California Rural Legal Assistance, Inc.

(UN)SAFE AT HOME:

The Health Consequences of Sub-standard Farm Labor Housing

A Review of the Literature and Call for Research.

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Rural Justice Forum

This paper was developed as part of the Rural Justice Forum (RJF), an ongoing series of conferences, workshops, and symposia convened each year by CRLA to showcase emerging research and advocacy focused on the needs of low-income rural communities and marginalized populations within California. CRLA began the RJF in 2008 through the generous support of The California Endowment and the Western Center for Agricultural and Safety at UC Davis. RJF topics of interest vary from year to year, but the focus is always informed by a desire to curb the negative effects of observable patterns of discrimination, exploitation and marginalization identified by over 164 CRLA staff working in over twenty-three California counties.

CRLA has three goals for the RJF 1) Provide a vehicle for bringing together researchers, policy makers and legal advocates to better understand complex problems facing low-income rural communities and marginalized populations 2) Support and guide the work of scholars and advocates across a number of backgrounds as they work to find solutions to large, complex social and legal problems 3) Communicate the findings and promising practices of new research that can improve the well-being and protections of those same communities and populations.

This paper reflects the focus of the RJF over the past two years: Addressing the persistent problem of substandard housing for farmworkers, and the related health implications of living in unhealthy environments. We hope you will join us in addressing this problem and finding solutions that will bring about healthier, safer lives for farmworkers in California and beyond. Please visit our website www.crla.org to sign up for Rural Justice Updates and to learn more about the ongoing work of the Rural Justice Forum.

Introduction

Farmworkers and their families in rural California and throughout this country often are forced to live in the most despicable and challenging conditions. They sleep in onion fields, live in caves dug into canyons, bathe in irrigation ditches, huddle under tarps or find refuge in cars, tool sheds, barns and in river banks, face rent gouging for substandard and dangerous housing units, rent rooms in dilapidated old motels, face housing discrimination because of who they are, what they look like or the language they speak and suffer retaliatory eviction and firing should they have the temerity to complain about such third world conditions in the richest nation in the world. The conditions and the consequences to their physical and emotional health and well being have been anecdotally documented, but research on these issues, and literature is lacking. This project is designed to assess the existing literature and contribute to the body of research on these issues, through the publication of this paper and the development of a network of advocates, researchers and practitioners seeking to encourage the development of housing conditions surveys and rigorous research to document the conditions and demonstrate the consequences to farmworker health and well-being.

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I. EXECUTIVE SUMMARY

Housing conditions of many American farm laborers have long been – and for many remain – poor. A wide range of health risks are associated with housing conditions of farm laborers and their families, including anxiety, depression, exposure to toxic agricultural chemicals due to proximity to fields or contaminated clothing, increased risk of infectious disease due to poor sanitary conditions, and increased risk of transmission of infectious disease due to crowded conditions. Yet the scientific literature has a paucity of reports of the directly measured health status of currently employed hired farm workers and how their health is affected by exposures to these risk factors. Similarly, only a few scholars are actively pursuing research on this topic.

The present report comprises a descriptive review of the scientific literature that examines farm labor housing conditions – in labor camps as well as in private market housing – and possible associations between sub-standard conditions and population health. Peer-reviewed research reports are relied upon in this review, although a very few, selective, additional reports also are discussed.

Studies of associations between farmworker housing conditions and health must be set in the context of the larger issue of housing conditions and health. Conditions in slums and tenements in rapidly industrializing cities of Europe and America focused the attention of social reformers and the emerging public health movement on the linkage between poor housing and poor health. Indeed, the American sanitarian movement made housing a health priority through the mid-20th century.

There is a large body of research literature examining housing conditions and health, but calls for more focus on housing conditions and health remain prominent in the public health community. Health risks have been linked to a wide range of housing conditions, including, but not limited to, structural conditions of buildings, building materials (e.g. lead paint), inadequate sewage and septic systems, the supply and quality of water, crowding within dwellings, and ventilation and indoor air pollution.

Increased health risks have been associated with neighborhood spatial factors, such as the physical and social conditions in neighborhoods and proximity to hazards. Most of these building and neighborhood conditions are intertwined with poverty. However, much of the research on housing and health has been conducted in urban settings, rather than rural settings where most farmworkers live.

The research literature on housing conditions and health is substantial, this literature is based largely on cross-sectional analyses, and thus is limited to conclusions of association rather than causation. Conceptual haziness, notably in studies of crowding, also has limited the validity of some findings. There are increasing studies based on longitudinal data, but many questions remain unanswered.

A recent review of the literature, and of national cross-sectional surveys of housing as compared with national cross-sectional surveys of the health status of the U.S. population at large, identified a major inadequacy of comparing these separate surveys to finding links between health status and housing conditions (Jacobs et al. 2009). These two types of surveys refer to different samples of homes and individuals. The authors concluded that it is essential that future studies seeking associations between housing conditions and health should be based on a

single survey that simultaneously examines health, housing and the nearby built environment (neighborhood) for individuals and their homes.

Farmworkers, especially Latino farmworkers, have become increasingly important in agriculture in the Pacific Coast regions and some other parts of the country, but California remains by far the dominant agricultural state with the largest farmworker population. The major agricultural counties of California are among the nation's poorest with the lowest quality of life. Much of the research and policy literature on farmworkers is based on the California experience.

Recent evidence finds that farm operators in California have substantially reduced or eliminated on-farm housing for their employees, displacing most migrant workers into the private market. This trend coincides with increased privatization of labor costs that includes greater reliance on labor market intermediaries, such as labor contractors, and increased dependence by workers on *raiteros* for transportation to and from the fields.

There is extensive anecdotal evidence, as well as some systematic evidence, of deplorable conditions of farmworker housing, both in labor camps and in private market dwellings. Existing data, however, both Census and Current Population Survey data, are limited by the inadequate identification and inclusion of farmworker housing on the Master Address File (MAF), making conditions under-represented. Surveys also fail to clearly identify farmworkers, so their housing conditions are not well measured. Studies in California and other states (e.g. North Carolina), nonetheless, have identified inadequate sanitation, unclean water, and poor structural conditions, among many other problems with farmworker housing.

The growing farmworker health literature identifies a wide range of occupational health hazards, but few studies have focused on the adverse health effects of farmworker housing. Some research has focused on the condition of farmworker housing or hazardous exposures in housing, but few studies have critically analyzed adverse health conditions and housing conditions. Some findings are consistent with the broader housing and health literature, for example the association of poor sanitary conditions with increased diarrheal disease.

There is a clear need for accurate and representative data on the effects of health hazards in farmworker housing and farmworker health. New research is needed that simultaneously examines health, housing and the nearby built environment instead of separately studying each of these factors. Carefully designed epidemiological studies using validated instruments and protocols are essential for obtaining data needed to make comprehensive assessments of the relationship between farmworker housing and health. Care must be taken in establishing informed consent protocols and addressing other ethical issues of identifying risks in housing where the residents have limited options either to correct these risks or find suitable, decent, affordable housing.

> *"The U.S. Department of Labor today announced the assessment of $36,134 in civil money penalties against eight growers in five Michigan counties for migrant housing and child labor law violations… James Smith, district director of the Labor Department's Wage and Hour Division…called the violations 'intolerable…Among the violations we cited were workers living in unlicensed labor camps with sewage from a faulty septic system seeping up in close proximity to living units, untreated waste water spilling out of broken pipes, no hot water for hand washing, and infestation by insects and rodents.'"*
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> - U.S. Department of Labor, October 27, 2009
> OPA News Release Number 09-1256-CHI

II. INTRODUCTION

Unsafe housing long has been recognized as a significant risk to the health of occupants. Jacob Riis' muckraking expose of living conditions in New York City's lower East Side tenements in the late 19th Century was instrumental in contributing to enactment of new public health requirements, known as the "tenement laws."

"An increasing body of evidence has associated housing quality with morbidity from infectious diseases, chronic illnesses, injuries, poor nutrition, and mental disorders…. In more recent years, epidemiological studies have linked substandard housing with an increased risk of chronic illness" (Krieger and Higgins. 2002), and that link begins early in life. A longitudinal study (Marsh et al. 2000) found that those living in adequate housing who previously had resided in inadequate housing had worse health than their peers who never had lived in poor housing.

The Centers for Disease Control and Prevention (U.S. CDC. 2008 B) estimates that there are more than 6 million units of substandard[1] housing in the U.S. According to Robert Novick of the World Health Organization, "[P]oor housing is always associated with high rates of morbidity and mortality, yet housing generally is not high on the list of societal needs and governmental priorities" (Thiele. 2002).

Housing conditions can significantly affect public health (U.S. CDC. 2008 B; Bashir. 2002), with research demonstrating that both individual homes and neighborhoods can have an adverse effect on health, and that these effects most often impact those living in poverty. Friedrich Engels recognized these facts in 1845 in *The Condition of the Working Class in England* (Engels. 1969). The relationship of wellness to housing now has become a major topic of public health research throughout the world.[2]

One important development of recent research is the realization that both health and equity are closely linked to the quality of the "built environment," a term referring not only to dwellings but also to the physical and social environment in which people reside (Frumkin. 2005). The location of housing, e.g., relative to toxic waste dumps, and community air and water quality long have been recognized to be important factors in public health. Today, local access by community residents to health care providers, schools, libraries, parks, transportation and local vendors of healthful food also are acknowledged to influence health.

Advocacy for environmental justice emerged when long-standing housing disparities between differing socio-economic groups were increasingly recognized as being associated with wellness. Equity with respect to race, ethnicity, nativity, and poverty status, as well as other determinants of socio-economic status, is now realized as one of the major contemporary challenges of environmental health, which should consider the wider community in addition to the dwelling.

Review of the scientific literature discloses that most research on the subject of housing and health in the United States has focused on urban settings, primarily in metropolitan areas. Only a few studies explicitly recognize rural or non-metropolitan communities as presenting risks to health. The concept of "slums" typically is associated with urban settings, as are "smog" and "crowded" housing conditions. Rural and non-metropolitan places by contrast often are thought of as "clean", "healthful" and "less crowded." This dichotomy goes back over 200 years to the "agrarian myth" described by Thomas Jefferson.

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[1] Note: Federal agencies use data on the year the structure was built to create formulas to determine substandard housing, using houses built before 1940. Benefield, Robert and Robert Bonnet, "Structural and Occupancy Characteristics of Housing," U.S. Census Bureau, November, 2003.

[2] http://www.ncbi.nlm.nih.gov/sites/entrez; using the search term "health housing" we find 10,564 citations in the academic literature; accessed 10/05/09.

Research that examines the relationship of housing to health in occupational groups that are primarily found in rural or non-metropolitan areas of the nation, such as agricultural or forestry workers is even less common. This lack of attention of the research community to the living conditions of rural workers is problematic for the present discussion. Most agricultural workers today are low-wage immigrants, and often are able to find a place to live only in some of the worst housing in the nation.

This report examines the hypothesis that sub-standard farm labor housing in both employer operated labor camps and private market dwellings adversely affects the health of worker and family member occupants. Farm labor is examined in some detail: the growth of labor-intensive agriculture, contemporary national findings regarding the status of farm labor housing, and a review California's current farm labor housing.

Conceptual links between farmworker health and housing conditions are reviewed to develop the hypothesis that sub-standard housing conditions have an adverse impact on the health of residents. Recent research findings on farmworker housing conditions are reviewed, followed by an examination of the contemporary scientific literature evidence his hypothesis, and concludes with findings from the 1999 statewide, cross-sectional survey of hired farm worker health as it relates to housing conditions.

The relationship between measurable health outcomes and sub-standard housing conditions for the population at large is examined and finally questions are posed about appropriate research methodology, and a series of challenges is made to the research and advocacy communities. This review is descriptive, not analytical, and relies nearly entirely, with only a very few exceptions, on peer-reviewed literature.

III. THE HEALTH CONSEQUENCES OF SUBSTANDARD FARMWORKER HOUSING

III.A. THE GROWTH OF LABOR-INTENSIVE AGRICULTURE

The number and geographic distribution of farm laborers is largely determined by the demand for agricultural labor. Labor-intensive U.S. crop production has become more important in recent years. By every measure – farm cash receipts, tons harvested, and land use – the nation's output of fruit, vegetable and ornamental crops has greatly increased during the period 1974-2007.[3]

Changes in both livestock and crop production have led to a greater reliance on farm laborers in recent years. Not only has there been a rising output of labor-intensive commodities, but also the number of persons whose occupation is "farmer" or "rancher" has plunged.[4]

Figure 1. Estimated Hired Farm Worker Demand (labor hours), by State 2007, U.S. Total Hired Farm Worker Demand = 2.2 billion hours
Source: USDA *Census of Agriculture*; USDA *Farm Labor*

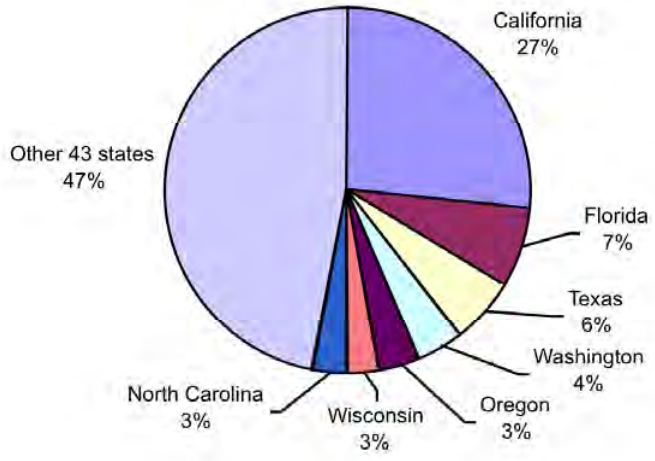

Figure 1 presents the estimated state-by-state share of total national demand for farm laborers in 2007, both crop and livestock farm workers, expressed in hours of labor. 5 California alone accounts for more than one-quarter of total U.S. hired labor demand, and its share of the national total grew from 19% to 27% in the 20-year period 1987-2007.

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[3] Census of Agriculture reports of the farm gate value of all U.S. fruit, vegetable and ornamental crops show an increase from 17.3% of all crops sold by farm operators in 1974 to 34.9% of the total crop sales in 2007. Annual tons of harvested fruits and vegetables increased from 45 million 69 million during the same period.

[4] During the period 2000-2007, the number of self-reported "farmers" reported in the Current Population Survey of the Bureau of Labor Statistics declined from an estimated 879,000 to 742,000, a loss of 137,000.

[5] The underlying data on which Figure 1 is based is comprised of two components: total farm operator expenditures for both hired and contract labor in 2007, and the annual average wage rate paid to hired labor for the same year. The former data is available in Table 4. Farm Production Expenses: 2007 and 2002, 2007 Census of Agriculture-State Data, cf. pp. 312 ff. *Census of Agriculture 2007. United States. Summary and State Data*, Volume 1. Geographic Area series. Part 51, United States Department of Agriculture, National Agricultural Statistics Service, Washington, DC, February 2009. The annual average wage rate for hired labor in each state for 2007 was computed from the U.S. Department of Agriculture publications, *Farm Labor*, November 2006 and November 2008.

III.B. WHERE DO FARM LABORERS LIVE?

III.B.1. Nationwide Assessments

National assessments of farm labor housing are sparse. The authoritative President's Commission on Migratory Labor stated categorically in 1951, "Much, if not most, of on-job housing of migratory farm labor in the United States is below minimum standards of decency."[6]

The Commission on Agricultural Workers (CAW), jointly appointed by the Office of the President and the U.S. Congress, reported in 1993, "Whether in labor supply communities or upstream areas, the number of farmworkers in need of housing exceeds the available housing stock. The result is overcrowding, the occupation of substandard units and homelessness."[7] "…[T]he vast majority of hired farmworkers are housed in seriously inadequate conditions. Most quarters are overcrowded…Other problems include use of dilapidated structures and of buildings not intended for residential use, such as garages and storage sheds."[8]

The CAW summarized some examples of deplorable conditions reflected in anecdotal reports from researchers. "Testimony presented to the Commission detailed the conditions of newly arrived immigrant workers living in cardboard houses in the canyons of San Diego. Researchers collecting Farm Labor Supply Study (FLSS) data in Parlier, California, found 20 or more men living in a single garage or backyard. Workers sleeping in vacant lots in Immokalee, FL paid $1 for showers, but lived in constant fear of being robbed while they camped out. Unaccompanied male workers in Michigan housed in small shacks originally built in the 1950s were required to share beds. Groups of five to nine men in Washington shared horse stalls in an abandoned barn."[9]

The National Research Council, in its 2008 review of the occupational safety and health research programs addressing agricultural workers, recommended that the National Institute for Occupational Safety and Health pursue new research to address problems associated with farm labor housing. The report states, "…virtually all recent health survey research have [sic] demonstrated that a large share of this workforce is still experiencing unwarranted risks to health that are associated with their housing conditions" (National Research Council. 2008).

Sub-standard housing conditions of many farm laborers and ethnic minority group residents in rural areas of California, and the obstacles which they face in seeking to obtain safe, decent and affordable housing have also been described in some detail (Jacobs. 2008). The absence of adequate governmental responses to these sub-standard housing conditions is also the subject of litigation in California.

Recently, a group of farm labor union and advocacy organizations collectively submitted comments in response to proposed changes in regulations concerning the non-immigrant guest worker program in agriculture (H-2A) that would have suspended the obligation of employers to provide housing that meets long-established federal standards. In those comments, the author noted, "…farmworkers throughout the country often are forced to live in dilapidated housing conditions that threaten the lives, health and safety of its occupants, regardless of whether they are families or unaccompanied workers." (Farmworker Justice, et al, 2008).

The most recent published report on the housing status of the nation's hired farm workers is based on the 2005-07 Current Population Survey (CPS) of the Bureau of Labor Statistics (Kandel 2008). The 2006 sample alone comprises 4,625 persons employed as hired farm workers and, for the first time, was able to distinguish the housing status of non-citizen hired farm workers as compared with citizens (Table 1).

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[6] *Migratory Labor in American Agriculture: Report of the President's Commission on Migratory Labor*, U. S. Government Printing Office, Washington, D.C., 1951, p. 138.
[7] *Report of the Commission on Agricultural Workers*, U.S. Government Printing Office, Washington, D.C., 1993, p. 50.
[8] Ibid, pp. 105-106.
[9] Ibid, p. 106, footnote 18.

Table 1. Housing, U. S. Hired Farm Workers, 2005-07 (Kandel. 2008)

Characteristic	*Noncitizen*	*Citizen*	*Total*
Persons per dwelling (average)	4.7	3.4	3.9
Families per dwelling (average)	1.8	1.2	1.4
Own dwelling	24%	69%	53%
Rent dwelling	62%	18%	34%
Noncash rental	13%	12%	13%
Public housing	1.4%	0.7%	0.9%
House or apartment	81%	89%	86%
Mobile home, trailer, other	19%	11%	14%

The CPS sample of hired farm worker households in Table 1 demonstrates that many share their dwelling with non-family members. Just over half reside in a dwelling owned by them or a member of their family. The typical dwelling is a house or apartment while one out of seven lives in a mobile home, trailer or other type of non-permanent dwelling.

The extent of shared living quarters is greater among non-citizen workers, averaging 1.8 families per dwelling as compared with 1.2 among citizen workers. A dwelling that houses non-citizen workers typically has more residents as compared with citizen workers, an average of 4.7 vs. 3.4 persons per dwelling. Just 24% of non-citizen hired farm workers reside in a dwelling owned by them or a member of their immediate family. Nearly one in five resides in a mobile home, trailer or other temporary quarters.

The major shortcoming of the CPS sample is that it relies on the Census of Population and Housing Master Address File (MAF), and primarily utilizes telephone interviews. Dwellings lacking a postal address, or those unrecognized by government authorities as suitable for human habitation, typically are missing from the MAF, which leads to both an undercount of farm laborers in the decennial Census as well as under-representation in the CPS. The telephone interview technique relies on dwellings with a landline and may tend to obtain a greater response rate from persons who speak English.

The study's author acknowledges that immigrant and undocumented workers may be inadequately represented in the CPS sample. Another possible shortcoming, not discussed by the author, is whether farm management personnel not directly involved in commodity production tasks, such as accountants, bookkeepers, office clerks, and machinists, were included in the sample. There was apparently no effort to separately report findings for livestock and crop workers.

Finally, in the actual report, the author compares the findings for hired farm workers with those for all U.S. households. Such a comparison does not adjust for the most important aspect of housing affordability, family income, which is not comparable between the two groups, i.e., family income in all U.S. households is substantially greater than in hired farm worker households. Thus, one would expect substantial differences in home ownership rates, and other important variables may differ as well, such as age distribution, race, ethnicity and poverty status, all of which are associated with patterns of housing tenure.

These housing findings from 2005-07 can be compared with an earlier study of farm labor housing tenure and wage compensation based on a national sample of 1,785 hired agricultural workers drawn from the 1984 Current Population Survey (CPS) of the Bureau of Labor Statistics (Perloff. 1991). Foremen and managers were carefully excluded from this sample, and the data refers only to housing units occupied at the time of the survey.

Nearly half the 1984 sample was living in owned housing, about one-quarter resided in rental units, and the remaining one-fourth lived in rent-free housing provided by the employer. Those who lived in owned housing were more likely to be younger, white, female, better educated, less likely Hispanic, and less likely to be a household head than workers living in rent-free housing. About half of workers living in rent-free housing and owned housing were employed on crop farms, but nearly three-fourths of renters were crop workers. Those who lived

in rent-free housing were more likely to live in the South and West than were homeowners. The report also found rent-free housing to be less prevalent in California and Florida and relatively common in Texas.

The rate of homeownership found in 2005-07 was nearly the same as in 1984, but the proportion of workers now residing in free employer-provided housing is just one-half of the earlier figure: one-eighth lived in free housing in 2005-07 vs. one-fourth in 1984. This finding also implies that fewer hired workers lived on farms in 2005-07 as compared with 1984.

The author of the earlier study noted that the CPS sampling methodology is less likely to include residents of sub-standard housing units or undocumented workers. Lacking findings regarding citizenship status of workers, however, this author was not able to extend the analysis in the manner of the more recent report.

Neither of these CPS samples included findings relative to housing quality or worker health. A second major limitation, common to both the 1984 and 2005-07 samples, is that much of the data relies on the March supplement to the CPS. Important aspects of both data sets refer to persons employed as hired farm laborers during March. March is not a month that corresponds to peak seasonal activity in agriculture in nearly every state. It is likely that the CPS methodology misses a large, and unknown, portion of the hired farm worker population.

There is no evidence in the most recent government report or in the peer-reviewed literature to indicate that the housing situation for hired farm workers on a national basis has changed appreciably in the past 20 years. The only noteworthy change in housing practices might be that substantially fewer workers in 2005-07 reside in free, employer-provided housing.

The National Agricultural Worker Survey of the U.S. Department of Labor (NAWS) is another source of information about the status of farm labor housing throughout the U.S. It conducts face-to-face interviews with an accurately drawn, national, cross-sectional sample of hired crop farm workers. The NAWS deliberately excludes livestock workers. The most recent published report from the NAWS is based on 6,472 worker interviews conducted between October 1, 2000 and September 30, 2002 (U.S. DoL. 2005).

The NAWS findings relative to farm labor housing are quite limited, but it finds 58% of crop workers rented their dwelling from someone other than their employer, 19% lived in a dwelling they or a family member owned, 17% resided in housing provided free by their employer, 4% rented housing from their employer, and 2% lived rent-free with family or friends. The comparable NAWS survey in 1993-94 indicates some differences. In this earlier survey, only 43% rented from non-employers and 33% lived in employer-provided housing.

The NAWS survey also finds 55% reside in some type of single-family dwelling or unit, 22% lived in an apartment, 16% lived in a trailer or mobile home, and the remaining 7% lived on various other types of housing, including dormitories, barracks, multifamily structure, motel or hotel. About 14% of crop workers lived on-farm as compared with 24% in the 1993-94 survey.

The NAWS findings indicate a significant trend over the years of fewer workers residing on-farm or in employer-provided housing. The housing findings are consistent with findings from the 2005-07 CPS sample. NAWS does not include measures of participants' health or housing quality. NAWS, like CPS is limited in its ability to inform this review regarding the relationship of farm labor housing to the health of occupants.

Increased privatization of farm labor market costs over the past two decades, such as has occurred in the significant decline of employer-provided housing for farm laborers, is also manifested in other aspects of the agricultural labor market. Farm operators have sharply increased their reliance on intermediaries, such as farm labor contractors[10] and farm managment firms, to supply needed labor, and, in California, workers have increasingly had to rely on private, for-profit *ratieros* to bring them to and from the fields (Villarejo et al. 2010).

[10] Census of Agricultural data indicate that Contract Labor production expenses on U.S. farms were 14.5% of total Hired and Contract Labor production expenses in 1987. By 2007, the Contract Labor share had increased to 20.6%.

III.B.2. Housing Standards – Labor Camps/Employee, Market Sector

National health and safety standards for farm labor camp housing that applies only for migrant workers are fully described under OSHA regulations (cf. 29 CFR 1910.142 et seq.). The Migrant and Seasonal Agricultural Worker Protection Act (1983) requires registration of farm labor contractors and their employees who perform farm labor contractor activities, including a requirement that all agricultural employers disclose information pertaining to housing, if provided by the employer. Form WH-521 must be completed by the employer and provided to the employee in advance. Among the information that is required are the name and address of the landlord, the name, address and phone number of the property manager (if not the owner), the address and phone number of the property, and specific details of the conditions of occupancy. The document also states, "This form must be posted in a conspicuous place or presented to each worker in English, Spanish, or another language, as appropriate." The Wage and Hour Division of the U.S. Department of Labor has responsibility for enforcement of MSAWPA.

Federal law (MSAWPA) requires that employer-provided housing for migrant workers not only be in full compliance with the OSHA standards but also with applicable state and local standards. Some states, such as California, have standards for employee housing and housing in general. A few local governments also have their own housing ordinances. All of these are intended to regulate health, safety and environmental risks.

At the same time, there are substantive differences between the OSHA requirements for employer-provided farm labor migrant housing and minimum quality standards established by the U.S. Department of Housing and Urban Development (HUD) for structures eligible for the Section 8, low-income, voucher program (Vallejos et al. 2009). These disparities are to the disadvantage of farm laborers regarding the maximum number of occupants per room used for sleeping, availability of flush toilets, and acceptability of shared toilet facilities by multiple housing units, among others.

The U.S. Environmental Protection Agency has responsibility under the Clean Water Act for assuring that labor camps have access to safe, potable water supplies. In California, County Public Health Officers are responsible for conducting assessments of drinking water quality in registered farm labor camps. Oversight inspections conducted by EPA have been limited. In California, the most recent EPA oversight inspections for compliance were conducted in 1991 (U.S. EPA. 1991).

Private sector, or market housing, is subject to state and/or local ordinances governing all residents irrespective of employment status. However, various Federal and State programs have sought to provide private sector housing targeted to eligible agricultural employees. Each of these programs has strict housing quality standards intended to protect the health and safety of residents. The most notable of current efforts are the Rural Development Housing Assistance program of the U.S. Department of Agriculture, and, in California, the Joe Serna, Jr., Farmworker Housing Grant Fund. These programs typically provide support to non-profit agencies serving farm laborers or to private developers. The Serna Fund explicitly requires matching funds from other sources, such as USDA's Rural Development program.

The California Endowment, a large private foundation, provided very substantial additional support of approximately $30 million for the development of suitable agricultural worker housing under its Agricultural Worker Health and Housing Program (AWHHP, now concluded). Like the Serna Grant Fund, the AWHHP sought proposals that would leverage significant additional resources, typically matching funds. The AWHHP program also required linking new health care services or access to care as part of this housing initiative.

III.B.3. California's Farm Labor Housing

Many, if not most, seasonal farm laborers in California resided in employer-owned labor camps during the early and mid-20th Century. It was estimated when the Bracero program ended in 1964 that 5,000 camps remained. More recent estimates indicate that fewer than 1,000 are open today. The decline of employer-owned camps is well established and described in a narrative history of California legislation seeking to regulate farm labor housing conditions (Javor. 2002). Recent anecdotal reports from the Kern County and Tulare County environmental health staff indicate that in these two San Joaquin Valley counties more than three-quarters of the camps in operation twenty years ago now have been closed.

A number of states, and notably California, have independent, and some would argue, stronger regulation of labor camp housing. The Employee Housing Act (1965) succeeded the Labor Camp Act of 1915 and governs the provision of employee housing to hired farm workers, forestry workers and certain others engaged in natural resource production. The reference to "labor camps" in the law was replaced by the term "employee housing" during the 1990s.

Administration of this law was assigned to the Housing and Community Development (HCD) agency of the State of California. Regulations implementing the EHA are very specific and employers must comply with numerous requirements (cf. 25 CCR 600 et seq.). The Employee Housing Facility Inspection Information Booklet describes the law in the following terms (California HCD. 2000), "The Employee Housing Act governs the construction, maintenance, use and occupancy of living quarters called 'employee housing' which are provided for five or more employees under specified circumstances." The law applies when living quarters in urban or rural areas is provided by an employer in connection with any work, or when living quarters in a rural area that is both provided by someone who is not an agricultural employer and is provided for agricultural workers employed by any agricultural employer.

The EHA requires that all places subject to the law must have a permit and be inspected prior to occupancy, again during occupancy, and again if an occupant files a complaint. The historically large number of labor camps and the enormity of the state created a divided enforcement scheme for the EHA. The HCD delegates responsibility for permitting and inspection to local government, county housing, health officers or environmental health departments.

Employers claim that housing standards imposed by the federal and state regulations are unrealistic and too expensive to implement by remodeling. Faced with the prospect of sanctions for being out of compliance with regulations, many employers simply closed their camps. Advocates believe that employers who closed their camps actually were trying to avoid regulation, and that claims of great expense to comply are exaggerated. Only a relatively small number of private labor camps remain in operation. Other factors, such as the widespread

settlement of Mexican immigrant workers in rural communities and the sharply increased reliance by farm operators on labor market intermediaries, such as farm labor contractors, have contributed to this trend. Also, in the immediate aftermath of the amnesty programs of the Immigration Reform and Control Act of 1986 (IRCA) the supply of newly legalized immigrant farm workers exceeded demand, which meant that some employers no longer needed to furnish housing in order to attract workers (Villarejo. 2010).

Public farm labor camps in California are known as Migrant Family Housing Centers. There are 25 in operation today providing a statewide total of 1,962 units (California HCD. 2008). The centers are under the direct administration of the local county housing authority in the counties where they are located. They are state owned.

The centers typically are open for only six months each year. Residents must leave when the camps close, even if their job lasts beyond the closing date. Eligibility for residence in one of the centers is limited to families and also requires applicants to present an income tax return for the prior year, or other evidence that demonstrates compliance with annual earned income limits for residents. Occupied units most often can be reserved for the following year, and applicants must present evidence regarding the location of their usual place of residence to demonstrate that they are, in fact, "migrant" workers.

There is no current or on-going survey of California's farm labor housing that directly measures its quality. Some cross-sectional research has either been designed as a statewide household survey (see the 1999 California Agricultural Workers Health Survey, a later section of this report), or as a survey of farm laborers or employers that includes some queries regarding housing.

The most recent annual survey of California farm employers includes some useful information about housing provided by employers (Farm Employers Labor Service. 2008). This survey is a cooperative effort of the Farm Employers Labor Service (FELS) and eight sector-based farm industry associations. A total of 533 employers participated in the 2008 survey, including both crop and livestock producers. It is likely that most respondents are among the larger employers in these sectors.

The main finding regarding farm labor housing from the FELS is that one-fourth (25%) of the employer respondents provide housing for some year-round employees, and about one-twentieth (5%) provide housing for at least some of their seasonal workers. One-sixth (17%) of the employers provide utilities without charge in their housing for year-round workers. Just one out of twenty-five (4%) of the employers provided free utilities services for their seasonal employees.

The survey does not provide information concerning the number of workers housed, or whether it is on-farm or off-farm; however, the FELS survey does provide information about the employer housing practices in each of eight agricultural industry sectors as well as for all industries combined. In addition, the survey provides similar information for each of four farm size categories, ranked by the total number of workers. The findings by industry sector are presented in Table 2; some employers produce commodities in more than one sector and are multiply represented (once in each sector's summary data).

The very wide range of employer-provided housing practices for year-round workers in the different sectors, from 10% among vegetable growers to 48% among dairy and livestock producers (Table 2). The 24/7 x 365 demand for labor in the dairy industry is facilitated by having workers onsite and available to work every day. Most vegetable growers have a greater reliance on labor contractors[11] and may not require daily attention to the crop on a year-round basis from their direct-hire employees.

[11] The FELS survey reports that 74% of Vegetable Crop producers hired labor contractors; in contrast, the average for all sectors was 51% relied on labor contractors (Farm Employers Labor Service, 2008).

Table 2. Employer-Provided Housing, California, 2008
Source: Farm Employers Labor Service, 2008

Sector (number of employer respondents = N)	*Percent providing housing for year-round workers*	*Percent providing housing for seasonal workers*
Vegetable crops (126)	10%	3%
Field/other row crops (113)	25%	7%
Tree crops (176)	30%	5%
Grapes (249)	27%	8%
Dairy/Livestock (68)	48%	4%
Poultry (17)	24%	6%
Ornamental crops (30)	17%	3%
All other commodities (45)	24%	11%
All commodities (533)	25%	5%

Just 29 of the 533 responding employers provide at least some seasonal employees with housing opportunities. There is no statistically significant difference among the various industry sectors in this regard.

It is apparent that there has been a substantial decrease in the share of employers providing housing for hired farm workers when these findings are compared with reports for earlier years from FELS. The most precipitous decline has been in housing for seasonal employees. Queries regarding employer-provided housing were first included in the annual FELS survey in 1986. In that year, 39% of farm employers (103 of 264 respondents) said they provided housing without charge to their year-round employees, and 17% (44 of 264 respondents) said they provided free housing to seasonal employees.

The most recent NAWS report for California (Aguirre. 2005) provides limited information as of 2003-04 from the perspective of the 2,344 randomly selected hired crop farm worker participants (Table 3). No livestock workers are included in the NAWS.

Some 96% of California's crop farm laborers live off-farm in dwellings not owned by their employer (Table 3). Just 3% reside in on-farm housing. The proportion residing on-farm is as large as 5% for U.S. citizen workers, but as low as 1% among indigenous Mexicans and Central Americans.

Most California crop farm laborers reside in single-family dwellings (62%) or apartments (29%). Another 9% live in mobile homes, barracks or duplex/triplex dwellings. The proportion residing in apartments varied greatly according to immigration status as with off-farm vs. on-farm residences. Just 8% of U.S. citizen workers lived in apartments as compared with 22% of documented immigrants, and 37% of undocumented workers. Among southern Mexican indigenous migrant workers, 43% said they had apartment residences.

Table 3. Farm Labor Housing, Hired Crop Workers, California, 2003-04
Source: Aguirre International. 2005, Exhibit 28, p. 31

	All crop workers	*Indigenous*	*U.S. Citizen*	*Green card*	*Unauthorized*
Type of housing					
Single family dwelling	62%	52%	86%	68%	54%
Apartment	29%	43%	8%	22%	37%
Mobile home	6%	4%	4%	7%	6%
Barracks/Dorm	2%	1%	0%	2%	2%
Duplex/Triplex	1%	<1%	1%	1%	<1%
Location of housing					
Off-farm (not employer-owned)	96%	99%	94%	95%	97%
Off-farm (employer-owned)	1%	0%	1%	2%	1%
On-farm of employer	3%	1%	5%	3%	2%

A separate summary of public access data from the California NAWS reported in each of successive two-year periods from 1989-90 through 2003-04, shows that 18% of hired crop workers in the most recent time frame lived in a house owned by them or a family member, unchanged from the earliest time frame reported (Aguirre Public Access Data. 2005). The proportion of California's crop workers residing on-farm in employer-owned housing, by contrast, has declined sharply from 13% of all workers in 1991-92 to the most recent figure of just 3% in 2003-04.

The findings from the FELS and from the NAWS indicate a substantial change in the pattern of farm labor housing in recent years: away from on-farm dwellings and labor camps toward private market housing in single-family dwellings and apartments. The evidence indicates that employer-owned housing is made available or provided by farm operators mainly for year-round workers.

The considerable evidence of a substantial shift of workers' residences away from on-farm, employer-provided housing to private market residences suggests that new priorities may be required to improve farm labor shelter. At the same time, there is also evidence of a considerable difference among various regions of the nation: in North Carolina, labor camps are the norm (Phelps. 2006), but in California, the vast majority of workers reside in market housing.

Much of the focus of initiatives to improve farm labor housing is the nuclear family, as reflected in the Migrant Housing Centers of California, or in most of the efforts of non-profit service organizations. While this priority resonates with the nation's attention to home ownership for families, the needs of unaccompanied workers, whose numbers are continuing to increase rapidly, appears to be ignored.

III.C. CONCEPTUAL LINKS BETWEEN FARMWORKER HEALTH AND HOUSING

There has been a substantial increase in research activity on the health of farmworker populations in recent years (Schenker. 1996; Villarejo & Baron. 1999; McCurdy & Carroll. 2000; Das et al. 2001; Zahm & Blair. 2001; Villarejo. 2003; Hansen & Donohoe. 2003; McCauley. 2005; Arcury et al. 2006; Mills et al. 2006; Villarejo & Schenker. 2007). Nevertheless, the amount of research has been limited and even basic characteristics of the population are unknown. This situation is exacerbated by rapid changes in the composition of the farmworker population, reflected in demographics that continue to occur even as this report is written.

A public health approach to disease causation recognizes that most diseases are caused by an interaction of biological, environmental and behavioral factors. It is further possible to consider many different environmental factors including social, family and community influences; living and working environments; and broad social, economic, cultural and environmental conditions at the local, state and national/global levels. Housing conditions may affect health via many mechanisms including environmental toxicants, social relationships, economic influences, psychological factors, economic factors and others. In the case of farm workers, in addition to the risk factors for asthma and other respiratory disease triggered by residential exposures, occupational exposures are important as well (Schenker et al. 1991).

Recent research on the "built environment" has begun to consider the influence of these broader factors on health, but most of this research has focused on urban environments. This broad "public health" conceptualization of housing and health is a very important consideration and should be analyzed in future research on farm labor housing. The present review focuses on more direct causative factors associating farm labor housing conditions in both employer operated labor camps and in private market dwellings with health outcomes.

Most chronic diseases (e.g. type 2 diabetes, high blood pressure) have not been directly associated with housing conditions, and most research on the causes of these diseases has focused on innate traits and behavioral factors such as smoking, diet and physical activity. One exception is several respiratory conditions that have been associated with indoor exposures, e.g. asthma and allergic disease due to indoor mold exposure, and lung cancer from exposure to environmental tobacco smoke. Asthma is also associated with exposures in cockroach-infested dwellings, a problem faced by many low-income populations (Arruda et al, 2001). Data generally are lacking on adverse long-term health outcomes for many potential exposures to chronic, low level toxicants such as volatile organic compounds.

Several acute health conditions are more plausibly associated with exposures in dwellings where workers reside. Consistent access to clean water is a critical necessity and contaminated drinking water is a likely source of acute gastrointestinal disease. Infectious disease vectors such as bacteria, viruses, fungi and insects also might exist indoors. Poor sanitation, inadequate food storage associated with lack of refrigeration, and improper garbage disposal methods may present heightened risks of infectious disease. Even poorly cleaned food preparation surfaces can promote the spread and growth of microorganisms normally present in some raw food products. Shelter is first and foremost a way of protecting oneself from adverse exposures to natural elements, such as rain, strong winds, and temperature extremes, and an inadequate shelter function of housing may contribute to disease among the inhabitants.

Mental health often is ignored in evaluating the health status of a population. The numerous anecdotal reports of either overcrowding or of loneliness among hired farm workers unaccompanied by family members suggest that assessments of mental health status very well might be considerably important.

Increasing numbers of hired farm workers are indigenous people from Mexico and Central America with a history of reliance on traditional medicine. Ethnospecific adverse conditions such as *susto* (extreme fright) are also more prevalent in the latter populations, and many conditions familiar to indigenous people are unknown to western medicine. Developing measures of mental health status appropriate to this population is especially challenging, and the

role of housing quality should be evaluated as a contributing factor (Hovey & Magaña. 2002; Magaña & Hovey. 2003).

Determining whether or not sub-standard housing is causing or exacerbating a particular health outcome can be extremely difficult. Careful hypothesis testing studies are needed to exclude non-causal associations or confounded associations not due to housing. Causal association should be established by consideration of classic epidemiological considerations such as the Bradford-Hill criteria. It is important to account for both underlying health factors in the population, often associated with poverty, and those factors caused or exacerbated by poor housing conditions.

Careful consideration should be given to multiple factors affecting disease risk, for example, tuberculosis incidence is greater in Latin American countries of origin for agricultural workers in the U.S. However, adverse housing conditions (e.g. overcrowding) may independently increase the risk of disease transmission. Workplace exposures, poor nutrition and co-existing disease may all contribute to the increased risk, independent of housing conditions.

Lack of access to medical care also is a major factor in determining an individual's health status. Lack of immunization, failure at early detection of illness, lack of preventive screening for indicators of chronic disease, all contribute to increased risk to health. Lack of health insurance is a major contributing factor to a breakdown of access to care. These factors are not directly considered to be due to sub-standard housing, but combine to adversely effect the farm labor population.

The preceding discussion is not intended to dissuade the study of farm labor housing conditions as affecting health status. Instead, it is to be a cautionary reminder that numerous factors contribute to a person's wellness, but it is important to have a solid scientific basis for attributing adverse health effects to housing. This is particularly true in a low-income population where numerous factors may contribute to ill health. Current farm laborers are mostly foreign-born, Hispanic men who lack any form of health insurance, all factors independently associated with health.

Labor-intensive agriculture and poverty: a dichotomy

Labor-intensive agriculture frequently presents a remarkable contrast of poverty amidst plenty. The most extreme disparity is found in smaller rural communities where farm laborers comprise a plurality of private sector employment. Such communities can be described as "farmworker towns."

The incidence of poverty within "farmworker towns" is associated with less favorable assessments of community well being. The recently developed American Human Development Index finds that California's 20th Congressional District is ranked worst among all 436 C.D.s of the entire United States (Burd-Sharps et al. 2009).[12] Some 44,000 agricultural workers reside in the 20th C.D. and the overall population is 68% Hispanic.[13] 31% of the people of this district lived in poverty as of 2008.[14]

The 20th C.D. also is one of the world's richest agricultural regions. The district ranks first among all 53 congressional districts in California according to the market value ($2.9 billion) of agricultural commodities produced on its farms, and is the second-ranking district in the entire United States according to the market value ($744 million) of its vegetable, melon and potato production.[15] The 20th C.D. encompasses most of the west side of the central and southern San Joaquin Valley, including major portions of Fresno, Kern and Kings Counties, as well as a portion of Tulare County. There are no surveys of housing quality within the 20th C.D. making it difficult to reach conclusions about the relationship of housing quality to the health status of residents, but the high incidence of poverty in this district likely would be associated with sub-standard housing.

III.D. FARM LABOR POVERTY, SUB-STANDARD HOUSING AND HEALTH

Findings on health outcomes among farm labor camps or otherwise associated with living conditions in the scientific literature are relatively sparse. While many studies of farm labor housing quality inform policy discourse concerning specific exposures that are associated with farmworker dwellings and suggest possible ways those factors may contribute to poor health, this types of research is best described as "exposure studies."

There are even fewer research reports in the peer-reviewed literature that describe measured adverse health outcomes and associations with simultaneously measured residential exposures. The only large-scale study of health outcomes and associations with housing conditions is the California Agricultural Workers Health Survey (CAWHS), discussed infra, but even the CAWHS lacked an independent assessment of dwelling quality by suitably trained evaluators.

III.D.1. Exposure Studies

A thorough examination of drinking water quality in California's labor camps was completed in an EPA Region 9 survey in 1991 seeking to identify camps in violation of the Safe Drinking Water Act. Some 191 labor camps serving over 8,500 people in 20 counties were found to be in violation (U.S. EPA. 1991). It also was discovered that local enforcement of water quality standards was lax.

Crowded conditions frequently are mentioned in the context of farm labor housing. A recent study of housing in North Carolina indicates that crowding is common in residences

[12] The American Human Development Index is a numerical average of factors based on district-wide measures of health status, earned income, and educational attainment.
[13] United States, Bureau of the Census, American Community Survey, 1-year ACS 2008; Table B24010 Sex by Occupation for the Employed Population 16 Years and Over, and Table C03001 Hispanic or Latino Origin by Specific Origin.
[14] Ibid. Table B17001 Poverty Status in the Past 12 Months by Age.
[15] United States. United States Department of Agriculture, National Agricultural Statistics Service, *2007 Census of Agriculture. Congressional District Profile*, California 20th District, Issued February 2009.

occupied by hired farm laborers (Early et al. 2006). Another study included an assessment of housing quality in the same state, remarking on the widespread crowded conditions and also observing that most farmworker family dwellings failed to meet U.S. HUD minimum standards for health and safety (Gentry et al. 2007).

The large-scale insertion of indigenous Mexicans and Central Americans into the U.S. farm labor market during the past several decades is associated with yet another layer of discrimination (Zabin et al. 1993). A recent report of an ethnographic, prospective cohort study of a 130 Triqui indigenous migrant workers from southern Mexico finds both working and housing conditions among farm laborers hierarchically organized to the disadvantage of indigenous migrants (Holmes. 2006).

The following is a brief overview of the much larger literature of exposure studies in which determinations of household exposures and potential risks to health were examined. There were no directly measured adverse health outcomes associated with the measured exposures in these reports.

- Inadequate sanitation and water facilities, or lack of laundry facilities, has been associated with an increased likelihood of pesticide contamination of all family members via work clothing brought into the home (Meister. 1991).
- Conditions in five Colorado farm labor camps as well as in a number of agricultural fields were studied; two of the camps lacked safe drinking water (Vela Acosta et al. 2002).
- Increasingly sophisticated, direct measures of pesticide contamination of farm labor dwellings indicate the presence of agricultural chemicals likely brought in from the fields, most probably in work clothing or work boots, or of exposures owing to the proximity of dwellings to fields that have been sprayed, or of exposures to pesticides used for home pest control (Bradman et al. 1997; Eskanazi et al. 1999; Fenske et al. 2000; Lu et al. 2000; McCauley et al. 2001; Hood, 2002; Curl et al. 2002; Castorina et al. 2003; Eskenazi et al. 2003; Goldman et al. 2004; Eskanazi et al. 2004; Lu et al. 2004; Quandt et al. 2004 A; Quandt et al. 2004 B; Bradman et al. 2005 A; Bradman et al. 2005 B; Fenske et al. 2005; Harnly et al. 2005; Lambert et al. 2005; Arcury et al. 2005; Bradman et al. 2006; Coronado et al. 2006; Furlong et al. 2006; Holland et al. 2006; McCauley et al. 2006; Rao et al. 2006; Arcury et al. 2007; Rao et al. 2007; Strong et al. 2008; Harnly et al. 2009). It is not yet clear whether there is an association between these findings of indoor pesticide exposure and measurable adverse health outcomes among residents.
- An effort to reduce organophosphate pesticide exposures to children of farm laborers has been reported (Thompson et al. 2008).
- A recent study of housing conditions in 644 residences of pregnant Latina women and their children the Salinas Valley finds a very large share were sub-standard, commonly having cockroach or rodent infestations, and 39% were also overcrowded (Bradman et al. 2005). Pesticides for home use were commonly stored or applied in many dwellings.
- A review of reports on farm labor housing conditions in the Eastern United States concludes there are substantial discrepancies between farm laborers' and the general population's exposure to hazardous housing, and that farm laborers likely face unacceptable risks to their health (Vallejos et al. 2009). While much of the data on which the review relies is not available in the academic literature, peer-reviewed research reports based on studies among farm labor camps in North Carolina suggest the authors' conclusion is warranted. Among the sub-standard conditions reported are widespread crowding, inadequate sanitary facilities, structural damage and faulty electrical systems. At the same time, the authors note there is little documentation on the condition of farm labor housing in the Eastern United States. The review also notes there is a paucity of research on the health effects among farm laborers of sub-standard housing.
- There are only a very few assessments of compliance of employer-provided farm labor housing with the requirements of Federal and, where applicable, state law. In both Florida

(Flocks and Burns. 2006) and North Carolina (Buhler et al. 2007), it was found that the Federally mandated enforcement inspections to ensure the quality of housing were either lax or infrequently conducted.

- A study of farm labor camp conditions in Eastern North Carolina finds widespread non-compliance with Federal standards in employer-operated labor camps, a prevalence of overcrowding, as well as a notable lack of complete and working sanitary or kitchen facilities in some units (Whalley et al. 2009). These authors specifically indicate that there is a marked absence of measures of specific health outcomes associated with the observed housing conditions.
- A recent study of California's indigenous migrant farm laborers from southern Mexico finds their living conditions to be "…consistently appalling" and the degree of crowding to be "…truly remarkable" (Mines. 2009). The degree of crowding was greatest in Coastal regions of the state, averaging 3.0 persons per room in Watsonville.

A summary description of findings regarding housing conditions in dwellings occupied by farm laborers and other populations has been published (Bradman et al. 2005). Table 4 presents findings from that paper, but only including those studies in which hired farm laborers comprised all, or nearly all, of the sample population. Findings regarding crowding from the CAWHS also are reported in Table 4. Particularly noteworthy is the high prevalence of pest and rodent infestations, evidence of structural decay, and of significant residential crowding (measured by the number of persons per room). Some caution is warranted in interpreting these findings because few surveys of farm labor housing are comprised of samples of randomly selected dwellings.

Table 4. Adverse Housing Conditions (%), CHAMACOS Cohort and Other Surveys
Source: Bradman et al. 2005, Table 2; Villarejo, 2010.

Home characteristic	CHAMACOS (n=644)	Local Farmworker Survey (n=780)	HAC Survey (n=4,625)	CAWHS (n=969)
Rodents	**32**	**18**	**19**	
Cockroaches	**60**	**48**	**19**	
Pesticides stored in home	**49**			
Peeling paint	**58**	**33**	**29**	
Leak under sink	**16**	**34**		
Gas stove without functional vent	**35**			
Water damage	**25**		**29**	
Rotting wood	**11**			
Moderate or extensive mold anywhere in home	**43**			
Moderate or extensive mold in child's sleeping area	**28**			
Wall moisture > 17%	**26**			
Density (number of persons per room)				
Less than 0.51	**2**			
0.51 - 1.00	**22**			
1.01 - 1.50	**37**		**74 > 1.0**	**48 > 1.0**
1.51 or greater	**39**			**25 > 1.5**

III.D.2. Health Outcomes Associated With Farm Labor Housing Conditions

The critical research question regarding how sub-standard farm labor housing contributes to adverse health outcomes requires simultaneous determinations of both the health status of residents and housing quality. The following section reviews studies that include both exposure assessment and measurement of health outcomes in the same population.

Among the health conditions described in the following review are infectious diseases, such as tuberculosis and parasitic infections. The latter diseases are far more prevalent in the countries of origin of immigrant farm workers than in the U.S. population. Immigrant workers infected in their countries of origin might spread the disease among other residents of farm labor dwellings while in the U.S. The real hazard in the case of tuberculosis in the U.S. is that poor housing and limited public health surveillance will result in the dissemination of active TB among farm laborers. Thus, a large number of unrelated farm laborers residing together in a single dwelling is a risk factor. The underlying risk for TB in the population is due to conditions in the countries of origin, exacerbated by inadequate health care after immigration to this country.

- Malaria is virtually unknown in the U.S., but is prevalent in most countries of origin of foreign-born hired farm laborers. Two dozen residents, primarily farm laborers living in encampments adjacent to a coastal lagoon in northern San Diego County became ill in an outbreak of malaria, and its rapid spread was partly attributed to squalid living conditions (U.S. CDC. 1990). A more recent case of malaria in rural Georgia was found to be associated with proximity to housing where seasonally employed immigrant workers from Mexico and Central America lived (MacArthur et al. 2001). The vector transmitting the disease was positively identified, but the association with immigrant workers was speculative.
- The prevalence of tuberculosis is higher in many countries of origin of foreign-born farm laborers, thus, crowded dwellings shared by large numbers of unrelated persons may independently increase the risk of contracting the disease. The first population-based study of tuberculosis among hired farm workers was conducted in North Carolina in which a high prevalence (33% among Hispanics, 54% among U.S.-born blacks, and 76% among Haitians) of positive reaction to the tuberculin PPD skin test was found (Ciesielski et al. 1994). A PPD positive prevalence of 24% was found in a survey of migrant farm labor camps residents in northeastern Colorado (Snyder et al. 1995). A lower prevalence (17%) of PPD positive skin tests was found in a larger sample of residents of two northern California government-funded migrant housing centers (McCurdy et al. 1997). In the North Carolina study, active tuberculosis occurred in 3.6% of US-born blacks and 0.47% of Hispanics. Several workers were referred for treatment in the Colorado study, but the California study found no cases of active TB.
- A study of stressors associated with symptoms of anxiety and depression found that "poor housing conditions" identified by farm laborers were associated with significantly elevated levels of anxiety and depression (Hovey & Magaña. 2002; Magaña & Hovey. 2003). Mental health outcomes among male migrant farm laborers were measured in a more recent study examining the prevalence of depression and anxiety (Hiott et al. 2008). Depression was found to be primarily associated with working conditions while anxiety was associated with social isolation, which is widely understood to be an important aspect of the housing conditions of many hired farm workers.
- A series of studies of the health effects of measurable in-utero pesticide exposures of children, including fetal growth and psychomotor development, found some adverse health outcomes associated with measures of specific pesticides in maternal serum or metabolites in maternal urine specimens. The reported adverse outcomes among the children, including neurodevelopment delays at 12 and 24 months, were associated with increases of measured indicators of exposure among Hispanic families in the Salinas

Valley, a major center of agricultural production (Eskanazi et al. 2004; Young et al. 2005; Eskanazi et al. 2006; Fenster et al. 2006).

- A survey of Mexican immigrants in Ventura County finds an elevated prevalence of *Taenia solium* (tapeworm) eggs at levels found in the developing world. The highest prevalence was found among laborers residing in farm labor camps in the county (DeGiorgio et al. 2005). The dissemination of this disease in the U.S. may be associated with poor sanitation and food preparation facilities.

III.D.3. California Agricultural Workers Health Survey – Housing And Health Findings

The California Agricultural Workers Health Survey (CAWHS) is the only statewide, cross-sectional survey of farm labor dwellings to simultaneously examine the health status of worker residents as well as gather information about the status of the dwellings. The CAWHS was a household survey of randomly selected dwellings in seven representative communities that relied on a multi-layered, stratified sampling procedure intended to assure that any person working as a hired farm worker in California at the time of the survey would have a known chance for participation (Villarejo & McCurdy. 2008). Recently reported and newly analyzed findings of associations between housing conditions and health status are reported herein for 969 participants in the CAWHS (Villarejo. 2010).

Many hired farm workers in California share their dwelling with two or more families in a house or apartment intended for single-family occupancy (Table 5). The CAWHS finds two-fifths (41%) of male participants, and nearly one-third (31%) of female participants, shared housing with unrelated persons. There can be other health concerns, including possible abuse, for children whose families reside with unrelated adults.

Table 5. Residential Characteristics, Hired Farm Workers California Agricultural Workers Health Survey (CAWHS), 1999

Characteristic	*Male (N=627)*	*Female (N=342)*
Shared with unrelated persons	41%	31%
Unaccompanied by family member	42%	17%
Resides alone	15%	6%
Dwelling lacks complete plumbing	6%	2%
Dwelling lacks complete food preparation facilities	5%	1%

A consequence of families sharing an apartment or house is that overcrowding is commonplace and extremely overcrowded conditions are also prevalent. Nearly one-half (48%) of CAWHS participants resided in a dwelling in which the number of persons per room (excluding bathrooms, but including kitchens) exceeded 1.0, corresponding to overcrowding. One-quarter (25%) lived in a dwelling in which the number of persons per room exceeded 1.5, the threshold for extreme overcrowding.

A review article finds the density standard for crowded living conditions in the U.S. has repeatedly been lowered over the years, changing from 2.0 persons per room (PPR) in 1940 to 1.5 PPR in 1950 and, finally, to the current 1.0 PPR in 1960 (Myers et al. 1996). Interestingly, the same review finds that a century earlier, crowding was measured by the *number of households* sharing a dwelling, which resonates with the CAWHS finding that between 30% and 40% of farm laborers have multiple households in a single dwelling.

A discussion of contemporary crowding standards through the national sociology listserve led to useful comments from a number of scholars.[16] All agreed the present standard is arbitrary and likely reflects societal views of the balance between privacy needs and deeply held cultural values. One comment suggested the imposition of an arbitrary standard by an elite may reflect fears of increasing masses of the poor, whether immigrant or not. Another pointed out that residing alone as an immigrant farm laborer might be more stressful than living in crowded conditions. The scholars agreed farm laborers should be asked about their views of crowding.

A surprising finding of the CAWHS was that over one-seventh (15%) of male participants resided alone; among female participants, just one-sixteenth (6%) said they lived alone. A substantial share of those who lived alone, resided in an automobile or an informal dwelling where space was severely limited.

CAWHS found that about 5%-6% of male participants lacked complete plumbing or food preparation facilities, or both. In the majority (75%) of such dwellings there were no refrigerators, stoves, toilets or washing facilities.

The CAWHS interviewers asked participants to report health conditions experienced during the 12-month period prior to the interview. The findings included several statistically significant associations between health outcomes and housing conditions.

Male participants who lived in an informal dwelling were two and one-half times more likely to report experiencing *nervios* (feeling extremely anxious or agitated) as compared with workers residing in a single family house or apartment (O.R. 2.5; 95% C.I. 1.5-4.4; $p<0.01$). Male participants who lived in a dwelling with 2.5 or more persons per room used for sleeping were two and three-quarters times more likely to report experiencing *susto* (extreme fright) as compared with workers residing in a dwelling with a lower density of residents (O.R. 2.7; 95% C.I. 1.4-5.4; $p<0.01$).

Some of the living arrangements of workers, apart from poor physical condition of the dwelling, were also associated with adverse health outcomes. Male participants who were unaccompanied by any family member and who resided with unrelated persons were two and one-half times more likely to engage in binge drinking (five or more drinks in a single episode) than accompanied workers (O.R. 2.6; 95% C.I. 1.4-4.8).

[16] The authors are grateful to Prof. Lynn Lofland, Department of Sociology, University of California, Davis, for her assistance in posting an inquiry on the national sociology listserve concerning the arbitrary nature of the crowding standard. Several scholar suggested citations in the social science literature that were particularly helpful.

Housing tenure is another factor that many associate with healthful lives. Indeed, the policy of the United States has strongly favored home ownership with tax incentives as well as various other forms of subsidies intended to assist low income persons, including hired farm workers, acquire homes. Many private foundations and non-profit service agencies seek similar goals. A large California state government program supports such housing opportunities specifically for hired farm laborers. Less prevalent are programs to provide decent, affordable, multi-family rental housing or rental housing for unaccompanied workers.

Table 6. Housing Tenure and Type of Dwelling, Hired Farm Workers California, 1999, CAWHS

	Male (N=627)	*Female (N=342)*
Housing tenure (CAWHS participants)		
Owner (member of household)	25%	20%
Renter (from farm employer)	7%	2%
Renter (not from farm employer)	58%	67%
Rent land only	3%	2%
Don't know/Not answered	8%	9%
Type of dwelling (CAWHS staff assessment)		
Permanent structure	79%	85%
Informal dwelling	11%	10%
Labor camp	7%	4%
Automobile used for travel to work	3%	1%

Most CAWHS participants met with a staff interviewer in the subject's place of residence, allowing staff to observe key features (Table 6). Most CAWHS participants were renters (69%), and 11% of workers in the CAWHS resided in informal dwellings, defined as not recognized by the U.S. Postal Service or county tax assessors. An additional 2% resided in autos used for transportation to and from work. Some of the informal dwellings identified in the CAWHS were trailers or mobile homes with features comparable to permanent dwellings. Other were structures not intended for human habitation, such as garages, sheds, and abandoned equipment or animal facilities.

The prevalence of informal dwellings among hired farm workers in agricultural regions of California was highlighted in a cross-sectional survey of the San Joaquin Valley city of Parlier, where more than 90% of the residents are of Hispanic ethnicity (Sherman et al. 1997). Beat-up trailers, shacks and garages filled with workers were found behind many of the homes of permanent residents of the city. Local officials ignore "back house" code violations because workers residing in them otherwise might be homeless. Many workers must choose between accepting poor housing conditions and living without any shelter. As rural areas of California experience sharp increases in the proportion of residents of Mexican origin, it becomes more common for homeowners and renters in these communities to offer temporary shelter to sojourners (Palerm. 1994).

The single most important factor in determining housing tenure is total family income. The CAWHS finds a significant correlation between increasing family income and home ownership ($r_s = 0.345$, $p<0.001$). The obvious conclusion is that the best policy to promote home ownership in this population is to support initiatives to substantially increase family income.

Residence in an informal dwelling or automobile used for travel to work was primarily associated with being unaccompanied by any member of the worker's immediate or extended family. Affordable housing presumably is not available for reasons associated with cost and other factors, including that such persons may be more likely to be sending a larger share of their earnings to family members in the country of origin; therefore, saving on housing costs is a high priority.

One of the most important findings of the physical examinations conducted among CAWHS participants is that there were no statistically significant associations between housing tenure, as measured by the "type of dwelling", and any of the following health outcomes: obesity, high serum cholesterol (non-fasting), high blood pressure, dermatitis, anemia, and diabetes risk (as measured by non-fasting blood glucose). In other words, the admittedly crude measure of housing quality described above (permanent structure, informal dwelling, labor camp and automobile used for travel to work) and careful measurement of indicators of adverse chronic health status did not indicate any associations with residing in informal housing, in a labor camp, or in an automobile used for transportation to and from work.

Additional variables reflecting possible housing risk factors were considered in an effort to extend this examination of housing quality in the CAWHS: lack of complete toilet facilities, lack of complete kitchen facilities, and occupancy averaging 2.5 persons per room or more. No significant associations were found between these three additional independent variables and indicators of adverse chronic health status.

This does not prove that farm labor housing quality, including sub-standard housing, has no effect on chronic health conditions, but it does suggest that cross-sectional survey research may be limited in its ability to observe such associations. Additional research, including prospective studies, is necessary.

The CAWHS was deliberately designed to be a statewide, cross-sectional, household survey but was not focused on examining possible links between housing quality and health status. Rather, its primary goal was to gather previously unknown and much-needed health status and access to care information. Also, the size of the CAWHS sample (about 940 dwellings) was not intended to fully inform a profile of current farm labor housing conditions. A much larger sample size is needed to be able to examine associations between housing conditions and health, especially for subgroups of workers, such as residents of employer-provided housing or of unaccompanied migrant workers.

Little is known about farm laborer housing conditions among those who reside in larger California communities, such as Oxnard (Ventura County), Stockton (San Joaquin County), Salinas (Monterey County) and Fresno (Fresno County), where tens of thousands of workers are known to reside, sometimes in conditions of extreme crowding. The largest city randomly selected in the sample of communities for the CAWHS (Vista, population 89,897 as of Census 2000) had a greater degree of household crowding than was found in the other six communities.

IV. THE NEXUS OF HOUSING AND HEALTH

The World Health Organization's Health Principles of Housing (WHO. 1989) identifies how adequate housing promotes health, including: protection against communicable diseases; protection against injuries, poisonings, and chronic diseases; and reducing psychological and social stresses. The Principles state that adequate housing consists of: safe water supply; sanitary disposal of excreta and solid wastes; drainage of surface water; personal and domestic hygiene; safe food protection; structural safeguards against disease transmission; as well as construction materials and techniques and structural safety, including ventilation and light, and suggests that the physical dwelling must be such that inhabitants are not exposed to dangerous conditions or hazardous substances.

A substantial literature supports the WHO Principles documenting how housing conditions can significantly affect public health, with research linking both individual houses and neighborhoods with adverse health effects (U.S. CDC. 2008; Bashir. 2002; Krieger and Higgins. 2002; Fullilove and Fullilove. 2000). Adverse health effects associated with poor housing may be cumulative across the life course (Marsh et al. 2000) and socio-economic status, in particular poverty, is intertwined in many of the studies of housing conditions and health outcomes. Poverty per se is not a cause of ill health, but it clearly has a direct bearing on housing choice

and quality. Separating health outcomes associated with poverty from health outcomes associated with poor housing quality is difficult, especially in cross-sectional analyses.[17]

The difficulty of separating dwelling-specific conditions from other factors has been described in the literature. A British study (Alder et al. 2005) of over 24,000 patient records living in three districts modeled chronic disease incidence across geographic neighborhoods to examine the relationship between various chronic health conditions and the value of a person's property. Among other things, it showed that those living in lower value housing are twice as likely to be suffering from coronary heart disease as those living in higher value properties. The risk of diabetes increased 1.3 times, independent of other risk factors (BMI, hypertension, age and smoking). In addition, the risk of hypertension (independent of smoking, age and BMI) was 1.4 times higher for those in these low-value housing neighborhoods. It is not clear if this is a neighborhood effect or an effect of the individual low-value houses. Finally, the study found that the risk of COPD increased 3.0 times for these residents. This study illustrates the association of housing and chronic disease, but at the same time it reflects the difficulty of separating out the individual effects of poverty, poor housing quality, and personal behaviors on health outcomes.

It also has been pointed out that a health "risk factor" does not necessarily have to be the proximate cause of a specific disease to be associated with it (Alder et al. 2005). A particular housing condition may act as a proxy for other influences that may or may not be observable, such as lifestyle behaviors (Northridge et al. 2003).

Recently, a comprehensive 30-year retrospective analysis of the relationship of housing and population health concluded that national survey research on this topic is hampered by the fact that separately conducted health and housing surveys collect data for completely different samples of homes and individuals (Jacobs et al. 2009). The National Health and Nutrition Examination Survey (NHANES) is constructed to accurately represent the population as a whole, while the American Housing Survey (AHS) collects data on a nationally representative sample dwellings where it is likely that no participant in NHANES actually resides. The authors conclude, "It would be far superior to measure such relationships in a survey that combines housing, health and community data in an integrated fashion."[18]

This review compares several NHANES and AHS surveys, however, finding changes in several health outcomes to be associated with specific changes in housing quality between 1970 and 2000 (Jacobs et al. 2009). For example, trends in the prevalence of childhood lead poisoning follows trends in dwelling age, water leaks, and ventilation; asthma follows ventilation, windows and dwelling age; and blood pressure trends follow community measures. This review also finds that health disparities among different racial/ethnic groups did not show any improvement during this 30-year time frame.

The observation that few studies attempting to identify associations between housing conditions and health outcomes actually assess both factors at the *same time and in the same population sample* is especially important in the context of farm labor. The worker population is continually changing, especially as new immigrants replace older, more established groups (McWilliams C. 1939). In California, these cycles have included European bindle stiffs, Chinese, Japanese, East Indians, Filipinos, "Oakies", "Arkies", Mexican contract workers (Braceros), Mexican-Americans, documented and undocumented Mexican migrants, and, most recently, indigenous migrants from southern Mexico and Central America.

What follows is a general discussion of a number of specific housing conditions that can affect the health of inhabitants. The discussion reviews the broader research literature on associations between housing and health, focusing on evidence that structural and physical conditions and mechanical systems of houses affect health outcomes, evidence that access to clean water and proper sanitation facilities in houses are associated with health outcomes, and evidence that neighborhood characteristics are associated with health outcomes.

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[17] Sub-standard housing conditions are most frequently found in neighborhoods in poverty.
[18] Cf. Jacobs et al, 2009, p. 602.

IV.A. HOUSING STUCTURE AND HEALTH

The World Health Organization identifies housing as the environmental factor most frequently associated with conditions for disease in epidemiological analyses. Housing conditions that affect health can be directly measured in or adjacent to the dwelling include the physical condition of the dwelling itself (roof, wall, windows, foundation and lead paint), as well as compliance with electrical, heating and cooling codes. Other factors include air pollution, pesticides and other toxic substances (e.g. asbestos), pests such as insects and rodents, molds and other allergens, and infectious agents. "Features of substandard housing, including lack of safe drinking water, absence of hot water for washing, ineffective waste disposal, intrusion by disease vectors (e.g., insects and rats), and inadequate food storage have long been identified as contributing to the spread of infectious diseases" (Mood 1993; Marsh, 1982; Howard, 1993).

IV.A.1. Structural Conditions

Structural conditions of buildings have been associated with a range of health risks. Building construction breaches are associated with dampness, water leaks, and mold, which can cause allergies, asthma and other chronic respiratory illnesses, even after controlling for potentially confounding factors such as income, social class, smoking, crowding, and unemployment (Bornehag et al. 2001; Peat et al. 1998). Construction quality is associated with a range of health risks. Construction of foundations, basements and ventilation are associated with indoor radon and other pollutants generated indoors (U.S. EPA. 2003 C). According to Krieger and Higgins (2002),

> "*Water intrusion is a major contributor to problems with dampness. In 1999, eleven million occupied homes in America had interior leaks and 14 million had exterior leaks. ...Damp houses provide a nurturing environment for mites, roaches, respiratory viruses, and molds, all of which play a role in respiratory disease pathogenesis. Cross-sectional epidemiological studies have also established associations between damp and moldy housing and recurrent headaches, fever, nausea and vomiting, and sore throats.*"

Construction of foundations, basements and ventilation are associated with indoor radon and other pollutants generated indoors (U.S. EPA. 2003 C). According to Hesselmar et al. (2005), building construction affects "both respiratory morbidity and sensitization independently, suggesting not only worsening of symptoms but also a causative relationship with disease development." In addition, the type of building (houses when compared with flats), the ventilation system and the presence of a basement all had "major implications on respiratory symptoms and atopic dermatitis."

IV.A.2. Indoor Air Quality

The health risks of indoor air pollutants have been well documented. They include allergies (Dales. 2008), malignancies (Hendee and Doege. 1988), asthma (King et al. 2004), dermatological disorders and sick building syndrome (U. S. EPA. 2008 D). Type, cleanliness and efficiency of heating and cooling facilities are associated with severity of asthma (Kercsmar et al. 2006). Interventions that reduced asthma included repair of faulty cold-air return to furnace and elimination of sub-slab heating duct systems. Air conditioning acts as a dehumidifier in hot weather, reducing damp and mould, which can cause allergies, asthma and other chronic respiratory illnesses, however, air conditioning has been associated with Sick Building Syndrome (SBS).

Inadequate ventilation is associated with indoor air pollution. Such pollutants include lead, radon, nitric oxide, carbon monoxide, carbon dioxide, sulphur dioxide, formaldehyde, smoke and other organic compounds. Other sources of indoor air pollution include tobacco

smoke and particulates from non-electric stoves, pesticides, polycyclic aromatic hydrocarbons (PAHs), allergens such as mold, cockroaches and pollen, volatile organic compounds (VOCs) from consumer products, the dust present in carpets and furniture, household pets, and pollutants entering the house from outside air. The accumulation of dust, dust mites, and tracked-in soil in old carpets, sofas, and mattresses appears to be a source of exposure to lead, pesticides, allergens, PAHs, and VOCs (Loftness et al. 2007). According to Franchi et al. (2006),

> *"These determinants can affect the respiratory system in various ways; they can cause or exacerbate chronic bronchitis, asthma, and acute respiratory diseases. They can also cause a decline in respiratory functions and sensitization to common aeroallergens. Some pollutants, like radon, environmental tobacco smoke and VOCs pose a significant cancer risk."*

When houses have few windows and doors or windows that do not open easily or at all, occupants are at increased risk of the effects of indoor air pollution (Wu et al. 2007). The health consequences of inadequate ventilation in the indoor environment were identified as early as the 18th century. Research has shown that increased ventilation reduces respiratory illness 9–20% (Fisk and Rosenfeld. 1997; Kroeling. 1987). Hesselmar et al. (2005) found that ventilation systems were associated with respiratory symptoms and atopic dermatitis.

IV.A.3. Protection From Excessive Heat And Cold

An inability to heat a house sufficiently (because of drafts, insufficient insulation and/or lack of a heat source) can affect health (Mäkinen. 2007). Lloyd et al. (2008) found that improvements in thermal quality improved not only exposure to cold, but also to damp and mold. They found that residents' systolic and diastolic blood pressures fell significantly, as well as an improvement in general health as reported subjectively, and as indicated by a reduction in the use of medication and in hospital admissions.

IV.A.4. Risks Of Injury

Windows are associated with falls from buildings. Such falls can result in head injuries, multiple traumas and even death. Risk factors include immigrant family setting, low socio-economic status of the parents, dangerous house constructions, and summertime evenings (Mayer et al. 2006).

Residents of substandard housing are at increased risk for fire and electrical injuries (U.S. CDC. 2008 A). Burn injuries are associated with on-electric domestic appliances that are used for heating, cooking, or lighting – or all three; these include appliances that use kerosene, petroleum, butane, liquefied petroleum gas and alcohol fuels. The burden of suffering from indoor fires is excessively distributed among the poor (Peck et al. 2008).

IV.A.5. Mobile Homes And Occupant Health

Hired farmworkers across the U.S. are three times as likely to live in mobile homes as the rest of the nation's population. Most farmworker families in North Carolina for example live in mobile homes (Early et al., 2006). There is not a lot of research focusing on the health effects of living in a mobile home, but the little there is shows that mobile home residence can be associated with a variety of health risks. An analysis of NHANES data (Riederer et al. 2008) found that living in a mobile home is a significant predictor of total daily chloroform inhalation exposure. Chloroform exposure is associated with liver and kidney damage and possibly birth defects (U.S. CDC. 2005 A). A USGS study of mobile home park wells found an association with exposure to MBTE, a gasoline additive (Ayotte. 2008). Wilson et al. (2006) found a two-fold risk of hip fracture associated with living in a mobile home.

The independent association of living in a mobile home and specific health outcomes is unknown, but mobile homes may increase exposure to many indoor pollutants resulting in increased health risks. The Federal Emergency Management Agency (FEMA) has admitted that trailers supplied to survivors of the Katrina hurricane contained formaldehyde, a known carcinogen, in the glues used in the walls, carpets and cabinets. Residents of the trailers had to be relocated to safer housing.

IV.A.6. Dwelling Age Effects

Older houses often have lead paint. The primary source of environmental lead is lead paint, and the EPA classifies risk of exposure according to year-built, reflecting regulatory changes regarding lead-based paint (U.S. EPA. 1998). Over 95% of the houses built prior to 1950 contain lead-based paint, as do 65% of houses built between 1950 and 1978 (U.S. CDC. 1991). The 1995 American Housing Survey estimated that there are 26,000,000 occupied housing units built before 1950. According to the CDC (U.S. CDC. 1991), lead toxicity is the major environmental risk facing children.

Older houses outside of urban centers have older wells and older septic systems. Septic systems deteriorate after 20 or more years, as soils in drain fields deteriorate and can become contaminated (U.S. EPA. 2002). Septic systems built before the early 1980s were frequently under-sized and were not based upon the drainfield soils, which effect treatment capacity (Lee et al. 2005). Well age is important indicator of its ability to keep out contaminants (Bonner. 2008).

IV.B. WATER AND SANITATION QUALITY

Access to a plentiful water supply -- including showers and/or baths, laundry facilities, and kitchen and bathroom sinks -- is associated with health conditions in multiple ways. Water is necessary to wash food before eating to avoid bacteria, fungi, pesticide, herbicide and nitrate contamination; to wash clothes and one's self after exposure to toxic substances, and to brush teeth to improve dental hygiene and avoid oral diseases. Hand washing is essential to avoid transmission of shigellosis, an increasingly serious problem with high attack rates, increasing resistance to antibiotics and high mortality (Khan. 1982).

IV.B.1. Drinking Water Quality

Approximately 10 percent of children between 1993 and 1999 lived in areas with major violations of water quality regulations (Comm Environ Coop. 2006). Health risks derive from exposure to waterborne pathogens such as *E. Coli, Crytopsoridium parvu*m, hepatitis, and *Giardia lamblia*. Hoetez (2008) calls these "neglected infections of poverty in the US." The presence of E coli in well water shows contamination by fecal matter, often by poorly functioning septic systems (U.S. CDC. 2003 A). Like *E. Coli*, cryptosporidium can contaminate private wells, when septic systems fail.

During the past two decades, "crypto has become one of the most common causes of waterborne disease in humans in the United States" (U.S. CDC. 2003 C). The problems are significant; for example, a Texas study (Leach et al. 2000) found 70% of children tested had antibodies to Cryptosporidium, associated with source of water supply, age, and socioeconomic status. Both E. Coli and cryptosporidium can be extremely harmful, even potentially fatal in children and the elderly (U.S. CDC. 2003 B).

Nitrates are another common drinking water contaminant, and they are highly associated with proximity to septic systems and livestock facilities. Nitrates are regulated in drinking water primarily because excess levels can cause methemoglobinemia or "blue baby" disease, but high nitrate levels can also be harmful to cigarette smokers, pregnant women and other vulnerable populations (McCasland. 2008; Powlson. 2008), such as those with inflammatory diseases (Ward. 2005)

Nitrates, in vulnerable subgroups, have been shown to associated with the occurrence of birth defects (Dorsch et al. 1984), Type I diabetes (Kostraba et al. 1992; Parslow et al. 1997), thyroid disruption (van Maanen et al. 1994), childhood brain tumors (Mueller et al. 2004), bladder and ovarian cancer (Weyer et al. 2001) stomach cancer (Sandor et al. 2001), colon cancer (De Roos et al. 2003) and Sudden Infant Death Syndrome or SIDS (George et al. 2001; Reid. 2000). Although residential drinking water point-of-use nitrate data are scarce (Weyer et al. 2006), risks to human health at lower levels of exposure is associated with concomitant exposure to bacteriologically-contaminated water or excess intake of nitrate from other sources. (U.S. EPA. 1987).

The American Academy of Pediatrics recommended on June 1, 2009 annual testing of wells for houses where children are present. The AAP notes that most wells are "extremely safe," but children drink relatively more water than adults and are therefore more susceptible to waterborne illness.

IV.B.2. Sanitary Facilities

More than 1.3 million households lack complete indoor plumbing. Approximately 75% of these are located in rural areas (2000 Census). Unsanitary disposal of solid waste and excreta is a primary source of biological contamination of water, food and soil. Approximately 25% of U.S. households depend on an onsite wastewater treatment system, and 95% of these are septic systems (U.S. EPA. 2008 C). While most of these occur in rural areas, many are located in neighborhoods that are adjacent or surrounded by cities (Johnson et al. 2004). Lack of sewers in densely populated areas or in areas of failing septic systems is associated with water contamination. Untreated wastewater contains more than 120 enteric viruses, causing a variety of diseases, including conjunctivitis, diarrhea, and paralysis.

Septic system failure can cause water contamination, and the chances of this happening are greatly increased under certain conditions. The top five reasons for septic system failure included soil wetness (seasonally-high water table or flooding), undersized systems, system age, and limited space for soil absorption field (Taylor et al. 1997).

Rios and Meyer (2007) found that indoor toilets in *colonias* (see below) were related to gastrointestinal illnesses, respiratory problems, and skin infections, as substandard septic tanks in addition to major drainage problems in the area (see Drainage of Surface Water, below) resulted in toilet backflow.

Rainwater runoff is a major source of septic system overload (Montgomery. 1990) and pollution (Hatt et al. 2004). This condition is further exacerbated by the cumulative density of lots in a neighborhood. Run-off from roofs and driveways should be directed away from the drainfield, which is difficult on small lots (U.S. EPA. 2001). Inadequate water drainage is associated with failing septic systems (Montgomery. 1990). Septic systems can be damaged when septic tanks are lifted out of the ground by floods where stormwater management is insufficient or when soils are saturated by flooding from heavy rains or activities such as car washing.

Increased impervious surface area from urbanization without stormwater management facilities leads to "pooling of stormwater, increasing potential breeding areas for mosquitoes, the disease vectors for dengue hemorrhagic fever, West Nile virus, and other infectious diseases," as well as with communicable diseases, nitrate contamination of drinking water; and safety hazards from flooding (Gaffield et al. 2003).

IV.B.3. Garbage And Waste Disposal

Inadequate garbage storage, collection or facilities (bagging/isolation and collection of household solid waste) is associated with insects, pests, rodent and other disease vectors (Childs et al. 1998). Prevalence of *Ascaris lumbricoides, Trichuris trichiura*, and hookworms is higher among children living in households without adequate solid waste disposal compared to those in areas with regular garbage collection and adequate isolation of solid waste (Moraes. 2007).

IV.C. CROWDED LIVING CONDITIONS

The association between poor housing conditions in urban tenements and poor health was taken as axiomatic by the early sanitarian or public health movement as well as the broader social reform movement (Duffy. 1990). Crowding within the tenements was particularly troublesome. Health concerns included increased risk of transmission of infectious diseases such as tuberculosis and safety in emergencies such as an outbreak of fire.

Overcrowding might be self-evident, but defining and measuring overcrowding is problematic. The most common measure of "crowding" is persons per room (PPR). As Myers et al. (1996) note, this "objective" measure of per room density of people in their housing, overcrowding is in fact a normative judgment of the point at which society density is considered to be unacceptable. This standard has shifted over time. In 1940, the local and federal standard was 2 PPR, dropping to 1.5 PPR by 1950 and 1 PPR by 1960 (Myers et al. 1996). There are other measures, notably the Canadian Overcrowding Index that combines persons per bedroom with age-sex patterns of sharing bedrooms (see Meng and Hall (2006) for a recent application). Exactly what constitutes "overcrowding" remains scientifically unresolved.

Myers et al. write:

> *"As yet, there is no basis in the scientific literature for choosing one standard of unacceptable crowding over another. The basic research issues are so problematic that researchers never get to the standard setting stage in applying their findings. Indeed, in a curious twist, they use the unproven standard (e.g. 1.00) to measure the basic phenomena whose extent they are trying to determine. Thus researchers ten to implicitly leave standard setting to professional organizations such as the American Public Health Association, or to building code officials…; meanwhile, these organizations pretend the standards have some basis in science."*

Cross-sectional studies have found an association between crowding (Clark et al. 2002) or adult crowding (Lienhardt et al. 2005), and between crowding and meningococcal disease (Baker et al. 2000). Other studies find no association between crowding and tuberculosis

(Coetzee et al. 1988). Habib et al. (2006) found no association between crowding and the prevalence of illness in a Palestinian refugee camp in Lebanon.

Pader (2002) argues that municipal codes and private covenants governing overcrowding "derive from a combination of upper-class English ideals and outdated scientific knowledge, with concomitant moralistic and assimilationist aspirations on the part of the policy makers."

Analysis of 1990 Census data found that while crowding had declined, it was more prevalent among immigrants, Latinos and Asians (Myers et al. 1996). They report a higher PPR among Asian households even as incomes rise. Despite this problem of defining overcrowding, research on its health effects continues.

The point at which a dwelling becomes overcrowded remains at issue, but persons per room, whether measured categorically (e.g. PPR>1) or continuously does measure household population density. Household population density (or "overcrowding") has been associated with poor health outcomes, notable for airborne infectious diseases. Most of these studies showing an association between current housing conditions and current health are cross-sectional.

Using longitudinal data from the National Child Development Study in the U.K., Marsh et al. (1999) show a link between crowding (PPR>1) and an increased likelihood of infectious diseases and respiratory diseases at age 11, and an increased likelihood of respiratory diseases for adults. They report that the earlier in life that children experienced crowding and poor hygienic conditions, the greater the subsequent increase in likelihood of disease. The authors note that effects of MMR vaccination (not available for this cohort) may have made the finding of increased infectious disease for children associated with crowding unlikely to be found today.

Crowding can be associated with stress or other psychological conditions. In a study of Palestinian refugee camps, Al-Khatib et al. (2005) found a statistically significant relationship between the number of children that sleep in one room, the number of children that sleep in one bed, the house size, and the total number of rooms with women's "feeling of privacy (mental health and well-being)." Gabe and William (1993) examined relationship between crowding and women's mental health. Using four categories of crowding, they report a significant J-shaped relationship between crowding and psychological distress even when controlling for socioeconomic status.

The responsibility for crowding shifted in the mid-1940s from public health agencies to code enforcement agencies (Duffy. 1990). Myers et al. (1996) write:

> *"As yet, there is no basis in the scientific literature for choosing one standard of unacceptable crowding over another. The basic research issues are so problematic that researchers never get to the standard setting stage in applying their findings. Indeed, in a curious twist, they use the unproven standard (e.g. 1.00) to measure the basic phenomena whose extent they are trying to determine. Thus researchers ten to implicitly leave standard setting to professional organizations such as the American Public Health Association, or to building code officials…; meanwhile, these organizations pretend the standards have some basis in science."*

Pader (2002) argues that municipal codes and private covenants governing overcrowding "derive from a combination of upper-class English ideals and outdated scientific knowledge, with concomitant moralistic and assimilationist aspirations on the part of the policy makers." Health risks assumed to be associated with overcrowding in the home remains the central rationale for these regulations.

There are clearly causes for concern about crowding. Crowding has been associated with risk of burns, a significant factor in housing code standards for crowding. A case control study examining risk factors for children's burns in Peru found that crowding (PPR>1) significantly increased risk of burns. When a house has a septic system, overcrowding affects water use and thus stress on septic systems. Septic system design is based on assumptions about water use by the average number of persons in a three-bedroom household.

IV.D. THE BUILT ENVIRONMENT – NEIGHBORHOOD EFFECTS

Houses do not exist in isolation, and conditions in the surrounding area—the neighborhood—may independently affect health. Neighborhood conditions in industrial tenements and urban ghettos have attracted at least as much policy attention as conditions within houses. Health conditions associated with physical conditions of buildings and infrastructure, the social and economic situations, proximity to hazardous or toxic sites, population density and related issues have all been studied. There has been a new focus on neighborhood design and physical activity.

A major analytic issue throughout studies is the intertwining effects of poverty, social conditions and housing conditions. This is true at the household level and even more so for neighborhood studies. Neighborhood-level studies tend to show associations where the agent is less clear, but these associations are often strong and can focus research and guide policies.

Research on the associations between neighborhood characteristics and health, neighborhood location and health, and health and physical activity associated with the built environment is reviewed below. These topics clearly overlap. Few wealthy people lived at Love Canal or in dilapidated housing or without sewer, however, even after accounting for individual risk factors such as socioeconomic status and race/ethnicity, living in a lower-income community is associated with poor health outcomes, including higher rates of obesity and mortality (Haan et al. 1987). The decline of neighborhood food stores in urban areas and its relationship to the rise of obesity has also been the subject of recent research (Wang et al. 2008).

Poor housing is a condition of poverty and the provision of adequate housing to the poor is a major component of social policy addressing poverty. The broader social environment has been associated with health outcomes. Pickett and Pearl (2001) reviewed 25 studies of neighborhood effects on health. They found a statistically significant association in all but two studies reviewed between at least one measure of social environment and a health outcome. A meta-study of the effects of neighborhood on mental health reports that 27 of 29 studies "found statistically significant association between mental health and at least one measure of neighborhood characteristics, after adjusting for individual factors" (Truong and Ma. 2006).

Regarding mental health in children, Yange et al. (2005) found that concentrated neighborhood disadvantage was associated with "more mental health problems and a higher number of children in the clinical range, after accounting for family demographic characteristics, maternal depression, and earlier child mental health scores." Families moving to a better neighborhood show improved mental health (Levanthal and Brooks-Gunn. 2003).

Effects of neighborhood conditions on health independent of characteristics of health have been examined using multilevel models. Multilevel models incorporate both individual characteristics and ecological or "neighborhood" characteristics usually measured with census data at the tract of block-group level. Cubbin et al. (2000), for example, found both individual and neighborhood effects in their analysis of injury mortality. Pearl et al (2001) found that "less-favorable" neighborhood socioeconomic conditions were associated with lower birth weight among African Americans and Asians after controlling for individual characteristics in California. Yen and Kaplan (1998) found neighborhood socioeconomic conditions associated with increased mortality risk. Diez Roux et al. (2001) report neighborhood conditions increased risk of coronary heart disease. These and similar research show that there are both individual socioeconomic factors and characteristics of places—neighborhood effects—that increase certain health risks.

IV.D.1. Proximity Of Housing To Potential Hazards

Health risks of housing site characteristics and the location of housing sites relative to potential hazards have both been examined (Mujahid et al. 2007; Morenoff et al. 2007). Air pollution from cars, for example, is greater for those living close to busy roadways, and high levels of traffic is associated with reduced lung function, increased asthma hospitalizations, asthma symptoms, bronchitis symptoms, and medical visits (Dong et al. 2008). More attention has been given to location of houses relative to specific risks such as hazardous sites or sources of pollution. Real and potential health risks to residents of Love Canal raised national concern about homes built on or near hazardous waste sites. However, studies of health risks to residents of housing located near landfills generally have been limited by the lack of direct exposure measures.

Air pollution from specific locations has been associated with increased health risks (Morello-Frisch et al. 2000). Point-source pollution is associated with cancer (Linder et al. 2008) and other health risks. Living within the vicinity of a pollution source has been associated with asthma incidence and asthma-related symptoms (Dong et al. 2008; Saha et al. 2005).

Proximity of housing to agricultural pesticides has been examined with varying results. (Reynolds et al. 2004) examined the incidence of breast cancer in California relative to proximity of housing to pesticide and found no effect. Some investigators (Lu et al. 2000; Lambert et al. 2005) have found that residential proximity to fields and orchards where pesticides were applied was significantly associated with increased organophosphate metabolites in the urine of children. A recent study finds that autism among children in California's Central Valley is associated with maternal residences near fields sprayed with specifically identified agricultural pesticides (Roberts et al. 2007). Many of studies have been limited by the lack of direct exposure measures.

A very recent publication finds associations between specific pesticides found in dust samples from residences in an important agricultural valley of California, and reported applications of these same materials in nearby fields (Harnly et al, 2009). Increases in the quantity of three pesticides found in the dust samples, including the organophosphate chlorpyrifos, were determined to be proportional to the amount of the material that had been applied in the fields.

IV.D.2. Neighborhood Characteristics And Health

The built environment – usually urban environments – has received increasing interest in health behavior research, with research focusing on mental health and physical activity. Neighborhood characteristics may affect mental health, though the research is limited. Leslie and Cerin (2008) examined perceived environmental characteristics and self-reported mental health perceptions. They identified factors of neighborhood satisfaction, including safety and walkability, access to destinations, social network, travel network, and traffic and noise, concluding that neighborhood satisfaction "may mediate the association between perceived environmental characteristics and measures of mental health in adults."

There is a growing research literature on urban design and physical activity (Owen et al. 2007). Concerns with increasing obesity as well as known positive effects on reduction of risks from cardiovascular and other diseases have driven this research. While there is evidence that physical activity increases in neighborhoods with certain design characteristics, the linkage of neighborhood design to improved health is – for the most part – asserted rather than demonstrated thus far.

IV.D.3. Underserved Communities On The Urban Fringe

There is a pattern of densely settled, underserved communities in the United States that are located on the fringe of urban places or even completely surrounded by municipalities. These communities are often a part of a larger community but not served by that community. They lack public water, sewer, streetlights, storm water drainage, etc. This phenomenon has been documented across the South (Johnson et al. 2004; Lichter et al. 2007), in California (Rubin et al. 2007) and along the U.S. Mexico border. The communities along the border are known as "*colonias*," and may exist in rural areas separate from larger urban areas. All of these communities have a dense settlement pattern, low-income residents, and few services including sanitation services.

IV.D.4. Underserved Mexico-U.S. Border Communities

There are various definitions of "colonias", so that demographic estimates differ. Doyle and Bryan (2000) define colonias as unincorporated areas in the U.S./Mexico border area "which are mostly semi-rural, un-zoned and unregulated 'communities' with no access to safe drinking water, sewage systems or public services such as police and fire protection or medical/dental care." Sanchez-Bane and Moya Guzman (1999) agree, adding that – according to the Texas Comptroller of Public Accounts, colonias are characterized by substandard housing. Davidhizar and Bechtel (1999) estimate that 500,000 people live in 12,500 colonias throughout the U.S. border region. Doyle and Bryan (2000) put the number at approximately 350,000 people. Rubin et al. (2007) estimate that there are at least 220 (predominantly-Latino) underserved, low-income unincorporated communities in the eight counties that comprise California's San Joaquin Valley.

A different view of the use of the term *colonias* has recently been published (Mukhija & Monkkonen. 2007). These authors draw on their research to suggest that the use of this term to name settlements with poor infrastructure "…can be misleading, prejudiced and risks being detrimental." Among other concerns, these authors point out that some of California's designated *colonias* are older communities, quite far from the U.S.-Mexico border, heterogeneous in demographics, and subject to different types of zoning regulations than Texas' designated *colonias*.

Davidhizar and Bechtel (1999), assert that colonias along the United States-Mexican border "are reflective of third-world communities . . . because of the limited infrastructure, diseases controlled in most parts of the world are epidemic within these communities." Mier et al. (2008), report that long-term residence in colonias is a predictor of worse physical health. The length of time living in a colonia, along with co-morbidity status and perceived problems with access to healthcare, also was associated with poorer mental health status. In an economic analysis of adding public health infrastructure in a colonia, Haass et al. (1996) estimated that access to safe drinking water and solid waste sanitation prevented 155 cases of hepatitis A and 5,165 cases of gastrointestinal illness over 26 years. Leach et al. (1999) found that children living in colonías along the border had a significantly higher prevalence of hepatitis A (37%) than children living in urban border communities (17%) or in a large metropolitan area (San Antonio, 6%). Leach et al. (2000) found higher prevalence rates of *Cryptosporidium parvum* in the colonias (89%) and urban border community (82%) compared to the urban non-border community (46%). Cech (1992) found unhealthy concentrations of groundwater contamination by fecal coliform bacteria on both sides of the border, a risk for waterborne infectious diseases.

IV.E. HOUSING INSTABILITY AND HOMLESSNESS

Many farm laborers are affected by an additional risk factor that must be considered in the context of housing and health: housing instability and homelessness. Migrant farm labor is still prevalent in the U.S. and, for many, can be understood as a form of housing instability. Some studies, such as the CAWHS, finds workers residing in structures not intended for human habitation: bare garages, lean-tos, abandoned vehicles, barns and animal stalls. By any measure, nearly all such workers are best described as homeless. While research on these topics is quite limited, there are some findings of note.

The necessity to move frequently makes monitoring of health conditions -- such as tuberculosis, diabetes, cancer, and HIV, which require careful monitoring and frequent treatment -- poses a special problem for those who move frequently. Diabetes is the leading cause of blindness, non-traumatic lower-limb amputation, and kidney failure (United States DHHS. 2005). According to the U.S. CDC, diabetes was the sixth leading cause of death in 2005 (Hsiang-Ching. 2008), and the fifth leading cause of death for Hispanics (U.S. CDC. 2005 B). Phinney et al. (2007) found that mental and physical health problems were significantly associated with homelessness. Specifically, homelessness is associated with hypertension (Kinchen et al. 1991), respiratory infections (Wood et al. 1990, Zolopa et al. 1994, and Kermode et al. 1999), and tuberculosis (Lobato et al. 2008).

V. HEALTH, HOUSING AND THE LAW

Burridge and Ormandy (1993) edited a comprehensive exploration of "Unhealthy Housing: Research, Remedies and Reform" from the perspective of legally-mandated reform of inadequate housing. Unfortunately, the law discussed is British law, but the discussions and citations are invaluable. We were unable to find a similar legal review for the United States.

VI. ADVOCACY AND POLICY RESEARCH ON FARM LABOR HOUSING AND HEALTH

There also is a large body of research published by advocacy organizations as well as policy assessments commissioned by various levels of government agencies and private foundations. Much of this research provides substantial and invaluable direct evidence of sub-standard farm labor housing conditions (Peck. 1989; National Advisory Council on Migrant Health. 1993; Villarejo et al. 2000; Applied Survey Research. 2001; Housing Assistance Council. 2001; Thompson & Wiggins. 2002; Villarejo & Schenker. 2005; Villarejo & Schenker. 2007; Strochlic et al. 2007; Strochlic et al. 2008; Washington State Farmworker Housing Trust. 2008). All of the reports that are based on field surveys of workers find evidence of overcrowding and sub-standard housing conditions. This additional research provides a critical voice, often in the words of workers themselves, to inform policy discourse, even though portions may be based on convenience samples or strictly anecdotal reports. The contributions of these organizations and agencies are helpful complements to the peer-reviewed literature on which the present discussion is based.

The largest of these studies is the national survey of 4,625 dwellings occupied during 1997 and 1998 by hired crop farm workers (Housing Assistance Council. 2001). First-hand observation and interviews with residents contributed to an assessment of the dwelling's structural integrity, and whether it had functioning sanitation, laundry and cooking facilities. About one-third of the dwellings were classified by the research team as "moderately substandard" or "severely substandard" according to the observed degree of physical deficiencies. In addition, data on crowding and on proximity to crop fields that had been treated with agricultural chemicals was also recorded. No data on the health of residents was collected.

While this survey did not obtain an accurately representative national cross-sectional sample of hired crop farm worker dwellings, the findings were retrospectively adjusted to conform to demographic profiles of this population using nationally representative findings from the NAWS. This study is only attempt to seek nationwide data on farm labor housing, but has not been published in the peer-reviewed scientific literature.

Two recent county-level cross-sectional surveys of farm labor housing needs successfully interviewed a total of 240 farm employers and nearly 400 hired workers (Strochlic et al. 2007; Strochlic et al. 2008). It was remarkable to learn the extent to which both workers and employers agreed in assessing priorities for addressing farm labor housing needs. These surveys also were a useful model for estimating the size of the worker population in each county with reasonable accuracy, as well as where workers actually reside. The Napa County study, for example, finds a sizeable share of the labor force resides outside of the county, and those workers commute on a daily basis to the vineyards, in some cases traveling as long as two hours to reach their jobs.

Another significant finding of those two studies was that workers seek to send as much money as possible back to family members in their home country, and that living in the most modestly-priced dwellings that can be found facilitates maximizing remittances. Many workers, especially those who are unaccompanied in the U.S., consciously compromise their living conditions in order to provide support for their family members back home.

VII. RECOMMENDATIONS FOR NEW RESEARCH INITIATIVES: METHODOLOGICAL ISSUES

"Why is there not more research on housing and health, and in particular on neighborhoods and health?" Dr. Richard Jackson (2008), former director of the CDC's National Center for Environmental Health, addressed this issue when he wrote of a woman in her 70s struggling in 95-degree heat along a 7-lane road with no sidewalks.

> *"If that poor woman had collapsed from a heat stroke, we docs would have written the cause of death as heat stroke and not lack of trees and public transportation, poor urban form, and heat-island effects. If she had been killed by a truck going by, the cause of death would have been 'motor-vehicle trauma,' and not lack of sidewalks and transit, poor urban planning, and failed political leadership."*

Twenty years ago, a study of this type was proposed (Peck, 1989):

> *"A comprehensive survey needs to be conducted in California to determined the range of shelter conditions for farmworkers, the costs (including utilities) of their accommodations, their location (on farms, in towns, in remote areas), ownership or control of their use, their tenure by unit, whether state or federal subsidies are provided, the size and features of the housing (whether there is heating, cooling, water, play-yards, laundry, cooking facilities, etc.). These housing factors should be correlated with the size and makeup of the household, the ethnic or racial make-up, and the citizenship or residency status."*

Such a study is needed today.

A primary issue in developing high-quality research on the possible health outcomes associated with housing and neighborhood conditions is the relative lack of cross-disciplinary collaborations: public health experts, advocates, primary care physicians, economists, anthropologists, sociologists, employers and workers all have important contributions to make to the research we envision.

There is a need for a variety of approaches and study designs, from case reports and case series through hypothesis generating (cross-sectional) and hypothesis testing (case-control and cohort) approaches. Randomized controlled trials – the "gold standard" experimental model used to measure the effects of interventions in medicine – is uncommon in housing research, where there is less of a history of experimentation, and a host of political and ethical problems. According to Thomson et al (2001),

> *"Much of the research investigating the links between housing and health has been cross-sectional and these studies have shown strong independent associations between housing conditions and health. However, results of studies in small areas are difficult to generalize to other contexts."*

VI. A. SPECIFIC RESEARCH RECOMMENDATIONS

Recommendations for research in this field follow:

- Future studies of the relationship between the health of farm laborers and the conditions in which they live should rely on simultaneous measures of both the health of residents and detailed assessments of both the dwelling conditions and the surrounding built environment in a fully integrated manner.
- Basic descriptive data also should be collected on dwellings currently occupied by hired farm workers and accompanying family members in California and elsewhere in the nation. Where do workers live and what is the quality of their housing; without this basic information,

speculation about the health impacts of current farm labor housing will likely continue indefinitely.

- New surveillance and research initiatives should make a substantial effort to engage employers. The recently concluded policy-oriented studies of farm labor housing needs in Napa and Mendocino counties included both worker and employer surveys (Strochlic et al. 2007; Strochlic et al. 2008).
- Survey research of farm labor housing conditions based on sound scientific principles, using appropriate study designs and research methods, is needed.[19] Sampling methods must be appropriate for difficult to reach populations.
- Expanded use of new technologies (e.g., Geographic Information Systems, or GIS) that can allow researchers to more clearly identify specific locations where exposures to health risk may have occurred or where a health episode transpired is needed. Ezz (2006) recommends an integrated trans-disciplinary framework using GIS to study the effects of multiple health risks within a geographic area, "…where some interaction of these variables can rise to the threat of disease…" or injury.
- Prospective cohort health studies should be initiated, along the lines of the MICASA cohort in Mendota. Tracking a sizeable population of workers over many years will make it be possible to determine the relationship of health risks posed by sub-standard farm labor housing, distinct from health risks associated with occupation or personal behaviors. A comparison of families of farm laborers who successfully move from sub-standard housing to newly constructed or remodeled dwellings also would be informative.
- Field-tested, housing assessment instruments and protocols should be developed and validated for use in survey research. Instruments and protocols tested and validated in field research, then could serve as a basis for national, state, county or local research.
- Research focused on the unaccompanied worker population, where the most glaring deficiencies of farm labor housing occur. This research should include having unaccompanied workers speak on their own behalf about how their perceived housing needs could best be met.
- Research should be directed to determine the scientific basis of the current standards for crowding and overcrowding. The issue of overcrowding is complex scientifically but the existing standards are incorporated into many local building codes.
- Evaluate the effects of unequal access to basic community facilities and services, such as sewers, water, public transportation, and medical providers, including emergency medical services.

VI. B. ETHICAL CONSIDERATIONS

A 2005 NRC/IOM report (Lo and O'Connell. 2005) addressed ethnical concerns for studies of health hazards in homes with children. The issues addressed in this report are central for design and informed consent of any future study of farmworker housing and health. High risk housing is disproportionately occupied by the poor who have limited options for alternative housing. Lower levels of education and, for farm workers, language issues may increase these difficulties. Many parents may believe that intervention studies may be designed to eliminate the hazardous conditions identified in their homes. Poor parents with limited housing alternatives may have to keep their children in the same housing even after risks have been identified by researchers. Careful design and communications with parents are essential to meet the ethical challenges of future studies of farmworker housing and health.

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[19] Cf. National Research Council, et al (2008), p. 188. Cited in References section of this report.

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