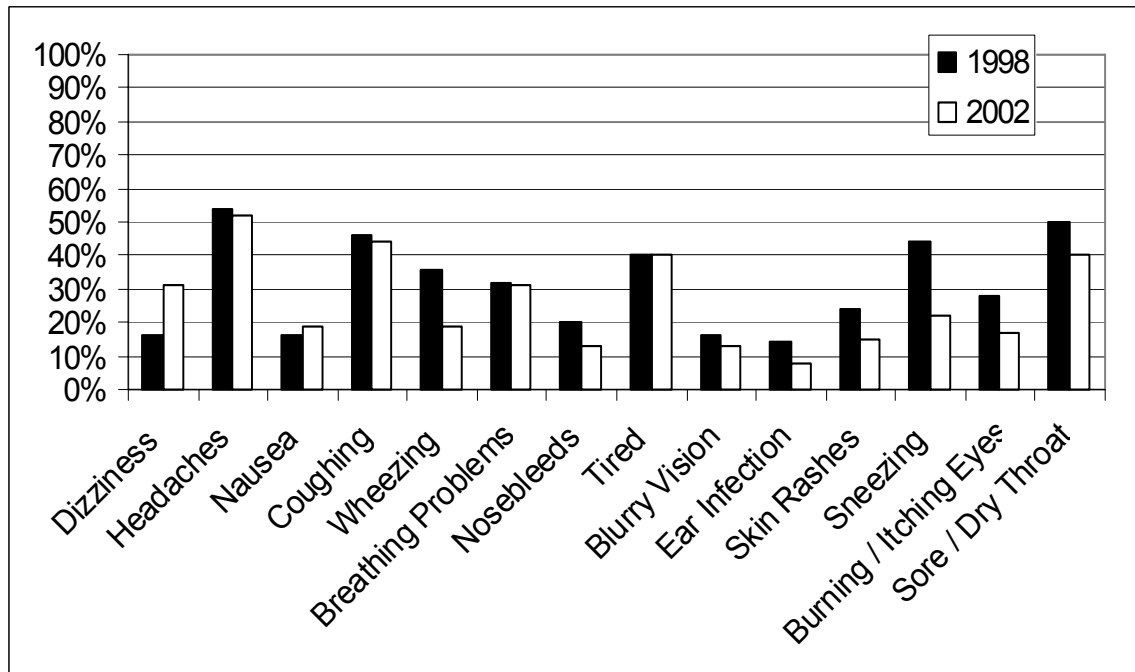


Figure 2a: Comparison of survey responses about housing conditions between the West Broadway (renovated) and Franklin Hill (un-renovated) developments. Based on Brugge et al., 2003.

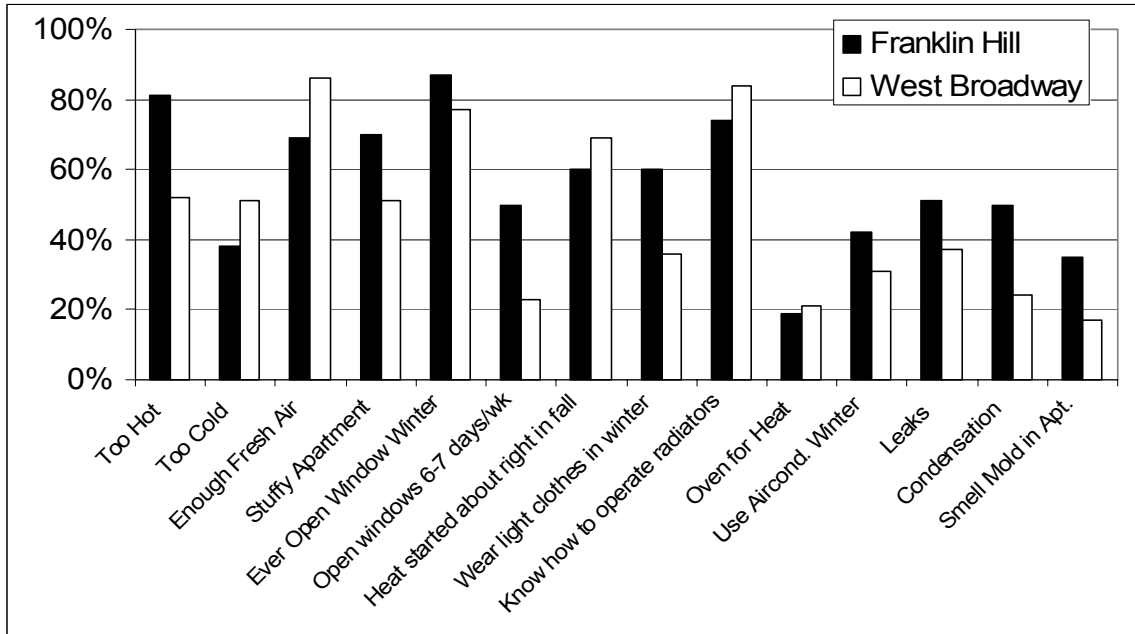


Figure 2b: Comparison of survey responses about symptoms in the preceding month between the West Broadway (renovated) and Franklin Hill (un-renovated) developments. Based on Brugge et al., 2003.

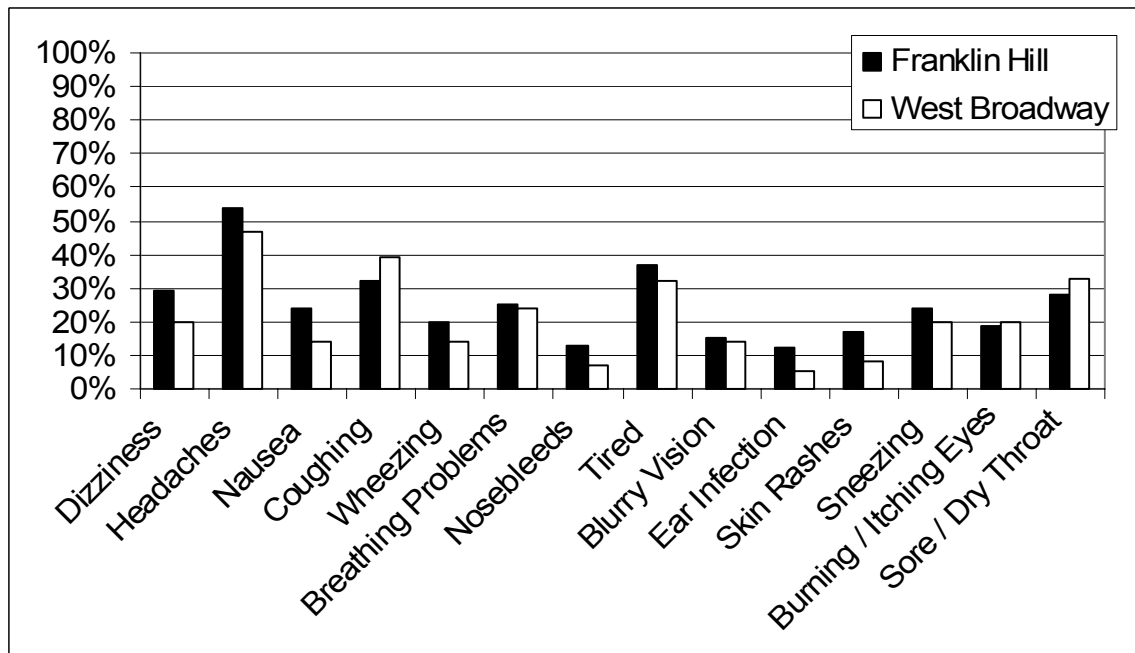


Figure 3: Comparison of work order requests for the West Broadway development before and after the 2001 energy and water upgrades.

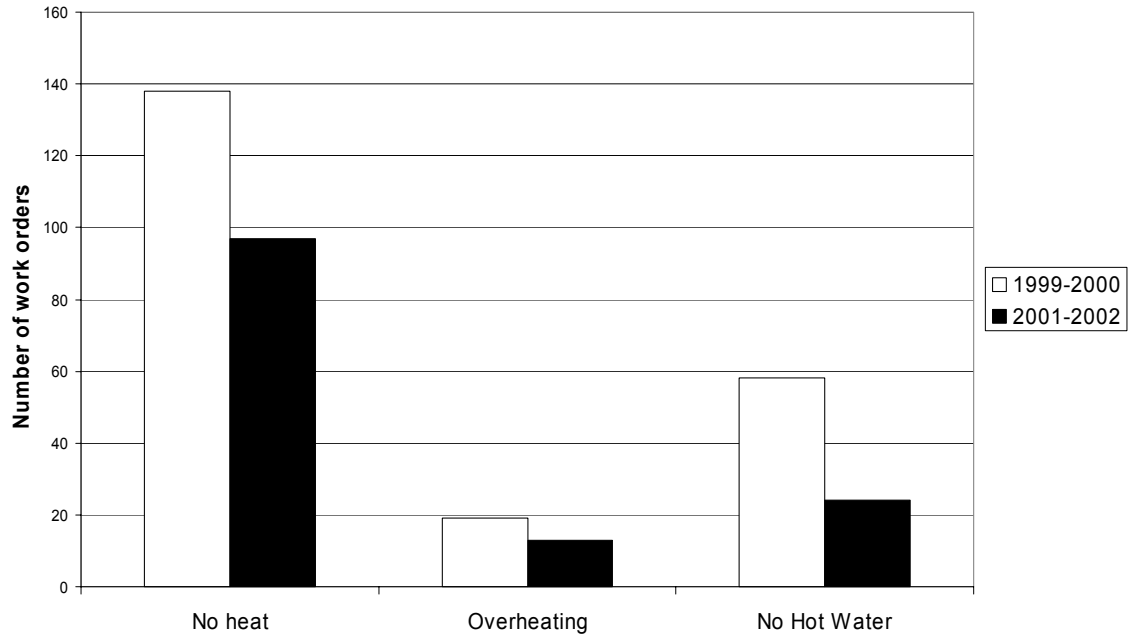


Figure 4a: Associations between low, medium and high daily water consumption and resident reported housing conditions and symptom indices in the West Broadway development (2002).

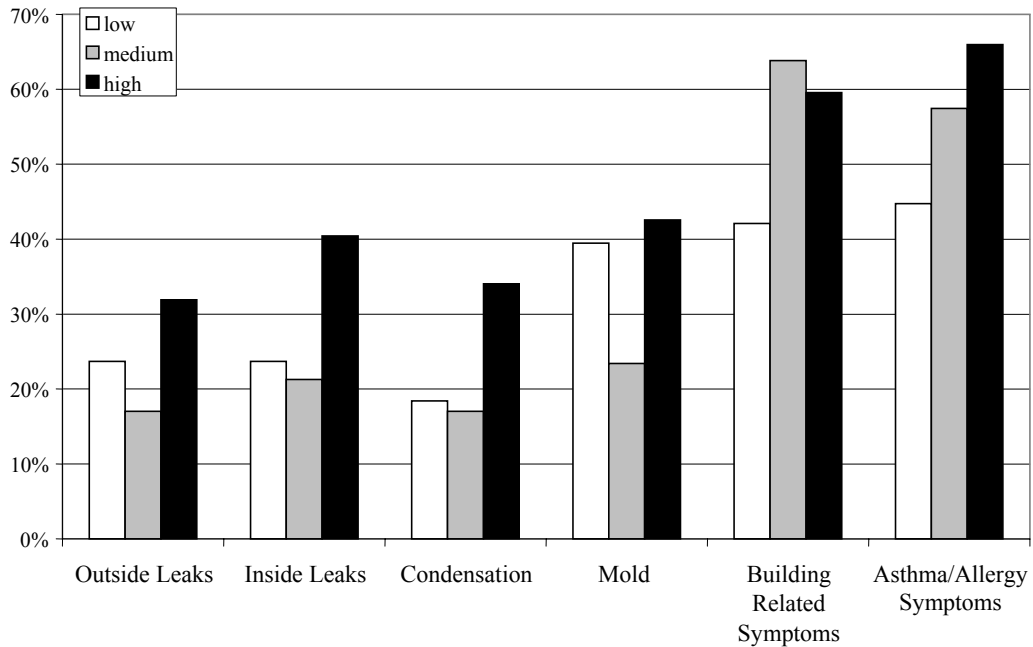


Figure 4b: Associations between low, medium and high nighttime water consumption and resident reported housing conditions and symptom indices in the West Broadway development (2002).

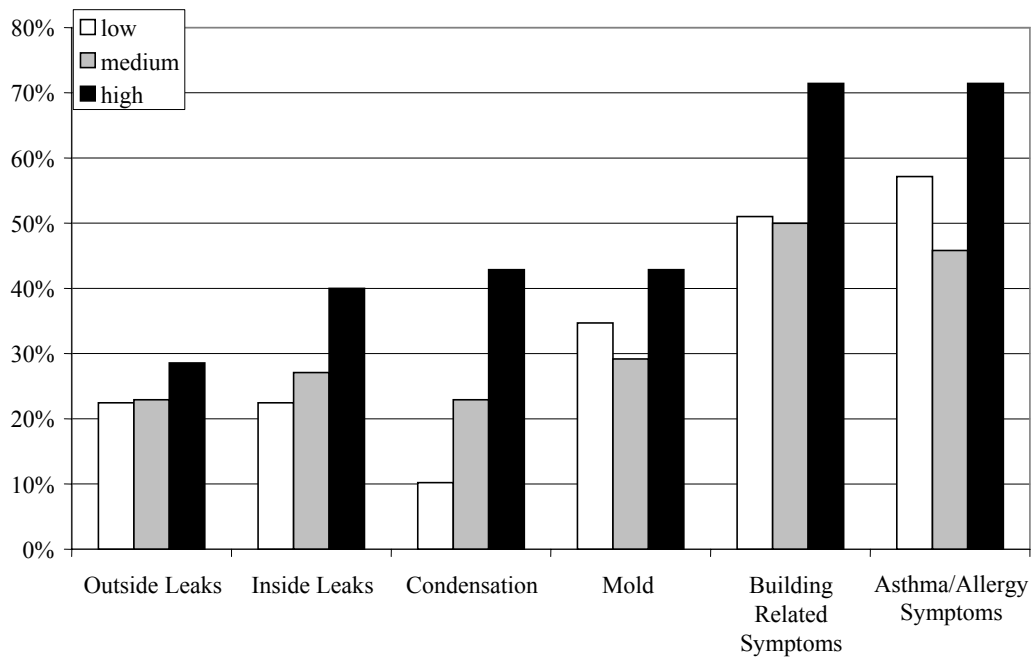


Figure 4c: Associations between low, medium and high gas consumption and resident reported housing conditions and symptom indices in the West Broadway development (2002).

