Supplementary Online Content

Chen KL, Miake-Lye IM, Begashaw MM, et al. Association of promoting housing affordability and stability with improved health outcomes: a systematic review. *JAMA Netw Open*. 2022;5(11):e2239860.
doi:10.1001/jamanetworkopen.2022.39860

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This supplementary material has been provided by the authors to give readers additional information about their work.
### eTable 1. Details of Studies of Primary Prevention of Housing Insecurity to Improve Health

| Author, year | Study design | Intervention and comparison populations and sample sizes at enrollment | Main health-related findings |
|--------------|--------------|-----------------------------------------------------------------------|------------------------------|
| **Short-term interventions** | | | |
| **Eviction moratoriums** | | | |
| Jowers et al.,1 2021 | Longitudinal study: ecological FE panel regression | Intervention: Counties with more days of active eviction moratoriums<br>Comparison: Counties with fewer days of active eviction moratoriums<br>Total n=3,141 counties | Physical health: each additional day of eviction moratorium was associated with 0.015-0.029 fewer COVID-19 cases (p<0.01) and 0.0006-0.001 fewer COVID-19 deaths per capita (p<0.01) at 8 months. |
| Leifheit et al.,2 2021a | Longitudinal study: ecological DiD | Intervention: Populations of states with active eviction moratoriums (n=27-44 states, variable over time; state populations not reported)<br>Comparison: Populations of states where eviction moratoriums had expired (n=0-17 states, variable over time; state populations not reported) | Physical health: active (vs. expired) eviction moratoriums were associated with lower COVID-19 incidence (IRR= 0.48c, p<0.05) and mortality (IRR= 0.19c, p<0.05) at 16 weeks. |
| Sandoval-Olascoaga et al.,3 2021 | Longitudinal study: unmatched case-control | Intervention: Adults with commercial insurance or Medicare Advantage in states with active eviction moratoriums (n=265,359-509,694; variable over time)<br>Comparison: Adults with commercial insurance or Medicare Advantage in states with expired eviction moratoriums (n=0-244,335; variable over time) | Physical health: active (vs. expired) eviction moratoriums were associated with decreased hazard of COVID-19 diagnosis (HR = 0.72p [p=0.004] at 5 weeks; HR = 0.55p [p<0.001] at 12 weeks) and with 2.4 percentage-point decrease in cumulative hazard of COVID-19 infection over 12 weeks (p=0.01). |
| An et al.,4 2021 | Longitudinal study: ecological FE panel regression | Intervention: Residents of states with active eviction moratoriums (sample size not reported)<br>Comparison: Residents of states with no active eviction moratorium (sample size not reported)<br>Total n= 50 states and District of Columbia | Mental health: among Black subgroup only, active (vs. expired) eviction moratoriums were associated with 1.9 percentage-point decrease in feeling anxious (p<0.01) and 1.6 percentage-point decrease in feeling down (p<0.001) at 11 weeks. No significant associations with mental health for total sample or Hispanic subgroup. |
| Author, year | Study design | Intervention and comparison populations and sample sizes at enrollment | Main health-related findings |
|-------------|--------------|------------------------------------------------------------------------|------------------------------|
| Leifheit et al., 2021b | Longitudinal study: individual FE panel regression | Intervention: Lower-income adults in states with active eviction moratoriums  
Comparison: Lower-income adults in states without active eviction moratoriums  
Total n=2317 adults; proportion in intervention and control groups not reported but variable over time | **Mental health:** strong eviction moratoriums were significantly associated with 2.2 percentage-point decrease in risk of mental distress (p=0.05) at 24 weeks; no significant association between weak moratoriums and mental distress. Although associations were not statistically significant in analyses stratified by race/ethnicity, magnitude of association between strong moratoriums and lower mental distress was larger for Hispanic and non-Hispanic White participants than for non-Hispanic Black participants (-7.2 and -2.1 versus -0.23 percentage points, respectively; p>0.05 for all). |
| Nelson et al., 2021 | Longitudinal study: individual DiD | Intervention: Veterans at imminent risk of homelessness who enrolled in the Supportive Services for Veteran Families (SSVF) homelessness prevention program and went on to receive temporary financial assistance for rent, utilities, security deposits, and other housing-related expenses (n=9337)  
Comparison: Veterans at imminent risk of homelessness who enrolled in the SSVF homelessness prevention program and did not receive temporary financial assistance (n=3849)  
*Study arm excluded from this review: homeless veterans in the SSVF rapid rehousing program* | **Health care utilization:** receipt of temporary financial assistance was associated with $219 reduction in total quarterly health care costs (p<0.001) and $103 reduction in quarterly outpatient costs (p<0.05) at 2 years; no significant association with inpatient costs. |
| Bovell-Ammon et al., 2020 | RCT | Intervention: Low-income parents with a history of housing insecurity and either a family member with frequent ED use or a child with a chronic health condition who were randomized to legal assistance with housing needs and/or waitlist priority for public housing (n=39)  
Comparison: Low-income parents with a history of housing insecurity and either a family member with frequent ED use or a child with a chronic health condition who were randomized to usual care (n=39) | **Mental health:** being offered legal assistance with housing needs and/or waitlist priority for public housing was associated with decreased anxiety (1.38-point lower change in Generalized Anxiety Disorder-2 score, p<0.05) and depression (1.04-point lower change in Patient Health Questionnaire-2 score, p<0.05) at 6 months. |
| Author, year | Study design | Intervention and comparison populations and sample sizes at enrollment | Main health-related findings |
|--------------|--------------|------------------------------------------------------------------------|----------------------------|
| **Long-term interventions** | | | |
| **Long-term (tenant- or unit-based) rent subsidies** | | | |
| Gubits et al., 8 2015 | RCT: Family Options Study | Intervention: Adults in families in emergency shelters who were eligible for and randomized to long-term rent subsidies (mostly vouchers and some public or multifamily housing; n=599)  
Comparison: Adult heads of families in emergency shelters who were eligible for long-term rent subsidies and randomized to usual care (n=540) | Physical health: no significant association between long-term rent subsidies and self-rated health at 20 months8,9 or 37 months10,11  
Mental health: long-term rent subsidies were associated with a 0.97-point reduction in Kessler-6 psychological distress score (p<0.01) at 20 months8,9 but not at 37 months10 nor between 20 and 37 months11; no significant association between long-term rent subsidies and PTSD symptoms at 20 months8,9 or 37 months10,11 |
| Shinn et al., 9 2016 | | | Health-related behavior: no significant association between long-term rent subsidies and alcohol or drug use at 20 months8,9 or 37 months10,11 |
| Gubits et al., 10 2016 | | | |
| Gubits et al., 11 2018 | | | |
| Wolitski et al., 12 2010 | RCT | Intervention: Low-income adults living with HIV and homeless or at severe risk of homelessness who were randomized to immediate rental assistance plus routine case management (n=315)  
Comparison: Low-income adults living with HIV and were homeless or at severe risk of homelessness who were randomized to routine case management alone (n=315) | Physical health: rental assistance significantly modified the association between time period and physical health summary score (p=0.006) at 18 months. Point estimates suggested slower physical health improvement for participants receiving rental assistance, but this was not formally tested. No significant associations for HIV viral load or CD4 count.  
Mental health: rental assistance significantly modified the association between time period and depression score (p=0.05) and perceived stress (p=0.03) at 18 months. Point estimates suggested earlier improvement in both depression score and stress for participants receiving rental assistance, but this was not formally tested. No significant associations for mental health summary score.  
Health-related behavior: no significant associations for number of sexual partners, sex trading, or unprotected sex with non-seropositive partner at 18 months.  
Health care utilization: no significant associations for use of any medical care, use of appropriate medical care, ED visits, hospitalizations, or antiretroviral therapy use or adherence at 18 months. |
| Author, year | Study design | Intervention and comparison populationsa and sample sizes at enrollment | Main health-related findingsb |
|--------------|--------------|------------------------------------------------------------------------|-------------------------------|
| Antonakos & Colabianchi,13 2018 | Longitudinal study: matched cohort | Intervention: Nonelderly adults who newly obtained housing assistance within the first 2 years of the study period (n=116)  
Comparison: Propensity-score-matched nonelderly adults who were eligible for but did not receive housing assistance during the study period (n=116) | Physical health: no significant association between housing assistance and BMI or obesity at 2, 4, or 6 years.  
Health-related behavior: housing assistance was associated with an 11 percentage-point increase in probability of smoking at 2 years (p=0.04), with positive but non-significant associations at 4 or 6 years. There was no significant association with alcohol consumption or physical activity at 2, 4, or 6 years. |
| Denary et al.,14 2021 | Longitudinal: individual fixed effects | Intervention: Low-income adults who newly gained housing assistance (n=84)  
Comparison: Future low-income adult recipients of housing assistance (n=84)  
Analyses excluded from this review: cross-sectional association between receiving vs. being waitlisted for housing assistance | Mental health: no significant association between gaining housing assistance and change in psychological distress at 2 years. |
| Fertig & Reingold,15 2007 | Longitudinal study: instrumental variables analysis | Intervention: Low-income mothers who moved into public housing within 1 year of delivering a child (n=323)  
Comparison: Low-income women who did not move into public housing within 1 year of delivering a child (n=1999)  
Analyses excluded from this review: cross-sectional association between living in vs. not living in public housing and analyses focused on subgroup of families with 2-3 children | Overall, no robust health benefit from public housing, but some evidence that moving into public housing was associated with increased obesity and worse overall health for mothers. E.g.:  
Physical health: moving into public housing was associated with worse self-rated health (1.8-point increase in poor self-rated health score, p<0.05) at 1 year in 1 of 2 instrumental variable (IV) models for the full sample. At 3 years, moving into public housing was associated with 9.8- and 5.0-kg/m² increases in BMI (p<0.05 for both) and with a 91.2 and 66.0 percentage-point increase in probability of being overweight (p<0.05 for both) in both IV models for the full sample.  
Mental health: no significant association between moving into public housing and depression at 1 or 3 years in any full-sample model.  
Health-related behaviors: no significant association with alcohol or drug use at 1 or 3 years in IV models. No significant association with tobacco use at 1 year (not assessed at 3 years). |
| Author, year | Study design | Intervention and comparison populationsa and sample sizes at enrollment | Main health-related findingsb |
|--------------|--------------|-----------------------------------------------------------------|-------------------------------|
| Hinds et al.,16 2018 | Longitudinal study: interrupted time series | Intervention: Adults in a Canadian provincial health plan who newly moved into public housing and stayed for at least 1 year (n=1942)  
Comparison: Future public housing residents in a Canadian provincial health plan, prior to their moving into public housing (n=1942) | **Health care utilization:** after a move into public housing, the average monthly time trend in utilization decreased by 8% for odds of hospitalization (p<0.01), by 0.01 for number of GP visits (IRR 0.99, p<0.05), and by 0.04 for number of prescriptions (p<0.01) at 1 year; no significant association with specialist visits or ED visits. |
| Hinds et al.,17 2019 | Longitudinal study: matched cohort | Intervention: Adults in a Canadian provincial health plan who newly moved into public housing and stayed for at least 1 year (n=2612)  
Comparison: Adults in a Canadian provincial health plan who had not lived in or applied for public housing (n=2612) | **Health care utilization:** moving into public housing was associated with a greater decrease in inpatient hospital days at 1 year (IRR for post- vs. pre-move= 0.60 for public housing and 1.25 for matched controls; p<0.01 for time by cohort interaction).  
No significant association between moving into public housing and change in hospitalizations, prescription drug use, or visits to primary care, specialist, or ED at 1 year. |
| Kalousová & Evangelist,18 2019 | Longitudinal study: cohort | Intervention: Non-elderly, urban-dwelling adult renters who received any housing assistance during the study period (n=31)  
Comparison: Non-elderly, urban-dwelling adult renters who were income-eligible for housing assistance but did not receive it during the study period (n=76) | **Physical health:** no significant association between housing assistance and chronic conditions or BMI at 4 years.  
**Mental health:** no significant association between housing assistance and depression at 4 years.  
**Health-related behavior:** housing assistance was associated with a 12 percentage-point increase in probability of smoking (p<0.05) at 4 years; no significant association with alcohol use. |
| O’Connell et al.,19 2008 | Longitudinal study: cohort (secondary analysis of RCT data) | Intervention: Recently homeless veterans with a psychiatric and/or a substance use disorder who obtained housing after being randomized to a HUD voucher plus intensive case management (n=169)  
Comparison: Recently homeless veterans with a psychiatric and/or a substance use disorder who obtained housing after being randomized to intensive case management alone (n=76)  
*Study arm excluded from this review: usual care alone* | **Physical health:** obtaining housing after being offered a HUD voucher was associated with a 0.6-point improvement in quality of life scores (p<0.01) at 5 years.  
**Health-related behavior:** obtaining housing after being offered a HUD voucher was associated with 0.1-point reductions in both the alcohol subscale and drug subscale of an addiction severity index (p<0.01 for both) at 5 years. No significant association with other addiction severity index subscales (employment, legal problems, psychiatric symptoms) nor with days of alcohol or drug use. |
| Author, year | Study design | Intervention and comparison populations\(^a\) and sample sizes at enrollment | Main health-related findings\(^b\) |
|-------------|--------------|-------------------------------------------------------------------------------------------------|-----------------------------------------------|
| Pfeiffer, 2018 | Longitudinal study: matched cohort | Intervention: Low-income, non-elderly adult renters who newly obtained housing assistance (vouchers or public housing units) during the study period (n=836)  
Comparison: Propensity-score matched low-income, non-elderly renters who did not newly obtain housing assistance during the study period (n=836 via 1:1 matching from 28,219 controls)  
*Unmatched regression analyses excluded from this review* | **Physical health:** no significant association between obtaining housing assistance with change in self-rated health at 1 year.  
**Health care utilization:** no significant association between obtaining housing assistance with change in health care spending at 1 year. |
| Zhong et al., 2020 | Longitudinal study: matched cohort | Intervention: People living with HIV who were newly enrolled in a New York City rental assistance program (n=85)  
Comparison: Matched cohort of people living with HIV in New York City who were not enrolled in the rental assistance program (n=170)  
*Study arms excluded from this review: housing placement assistance, permanent supportive housing* | **Physical health:** Receiving rental assistance for 1+ years was associated with greater likelihood of HIV viral suppression (RR=1.1, \(p<0.05\)) and improved CD4 count (RR=1.18, \(p<0.05\)) at 1 year, but no significant associations at 2 years. Receiving rental assistance for less than 1 year was not significantly associated with HIV viral suppression or improved CD4 count.  
**Health care utilization:** Receiving rental assistance for 1+ years was associated with greater likelihood of receiving HIV surveillance labs at 1 year (RR=1.08, \(p<0.05\)) and at 2 years (RR=1.05, \(p<0.05\)). Receiving rental assistance for less than 1 year was not significantly associated with receiving HIV surveillance labs. |
| Fenelon et al., 2017 | Cross-sectional design with quasi-waitlist control | Intervention: Adults currently receiving HUD rental assistance via either vouchers, public housing, or multifamily housing (total n=8049-8695, depending on outcome)  
Comparison: Adults who would receive HUD rental assistance within the next 24 months (n=3362-4091, depending on outcome) | **Physical health:** public housing and multifamily housing were each associated with a 4.8 percentage-point decrease in probability of fair or poor self-rated health (\(p=0.02\) and \(p=0.01\), for public housing and multifamily housing, respectively). No significant association between housing choice vouchers and self-rated health. Some evidence of heterogeneity by race/ethnicity.  
**Mental health:** public housing was associated with a 5.4 percentage-point decrease in probability of serious psychological distress (\(p=0.002\)). No significant associations between housing choice vouchers or multifamily housing and distress. Some evidence of heterogeneity by race/ethnicity. |
| Author, year | Study design | Intervention and comparison populations\(^a\) and sample sizes at enrollment | Main health-related findings\(^b\) |
|-------------|--------------|-------------------------------------------------------------------------|-----------------------------------|
| Simon et al.,\(^23\) 2017 | Cross-sectional design with quasi-waitlist control | Intervention: Nondisabled adults currently receiving HUD housing assistance (n=3179)  
Comparison: Non-disabled adults who would receive HUD housing assistance within the next 24 months (n=835) | **Health care access:** housing assistance was associated with a 5.3 percentage-point decrease in probability of being uninsured (p<0.05) and a 7.9 percentage-point decrease in unmet medical need due to cost (p<0.001); no significant association with lack of usual source of care. In stratified analyses, public housing was associated with a 10.9 percentage-point decrease in probability of unmet medical needs due to cost (p<0.05) but not with health insurance or lack of usual source of care. Positive but non-significant associations with health care access outcomes for vouchers and multifamily housing. |
| Wong et al.,\(^24\) 2018 | Cross-sectional design with quasi-waitlist control | Intervention: Low-income adults currently receiving HUD housing assistance (n=5233)  
Comparison: Low-income adults who would receive HUD housing assistance within the next 24 months (n=1023) | **Health-related behavior:** housing assistance was associated with increased odds of physical activity in the nonsenior subgroup only (aOR = 1.47; p=0.01). No significant association for the total sample or the senior subgroup. No evidence of effect modification by neighborhood socioeconomic status. |
| Wong et al.,\(^25\) 2019 | Cross-sectional design with quasi-waitlist control | Intervention: Adults currently receiving HUD housing assistance who were eligible for colorectal, breast, or cervical cancer screening (n=1083-1729)  
Comparison: Adults who would receive HUD housing assistance within the next 24 months who were eligible for colorectal, breast, or cervical cancer screening (n=168-299) | **Health care utilization:** no significant associations between any housing assistance and receipt of age-appropriate screening for colorectal, breast, or cervical cancers. |
| **Homeownership assistance** | | | |
| Munford et al.,\(^26\) 2020 | Longitudinal study: ecological FE panel regression\(^c\) | Intervention: Populations of U.K. districts with higher maximum "Right-to-Buy" subsidies to help renters in public housing buy their homes  
Comparison: Populations of districts with lower maximum "Right-to-Buy" subsidies  
Total n=311 districts; district populations not reported | **Physical health:** a £22,000 increase in the maximum homeownership assistance subsidy (equivalent to difference between highest and lowest subsidy in sample) was associated with a 0.010 percentage-point\(^d\) (0.02 standard deviations) decrease in prevalence of longstanding health conditions (p<0.05) and 0.026-point\(^e\) (0.14 standard deviations) decrease in average number of health problems (p<0.05) in a district at 10 years. |

\(^a\)Sample sizes at enrollment may vary due to differences in follow-up rates.  
\(^b\)Main findings may include additional details not listed here.  
\(^c\)Ecological analyses were used to examine associations at the district level.  
\(^d\)Percentage-point change in outcome.  
\(^e\)Mean change in outcome.
Notes: DiD= difference-in-differences analysis. COVID-19= Coronavirus disease 2019. aOR = adjusted odds ratio. IRR= incidence rate ratio. HR= hazard ratio. FE= fixed effects. HUD = U.S. Department of Housing and Urban Development. BMI = body mass index.

*a* All studies were conducted in the United States except where otherwise specified.

*b* Table entries exclude study findings not relevant to our main review outcomes of physical health, mental health, health-related behaviors, health care utilization, and health care access. We accepted a significance level of alpha < 0.05 for all studies.

*c* Study authors originally reported the incidence rate ratios or hazard ratios for expired vs. active moratoriums; we report the inverse to estimate the outcomes associated with active vs. expired moratoriums.

*d* The study included in this section offered intervention-group participants a variety of legal and financial services along with application assistance and waitlist priority for public housing to eligible participants. Because the study did not report the number of participants who received each type of assistance, and because the follow-up period was short (6 months), we classified this in the short-term interventions section, separate from the section assessing long-term rent subsidies.

*e* The original study used local area district (LAD)-level maximum Right-to-Buy subsidy as an instrumental variable to study the effect of homeownership on health outcomes. To estimate the association between maximum Right-to-Buy subsidy on health, we used results from authors’ ecological fixed-effects instrumental variables analysis to calculated the product of the coefficient for LAD-level maximum subsidy from the regression on LAD ownership rate and the coefficient for LAD homeownership rate from the regressions prevalence of longstanding health conditions and average number of health conditions, scaled to approximate the change in each outcome associated with an increase from the lowest to the highest maximum subsidy in the study. The 2-stage residual inclusion model used the authors’ individual-level analyses did not permit direct inference about the association between maximum subsidy and health outcomes.
etTable 2. Cochrane Risk of Bias for Randomized Controlled Trials

| Author, year | Random sequence generation | Allocation concealment | Blinding of participants and personnel | Blinding of outcome assessment | Incomplete outcome data | Selective reporting |
|--------------|----------------------------|------------------------|----------------------------------------|-------------------------------|------------------------|-------------------|
| Bovell-Ammon et al.,\(^7\) 2020 | Unclear | Unclear | High risk | High risk | Low risk | Low risk |
| Gubits et al.,\(^8\) 2015 | Low risk | Low risk | High risk | High risk | Low risk | Low risk |
| Gubits et al.,\(^9\) 2016 | Low risk | Low risk | High risk | High risk | Low risk | Low risk |
| Gubits et al.,\(^10\) 2018 | Low risk | Low risk | High risk | High risk | Low risk | Low risk |
| Shinn et al.,\(^9\) 2016 | Low risk | Low risk | High risk | High risk | Low risk | Low risk |
| Wolitski et al.,\(^12\) 2010 | Low risk | Low risk | High risk | Low risk (CD4 and HIV viral load); High risk (all other outcomes) | Low risk | Low risk |

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## eTable 3. Risk of Bias in Non-Randomized Studies of Intervention (ROBINS-I)

| Author, year          | Confounding | Selection bias | Bias in measurement classification of interventions | Bias due to deviations from intended interventions | Bias due to missing data | Bias in measurement of outcomes | Bias in selection of the reported result |
|-----------------------|-------------|----------------|------------------------------------------------------|---------------------------------------------------|--------------------------|-----------------------------------|----------------------------------------|
| An et al., 4 2021     | High        | Low            | Low                                                  | Low                                               | Low                      | Low                               | Uncertain                             |
| Antonakos & Colabianchi, 13 2018 | High        | Low            | Low                                                  | Low                                               | Uncertain                | Low                               | Uncertain                             |
| Denary et al., 14 2021 | Low         | Low            | Low                                                  | Low                                               | Low                      | Low                               | Uncertain                             |
| Fenelon et al., 22 2017 | Low         | Low            | Low                                                  | Low                                               | Low                      | Low                               | Uncertain                             |
| Fertig & Reingold, 15 2007 | Low         | Low            | Low                                                  | Low                                               | Uncertain                | Low                               | Uncertain                             |
| Jowers et al., 1 2021 | High        | Low            | Low                                                  | Low                                               | Low                      | Low                               | Low                                   |
| Hinds et al., 16 2018 | Low         | Low            | Low                                                  | Low                                               | Low                      | Low                               | Uncertain                             |
| Hinds et al., 17 2019 | High        | Low            | Low                                                  | Low                                               | Low                      | Low                               | Uncertain                             |
| Kalousová & Evangelist, 18 2019 | High        | High           | Low                                                  | Low                                               | Low                      | Low                               | Uncertain                             |
| Leifheit et al., 27 2021a | High        | Low            | Low                                                  | Low                                               | Low                      | Low                               | Low                                   |
| Leifheit et al., 5 2021b | Low         | Low            | Low                                                  | Low                                               | Low                      | Low                               | Uncertain                             |
| Munford et al., 26 2020 | High        | Low            | Low                                                  | Low                                               | Low                      | Low                               | Uncertain                             |
| Nelson et al., 8 2021 | Low         | Low            | Low                                                  | Low                                               | Low                      | Low                               | Low                                   |
| O'Connell et al., 19 2008 | High        | High           | Low                                                  | Low                                               | Low                      | Low                               | Uncertain                             |
| Pfeiffer, 20 2018     | High        | Low            | Low                                                  | Low                                               | Low                      | Low                               | Uncertain                             |
| Sandoval-Olascoaga et al., 3 2021 | High       | Low            | Low                                                  | Low                                               | Low                      | Low                               | Low                                   |
| Simon et al., 23 2017 | Low         | Low            | Low                                                  | Low                                               | Low                      | Low                               | Uncertain                             |
| Wong et al., 24 2018  | Low         | Low            | Low                                                  | Low                                               | Low                      | Low                               | Uncertain                             |
| Wong et al., 25 2019  | Low         | Low            | Low                                                  | Low                                               | Low                      | Low                               | Uncertain                             |
| Zhong et al., 21 2020 | High        | Low            | Low                                                  | Low                                               | Low                      | Low                               | Uncertain                             |
**eTable 4. Reporting on Race/Ethnicity**

| Author, year                | Reported descriptive race/ethnicity data | Controlled for race/ethnicity as confounder<sup>a</sup> | Assessed race/ethnicity as moderator | Included text justifying conceptual meaning of race/ethnicity |
|-----------------------------|------------------------------------------|--------------------------------------------------------|--------------------------------------|-------------------------------------------------------------|
| An et al.,<sup>4</sup> 2021 | X                                       | X                                                      | X                                    | X                                                           |
| Antonakos & Colabianchi,<sup>13</sup> 2018 | X                                       | X                                                      | X                                    |                                                             |
| Bovell-Ammon et al.,<sup>7</sup> 2020 | X                                       | X                                                      | X                                    |                                                             |
| Denary et al.,<sup>14</sup> 2021 | X                                       | X                                                      | X                                    | X                                                           |
| Fenelon et al.,<sup>22</sup> 2017 | X                                       | X                                                      | X                                    |                                                             |
| Fertig & Reingold,<sup>15</sup> 2007 | X                                       | X                                                      | X                                    |                                                             |
| Gubits et al.,<sup>8</sup> 2015 | X                                       | X                                                      | X                                    |                                                             |
| Gubits et al.,<sup>10</sup> 2016 | X                                       | X                                                      | X                                    |                                                             |
| Gubits et al.,<sup>11</sup> 2018 | X                                       | X                                                      | X                                    |                                                             |
| Hinds et al.,<sup>16</sup> 2018 | X                                       | X                                                      | X                                    |                                                             |
| Hinds et al.,<sup>17</sup> 2019 | X                                       | X                                                      | X                                    |                                                             |
| Jowers et al.,<sup>1</sup> 2021 | X                                       | X                                                      | X                                    |                                                             |
| Kalousová & Evangelist,<sup>18</sup> 2019 | X                                       | X                                                      | X                                    |                                                             |
| Leifheit et al.,<sup>27</sup> 2021a | X                                       | X                                                      | X                                    |                                                             |
| Leifheit et al.,<sup>5</sup> 2021b | X                                       | X                                                      | X                                    |                                                             |
| Munford et al.,<sup>26</sup> 2020 | X                                       | X                                                      | X                                    |                                                             |
| Nelson et al.,<sup>6</sup> 2021 | X                                       | X                                                      | X                                    |                                                             |
| O'Connell et al.,<sup>19</sup> 2008 | X                                       | X                                                      | X                                    |                                                             |
| Pfeiffer,<sup>20</sup> 2018 | X                                       | X                                                      | X                                    |                                                             |
| Sandoval-Olascoaga et al.,<sup>3</sup> 2021 | X                                       | X                                                      | X                                    |                                                             |
| Shinn et al.,<sup>9</sup> 2016 | X                                       | X                                                      | X                                    |                                                             |
| Simon et al.,<sup>21</sup> 2017 | X                                       | X                                                      | X                                    |                                                             |
| Wolitski et al.,<sup>12</sup> 2010 | X                                       | X                                                      | X                                    |                                                             |
| Wong et al.,<sup>23</sup> 2018 | X                                       | X                                                      | X                                    |                                                             |
| Wong et al.,<sup>24</sup> 2019 | X                                       | X                                                      | X                                    |                                                             |
| Zhong et al.,<sup>21</sup> 2020 | X                                       | X                                                      | X                                    |                                                             |

<sup>a</sup>Includes matching on race/ethnicity or use of individual fixed effects that would account for race/ethnicity as a time-invariant characteristic.
**eAppendix 1. Detailed Search Strategy**

We developed the following search strategy together with an experienced reference librarian:

| Database searched, language, time period, and number of results | Search strategy |
|---|---|
| **PubMed** | **Original search terms:**  
First search run (2011-2021 articles): 22 August 2021  
Second search run (2005-2010 articles): 2 September 2021  
Housing[tiab] OR household*[tiab] OR neighborhood*[tiab]  
AND  
health[tiab] OR "public health"[tiab] OR covid-19[tiab] OR SARS-CoV-2[tiab]  
AND  
"rent assistance"[tiab] OR voucher*[tiab] OR evict*[tiab] OR instability*[tiab] OR "affordable housing"[tiab] OR "housing assistance"[tiab] OR "rental assistance"[tiab] OR "section 8"[tiab] OR "housing subsidy"[tiab] OR "housing subsidies"[tiab] OR "rent control"*[tiab] OR "rent stabilization"[tiab] OR "stabilized rent"[tiab] OR "legal assistance"[tiab] OR "housing counseling"[tiab] OR "housing referral"*[tiab] OR ((tenant*[tiab] OR foreclosure*[tiab]) AND protect*[tiab]) OR (tenant[tiab] AND ("anti harassment"[tiab] OR antiharassment[tiab] OR "right of return"[tiab]) OR ((screening[tiab] OR referral*[tiab]) AND "housing services"[tiab]))  
AND  
"public housing"[tiab] AND health[tiab] |
| Language: English | Time period: 2005-present  
927 results (original search)  
AND  
"public housing"[tiab] AND health[tiab] |
| Additional search terms | Note: As part of our reference mining, we discovered 2 studies that would meet eligibility criteria but which we missed by our initial searches, due to indexing that used terms related to housing affordability and stability but not specifically “public housing.” Therefore, we conducted an additional search in PubMed from 2005-2022 using the term “public housing,” which identified an additional 375 titles for review:  
**Additional search terms**  
Search run (2005-2022): 7 May 2022  
"public housing"[tiab] AND health[tiab] |
| Database searched, language, time period, and number of results | Search strategy |
|---------------------------------------------------------------|-----------------|
| **Web of Science (SCI-Expanded; SSCI; A&HCI)** | **2011-2021 search run: 22 August 2021**  
**2005-2010 search run: 2 September 2021**  
Type: Articles, Review Articles; Early Access |  
Language: English  
Time period: 2005-present  
1478 results  
**Search strategy**  
TS=(Housing OR household* OR neighborhood*)  
AND  
TS=(health OR "public health" OR covid-19 OR SARS-CoV-2)  
AND  
"rent assistance" OR voucher* OR evict* OR instability OR "affordable housing" OR "housing assistance" OR "rental assistance" OR "section 8" OR "housing subsidy" OR "housing subsidies" OR "rent control*" OR "rent stabilization" OR "stabilized rent" OR "legal assistance" OR "housing counseling" OR "housing referral*" OR TS=(tenant* OR foreclosure*) AND TS=("anti harassment" OR antiharassment OR "right of return")  
OR TS=(screening OR referral*)  
AND TS="housing services") |
| **Social Interventions Research & Evaluation Network (SIREN)** | **Search run: 3 December 2021**  
Filter: Social determinant of health = “housing stability” |  
343 results |
| **EconLit (EBSCO)** | **Search run: 9 September 2021**  
Type: Academic Journals |  
Language: English  
Time period: 2005-present  
106 results  
**Search strategy**  
TI(Housing OR household* OR neighborhood*) OR AB(Housing OR household* OR neighborhood*)  
AND  
TI(health OR "public health" OR covid-19 OR SARS-CoV-2) OR AB(health OR "public health" OR covid-19 OR SARS-CoV-2)  
AND  
TI("rent assistance" OR voucher* OR evict* OR instability OR "affordable housing" OR "housing assistance" OR "rental assistance" OR "section 8" OR "housing subsidy" OR "housing subsidies" OR "rent control*" OR "rent stabilization" OR "stabilized rent" OR "legal assistance" OR "housing counseling" OR "housing referral*") OR AB("rent assistance" OR voucher* OR evict* OR instability OR "affordable housing" OR "housing assistance" OR "rental assistance" OR "section 8" OR "housing subsidy" OR "housing subsidies" OR "rent control*" OR "rent stabilization" OR "stabilized rent" OR "legal assistance" OR "housing counseling" OR "housing referral")  
OR (TI(tenant* OR foreclosure*) AND TI(protect*)) OR (AB(tenant* OR foreclosure*) AND AB(protect*)) OR (TI(tenant) AND TI("anti harassment" OR antiharassment OR "right of return")) OR (AB(tenant) AND AB("anti harassment" OR antiharassment OR "right of return"))  
OR (TI(screening OR referral*) AND TI("housing services")) OR (AB(screening OR referral*) AND AB("housing services")) |
| Database searched, language, time period, and number of results | Search strategy |
|---------------------------------------------------------------|-----------------|
| **Google** *(gray literature search)*                         | *Search run: 7 December 2021*  
We screened the first 50 results for each of the following search strings:  
1) housing insecurity intervention health  
2) housing instability intervention health  
3) housing insecurity prevention health  
4) housing affordability intervention health  
5) housing assistance health outcomes |
| No restriction on time period                                  |                 |
| 250 results                                                   |                 |
| **Expert Consultation and Reference Mining**                 | *n/a*          |
| No restriction on time period                                  |                 |
| 16 results                                                    |                 |
### eAppendix 2. Studies Excluded After Full-Text Review, by Reason for Exclusion

**Study Design, n=23**

1. **Homelessness And Health: Funders See The Connection.** Health Aff (Millwood), 2020. 39(11): p. 2033-2034.
2. Beer, A., et al., **Housing Policy, Housing Assistance and the Wellbeing Dividend: Developing an Evidence Base for Post-GFC Economies.** Housing Studies, 2011. 26(7-8): p. 1171-1192.
3. Benfer, E.A., et al., **Correction to: Eviction, Health Inequity, and the Spread of COVID-19: Housing Policy as a Primary Pandemic Mitigation Strategy.** J Urban Health, 2021. 98(1): p. 159.
4. Butcher, L., **AHA: HOUSING IS HEALTH CARE: Housing instability provides a challenge for hospitals and health systems.** Hosp Health Netw, 2017. 91(1): p. 28-29.
5. Dasinger, L.K. and R. Speiglman, **Homelessness prevention: the effect of a shallow rent subsidy program on housing outcomes among people with HIV or AIDS.** AIDS Behav, 2007. 11(6 Suppl): p. 128-39.
6. Drabo, E.F., et al., **A Social-Return-On-Investment Analysis Of Bon Secours Hospital’s ‘Housing For Health’ Affordable Housing Program.** Health Aff (Millwood), 2021. 40(3): p. 513-520.
7. Garg, A., Burrell, L., Triposi, Y., Goodman, E., Brooks-Gunn, J., & Duggan, A. K., **Maternal mental health during children's first year of life: Association with receipt of Section 8 rental assistance.** Housing Policy Debate, 2013. 23(2): p. 281-297.
8. Garg, A., et al., **Maternal Mental Health during Children's First Year of Life: Association with Receipt of Section 8 Rental Assistance.** Housing Policy Debate, 2013. 23(2): p. 281-297.
9. Grande, K.M., et al., **Social determinants of health in public health practice: case study of rent stipends to augment tuberculosis cluster management.** J Health Care Poor Underserved, 2014. 25(4): p. 1799-809.
10. Hackett, K.A., et al., **Community land trusts: releasing possible selves through stable affordable housing.** Housing Studies, 2019. 34(1): p. 24-48.
11. Hernández, D., "Extra Oomph:” Addressing Housing Disparities through Medical Legal Partnership Interventions. Hous Stud, 2016. 31(7): p. 871-890.
12. Holtgrave, D.R., et al., **Cost-utility analysis of the housing and health intervention for homeless and unstably housed persons living with HIV.** AIDS Behav, 2013. 17(5): p. 1626-31.
13. Keene, D.E., et al., **Rental Assistance and Adult Self-Rated Health.** J Health Care Poor Underserved, 2020. 31(1): p. 325-339.
14. Martin, E.J., **AFFORDABLE HOUSING, HOMELESSNESS, AND MENTAL HEALTH: WHAT HEALTH CARE POLICY NEEDS TO ADDRESS.** J Health Hum Serv Adm, 2015. 38(1): p. 67-89.
15. Moran-McCabe, K., A. Gutman, and S. Burris, **Public Health Implications of Housing Laws: Nuisance Evictions.** Public Health Rep, 2018. 133(5): p. 606-609.
16. Nande, A., et al., **The effect of eviction moratoria on the transmission of SARS-CoV-2.** Nat Commun, 2021. 12(1): p. 2274.
17. Novick, T.K., et al., **Housing Instability and Health Care Engagement Among People With CKD.** Kidney Med, 2020. 2(3): p. 367-368.

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18. Pollack, C.E., et al., *Leveraging the Affordable Housing Sector to Respond to the Opioid Crisis*. Public Health Reports: p. 6.

19. Sills, S.J. and B.A. Rich, *Housing Instability and Public Health: Implications of the Eviction Moratoria During the COVID-19 Pandemic*. N C Med J, 2021. **82**(4): p. 271-275.

20. Sullivan, C.M., H.D. Bomsta, and M.A. Hacskaylo, *Flexible Funding as a Promising Strategy to Prevent Homelessness for Survivors of Intimate Partner Violence*. Journal of Interpersonal Violence, 2019. **34**(14): p. 3017-3033.

21. Vega, W.A. and S.P. Wallace, *Affordable Housing: A Key Lever to Community Health for Older Americans*. Am J Public Health, 2016. **106**(4): p. 635-6.

22. Vold, L., M. Lynch, and W. Martin, *A Review of Housing and Food Intersections: Implications for Nurses and Nursing Research*. Can J Nurs Res, 2019. **51**(4): p. 221-232.

23. Zafari, Z. and P. Muennig, *The cost-effectiveness of limiting federal housing vouchers to use in low-poverty neighborhoods in the United States*. Public Health, 2020. **178**: p. 159-166.

Wrong Intervention, n=24

1. Cohn, K., Ahmad, H., Brown, L., et. al., *Promoting Housing Security and Healthy Homes for Families Served by Maternal, Child and Adolescent Health Programs*. 2017, San Francisco Department of Public Health.

2. Evans, W.N., et al., *Housing and Urban Development-Veterans Affairs Supportive Housing Vouchers and Veterans’ Homelessness, 2007-2017*. American Journal of Public Health, 2019. **109**(10): p. 1440-1445.

3. Galster, G.C., et al., *Benefit-Cost Analysis of an Innovative Program for Self-Sufficiency and Homeownership*. Evaluation Review, 2019. **43**(1-2): p. 3-40.

4. Garland, E., et al., *Impact of LEED-certified affordable housing on asthma in the South Bronx*. Prog Community Health Partnersh, 2013. **7**(1): p. 29-37.

5. Hayes, M., Zonneville, M., Bassuk, E., *The SHIFT Study: Final Report*. American Institutes for Research.

6. Hoffman, D., M.E. Kehn, and D.J. Lipson, *The Missing Link: Examining the Impact of Housing Vouchers and Community-Based Services and Supports on Transitions From Nursing Facilities to the Community*. Journal of Disability Policy Studies, 2017. **27**(4): p. 243-251.

7. Horwitz, L., Chang, C., Arcilla, H., Knickman, J. *Housing-Focused Interventions at the Top of Health Systems’ Community Investments*. 2020; Available from: https://housingmatters.urban.org/research-summary/housing-focused-interventions-top-health-systems-community-investments.

8. Katz LF, Kling JR, Liebman JB. Moving to Opportunity in Boston: Early Results of a Randomized Mobility Experiment. Q J Econ. 2001;116(2):607-654. Accessed December 2, 2021. [https://www.jstor.org/stable/2696474](https://www.jstor.org/stable/2696474)

9. Kling J, Liebman J, Katz L. Experimental Analysis of Neighborhood Effects. Econometrica. 2007;75(1):83-119.10. Losonczy LI, H.D., Wang M, et al, *The Highland Health Advocates: A preliminary evaluation of a novel programme addressing...
the social needs of emergency department patients. Emerg Med J.

11. Ludwig, J., Liebman, J.B., Kling, J.R., Duncan, G.J., Katz, L.F., Kessler, R.C. and Sanbonmatsu, L., What can we learn about neighborhood effects from the moving to opportunity experiment? American Journal of Sociology, 2008. 114(1): p. 144-188.

12. Ludwig J, Sanbonmatsu L, Gennetian L, et al. Neighborhoods, Obesity, and Diabetes — A Randomized Social Experiment. N Engl J Med. 2011;365(16):1509-1519. doi:10.1056/NEJMsa1103216

13. Ludwig J, Duncan GJ, Gennetian LA, et al. Neighborhood Effects on the Long-Term Well-Being of Low-Income Adults. Science. Published online September 21, 2012. doi:10.1126/science.1224648

14. Mehta, A.J., et al., Subsidized Housing and Adult Asthma in Boston, 2010-2015. American Journal of Public Health, 2018. 108(8): p. 1059-1065.

15. Nelson, R.E., et al., Association of Temporary Financial Assistance With Housing Stability Among US Veterans in the Supportive Services for Veteran Families Program. JAMA Netw Open, 2021. 4(2): p. e2037047.

16. Orr L, Feins JD, Jacob R, et al. Moving to Opportunity for Fair Housing Demonstration Program: Interim Impacts Evaluation. U.S. Department of Housing and Urban Development; 2003.

17. Pollack CE, Blackford AL, Du S, Deluca S, Thornton RLJ, Herring B. Association of Receipt of a Housing Voucher With Subsequent Hospital Utilization and Spending. JAMA. 2019;322(21):2115. doi:10.1001/jama.2019.17432

18. Pollack CE, Du S, Blackford AL, Herring B. Experiment To Decrease Neighborhood Poverty Had Limited Effects On Emergency Department Use. Health Aff (Millwood). 2019;38(9):1442-1450. doi:10.1377/hlthaff.2019.00452

19. Rodabaugh KJ, H.M., Myszka D, Sandel M, A medical-legal partnership as a component of a palliative care model. J Palliat Med.

20. Ryan AM, K.R., Suther E, Hansen M, Sandel M, Pilot study of impact of medical-legal partnership services on patients’ perceived stress and wellbeing. J Health Care Poor Underserved.

21. Sanbonmatsu L, Ludwig J, Katz L, et al. Moving to Opportunity for Fair Housing Demonstration Program - Final Impacts Evaluation. US Department of Housing & Urban Development, PD&R; 2011.

22. Sanbonmatsu L, Marvakov J, Potter NA, et al. The Long-Term Effects of Moving to Opportunity on Adult Health and Economic Self-Sufficiency. Cityscape J Policy Dev Res. 2012;14(2):109-136.

23. Teufel JA, W.D., Goffinet D, Thorne W, Brown SL, Gettngier L, Rural medical-legal partnership and advocacy: A three-year follow-up study. J Health Care Poor Underserved.

24. Tsai, J., Middleton, M., Villegas, J., Johnson, C., Retkin, R., et. al. Veterans Experiencing Homelessness and Housing Instability Benefit from Medical-Legal Partnerships. 2021; Available from: https://housingmatters.urban.org/research-summary/veterans-experiencing-homelessness-and-housing-instability-benefit-medical-legal.

Not Adults, n=3

1. Fetzer-Rice, B. Opinion: Housing stability can lead to better health for pregnant women

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and their babies. 2021; Available from: https://www.dispatch.com/story/opinion/columns/guest/2021/05/29/beth-fetzer-rice-improving-housing-stability-can-lead-better-health/7476245002/.

2. Heath, S. Community-Based Program Links Housing Security, Health Outcomes. 2021; Available from: https://patientengagementhit.com/news/community-based-program-links-housing-security-health-outcomes.

3. Lim S, S.T., Hall G, Walters S, Gould LH, Impact of a New York City supportive housing program on housing stability and preventable health care among homeless families. Health Serv Res.

Duplicate, n=2

1. Health Starts at Home. Available from: https://www.tbf.org/nonprofits/grant-making-initiatives/health-starts-at-home

2. Galvin, G. A Modest Return for Housing Vouchers. 2019; Available from: https://www.usnews.com/news/healthiest-communities/articles/2019-12-03/housing-vouchers-had-modest-effect-on-health-care-use-study-shows.

Chronic Homelessness, n=1

1. Wiewel, E.W., et al., Housing Subsidies and Housing Stability are Associated with Better HIV Medical Outcomes Among Persons Who Experienced Homelessness and Live with HIV and Mental Illness or Substance Use Disorder. AIDS Behav, 2020. 24(11): p. 3252-3263.

No Full-text Available, n=1

1. Miller, D. and T. Byrne. Does the Value of Housing Assistance Impact Health Outcomes? 2020; Available from: sswr.confex.com/sswr/2020/webprogram/Paper40176.html.

No Relevant Outcomes, n=1

1. Carlson, D., et al., The Benefits and Costs of the Section 8 Housing Subsidy Program: A Framework and Estimates of First-Year Effects. Journal of Policy Analysis and Management, 2011. 30(2): p. 233-255.
eAppendix 3. Detailed Description of Methods

Methods

Study Selection Process

Two authors (KLC and PGS) independently screened titles identified in our initial search. Titles flagged as relevant by at least one reviewer were advanced for abstract screening. Two authors (KLC and PGS; KLC and IML; and PGS and IML) independently screened abstracts and full-text articles in duplicate, with disagreements resolved via group discussion.

Study Inclusion and Exclusion Criteria

We included studies published in English in or after 2005 that met the following criteria:

1) **Setting:** We included studies conducted in high-income countries, such that results are applicable to the United States. *We excluded studies conducted in low- and middle-income countries.*

2) **Population:** We included studies that were focused on adults who were not chronically homeless. *We excluded studies focused predominantly or exclusively on populations meeting the HUD definition of chronically homeless (defined as experiencing homelessness for at least one year while struggling with a disability such as serious mental illness, substance use disorder, or physical disability).* We also excluded studies focused predominantly or exclusively on children and adolescents, as the focus of our sponsor was adults with housing insecurity.
3) **Intervention:** We included studies evaluating programs or policies intended to achieve primary prevention of housing insecurity by directly improving housing affordability and/or stability. We specifically included (1) any targeted primary prevention interventions delivered at the individual or household level and (2) housing-related structural prevention interventions that were delivered by or in partnership with the health care sector. We classified targeted primary prevention interventions as short-term if they addressed an acute need, such as an imminent eviction threat, and long-term if they acted to improve affordability or stability for a prolonged (>6 months) or indefinite period. We excluded interventions focused on secondary prevention for people experiencing acute housing loss or high-risk housing transitions (e.g. medical respite, transitional housing, rapid re-housing, or case management) and tertiary prevention for people experiencing chronic homelessness (e.g. permanent supportive housing, Housing First, or case management). For interventions such as emergency housing assistance that can be relevant to either primary or secondary prevention, we focused only housing-related assistance aimed at helping tenants remain housed, thereby excluding short-term rapid rehousing assistance for people already experiencing homelessness and mental health services for people with psychiatric disorders. We also excluded protections against housing discrimination, remediation of health/safety hazards or energy inefficiencies, and non-housing programs with the potential to improve housing security by mitigating poverty (e.g. tax credits, food stamps, or Medicaid). Also excluded were structural prevention interventions that did not explicitly involve the health sector (i.e. municipal zoning changes). We excluded evaluations of moves from public housing to voucher-
subsidized housing occurring in the context of public housing demolition or rehabilitation. Furthermore, we excluded studies addressing multiple social needs if they did not separately report the effect of the housing component of an intervention. Finally, we excluded evaluations of the Moving to Opportunity study, which was intended to assess the impact of neighborhood context, rather than housing affordability or stability.

4) **Outcomes:** We included studies that assessed outcomes related to physical health (including measures of self-rated health and quality of life), mental health, health-related behaviors (including measures of substance use and addiction but acknowledging that they are governed by complex biological conditions), health care utilization, and health care access among adults. For studies evaluating structural prevention interventions, we also included studies that assessed housing stability as a secondary outcome. *We excluded outcomes pertaining to children and adolescents. We considered outcomes related to social networks, interpersonal violence, safety, crime, and “goal-oriented thinking” to be not explicitly health-related and thus out of scope of this review.*

5) **Design:** We included quantitative randomized and rigorous observational studies that employed quantitative methods aimed at reducing selection bias (e.g. difference-in-difference analysis, cohort studies, controlled before-and-after studies, time series analyses), adapting an approach used by the Patient-Centered Outcomes Research Institute in reviewing health effects of social needs interventions. *We excluded qualitative studies and quantitative studies that purely described associations between housing status and health. We also excluded cross-sectional comparisons between people*
currently receiving vs. currently waitlisted for housing assistance, even if they controlled for demographic confounders, because most housing agencies rely on non-random waitlist prioritization schemes.\textsuperscript{30} We also excluded simulation or modeling studies that relied on previously published effect estimates and did not contribute new evidence regarding causal relationships.\textsuperscript{31–34}

Data Extraction and Quality Assessment Processes

Two authors (KLC and PGS; KLC and IML; PGS and IML; KLC and FJZ) independently extracted data from included studies, with discrepancies resolved via group discussion. Extracted data elements included study design, intervention type (using categories derived from our conceptual model [Figure 1]), population, sample size, follow-up period, and outcomes. For studies reporting multiple analyses, we extracted only those that met our inclusion criteria. For studies that reported relative outcomes as associations for the control group relative to the intervention group, we inverted results to represent associations for the intervention relative to the control condition. Two authors (KLC and PGS) independently assessed risk of bias using the Cochrane Risk of Bias Tool\textsuperscript{35} and the Risk of Bias in Non-Randomized Studies of Interventions tool.\textsuperscript{36}

Certainty of Evidence Assessment

We rated certainty of the evidence using a modified version of the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) system\textsuperscript{37–40} adopted by a committee of the National Academies of Sciences, Engineering, and Medicine for use in evaluating diverse types of evidence relevant to complex public health interventions.\textsuperscript{41} In brief,
for each measured association between an intervention and outcome, two authors (KLC and PGS) tallied the number of RCTs and observational studies, then appraised the overall seriousness of limitations of those studies by reviewing the relevant risk of bias assessments in eTables 2 and 3. Notably, although all included RCTs were deemed to be at high risk of bias due to non-blinding of participants and personnel because housing affordability and stability interventions inherently preclude participant blinding, we did not place particularly high weight on this domain in assessing overall evidence limitations. Next, we judged whether evidence for a given association was limited by serious indirectness, identified as whether the study population, outcomes, and/or comparisons were relevant to our research question. We then assessed consistency of evidence as the extent to which findings from various studies were in agreement in terms of magnitude, direction, and statistical significance of findings, including whether results of subgroup analyses differed between studies. We evaluated studies for precision by considering sample size and width of reported confidence intervals relative to the magnitude and clinical significance of reported associations. Finally, we considered upgrading the certainty of evidence rating for outcomes supported by other considerations, including parallel evidence (evidence supporting similar conclusions from outside the context under review) or mechanistic evidence (established causal relationships that are reasonably applicable to and supportive of the association being reviewed).

As an example, in assessing the association of eviction moratoriums and fewer COVID-19 cases and deaths, the 3 relevant observational studies were judged as having serious study limitations due to high risk of confounding in all 3 studies (see eTable 3). However, the remaining GRADE domains supported greater certainty of evidence: no serious indirectness, since the evaluated populations, interventions, and comparisons were directly relevant to
assessing the association of eviction moratoriums with COVID-19 cases and deaths; consistent findings across the 3 studies that eviction moratoriums were associated with fewer COVID-19 cases and deaths; and no serious imprecision, because sample sizes were large, and confidence intervals were narrow and surpassed a reasonable clinical decision threshold. Summative assessment of the GRADE domains led us to conclude that the certainty of evidence was moderate in support of an association between eviction moratoriums and fewer COVID-19 cases and deaths.

As a second example, in evaluating the association between long-term rent subsidies and health status or quality of life, we reviewed evidence from 2 relevant RCTs8–12 and 4 observational studies.15,19,20,22 Study limitations were judged as serious mostly because of high risk of confounding and uncertainty of bias in selection of the reported result in the majority of the observational studies. Risk of bias in the 2 RCTs, due to nonblinding of participants and personnel (given the nature of the intervention) as well as nonblinding of outcome assessment (given use of phone surveys to collect self-reported outcome measures), was considered a less serious limitation but nonetheless supported the overall conclusion of serious study limitations. Next, we concluded that the evidence was limited by serious indirectness for several reasons. First, in the 2 RCTs8–12 and one observational study,19 study samples included participants already experiencing homelessness and/or living in emergency shelters, making study findings less relevant to the question of how long-term rent subsidies could impact health by preventing loss of housing. Second, two studies focused on narrow clinical populations (people living with HIV12 or veterans with psychiatric and/or substance use disorders19) that did not directly match the general adult population of interest to our study. Furthermore, two studies included intensive case management in both the intervention and control arms,12,19 thus contributing only indirect

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evidence to our understanding of how long-term rent subsidies might influence health in the absence of concurrent case management interventions. We judged the evidence as inconsistent because 3 studies found no significant association between long-term rent subsidies and health status or quality of life,8-11,20 while 2 studies found positive associations19,22 (but with heterogeneity by intervention category and race/ethnicity in one study22) and 2 studies found possible negative associations12,15 (though findings were not consistent across statistical models15). Because many studies reported wide confidence intervals spanning effect sizes of questionable clinical significance, we appraised the evidence as limited by serious imprecision. Finally, in our summative assessment, we concluded that the serious limitations across all GRADE domains contributed to very low certainty of evidence that there was no association between long-term rent subsidies and health status or quality of life.

Classification of Reporting on Race/Ethnicity

Two authors (KLC and IML) independently classified include studies according to how they addressed race/ethnicity as concepts and/or variables. Categories designated whether studies: reported race/ethnicity in descriptive tables, included race/ethnicity as a potential confounder (including matching on race/ethnicity or use of individual fixed effects that would account for race/ethnicity as a time-invariant characteristic), and/or included race/ethnicity as a potential moderator. Additionally, we identified studies that included any narrative justification or conceptualization of race/ethnicity as it pertained to housing insecurity and health. For the latter item, we liberally gave credit to any study that 1) explicitly defined race and/or ethnicity, 2) named racism and its mechanisms relevant to housing and health, 3) described why variables for race/ethnicity might confound the relationship between housing insecurity or housing
assistance and health outcomes, 2) acknowledged racial/ethnic disparities in risk for housing insecurity, 3) assessed whether intervention effectiveness might differ by race/ethnicity.
eReferences.

1. Jowers K, Timmins C, Bhavsar N, Hu Q, Marshall J. Housing Precarity & the COVID-19 Pandemic: Impacts of Utility Disconnection and Eviction Moratoria on Infections and Deaths Across US Counties. National Bureau of Economic Research; 2021. doi:10.3386/w28394

2. Leifheit KM, Linton SL, Raifman J, et al. Expiring Eviction Moratoriums and COVID-19 Incidence and Mortality. Am J Epidemiol. 2021;(kwab196). doi:10.1093/aje/kwab196

3. Sandoval-Olascoaga S, Venkataramani AS, Arcaya MC. Eviction Moratoria Expiration and COVID-19 Infection Risk Across Strata of Health and Socioeconomic Status in the United States. JAMA Netw Open. 2021;4(8):e2129041. doi:10.1001/jamanetworkopen.2021.29041

4. An X, Gabriel SA, Tzur-Ilan N. More Than Shelter: The Effects of Rental Eviction Moratoria on Household Well-Being. SSRN. Published online September 7, 2021.

5. Leifheit KM, Pollack CE, Raifman J, et al. Variation in State-Level Eviction Moratorium Protections and Mental Health Among US Adults During the COVID-19 Pandemic. JAMA Netw Open. 2021;4(12):e2139585. doi:10.1001/jamanetworkopen.2021.39585

6. Nelson RE, Montgomery AE, Suo Y, et al. Temporary Financial Assistance Decreased Health Care Costs For Veterans Experiencing Housing Instability. Health Aff (Millwood). 2021;40(5):820-828. doi:10.1377/hlthaff.2020.01796

7. Bovell-Ammon A, Mansilla C, Poblacion A, et al. Housing Intervention For Medically Complex Families Associated With Improved Family Health: Pilot Randomized Trial. Health Aff (Millwood). 2020;39(4):613-621. doi:10.1377/hlthaff.2019.01569

8. Gubits D, Shinn M, Bell S, et al. Family Options Study: Short-Term Impacts of Housing and Services Interventions for Homeless Families. U.S. Department of Housing and Urban Development, Office of Policy Development and Research; 2015. Accessed February 23, 2022. https://www.ssrn.com/abstract=3055272

9. Shinn M, Brown SR, Wood M, Gubits D. Housing and Service Interventions for Families Experiencing Homelessness in the United States: An Experimental Evaluation. Eur J Homelessness. 2016;10(1):13-30. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6133270/

10. Gubits D, Shinn M, Wood M, et al. Family Options Study: 3-Year Impacts of Housing and Services Interventions for Homeless Families. U.S. Department of Housing and Urban Development, Office of Policy Development and Research; 2016. Accessed March 25, 2020. https://www.ssrn.com/abstract=3055295

11. Gubits D, Shinn M, Wood M, Brown SR, Dastrup SR, Bell SH. What Interventions Work Best for Families who Experience Homelessness? Impact Estimates from the Family Options Study. J Policy Anal Manage. 2018;37(4):735-766. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6168747/
12. Wolitski RJ, Kidder DP, Pals SL, et al. Randomized Trial of the Effects of Housing Assistance on the Health and Risk Behaviors of Homeless and Unstably Housed People Living with HIV. *AIDS Behav.* 2010;14(3):493-503. doi:10.1007/s10461-009-9643-x

13. Antonakos CL, Colabianchi N. Impact of Rental Assistance on Modifiable Health Risk Factors and Behaviors in Adults. *Cityscape.* 2018;20(2):13.

14. Denary W, Fenelon A, Schlesinger P, Purtle J, Blankenship KM, Keene DE. Does rental assistance improve mental health? Insights from a longitudinal cohort study. *Soc Sci Med.* 2021;282:114100. doi:10.1016/j.socscimed.2021.114100

15. Fertig AR, Reingold DA. Public housing, health, and health behaviors: Is there a connection? *J Policy Anal Manage.* 2007;26(4):831-860. doi:10.1002/pam.20288

16. Hinds AM, Bechtel B, Distasio J, Roos LL, Lix LM. Changes in healthcare use among individuals who move into public housing: a population-based investigation. *BMC Health Serv Res.* 2018;18:411. doi:10.1186/s12913-018-3109-7

17. Hinds AM, Bechtel B, Distasio J, Roos LL, Lix LM. Public housing and healthcare use: an investigation using linked administrative data. *Can J Public Health.* 2019;110(2):127-138. doi:10.17269/s41997-018-0162-2

18. Kalousová L, Evangelist M. Rent Assistance and Health: Findings from Detroit. *Hous Stud.* 2019;34(1):111-141. doi:10.1080/02673037.2018.1441977

19. O’Connell MJ, Kasprow W, Rosenheck RA. Rates and Risk Factors for Homelessness After Successful Housing in a Sample of Formerly Homeless Veterans. *Psychiatr Serv.* 2008;59(3):8.

20. Pfeiffer D. Rental Housing Assistance and Health: Evidence From the Survey of Income and Program Participation. *Hous Policy Debate.* 2018;28(4):515-533. doi:10.1080/10511482.2017.1404480

21. Zhong Y, Beattie CM, Rojas J, Farquhar XP, Brown PA, Wiewel EW. Enrollment Length, Service Category, and HIV Health Outcomes Among Low-Income HIV-Positive Persons Newly Enrolled in a Housing Program, New York City, 2014–2017. *Am J Public Health.* 2020;110(7):1068-1075. doi:10.2105/AJPH.2020.305660

22. Fenelon A, Mayne P, Simon AE, et al. Housing Assistance Programs and Adult Health in the United States. *Am J Public Health.* 2017;107(4):571-578. doi:10.2105/AJPH.2016.303649

23. Simon AE, Fenelon A, Helms V, Lloyd PC, Rossen LM. HUD Housing Assistance Associated With Lower Uninsurance Rates And Unmet Medical Need. *Health Aff Proj Hope.* 2017;36(6):1016-1023. doi:10.1377/hlthaff.2016.1152

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24. Wong MS, Roberts ET, Arnold CM, Pollack CE. HUD Housing Assistance and Levels of Physical Activity Among Low-Income Adults. Prev Chronic Dis. 2018;15:170517. doi:10.5888/pcd15.170517

25. Wong MS, Arnold CM, Roberts ET, Pollack CE. The Relationship Between Federal Housing Assistance and Uptake of Cancer Screening Among Low-Income Adults. J Gen Intern Med. 2019;34(12):2714-2716. doi:10.1007/s11606-019-05037-z

26. Munford LA, Fichera E, Sutton M. Is owning your home good for your health? Evidence from exogenous variations in subsidies in England. Econ Hum Biol. 2020;39:100903. doi:10.1016/j.ehb.2020.100903

27. Leifheit KM, Linton SL, Raifman J, et al. Expiring Eviction Moratoriums and COVID-19 Incidence and Mortality. Am J Epidemiol. 2021;190(12):2503-2510. doi:10.1093/aje/kwab196

28. U.S. Department of Housing and Urban Development. Homeless Emergency Assistance and Rapid Transition to Housing (HEARTH): Defining Chronically Homeless Final Rule.; 2015. Accessed September 8, 2021. https://www.hudexchange.info/resource/4847/hearth-defining-chronically-homeless-final-rule/

29. Viswanathan M, Kennedy S, Edler M, et al. Social Needs Interventions to Improve Health Outcomes. Patient-Centered Outcomes Research Institute; 2021. Accessed October 22, 2021. https://www.pcori.org/sites/default/files/PCORI-Social-Needs-Interventions-to-Improve-Health-Outcomes-Scoping-Review-Evidence-Map-Report.pdf

30. Collinson R, Ellen IG, Ludwig J. Low-Income Housing Policy. In: Moffitt RA, ed. Economics of Means-Tested Transfer Programs in the United States. Vol 2. University of Chicago Press; 2016:59-126. doi:10.7208/chicago/9780226392523.001.0001

31. Nande A, Sheen J, Walters EL, et al. The effect of eviction moratoria on the transmission of SARS-CoV-2. Nat Commun. 2021;12(1):2274. doi:10.1038/s41467-021-22521-5

32. Drabo EF, Eckel G, Ross SL, et al. A Social-Return-On-Investment Analysis Of Bon Secours Hospital’s ‘Housing For Health’ Affordable Housing Program. Health Aff (Millwood). 2021;40(3):513-520. doi:10.1377/hlthaff.2020.00998

33. Holtgrave DR, Wolitski RJ, Pals SL, et al. Cost-Utility Analysis of the Housing and Health Intervention for Homeless and Unstably Housed Persons Living with HIV. AIDS Behav. 2013;17(5):1626-1631. doi:10.1007/s10461-012-0204-3

34. Zafari Z, Muennig P. The cost-effectiveness of limiting federal housing vouchers to use in low-poverty neighborhoods in the United States. Public Health. 2020;178:159-166. doi:10.1016/j.puhe.2019.08.016

35. Cochrane Bias Methods Group. RoB 2: A revised Cochrane risk-of-bias tool for randomized trials. Accessed November 30, 2021.

© 2022 Chen KL et al. JAMA Network Open.
36. Sterne JA, Hernán MA, Reeves BC, et al. ROBINS-I: a tool for assessing risk of bias in non-randomised studies of interventions. *BMJ*. 2016;355:i4919. doi:10.1136/bmj.i4919

37. Guyatt GH, Oxman AD, Vist GE, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*. 2008;336(7650):924-926. doi:10.1136/bmj.39489.470347.AD

38. Howick J, Glasziou P, Aronson JK. The evolution of evidence hierarchies: what can Bradford Hill’s ‘guidelines for causation’ contribute? *J R Soc Med*. 2009;102(5):186-194. doi:10.1258/jrsm.2009.090020

39. Zhang Y, Alonso-Coello P, Guyatt GH, et al. GRADE Guidelines: 19. Assessing the certainty of evidence in the importance of outcomes or values and preferences—Risk of bias and indirectness. *J Clin Epidemiol*. 2019;111:94-104. doi:10.1016/j.jclinepi.2018.01.013

40. Zhang Y, Coello PA, Guyatt GH, et al. GRADE guidelines: 20. Assessing the certainty of evidence in the importance of outcomes or values and preferences—Inconsistency, imprecision, and other domains. *J Clin Epidemiol*. 2019;111:83-93. doi:10.1016/j.jclinepi.2018.05.011

41. Calonge N, Shekelle PG, Owens DK, et al. A framework for synthesizing intervention evidence from multiple sources into a single certainty of evidence rating: Methodological developments from a US National Academies of Sciences, Engineering, and Medicine Committee. *Res Synth Methods*. Published online June 20, 2022. doi:10.1002/jrsm.1582