The Contributions of Physical Infrastructure to Environmental Health Disparities: Housing, Transportation and Water

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Outline

- Definitions
- A Framework: Shared Commons & Infrastructure
- Methods
- Housing Findings
- Conclusions

Infrastructure

- Provides shelter from the elements, access to food, clean water, clothing and other basic necessities of life.
- Human communication, interaction, movement, psycho-social well-being, our very individual and collective identities.
- Physical infrastructure is a major part of what we need to build social norms.

Purpose

- Populations ill-served by physical infrastructure have a host of unmet needs and environmental diseases and injuries, making their full participation in a productive society problematic.
- Profound losses for both society at large, as well for at-risk communities and individuals.
- Reviews scientific data on disparities in the physical infrastructure and associated health outcomes
- Inform policy, assess prospects for interventions, and identify research needs.

World Health Organization

- “Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (WHO, 1946).
- To promote environmental health and eliminate disparities, infrastructure must go beyond controlling injury, disability or disease as a result of interactions between the physical environment and people
- Infrastructure must *support* good health.

UN Commission on Human Rights, 1947

Everyone, without distinction as to economic and social conditions, has the right to the preservation of his health through the highest standards of food, clothing, housing and medical care which the resources of the State and community can provide. The responsibility of the State and community for the health and safety of its people can be fulfilled only by provision of adequate health and social measures.

Methods

- Physical infrastructure has two overlapping categories: individual and community.
- A house and its immediate surroundings (the yard) are typically thought of as mostly private, individual entities, but are not isolated
- Transportation systems are generally conceived at the community, city and/or national levels, although there are individuall aspects (auto)
- Other examples of community-level types of physical infrastructure include schools, parks, and fuel and electrical power systems.
- Here, we look at 3 forms of physical infrastructure
  - Housing
  - Transportation
  - Water
  - Significant overlap among them all.

Florence Nightingale

"The connection between health and the dwelling of the population is one of the most important that exists."

Cited in Lowry, S, BMJ, 1991, 303, 838-840

Miasma & Housing-Related Disease

The miasma that was thought to cause cholera was linked to the squalor of the poor.

Health in the Late 19th Century

- Challenge of Tuberculosis, Typhoid, Cholera Seemed Insurmountable
- Lessons for Public Health Officials, Architects and Planners: Light, Fresh Air, Reduce Crowding, Improve Sanitation.
- With Improved Living Conditions & Medical Interventions, Disease Rates Declined
- Atrophy

Are Buildings a Shared Commons?
Are Buildings Part of the Infrastructure?

What is The Commons?

"The commons is everywhere. It is the air we breathe, the words we speak, the traditions we respect. It is tangible and intangible, ancient and modern, local and global. It is everything we inherit together, as part of a community, as distinct from things we inherit individually. It is everything that is not privately or state-owned. …"

Cuyahoga River ca. 1960

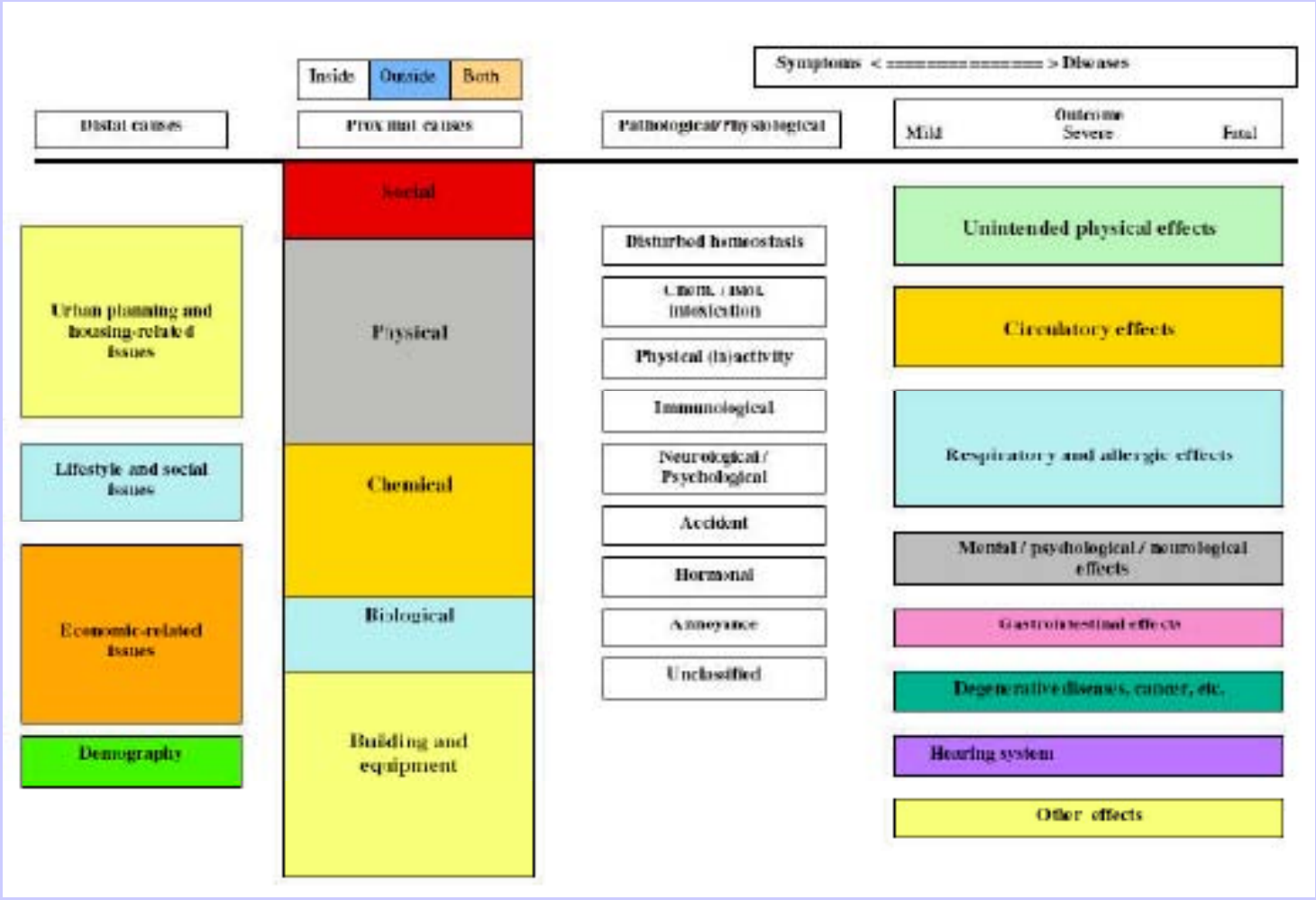
Commons

- Clean Water
- Clean Air
- Hazardous Waste on private land
- Toxics (TSCA and REACH)
- Workplace Safety and Health
- Child Labor
- Housing is mostly privately owned

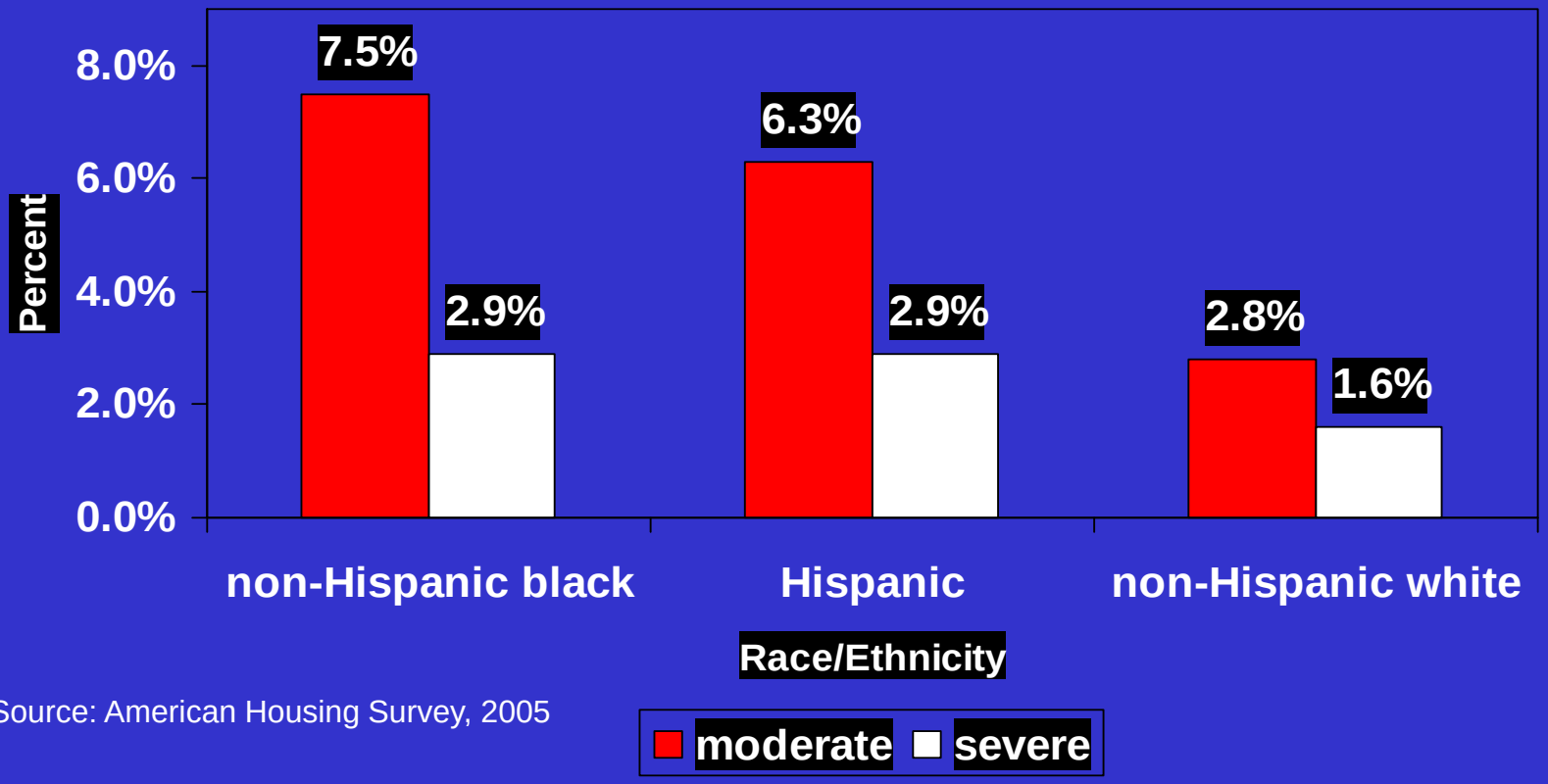
Housing Hazards

- physical conditions such as heat, cold, energy efficiency, radon exposure, noise, inadequate light, ventilation, and fine particulates in the home;
- Chemical conditions such as volatile organic chemicals (VOC) and other chemical emissions, environmental tobacco smoke (ETS), and lead;
- Biological conditions – e.g. rodents, house dust mites, pets and their relation to respiratory, allergic, or asthmatic effects, and humidity and mold;
- Building and equipment conditions – e.g. accidents and unintentional injuries, and access to sewer services (hygiene and sanitation issues); and
- Social conditions – e.g. architectural features related to mental health.

WHO Causal Web



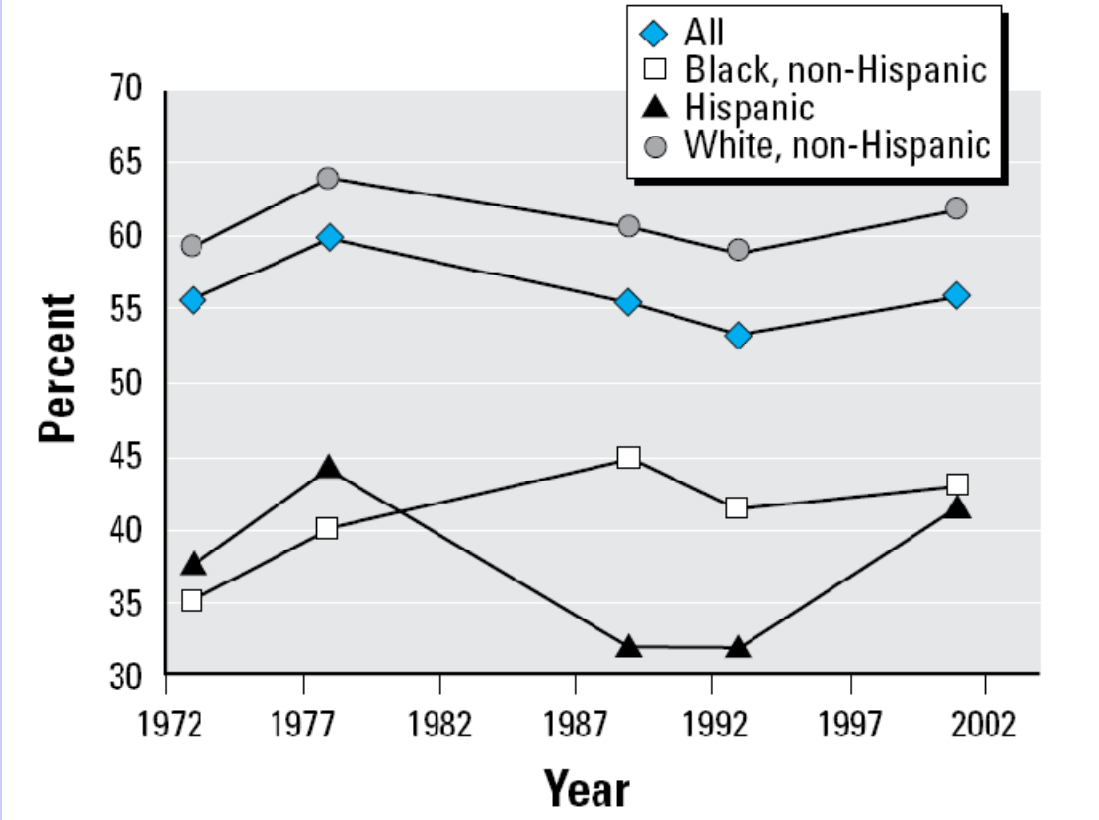
Race/Ethnicity and Substandard Housing



Source: American Housing Survey, 2005

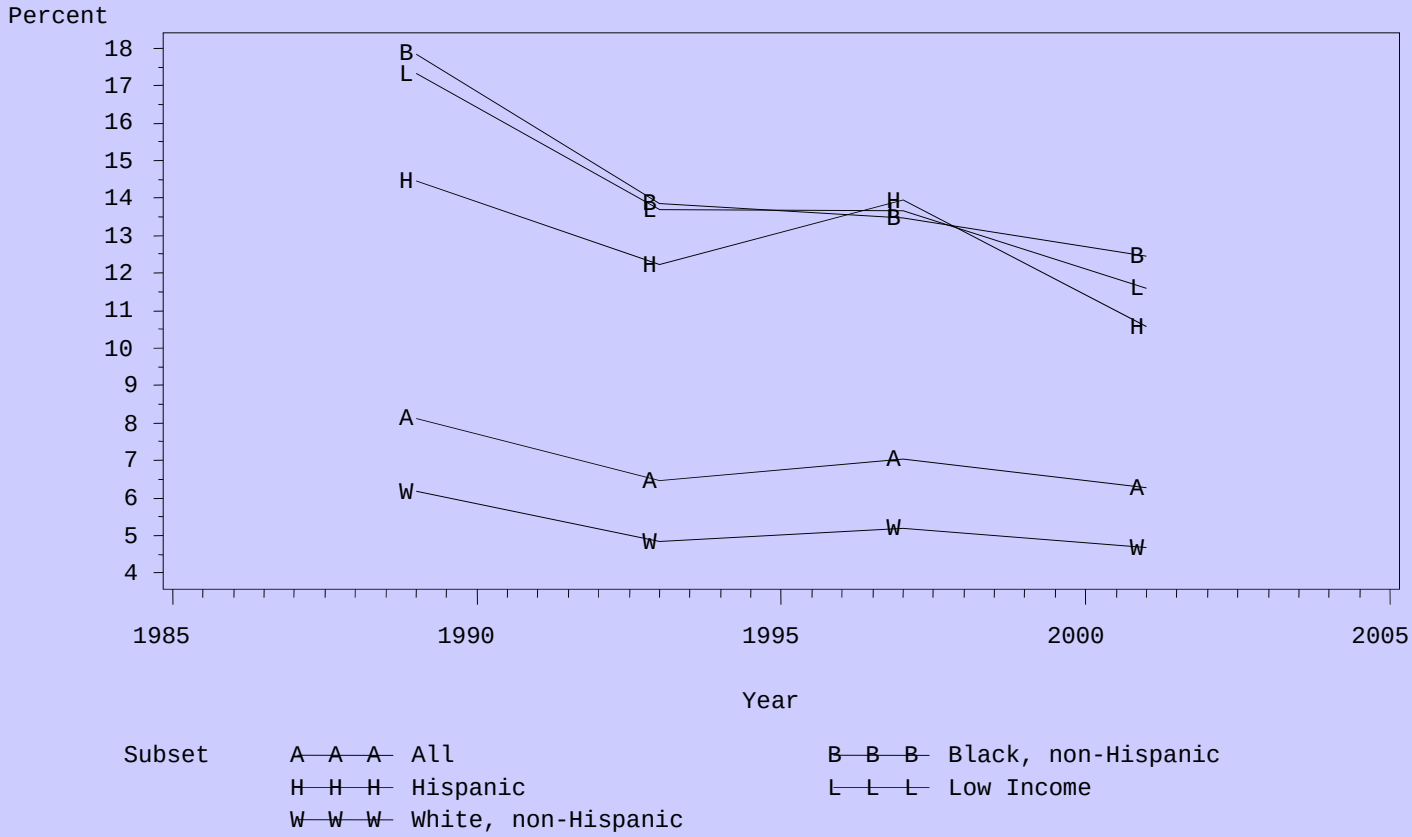
General Good or Excellent Health, 1972-2002

(National Health & Nutrition Examination Survey)

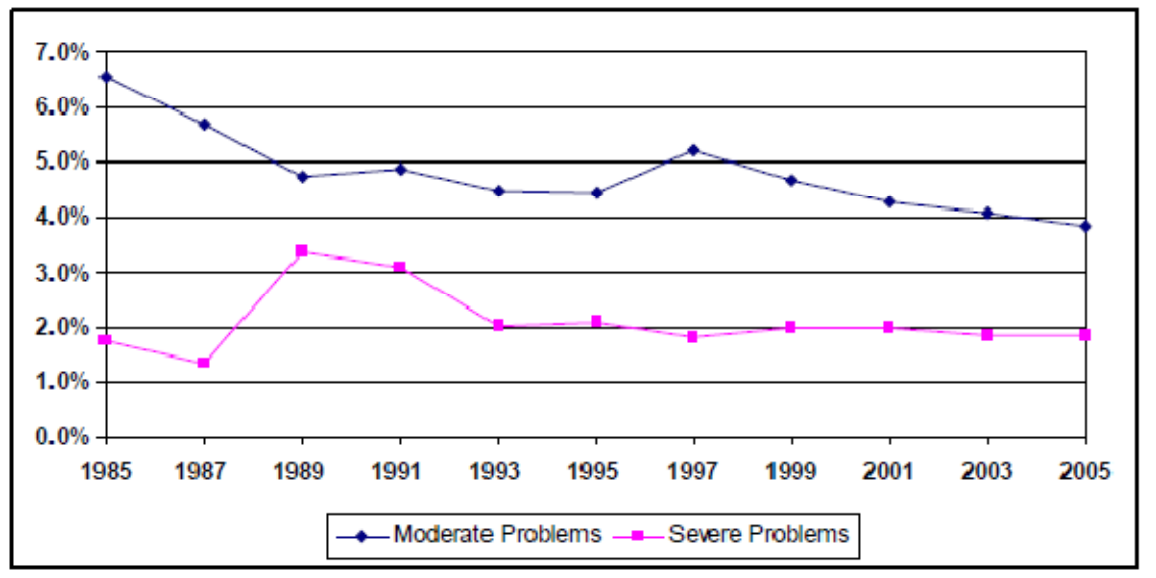


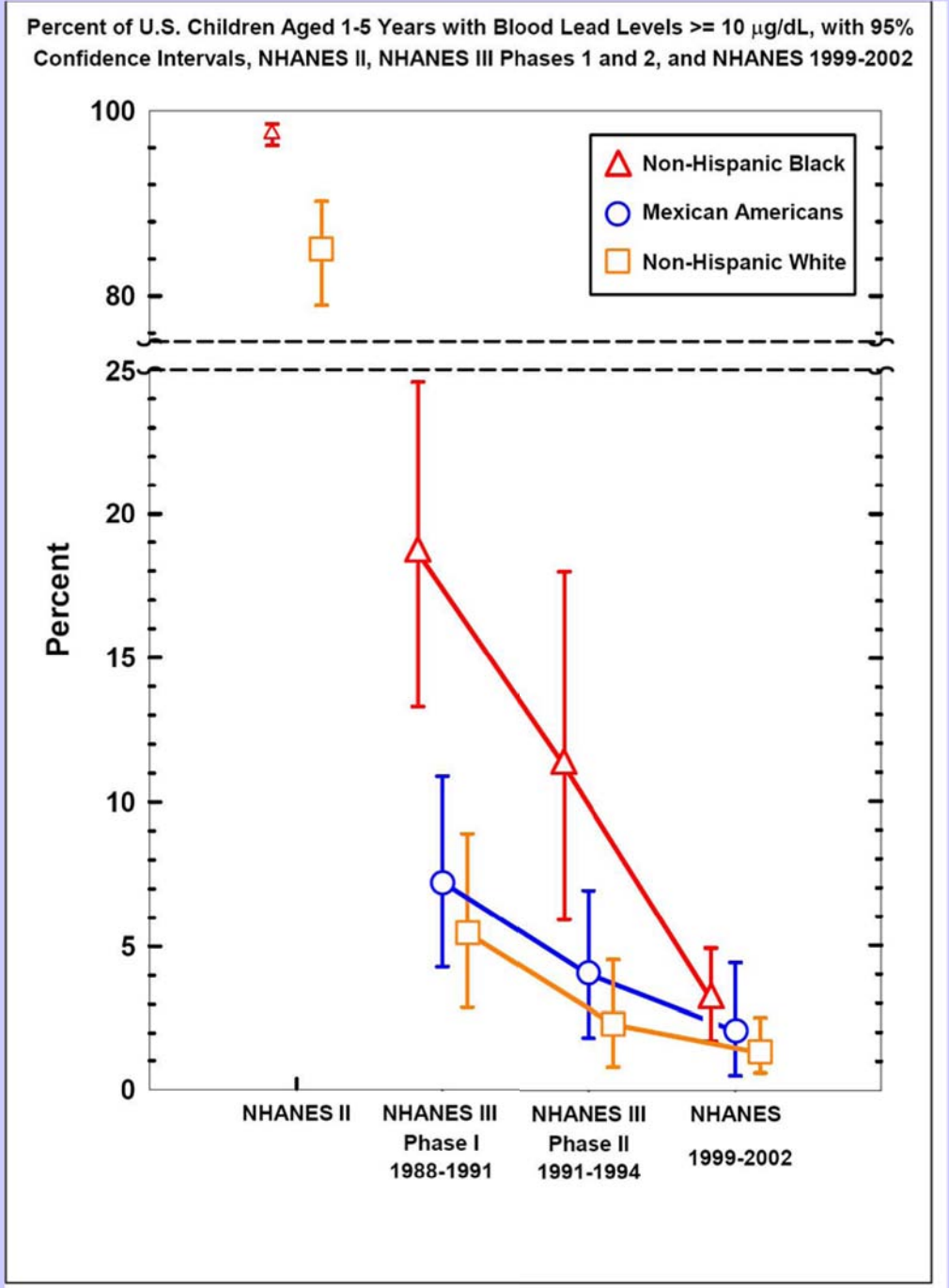
Jacobs et al. 2009. The Relationship of Housing and Population Health: A 30 Year Retrospective Analysis. EHP 117:597-604

Percent of Housing With Moderate Physical Problems by Race, Ethnicity and Income, 1989-2005 (American Housing Survey)

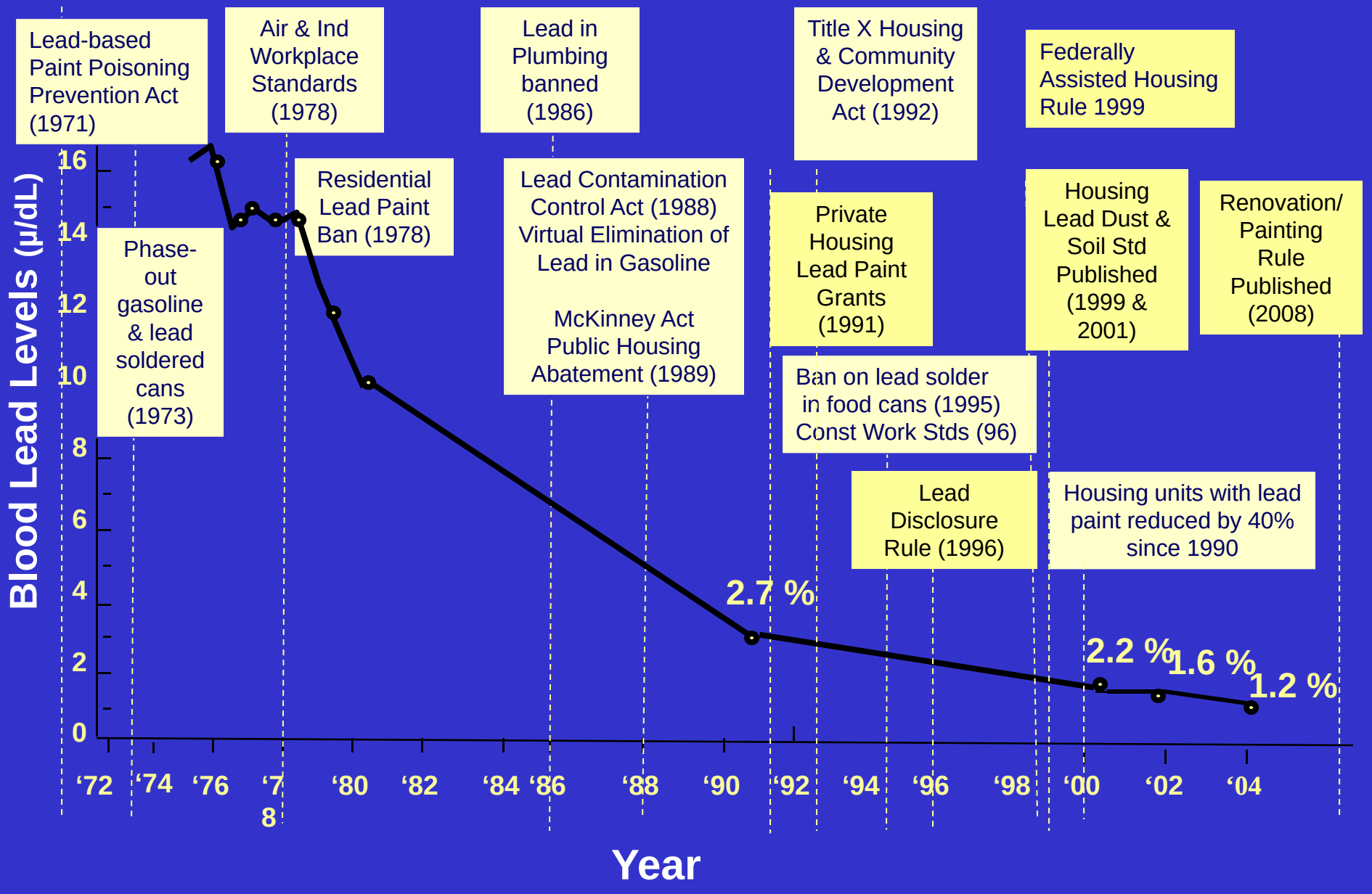


Percent of Housing with Problems Shows Little Improvement Since 1985




Percent of U.S. Children Aged 1-5 Years with Blood Lead Levels >= 10 µg/dL, with 95% Confidence Intervals, NHANES II, NHANES III Phases 1 and 2, and NHANES 1999-2002
100
80
25
20
15
10
5
0
Percent
Non-Hispanic Black
Mexican Americans
Non-Hispanic White
NHANES II
NHANES III Phase I 1988-1991
NHANES III Phase II 1991-1994
NHANES 1999-2002

US Policies & Blood Lead 1971-2004



Lead Paint Barriers Before the 1990s

- No health-based exposure standards for paint, dust or soil
- No standard inspection or abatement protocols
- No prohibited paint removal methods
- No lab QA/QC
- No performance criteria for paint XRFs

Lead Paint Barriers Pre-1990 (cont'd)

- No trained or licensed inspectorate or abatement work force
- No regulation of renovation and painting
- No occupational standards to protect workers
- No training curricula
- No concerted public education
- No laws regarding disclosure of known lead paint hazards & no enforcement
- No funding to address hazards in low-income privately owned high risk housing

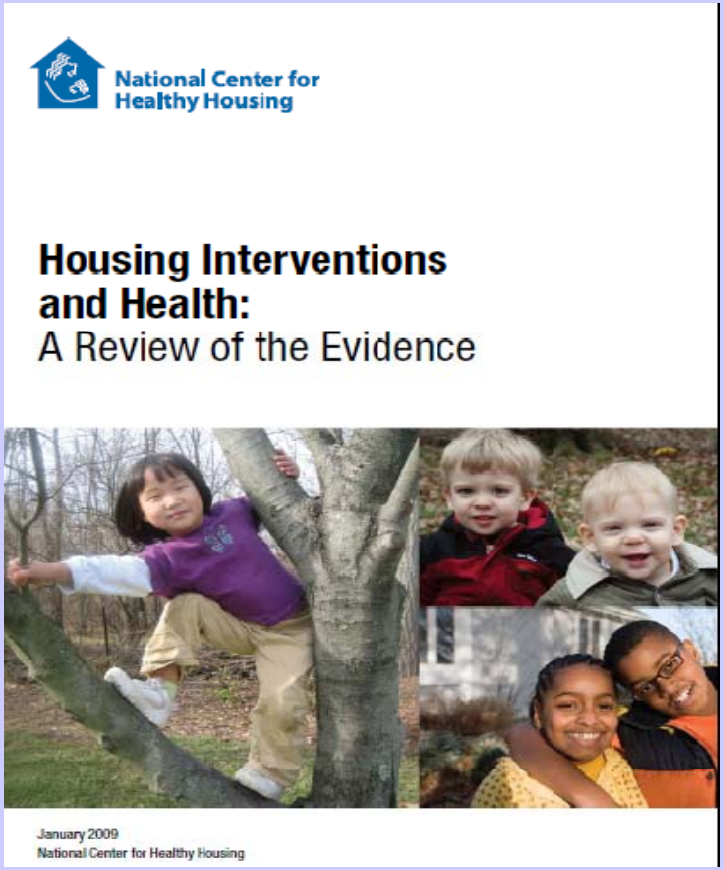
Sufficient Evidence (WHO, 2005)

- **PHYSICAL FACTORS:**
  - Heat and cold - excess winter & summer mortality
  - Energy efficiency of housing and respiratory health
  - Radon exposure in dwellings and lung cancer
  - Neighborhood and building noise and mental health
- **SOCIAL FACTORS:**
  - Multifamily housing, high-rise housing, housing quality and mental health
- **CHEMICAL FACTORS:**
  - ETS exposure in dwellings and respiratory and allergic effects
  - Lead-related health effects
- **BIOLOGIC FACTORS:**
  - Humidity and mold in dwellings and respiratory health effects
  - Hygrothermal conditions and house dust mite exposure (asthma)

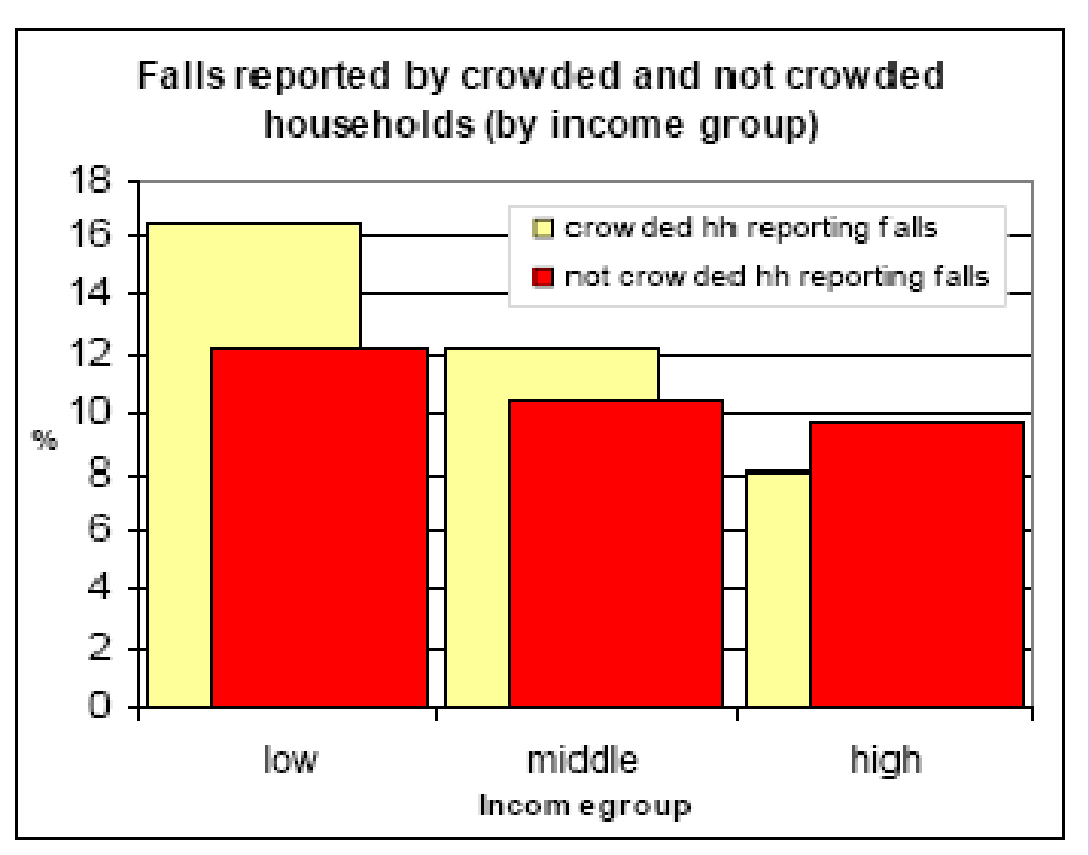
Some Evidence (WHO, 2005)

- **PHYSICAL FACTORS:**
  - Ventilation in the dwelling and respiratory and allergic effects
- **CHEMICAL FACTORS:**
  - VOCs and respiratory, cardiovascular and allergic effects
- **BIOLOGICAL FACTORS:**
  - Cockroaches and rodents in dwellings and respiratory and allergic effects
  - Cats, dogs and mites in dwellings and respiratory and allergic effects
  - Pets and mites and respiratory, allergic or asthmatic effects
- **BUILDING FACTORS:**
  - Sanitation and hygiene conditions and related physical health effects
- **SOCIAL FACTORS:**
  - Social conditions of housing and fear/fear of crime
  - Poverty and social exclusion and related health effects
  - Crowding and related health effects
  - Social factors/social climate and mental health

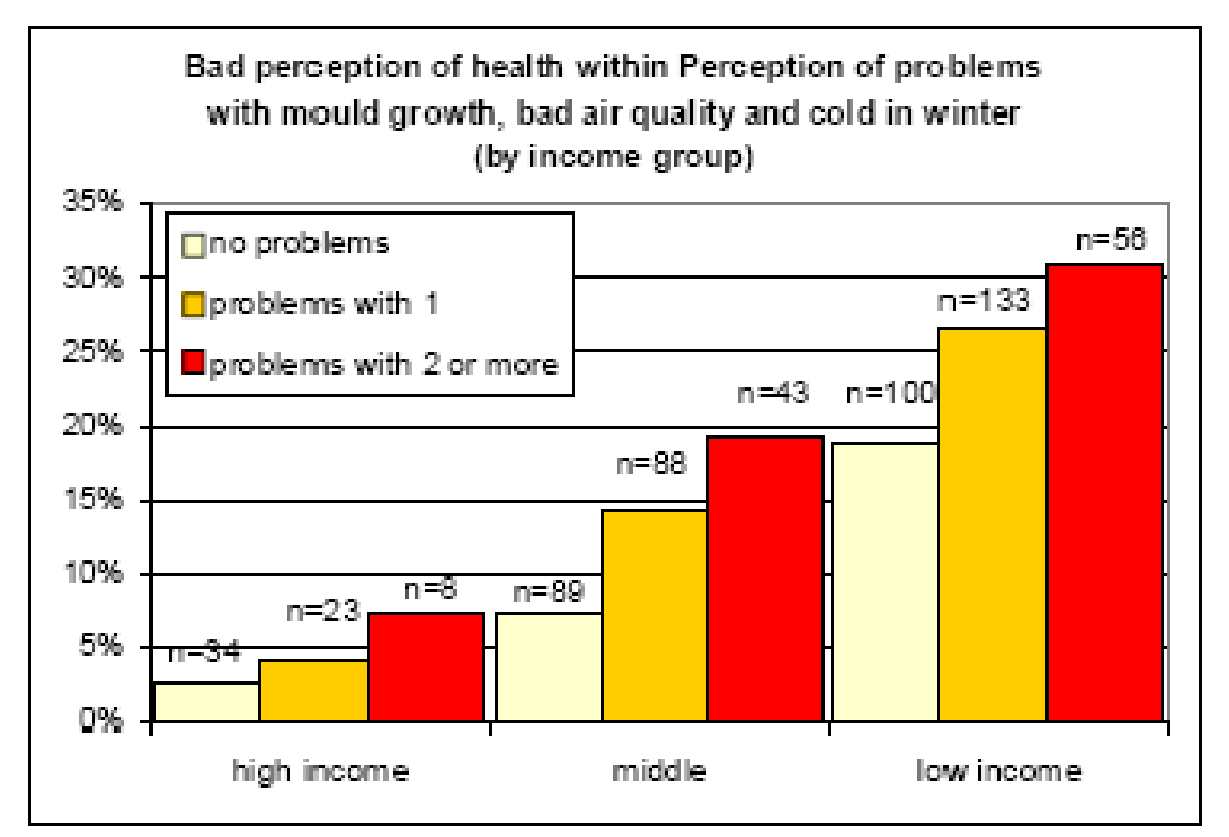
Today's Chronic Diseases & Injuries Asthma, Cancer, Neurological Deficits, Others



Integrated Housing and Health Surveys (LARES, WHO)



LARES on Mold, Air Quality and Cold by Income Group



Housing Segregation & Health

- Numerous studies document adverse health consequences associated with living in highly segregated neighborhoods.
- NHANES data showed significant variation in Body Mass Index by neighborhood and ethnicity (Do et al., 2007).
- Comparison of mortality between residents of poor and very-poor (i.e., public housing) neighborhoods in New York City show clear disparities in age-standardized all-cause mortality rates, with preventable diseases such as malignancies, diabetes, chronic lung disease contributing to the disparity (Althoff et al., 2009).
- Another study reported that repeated hospitalizations for childhood asthma were correlated with children residing in the census tracts with the highest proportion of crowded housing conditions, highest racial minorities, and highest neighborhood level poverty (Liu and Pearlman 2009).

Crowding, Housing Instability

- Four nationally representative surveys: worsening economic standing associated with poorer health care access, being uninsured, postponing care and higher hospitalization rates (Reid et al., 2008)
- 12,058 households, asthma was most prevalent in Puerto Rican households, followed by other Hispanic and black households,
  - Deteriorated housing conditions and low social cohesion had higher odds of asthma (Rosenbaum, 2008).
  - Maintenance problems, toilet, heating breakdowns,presence of rats or mice, leaks, cracks or holes in floors walls or ceilings and broken plaster.
- The study also used measures of crowding, and the neighborhood indicators included boarded up buildings nearby.
- Multiple housing deficiencies are found together
- These factors were independent of the influence of socioeconomic status, but not race and ethnicity.
- Housing discrimination contributes to poorer health status.

Allergens & Asthma

- HUD National Survey of Lead and Allergens
- over 80% of homes in the U.S. have detectable levels of house dust mite allergen in the bedroom
- 46% had levels associated with sensitization
- 24% had levels associated with asthma morbidity
- Allergens were most highly concentrated in low-income housing
- (Arbes et al., 2003).

Moving to Opportunity

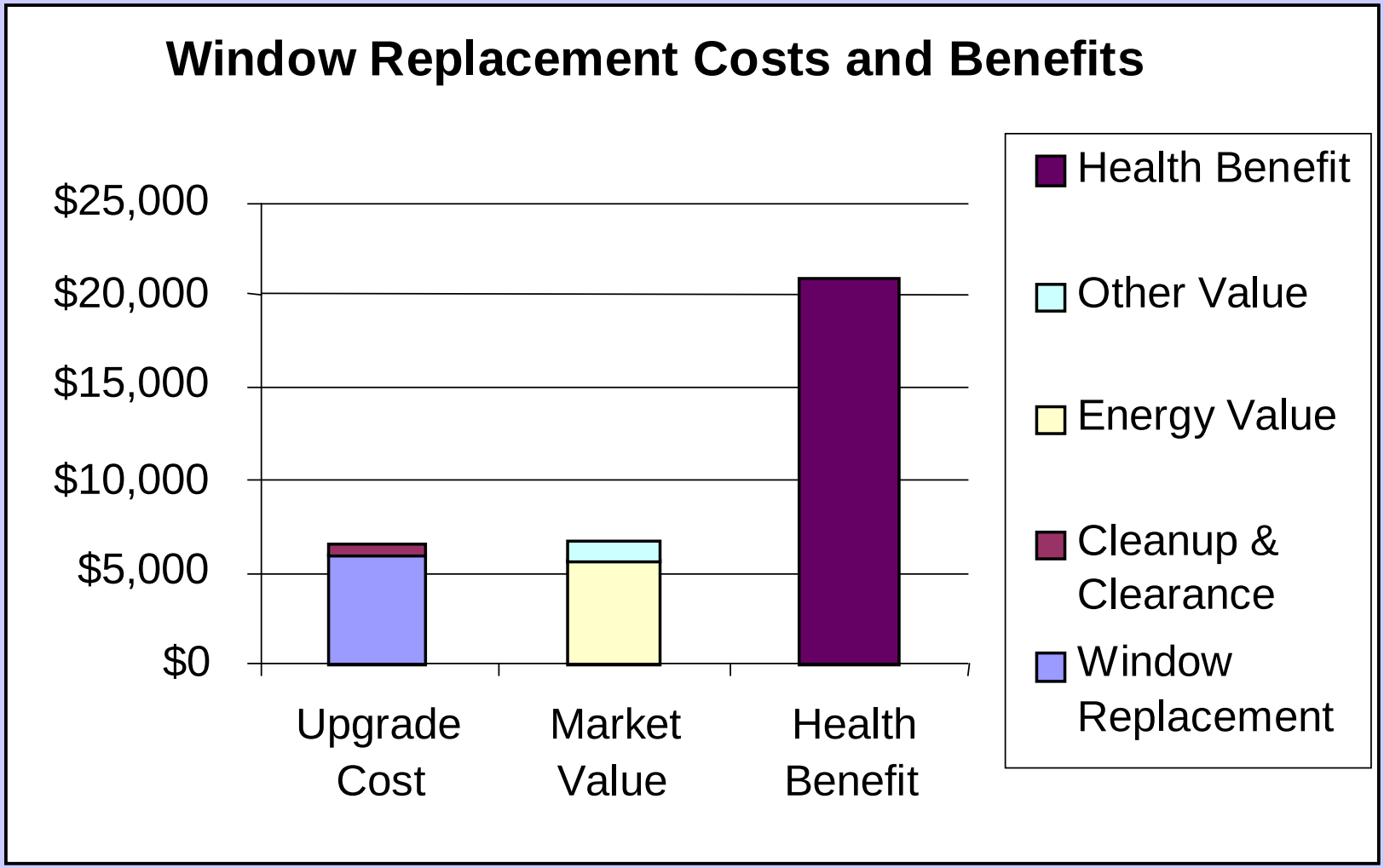
- Better health among members of the experimental group
- Reduction in adult obesity by 11% in the experimental group.
- In girls, the experimental group showed improved perceived safety and improved mental health (including reductions in psychological distress, depression, and generalized anxiety disorder), and lower rates of smoking and marijuana use (Orr et al., 2003).

Injury

- Diagnostic codes in Illinois from 1990-2000
- Risk of falls
- Concentration of owner-occupied housing and age of housing are significantly associated with non-fatal hospitalized pediatric injury
- Housing conditions mediate poverty, and individual- and community-level determinants (Shenassa et al., 2004).

Housing Market Price & Health

- Should a Healthy Home Cost More?
- Why are Healthy Homes Investments Unlike Other Home Improvements?
- Finding Market Vehicles to Provide Incentives to Promote Investment in Green Healthy Homes & Communities
- Cost of NOT Making Homes Healthy
- Cost Shifting


Window Replacement Costs and Benefits
$25,000
$20,000
$15,000
$10,000
$5,000
$0
Upgrade Cost
Market Value
Health Benefit
Health Benefit
Other Value
Energy Value
Cleanup & Clearance
Window Replacement

Minnesota Health Findings (Adults)

- General health reported as either very good or excellent increased from 33% to 62% (p=0.052)
  - Chronic bronchitis 10% → 0% (p=0.025);
  - Hay fever (12% → 4% (p=0.046);
  - Sinusitis (12% → 2%; p=0.025);
  - Asthma (12% → 4%; p=0.046);
  - Hypertension (10% → 4%; p=0.083).

Minnesota Findings
Children

- General health reported as either excellent or very good increased from 53% to 65% (p= 0.286)
  - Respiratory allergies decreased from 15% ⇒ 4% (p=0.083)
  - Ear infections also improved by the same amount (p=0.083).
  - Doctor diagnosis of eczema or other skin allergy decreased from 23% → 0% (p=0.083).
  - No change in asthma (n=2)

Cleanliness, Comfort, Safety, Outdoor Play

- Residents reported that their newly renovated homes were:
  - easier to clean (86%, $p<0.001$),
  - more comfortable (88%, $p<0.001$),
  - safer (86%, $p=0.008$)
  - and that their neighborhood was safer (83%, $p=0.021$)
  - that their children played outside more often (86%, $p=0.059$).

Moisture

- Fewer people reported that their newly renovated homes had:
  - moisture problems (29% ⟹ 4%; p=0.020)
  - evidence of water or dampness due to broken pipes, leaks, heavy rain, or flooding
    - (39% ⟹ 18%; p=0.083)
  - a need for either a dehumidifier
    - (24% ⟹ 3%; p=0.014)
  - or a humidifier (17% ⟹ 7%; p=0.083).

Pests

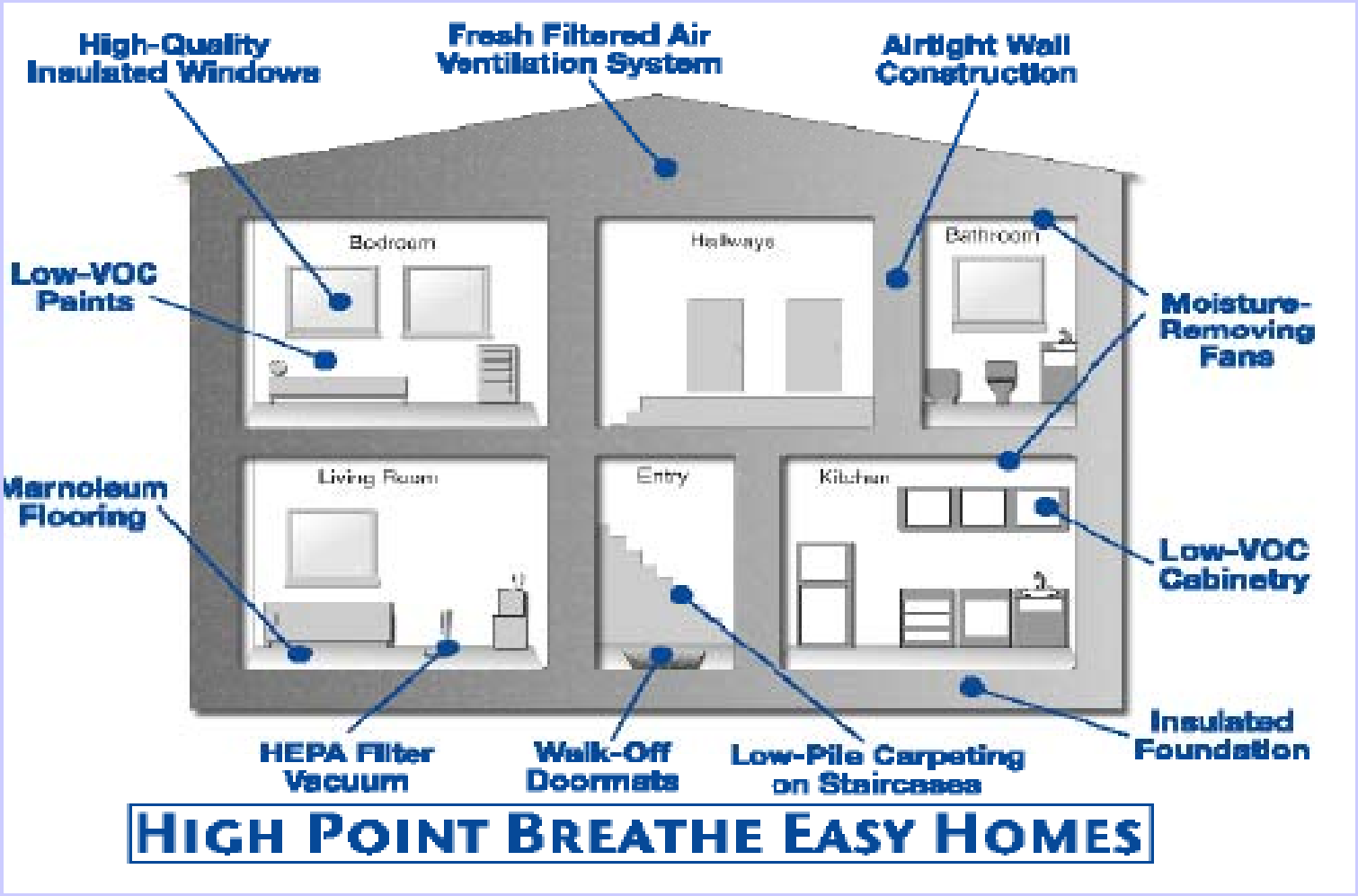
- Fewer problems with cockroaches
  - (17% ⟹ 7%; p=0.083).
- Lower use of insecticides by residents
  - (21% ⟹ 4%; p=0.059)
- Lower use of insecticides by exterminators or maintenance personnel
  - (37% ⟹ 4%; p=0.003)
- Fewer problems with mice or rats
  - (25% ⟹ 0%; p=0.046).

Smoking

- Fewer people reported that there was smoke inside their homes due to incense, cigarettes, cigars, pipes, wood fires, or non-tobacco cigarettes
  - (54% ⇨ 36%; p=0.025)

Energy & Water Consumption

- 46% reduction in total energy use
- An estimated 39% reduction in CO_2 emissions from power plants.


High-Quality Insulated Windows
Fresh Filtered Air Ventilation System
Airtight Wall Construction
Low-VOC Paints
Moisture-Removing Fans
Linoleum Flooring
Low-VOC Cabinetry
HEPA Filter Vacuum
Walk-Off Doormats
Low-Pile Carpeting on Staircases
Insulated Foundation
Bedroom
Hallways
Bathroom
Living Room
Entry
Kitchen
HIGH POINT BREATHE EASY HOMES

Breath Easy Home Study – *Preliminary Results (1)*

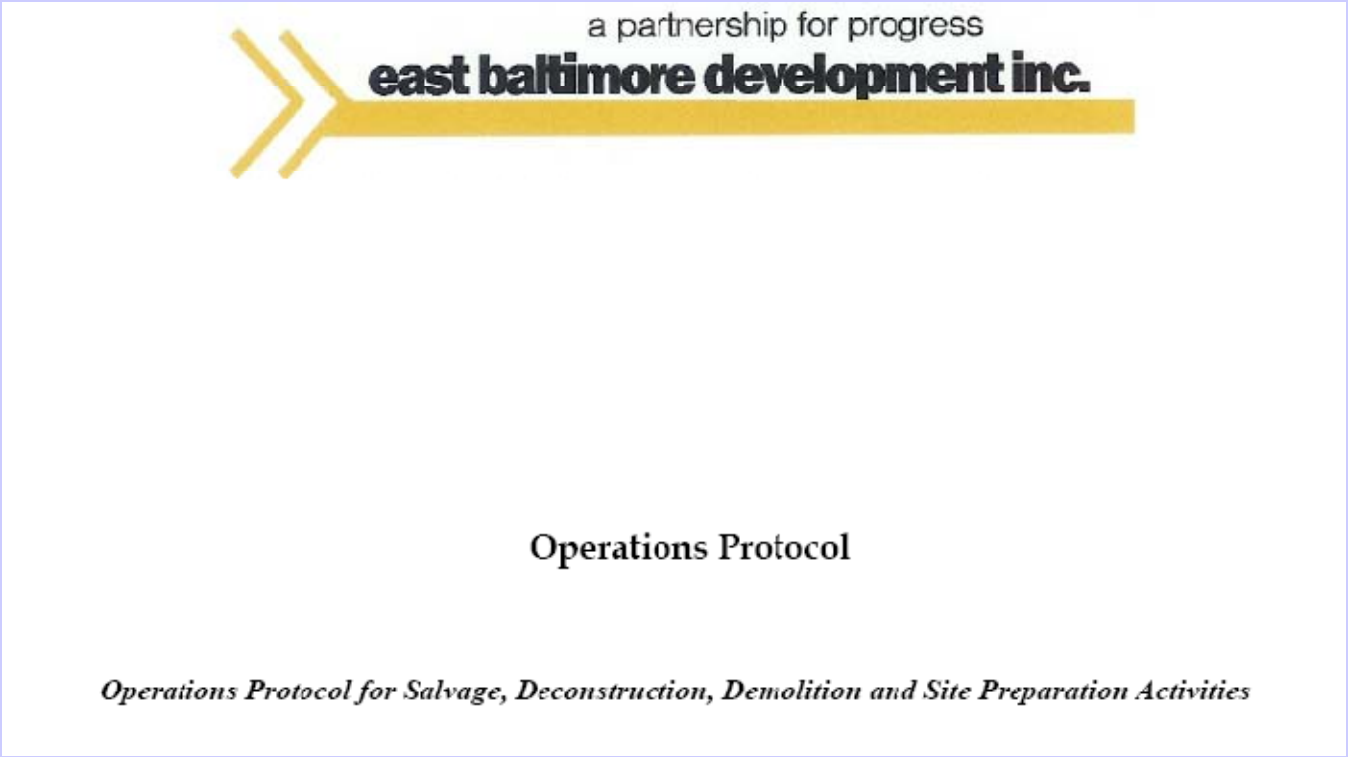
Endpoints	Old Home				New Home	home Δ	
	Base n=22	Exit1* n=22	Δ	p	Exit 2 n= 34	Δ	p
Symptom-free days/2 wks	7.0	7.1	0.1	.964	12.4	4.8	.004
Caretakers quality of life	4.9	5.0	0.1	.810	5.8	0.8	.002
Urgent clinical care (%)	60.0	60.0	0	1.00	20.6	-41.2	.002
Asthma trigger exposure [t]	2.0	1.4	-0.6	.016	.03	-1.33	.000

* upon exit1 (old home) 35 families were enrolled, only 22 had old home baseline

[t] presence of rodent, roach, pet, mould or moisture

Chicago (note observer)

Baltimore 2006
EBDI Site



EBDI Demolition Protocols (1)

- Roles & Training in Lead Safe Work Practices
- Designation of Full Time Dust Suppression Manager
- Salvage and Deconstruction
- Community Organization Meetings & Notification
- Independent Advisory Panel
- Walk-off mats and HEPA vacuums for nearby residents
- Demolition, Debris Removal, Transport
- Landscaping, greening of lots, street and sidewalk cleaning
- Environmental Monitoring & Reporting

EBDI Demolition Protocols (2)

- Jersey Barriers
- Fencing with Poly
- Sediment control
- Fire Hoses
  - At least 2 hoses during active demolition
    - one above, one below
  - 1 hose used on debris when equipment is moving over it
  - 4 hoses on many occasions to reduce dust
- Deconstruction & salvage if feasible given structural soundness of buildings

EBDI Project Area

Conclusion

- There is sufficient scientific evidence to implement housing and community interventions to improve health and prevent housing-related disease and injuries
- Housing related health disparities can be reduced
- Research needs remain
- Cross-sectoral, integrated policies to enable individual programs to get the biggest bang for the buck
- Making investments in housing and social determinants of health makes sense, but will not happen without sound policies

Policy Implications for Housing Disparities

- High Costs of Health Care/Health Insurance
- Mortgage Crisis & Affordable Housing
- Economic Recovery
- Healthy Housing, Green Development, Climate Change

- Problems?? OR
- An Unprecedented Convergence!!

Substandard Housing And Community Disinvestment Is:

- Not Sustainable
- Not Affordable
- Not Healthy

Contact Information

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