Using Point-in-Time Homeless Counts to Monitor Mortality Trends Among People Experiencing Homelessness in Los Angeles County, California, 2015–2019

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See also Galea and Vaughan, p. 2094.

Objectives. To report trends in mortality rates, mortality rate ratios (MRRs), and causes of death among people experiencing homelessness (PEH) in Los Angeles County, California, by using annual point-in-time homeless counts and to compare findings to published longitudinal cohort studies of homeless mortality.

Methods. We enumerated homeless deaths and determined causes by using 2015–2019 medical examiner–coroner data matched to death certificate data. We estimated midyear homeless population denominators by averaging consecutive January point-in-time homeless counts. We used annual demographic surveys of PEH to estimate age- and gender-adjusted MRRs. We identified comparison studies through a literature review.

Results. Mortality rates increased from 2015 to 2019. Drug overdose was the leading cause of death. Mortality was higher among White than among Black and Latino PEH. Compared with the general population, MRRs ranged from 2.8 (95% confidence interval [CI] = 2.7, 3.0) for all causes to 35.1 (95% CI = 31.9, 38.4) for drug overdose. Crude mortality rates and all-cause MRRs from comparison cohort studies were similar to those in the current study.

Conclusions. These methods can be adapted by other urban jurisdictions seeking to better understand and reduce mortality in their homeless populations. (*Am J Public Health*. 2021;111(12):2212–2222. https://doi.org/10.2105/AJPH.2021.306502)

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Public health strategies for reducing mortality in the general population are guided by trends in mortality rates that use midyear census estimates as proxies for person-years of exposure to mortality risk. Tracking mortality prevention efforts for people experiencing homelessness (PEH) is more challenging because PEH are not well-represented in census data.[1] Nevertheless, the need for these efforts is urgent, as evidenced by a growing number of cohort studies finding that mortality rates among PEH are considerably higher than those among the general public.[2–19] These studies of PEH served by specific shelter or health care systems tracked deaths over time to derive homeless mortality rates using person-years of observation as denominators. Standardized mortality ratios or mortality rate ratios (MRRs) were then estimated to compare homeless mortality with general population mortality. However, these studies are of limited use to local officials seeking data to guide homeless mortality reduction strategies in their communities because they were conducted over different time periods in different jurisdictions.

Rather than relying on census data, local officials can leverage federally mandated census-like estimates of homeless populations, called point-in-time (PIT) counts, for monitoring

mortality rates among PEH. In 2007, the US Department of Housing and Urban Development began requiring local homeless services authorities, called continuums of care (CoCs), to conduct biannual counts of sheltered and unsheltered PEH in their jurisdictions as a condition of funding. These PIT counts occur during the last 10 days of January. According to a recent US Government Accountability Office study, there is considerable variability in the quality of PIT count data across the 397 CoCs in the United States, although quality is highest among CoCs in large urban areas.[20]

The current study estimated mortality rates and MRRs among PEH in Los Angeles (LA) County, California, which has the largest unsheltered population in the United States. The LA County CoC PIT count methodology is particularly strong as it includes (1) a canvassing of all census tracts (i.e., a complete census) for the unsheltered count and (2) a demographic survey in a stratified random sample of census tracts to produce gender, age-group, and racial/ethnic estimates for unsheltered PEH with specified sampling errors.[21] Thus, the LA County CoC PIT count provides a good test case from which to assess the potential utility of PIT-count data for calculating PEH mortality rates. To make this assessment, we compared the results of a PIT count–based methodology in LA County with those of longitudinal cohort studies from other jurisdictions. We examined methodological strengths, limitations, and differences of each approach.

Specifically, we used LA County CoC PIT count data and medical examiner–coroner (MEC) data matched to death certificate data to (1) estimate all-cause and cause-specific mortality trends among PEH in LA County from 2015 to 2019, (2) compare age-adjusted mortality trends among gender and racial/ethnic subgroups of PEH from 2017 to 2019, and (3) compare all-cause and cause-specific PEH mortality rates with corresponding rates in the general LA County population for the combined years of 2017 to 2019. We assumed that the average of 2 consecutive January PIT counts approximates person-years of exposure to homelessness for the index year and can thus serve as a reasonable denominator for an annual homeless mortality rate. To explore this assumption, we compared the mortality rates and MRRs from the current study to those reported in previously published cohort studies.

METHODS

Because California death certificates do not systematically document homelessness, this study's primary source of data on homeless deaths was the LA County MEC. State law requires the MEC to investigate all violent, sudden, unusual, or unattended deaths. Before this study was conducted, LA County had begun to use MEC data to produce informal counts of homeless deaths. We augmented the subset of 2015–2019 MEC case records coded as homeless through systematic text-based searches of relevant data fields to identify misclassified records. All records with emergency shelter or transitional housing addresses were coded as homeless. Cases with homeless key words (i.e., homeless, transient, shelter, lives in van, lives in car, lives in vehicle, no fixed abode, no known residence, tent, encampment, indigent, skid row, and vagrant) in descriptive fields were independently reviewed by 2 analysts using Department of Housing and Urban Development homelessness criteria, and those cases meeting criteria were also coded as homeless.

To identify homeless deaths not investigated by the MEC, we also searched all 2015–2019 LA County death certificates for addresses suggesting homelessness, including homeless key words, emergency shelter or transitional housing addresses, and location descriptions consistent with instructions for local registrars on how to code addresses for homeless decedents. As an additional check on the completeness of MEC data as a source for homeless deaths—particularly those occurring in hospitals—we compared the proportion of MEC homeless deaths that occurred in hospitals to the proportion of all MEC investigated deaths and all LA County deaths in hospitals.

We obtained LA County mortality data for 2017–2019 MRRs from the Los Angeles County Department of Public Health. Data from 2018 to 2019 did not include out-of-state deaths among LA County residents.

Population Denominators

We used the averages of 2 consecutive January PIT homeless counts to estimate midyear homeless population denominators for annual rate calculations. The LA County CoC PIT count is conducted by the LA Homeless Services Authority in collaboration with researchers at the University of Southern California.[21] The unsheltered count consists of an enumeration in all 2163 LA County CoC census tracts using trained volunteers and special outreach teams assigned to hard-to-reach places. The sheltered count is an enumeration of all individuals living in emergency shelters and transitional housing in the LA County CoC, including

those receiving vouchers for hotels or motels provided by emergency shelters. Three cities within LA County—Pasadena, Glendale, and Long Beach—which together comprised an average of 4% of the county homeless population from 2015 to 2020, have their own CoCs and PIT counts, and are the only portions of LA County not served by the LA County CoC. We used the sums of all 4 CoC PIT counts to estimate the countywide PEH population.

We obtained estimates of the gender, racial/ethnic, and age-group characteristics of unsheltered PEH from demographic surveys conducted in stratified random samples of census tracts.[21] In January 2020, for example, 6368 surveys were completed across 505 selected census tracts. Numbers of surveys and tracts were similar across years. Demographic estimates of sheltered PEH came from the LA County CoC's Homeless Management Information System. To estimate the demographic characteristics of PEH countywide, we assumed that the demographics of PEH in the 3 smaller CoCs were the same as those in the LA County CoC, which appears to be reasonable based on PIT count reports from Long Beach and Pasadena.[22,23] We used the averages of 2 consecutive years of demographic data to approximate midyear demographic estimates for 2017 to 2019. We obtained demographic data for the 2017–2019 LA County population from Hedderson Demographic Services.

Causes of Death

MEC records were matched to death certificate data to capture *International Classification of Diseases, Tenth Revision*[24] cause-of-death codes only available from death certificates; 98% of MEC records were successfully matched. This matching also allowed for homeless deaths investigated by the MEC to be distinguished from those identified solely from death certificate addresses.

Mortality Rate Ratios

We used MRRs to compare directly standardized rates. The standard population was the 2010 US census population for LA County. First, we compared all-cause mortality rates among racial/ethnic and gender subgroups of PEH, by year, for 2017 to 2019. We calculated MRRs by dividing the directly standardized rate for each PEH subgroup by that of the reference subgroup. The direct standardization in these analyses was based on age only. The age groupings used (< 18, 18–24, 25–54, 55–61, and ≥ 62 years) were dictated by LA Homeless Services Authority's age-group reporting conventions. Second, we compared all-cause and cause-specific mortality rates among PEH with those among the general LA County population for the combined years of 2017 through 2019. We calculated MRRs by dividing the directly standardized rates for PEH by those for the LA County population. The direct standardization in these analyses was based on age and gender. We calculated 95% confidence intervals (CIs) for all rates and MRRs by using SAS version 9.4 and SAS/STAT version 14.3 (SAS Institute, Cary NC). We used conservative CIs for rates; only lognormal CIs were available for MRRs.

Comparisons With Previous Cohort Studies

We conducted a review of published studies of homeless mortality to identify findings that could be compared with those of the current study. Primary inclusion criteria included prospective or retrospective cohort studies that reported mortality rates as numbers of deaths during the study period divided by person years of observation, and MMRs or standardized mortality ratios (SMRs) comparing mortality in a homeless population to mortality in a general population. We excluded studies that focused exclusively on hospitalized PEH, veterans, or other age-, gender-, or disease-related subgroups of PEH.

RESULTS

The PIT population of PEH increased by 50% from January 2015 to January 2020, from 44 359 to 66 436 (Table 1). In January 2020, 72% of PEH were unsheltered, 38% (95% CI = 31.8%, 45.1%) were chronically homeless; 67% (95% CI = 64.2%, 70.1%) were male; and approximately 77% were younger than 55 years. African Americans comprised 34% (95% CI = 27.1%, 40.5%) of the homeless population, compared with 9% of the general population. Latinos comprised 36% (95% CI = 29.8%, 42.2%) of the homeless population compared with 49% of the general population. Whites were proportionately represented among PEH.

Mortality Trends

Of 4988 homeless deaths identified, 235 (5%) were identified solely from death certificate data. Of 4753 MEC-investigated homeless deaths identified, 1517 (32%) occurred in hospitals. By comparison, 36% of all 2015–2019 MEC deaths and 41% of all 2017–2019 LA County deaths occurred in hospitals.

From 2015 to 2019, deaths among PEH increased from 741 to 1267, and the crude mortality rate increased by

TABLE 1— Size and Characteristics of Homeless Population: Los Angeles County, California, 2015–2020

Characteristics	2015[a] (n = 44 359), %	2016[a] (n = 46 874), %	2017 (n = 55 048), % (95% CI)[b]	2018 (n = 52 765), % (95% CI)[b]	2019 (n = 58 936), % (95% CI)[b]	2020 (n = 66 436), % (95% CI)[b]
Gender[c]						
Male	66	66	68 (65, 70)	68 (66, 70)	68 (65, 71)	67 (64, 70)
Female	33	33	32 (27, 37)	31 (27, 35)	31 (26, 37)	32 (28, 37)
Age, y						
< 18	10	8	9 (8,10)	9 (8, 11)	9 (4, 14)	12 (7, 16)
18–24	8	8	6 (0, 22)	6 (0, 14)	6 (0, 23)	7 (0, 18)
25–54	57	60	61 (59, 63)	59 (57, 62)	61 (56, 65)	58 (54, 62)
55–61	17	16	16 (9, 23)	16 (9, 22)	15 (2, 28)	14 (3, 24)
≥ 62	8	9	8 (0, 17)	10 (1, 18)	9 (0, 24)	10 (0, 23)
Race/ethnicity[d]						
Non-Hispanic Black	39	39	40 (30, 50)	36 (30, 41)	33 (24, 42)	34 (27, 40)
Hispanic/Latino	27	27	35 (25, 45)	35 (29, 41)	36 (27, 45)	36 (30, 42)
Non-Hispanic White	25	26	20 (3, 37)	25 (18, 32)	25 (14, 35)	25 (17, 34)
Shelter status[e]						
Unsheltered	70	75	73	75	75	72
Sheltered	30	25	27	25	25	28
Chronically homeless	34	31	31 (24, 38)	27 (22, 31)	28 (17, 38)	38 (32, 45)

Note. CI = confidence interval. Totals were based on a countywide census enumeration. Percentages and CIs were estimated from a sample survey of the Los Angeles County continuum of care (CoC), which comprised an average of 96% of people experiencing homelessness (PEH) in Los Angeles County from 2015 to 2020.[21] Age and racial/ethnic characteristics of PEH in the smaller CoCs were similar to those in the Los Angeles CoC.[22,23]

[a]95% CIs were not available for 2015 and 2016 demographic estimates. These estimates were based on sample surveys similar to those for the 2017-to-2020 point-in-time counts but were conducted by a different group of university-based researchers that was not accessible to the University of Southern California researchers who conducted the more recent surveys.
[b]CI minima were set to zero if they were less than or equal to zero.
[c]Male and female genders include those who identified as transgender and identified their gender as male or female. Those who identified as gender nonconforming are not reported because their numbers were small and statistically unstable.
[d]Those identifying with other racial/ethnic groups were not reported because their numbers were small and statistically unstable.
[e]Percentages of sheltered and unsheltered PEH are from the Los Angeles CoC and have no CIs because they are based on full census enumerations.

24%, from 1624 to 2021 per 100 000 (Table 2). Mortality rates increased more among females (34%) than among males (22%). Rates increased only slightly among those aged 25 to 54 years but increased substantially among all other age groups. Blacks experienced a 40% increase in mortality over this period, versus more modest increases among Whites and Latinos of 10% and 16%, respectively.

The top 5 causes of death were drug overdose, coronary heart disease, traffic injury, homicide, and suicide. These 5 causes accounted for almost two thirds of all deaths. Crude mortality rates from all causes except homicide increased from 2015 to 2019. Drug overdose death rates increased precipitously from 2016 to 2019, surpassing coronary heart disease as the leading cause of death in 2017.

Mortality Rate Ratios

From 2017 to 2019, despite a decrease in the age-adjusted mortality rate among White PEH (2600 per 100 000 vs 2237 per 100 000) and an increase in the age-adjusted mortality rate among Black PEH (1136 per 100 000 vs 1321 per 100 000), the MRRs for Black versus White PEH remained significantly less than 1 (0.44 [95% CI = 0.36, 0.52], 0.51 [95% CI = 0.43, 0.60], and 0.59 [95% CI = 0.50, 0.69], respectively; Table 3). Findings for Latino versus White PEH were similar. However, by 2019, the MRR was no longer significantly different from 1 (0.58 [95% CI = 0.49, 0.69], 0.77 [95% CI = 0.66, 0.90], and 0.88 [95% CI = 0.76, 1.02], respectively). Age-adjusted MRRs

TABLE 2— Number of Deaths and Crude Rates per 100 000 Among People Experiencing Homelessness: Los Angeles County, California, 2015–2019

	2015 (n = 45 617[a]), No. of Deaths (Crude Rate)	2016 (n = 50 961[a]), No. of Deaths (Crude Rate)	2017 (n = 53 907[a]), No. of Deaths (Crude Rate)	2018 (n = 55 851[a]), No. of Deaths (Crude Rate)	2019 (n = 62 686[a]), No. of Deaths (Crude Rate)	% Change 2015–2019
All deaths	741 (1624)	871 (1709)	995 (1846)	1114 (1995)	1267 (2021)	24
Gender						
Male	601 (1992)	720 (2109)	803 (2207)	884 (2362)	1023 (2436)	22
Female	135 (895)	146 (895)	188 (1125)	219 (1265)	236 (1195)	34
Age, y						
18–24	14 (399)	24 (678)	20 (618)	28 (836)	29 (712)	78
25–54	393 (1475)	422 (1371)	491 (1518)	570 (1701)	573 (1536)	4
55–61	167 (2239)	193 (2397)	238 (2759)	259 (2992)	319 (3510)	57
≥ 62	160 (4176)	225 (5319)	241 (4967)	244 (4599)	336 (5642)	35
Race/ethnicity						
White	301 (2593)	340 (2907)	369 (3042)	406 (2908)	447 (2852)	10
Black	186 (1048)	220 (1090)	253 (1252)	258 (1359)	307 (1462)	40
Latino	218 (1773)	268 (1696)	324 (1717)	388 (1957)	463 (2052)	16
Cause of death						
Overdose	149 (327)	153 (300)	246 (456)	273 (489)	346 (552)	69
CHD	141 (309)	208 (408)	194 (360)	227 (406)	255 (407)	32
Transportation-related injuries	54 (118)	70 (137)	92 (171)	102 (183)	103 (164)	39
Homicide	54 (118)	65 (128)	60 (111)	78 (140)	73 (116)	−2
Suicide	36 (79)	36 (71)	51 (95)	57 (102)	58 (93)	18

Note. CHD = coronary heart disease.

[a]These are the averages of the index year and subsequent year populations, which are the midyear estimates used to calculate mortality rates. The percent change in the total homeless population from 2015 to 2019 was 37%.

of male versus female PEH were significantly greater than 1, but decreased from 2017 to 2019 (1.50 [95% CI = 1.24,1.80], 1.51 [95% CI = 1.27, 1.79], and 1.41 [95% CI = 1.19, 1.67], respectively). Gender differences in drug overdose mortality rates were considerably smaller than for all causes and were not statistically significant in 2018 and 2019 (1.29 [95% CI = 0.95, 1.76] and 1.25 [95% CI = 0.93, 1.69], respectively; not shown). For the combined years of 2017 through 2019, PEH experienced an almost 3-fold greater risk of mortality than the general LA County population (2.8; 95% CI = 2.7, 3.0; Table 4). MRRs were markedly higher for drug overdose (35.0; 95% CI = 31.9, 38.4), traffic injury (15.3; 95% CI = 13.0, 18.0), homicide (14.3; 95% CI = 12.1, 17.0), and suicide (7.7; 95% CI = 6.4, 9.3).

Comparisons With Cohort Studies

Nine cohort studies met inclusion criteria for comparisons with the current study (Table 4): 5 from the United States,[2–4,11,17] 1 from Canada,[7] and 3 from Europe.[5,8,9] All US studies were conducted in northeastern cities. All but 3 studies used homeless shelter registries to identify cohorts. The 3 studies from Boston, Massachusetts,[3,11,17] used client encounter data from Boston Health Care for the Homeless. Cohort follow-up periods ranged from 3 to 11 years and the total number of deaths recorded ranged from 67 to 3280. All but 1 study[9] reported crude mortality rates per person-years of observation, and all but 1[8] reported these rates by gender, age group, or race/ethnicity. Six studies used direct standardization of rates and reported MRRs comparing PEH mortality to general population mortality.[2,3,7–9,11] Three used indirect standardization and reported SMRs for comparisons with a general population.[4,5,17]

TABLE 3— Age-Adjusted Mortality Rates and Morality Rate Ratios Among Subgroups of People Experiencing Homelessness: Los Angeles County, California, 2017–2019

Characteristic[a]	2017			2018			2019		
	No. of Deaths	Age-Adjusted Mortality Rate per 100 000 (95% CI)[b]	MRR (95% CI)[c]	No. of Deaths	Age-Adjusted Mortality Rate per 100 000 (95% CI)[b]	MRR (95% CI)[c]	No. of Deaths	Age-Adjusted Mortality Rate per 100 000 (95% CI)[b]	MRR (95% CI)[c]
Race/ethnicity									
White	369	2600 (2306, 3036)	1 (Ref)	406	2318 (2072, 2680)	1 (Ref)	447	2237 (2014, 2542)	1 (Ref)
Latino	324	1506 (1327, 1709)	0.58 (0.49, 0.69)	388	1782 (1587, 2001)	0.77 (0.66, 0.90)	463	1970 (1772, 2189)	0.88 (0.76,1.02)
Black	253	1136 (988, 1305)	0.44 (0.36, 0.52)	258	1174 (1026, 1343)	0.51 (0.43, 0.60)	307	1321 (1169, 1489)	0.59 (0.50, 0.69)
Gender									
Female	188	1209 (1016, 1435)	1 (Ref)	219	1246 (1062 ,1461)	1 (Ref)	236	1401 (1194, 1640)	1 (Ref)
Male	803	1809 (1673, 1965)	1.50 (1.24, 1.80)	884	1881 (1750, 2030)	1.51 (1.27, 1.79)	1023	1977 (1849, 2119)	1.41 (1.19,1.67)

Note. CI = confidence interval; MRR = mortality rate ratio.

[a]Race/ethnicity and gender data were available for 100% of homeless deaths. Age data for age adjustments were missing for less than 1% of deaths for the race/ethnicity and gender analyses.

[b]CIs for rates, rounded to integer values, are computed to be conservative and are based on a γ distribution.

[c]CIs for MRRs, rounded to 2 decimal places, are based on a lognormal distribution.

We found an overall crude mortality rate of 1964 per 100 000 (Table 4). The average among 7 cohort studies reporting comparable rates was 1939 per 100 000. Although 3 studies reported gender-specific rates only by age group or race/ethnicity,[2,3,11] gender-specific rates in the current study fell in the middle of the range reported across the cohort studies (males: 2332 current vs 1772–4618; females: 1179 current vs 196–2588; Table 4).

None of the selected cohort studies reported an overall MRR adjusted for age and gender as did the current study. However, Hibbs et al.[2] reported an age-adjusted overall MRR of 3.5, and Morrison[8] reported an age-, gender-, and morbidity-adjusted overall MRR of 1.6. Nordentoft and Wandall-Holm[5] reported an age- and gender-adjusted overall SMR of 3.8, and Roncarati et al.,[17] in their study of unsheltered PEH, reported an age-adjusted SMR of 9.8.

In the current study, the age-adjusted MRR for female PEH was significantly lower than that for males (2.6; 95% CI = 2.3, 2.8 vs 3.1; 95% CI = 2.9, 3.2). Only 2 cohort studies reported significant gender difference in MRRs—both reporting higher rates for females.[4,5]

Much like the 6 studies reporting SMRs or MRRs for circulatory system or heart disease,[3,7–9,11,17] the current study found the MRR for coronary heart disease to be only slightly higher than that for all causes (3.6; 95% CI = 3.2, 4.1). However, while previously reported MRRs or SMRs for drug-related deaths were 1.5 to 5 times greater than those for all causes (Table A, available as a supplement to the online version of this article at http://www.ajph.org),[7,8,11,17] the current study reported an MRR for drug

TABLE 4— Comparison of Current Study to Selected Cohort Studies of Homeless Mortality

Study: Location; Period; Population	No. of Deaths	Category–Subgroup: Crude Mortality Rate Per 100 000[a]; MRR or SMR (95% CI)[b]	Adjustment Factor(s)	Comparison Population
Current: Los Angeles County; 2017–2019; all sheltered and unsheltered PEH (PIT count)	3376	Total: 1964; 2.8 (2.7, 3.0)	Age and gender	Los Angeles County general population
		Gender–male: 2332; 3.1 (2.9, 3.2); female: 1179; 2.6 (2.3, 2.8)	Age	
		Age–18–24 y: 737; 11.1 (8.8, 14.0); 25–54 y: 15 971; 8.4 (7.9, 8.8); 55–61 y: 3196; 4.6 (4.2, 5.0); ≥ 62 y: 5220; 1.5 (1.4, 1.7)	Gender	
		Cause of death–drug overdose: 506; 35.0 (31.9, 38.4); coronary heart disease: 396; 3.6 (3.2, 4.1); traffic injury: 174; 15.3 (13.0, 18.0); homicide: 124; 14.3 (12.1, 17.0); suicide: 97; 7.7 (6.4, 9.3)	Age and gender	
Barrow et al.[4]: New York City; 1987–1994; representative sample of single adult shelter residents	161	Total: NR; NR	NR	New York City general population
		Gender–male: 1765; 2.2 (1.9, 2.6); female: 1458; 3.7 (2.6, 5.2)	Age	
Baggett et al.[11]: Boston, MA; 2003–2008; adults with an in-person encounter with Boston Health Care for the Homeless	1302	Total: 1440; NR	NR	Massachusetts general population
		Gender by age–male 25–44 y: 950; 8.6 (7.4, 9.9); male 45–64 y: 2338; 4.5 (4.1, 4.9); male 65–84 y: 4051; 1.1 (0.1, 1.4); female 25–44 y: 586; 9.6 (7.4, 12.4); female 45–64 y: 1469; 4.5 (3.6, 5.6); female 65–84 y: 2353; 1.1 (0.1, 1.8)	Race	
Roncarati et al.[17]: Boston; 2000–2009; unsheltered adults with an in-person encounter with Boston Health Care for the Homeless	134	Total: 3713; 9.8 (8.2, 11.5)	Age	Massachusetts general population
		Gender–male: 4618; NR; female: 1592; NR	NR	
Nordentoft and Wandall-Holm[5]: Copenhagen, Denmark; 1991–2002; residents of 2 hostels for homeless people	141	Total: 2544; 3.8 (3.5, 4.1)	Age and gender	General population of Copenhagen
		Gender–male: 2537; 2.8 (2.6, 3.1); female: 2588; 5.6 (4.3, 6.9)	Age	
Hwang et al.[7]: Canada; 1991–2001; residents of shelters, rooming houses, and hotels aged ≥ 25 y who could be linked to tax records	3280	Total: 2315; NR	NR	Representative sample of general population of Canada
		Gender–male: 2467; 2.0 (1.9, 2.1); female: 1260; 1.8 (1.7, 1.9)	Age	
Morrison[8]: Glasgow, Scotland; 2000–2005; adults with encounters	457	Total: 1414; 1.6 (1.3, 1.9)	Age, gender, and morbidity	Age- and gender-matched random sample of nonhomeless Glasgow population

Continued

TABLE 4— Continued

Study: Location; Period; Population	No. of Deaths	Category–Subgroup: Crude Mortality Rate Per 100 000[a]; MRR or SMR (95% CI)[b]	Adjustment Factor(s)	Comparison Population
with the homeless service system				
Hibbs et al.[2]: Philadelphia, PA; 1985–1987; sheltered and unsheltered PEH registered with at least 1 of 2 local homeless service agencies	67	Total: 1035; 3.5 (2.8, 4.5)	Age	General population of Philadelphia
		Race by gender–White male: 1742; 4.9 (2.8, 8.6); non-White male: 772; 1.6 (1.0, 2.5); White female: 1174; 4.5 (1.9, 10.8); non-White female: 888; 2.2 (1.3, 3.6)	Age	
Beijer et al.[9]: Stockholm, Sweden; 1995–2005; adults with registered stays at homeless shelters	421	Total: 2856; 2.8 (2.5, 3.1)	NR	General population of Stockholm
		Gender–male: 3270; 3.1 (2.8, 3.5); female: 2469; 2.5 (1.9, 3.1)	Age	
Hwang et al.[3]: Boston; 1988–1993; adults with an in-person encounter with Boston Health Care for the Homeless	606	Total: 1114; NR	NR	General population of Boston
		Gender by age–male 18–24 y: 534; 5.9 (2.1, 17.0); male 25–44 y: 1218; 3 (2.6, 3.5); male 45–64 y: 2170; 1.6 (1.3, 1.8); female 18–24 y: 196; 11.8 (4.2, 33.1); female 25–44 y: 490; 3.9 (2.8, 5.5); female 45–64 y: 1004; 1.5 (1.0, 2.2)	Race	

Note. MRR = mortality rate ratio; NR = not reported; PEH = people experiencing homelessness; PIT = point in time; SMR = standardized mortality ratio.

[a]Beijer et al.[9] reported age-adjusted rates only. All other studies reported crude rates. Except for the current study, all studies reported rates per person-years of observation.
[b]Barrow et al.,[4] Roncarati et al.,[17] and Nordentoft and Wandall-Holm[5] reported SMRs. All other studies reported MRRs.

overdose that was 12 times greater than the all-cause MRR.

DISCUSSION

To our knowledge, this is the first published study of homeless mortality rates and MRRs for LA County. While studies in other jurisdictions have relied on cohort designs to determine mortality rates per person-years of observation, this one used annual PIT counts to approximate person-years of homelessness much like census data are used as denominators in studies of general population mortality. We are aware of only 2 other studies that used PIT-like counts to calculate homeless mortality rates.[25,26]

The comparisons in Table 4 help to demonstrate the similarity of our findings with those of previous cohort studies. They also point to interesting differences. For example, the only study of unsheltered PEH[17] reported the highest overall SMR of 9.8 compared with the general population. Because about three quarters of LA County's homeless population are unsheltered, it is notable that the overall MRR for LA County was closer to those reported in studies of sheltered PEH. This may be attributable to differences between LA County and other study locations in the demographic characteristics of PEH or in the environmental conditions they face. This study's finding of a lower MRR for females than males may be attributable to differences in the circumstances of female PEH in LA County compared with other locations, although the lack of gender differences in drug overdose mortality points to the particular need for substance use interventions targeting female PEH.

Like Hibbs et al., Baggett et al., and Roncarati et al.,[2,11,17] in our current

study, we found that mortality rates among White PEH were significantly higher than those among Black PEH. The authors of the previous studies suggest that Black PEH may have fewer comorbidities when they become homeless because their homelessness is more closely linked to adverse socioeconomic circumstances rooted in systemic racism and discrimination. By contrast, White individuals may experience years of accumulated mental, behavioral, and physical comorbidities before they become homeless. Thus, both the disproportionate representation of Blacks among PEH and lower mortality rates among Black versus White PEH are likely explained by systemic racism and discrimination.

Limitations

A limitation of this study is that we may not have identified all deaths among PEH during the study period because we assumed that the MEC investigates nearly all homeless deaths. We were able to identify a small number of non-MEC deaths from searches of death certificate address fields, but these may contain outdated or next-of-kin addresses and are, thus, not always reliable indicators of homelessness. While a sizable proportion of MEC-investigated deaths occurred in hospitals, the hospital proportions of all MEC and all LA County deaths were greater. Thus, we may have missed an unknown number of PEH who died in hospitals of natural causes without MEC involvement.

Another limitation is that an annual PIT count may not be an accurate approximation of person-years of exposure to homelessness. A PIT count will underestimate the number of people who have experienced homelessness for any portion of the year, but most of the latter—particularly in Los Angeles County, where only about a third of PEH are chronically homeless—do not contribute a full person year of exposure to homelessness. A more salient concern is whether a PIT count approximates the number of PEH on an average day of the year—the assumption inherent in general population mortality statistics using midyear population denominators. Having a federally supported process for conducting annual PIT counts allows for this concern to be addressed empirically. The lack of volatility in the LA County CoC PIT count from year to year provides some reassurance that the average of 2 consecutive annual counts is a reasonable estimate of the average number of PEH on any given day during the index year.

Finally, it is important to note that methodological differences between this study and previous cohort studies may have contributed to some differences in the findings. In the current study, all deaths occurred while the decedent was experiencing homelessness, and the denominator for mortality rates is expressed as person-years of homelessness. Deaths in previous studies occurred among cohorts of PEH who may or may not have been homeless when they died. Denominators in these studies are expressed as person-years of observation. Thus, if the risk of dying from particular causes of death is elevated during periods of homelessness but decreases during periods of stable housing, the current study would likely find higher mortality rates from these causes because of the study design. The 3 causes of homeless deaths with the highest MRRs compared with the general LA County population align with this logic. Homicide is easier to perpetrate against someone lacking the protection of a home. People living on the street are more exposed to potentially lethal road traffic than those who are housed. Someone who is severely addicted to drugs may lose his or her housing as a result of their addiction, in which case an overdose death may be associated with an inability to regain housing.

This same methodological difference may explain why, unlike previous studies,[11–13,17,19] the current study did not identify cancer among the top causes of death among PEH. Unlike coronary heart disease—a leading cause of natural death among LA County PEH—cancer is more likely to go unreported as a cause of death if it is not diagnosed before death. Those who die while experiencing homelessness may be less likely to receive the full autopsy necessary to identify undiagnosed cancer (Jonathan Lucas, medical examiner; e-mail communication; March 24, 2021). By contrast, members of study cohorts defined by their registered use of shelter and homeless health care systems may have better access to diagnostic services and, once diagnosed with cancer, may be more able to access permanent supportive housing.

Public Health Implications

This study has demonstrated the feasibility of monitoring homeless mortality to inform local prevention strategies using (1) federally mandated homeless counts and accompanying demographic surveys to estimate population size and demographic composition and (2) linked coroner and death certificate data to enumerate deaths and identify causes. It has also demonstrated the general consistency of findings with

those of previous studies of homeless mortality that used longitudinal cohort designs. The results of the analyses described here informed the organization of a cross-department homeless mortality prevention initiative in LA County. Priority strategies of the initiative include improvement and expansion of substance use disorder treatment services for PEH, expansion of interim housing options for PEH in substance use disorder treatment, and prioritization of permanent housing placement for those completing substance use disorder treatment, among others. The LA County Department of Public Health now produces an annual homeless mortality report to inform this ongoing initiative. The methods described in this study can be applied in other US urban jurisdictions seeking to better understand mortality trends and reduce preventable deaths in their homeless populations. AJPH

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CONTRIBUTORS

W. Nicholas conceptualized the study design, oversaw the analyses, and led the writing of the article. L. Greenwell led the analyses and contributed to the writing and editing of the article. B. Henwood contributed to the writing and editing of the article. P. Simon provided input on the study design and analyses and contributed to the writing and editing of the article.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to disclose.

HUMAN PARTICIPANT PROTECTION

This study was conducted in accordance with the statutory duties of the Los Angeles County Department of Public Health and was deemed research of an exempt type by the department's institutional review board.

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