Association of Race and Sites of Care With Pressure Ulcers in High-Risk Nursing Home Residents

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Context A variety of nursing home quality improvement programs have been implemented during the last decade but their implications for racial disparities on quality are unknown.

Objectives To determine the longitudinal trend of racial disparities in pressure ulcer prevalence among high-risk, long-term nursing home residents and to assess whether persistent disparities are related to where residents received care.

Design, Setting, and Participants Observational cohort study of pressure ulcer rates in 2.1 million white and 346 808 black residents of 12 473 certified nursing homes in the United States that used the nursing home resident assessment; Online Survey, Certification, and Reporting files; and Area Resource Files for 2003 through 2008. Nursing homes were categorized according to their proportions of black residents.

Main Outcome Measures Risk-adjusted racial disparities between and within sites of care and risk-adjusted odds of pressure ulcers in stages 2 through 4 for black and white residents receiving care in different nursing home facilities.

Results Pressure ulcer rates decreased overall from 2003 through 2008 but black residents of nursing homes showed persistently higher pressure ulcer rates than white residents. In 2003, the pressure ulcer rate was 16.8% (95% confidence interval [CI], 16.6%-17.0%) for black nursing home residents compared with 11.4% (95% CI, 11.3%-11.5%) for white residents; in 2008, the rate was 14.6% (95% CI, 14.4%-14.8%) compared with 9.6% (95% CI, 9.5%-9.7%), respectively ($P>.05$ for trend of disparities). In nursing homes with the highest percentages of black residents (≥35%), both black residents (unadjusted rate of 15.5% [95% CI, 15.2%-15.8%] in 2008; adjusted odds ratio [AOR], 1.59 [95% CI, 1.52-1.67]) and white residents (unadjusted rate of 12.1% [95% CI, 11.8%-12.4%]; AOR, 1.33 [95% CI, 1.26-1.40]) had higher rates of pressure ulcers than nursing homes serving primarily white residents (concentration of black residents <5%), in which white residents had an unadjusted rate of 8.8% (95% CI, 8.7%-8.9%).

Conclusions From 2003 through 2008, the prevalence of pressure ulcers among high-risk nursing home residents was higher among black residents than among white residents. This disparity was in part related to the site of nursing home care.

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Pressure ulcers are a common health problem among nursing home residents and substantially increase morbidity, mortality, and the cost of care.[1,2] Racial disparities in pressure ulcer prevalence in nursing homes are well documented.[3-6] To achieve the national priority of reducing and eliminating health care disparities,[7] it is imperative to understand the reasons underpinning such disparities. Previous studies suggest that a disproportionate number of minority residents reside in nursing homes with limited clinical and financial resources.[8,9] Therefore, in addition to race itself, care provided at the lowest-quality nursing homes (site of care) may play an important role in the higher rate of pressure ulcers observed in black residents.

Since late 2002, national nursing home quality improvement and public reporting programs have been launched.[10-12] During the same period, a variety of state[13,14] and local[5,15] initiatives also have been implemented. These programs aimed to improve overall quality, including reducing pressure ulcers, but focused little attention on widespread racial disparities. Therefore, they may have had no effect on reducing disparities despite overall improvement in care over time. Prior research has focused on overall improvements shortly after the implemen-

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tation of the quality improvement programs and on the documentation of cross-sectional disparities but has shed little light on the longitudinal trend of disparities.

This study analyzed the trend of pressure ulcer prevalence in nursing homes by race and site of care from 2003 through 2008. We further sought to determine whether disparities are primarily related to race or the race mix of the nursing home where care is delivered, and whether site-of-care disparities are associated with the managerial, financial, or geographic features of nursing homes.

METHODS

Study Sample

We used the Minimum Data Set (MDS) files for nursing homes from 2003 through 2008 to identify long-term care residents; their pressure ulcer rate was calculated annually using similar methods developed by the Centers for Medicare & Medicaid Services (CMS) for publicly released quality measures.[16] The MDS is a nationally mandated tool for patient assessment and care planning in all nursing homes certified by the CMS.[17] More than 90% of nursing homes in the United States are certified by the CMS.[18] For long-term care residents, full MDS assessments are performed at admission, annually thereafter, and when a significant change in health status occurs, while abbreviated assessments are performed on a quarterly basis. The diagnostic, functional, and other common assessments of the MDS are shown to be of high validity and internal consistency for research purposes.[19-21] Specifically, a multistate study confirms the validity and interrater reliability (weighted $\kappa > 0.80$) of the MDS's pressure ulcer assessments.[20]

We analyzed the annual and significant change in health status assessments, which contain more than 350 items related to each resident's demographic, physical, and mental health status and disease diagnoses. Race and ethnicity were identified at admission by nursing home staff and were categorized as non-Hispanic white, black, Hispanic, Asian/Pacific Islander, or American Indian/Alaskan native. We confirmed that residents targeted for this analysis had 1 or more prior quarterly assessments (ie, they had stayed in the nursing home for ≥90 days).

Residents were included in the study if they required extensive assistance or were totally dependent on staff assistance for bed mobility or moving between surfaces, were in a coma, or had malnutrition (*International Classification of Diseases, Ninth Revision, Clinical Modification* codes 260-262, 263.0-263.2, 263.8, and 263.9). These residents are believed to be at high risk for developing pressure ulcers,[16] and cross-sectional racial disparities have been reported in prior studies. Pressure ulcers of any stage were determined by nurse assessment or physician diagnosis (*International Classification of Diseases, Ninth Revision, Clinical Modification* codes 707.21-707.24 for stages 1-4, respectively). For the purpose of analyzing racial disparities, we retained only non-Hispanic white and black residents in our analyses and excluded the small number (<6%) of residents with other race and ethnicities.

This study was approved by the institutional review boards of the University of Iowa and the University of California, Irvine; patient informed consent was waived by both institutional review boards

Variables

Our primary outcome was whether the resident had a stage 2 or higher pressure ulcer reported each year. The unit of analysis was the resident year or each assessment. The independent variables were race (white or black) and racial composition of the nursing homes. For each nursing home, we calculated the proportion of all its long-term care residents who were black and performed preliminary analyses on the association of racial composition with the pressure ulcer rate. Facilities were categorized as having a high concentration of black residents (≥35%), medium-high concentration (15%-34.9%), medium concentration (5%-14.9%), or low concentration (<5%). In sensitivity analyses, we examined alternative cutoff points for categorization; the results were similar and thus are not presented herein.

Nursing home resident characteristics that were potentially associated with the risk of developing pressure ulcers were selected a priori.[3,4,6,22-24] These characteristics included age, sex, difficulties in the activities of daily living, Cognitive Performance Scale score, and the presence or absence of dementia (Alzheimer disease or other types of dementia), stroke, diabetes, other endocrine disease, cardiovascular disease, musculoskeletal disease, cancer, malnutrition, incontinence (frequent or complete bowel or bladder incontinence), antipsychotic drug use, daily physical restraint use, 1 or more hospital admissions during the past 90 days, or being at the end stage of life (≤6 months to live). The age categories were younger than 65 years, 65 to 74 years, 75 to 84 years, and 85 years or older. Activities of daily living included bed mobility, transferring, dressing, eating, toilet use, personal hygiene, and bathing; each activity of daily living was coded as 0 if the resident was independent, needed staff supervision, or limited assistance and 1 if the resident needed extensive staff assistance or had total dependence. The total range of the aggregate activities of daily living score was between 0 and 7. The Cognitive Performance Scale score was defined using a validated MDS algorithm developed by Morris et al[25] and had a range of 0 (cognitively intact) to 6 (very severely impaired in cognition).

We obtained nursing home characteristics from the Online Survey, Certification, and Reporting facility-level database for 2003 through 2008; the database is maintained and updated by the CMS for annual recertification and public reporting purposes. Facility characteristics included total number of beds, profit status (categorized as for-profit, nonprofit, or government), chain affiliation (yes or no), a measure of

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facility financial capability based on the percentage of Medicaid-reimbursed residents, care in hours per resident per day provided by a registered nurse, licensed practical or vocational nurse, and certified nurse assistant, and numbers of total and health care–related deficiency citations issued by state regulators during annual inspections.[26]

Lastly, we used the Area Resource Files for the corresponding years to characterize the county where each nursing home was located.[8] County characteristics included the percentage of elderly population (≥65 years), a measure of the degree to which each nursing home competes for long-term care patients with all of the other nursing homes in the county,[27] and urban vs rural location.

Analysis

We compared racial differences in demographic and clinical factors during the full study period and stratified data using 2-year intervals (2003-2004, 2005-2006, and 2007-2008). Bivariate generalized estimating equations[28] with binomial distribution and logit link function for race were used for the analyses of categorical variables and bivariate linear mixed models were used for continuous variables; the models accounted for the repeated assessments of patients over the study years. We performed similar analyses for the trend in pressure ulcer rate according to race and nursing home categories. Nursing home and county characteristics were compared by nursing home categories using χ^2 tests or analyses of variance as appropriate.

We fit multivariate patient-level linear models to compute 3 types of risk-adjusted racial disparities in pressure ulcer prevalence: overall disparity, the disparity due to residents being cared for in different nursing homes (between sites of care), and the disparity among black and white residents in the same nursing home (within sites of care). For each year, we first fit a model that had race as the independent variable and adjusted for the aforementioned patient characteristics to estimate the overall risk-adjusted disparity. We then fit another model that further adjusted for the fixed effects of nursing homes to estimate the within-site disparity.[29] The between-site disparity was calculated as the difference between the 2 estimates.

We further categorized all residents according to race and site of care: (1) black residents in facilities with high concentrations of blacks, (2) white residents in facilities with high concentrations of blacks, (3) black residents in facilities with medium-high concentrations of blacks, (4) white residents in facilities with medium-high concentrations of blacks, (5) black residents in facilities with medium concentrations of blacks, (6) white residents in facilities with medium concentrations of blacks, (7) black residents in facilities with low concentrations of blacks, and (8) white residents in facilities with low concentrations of blacks. For each year, we fit a set of logistic regression models that determined the relationship between these groups and the odds of having pressure ulcers, using white residents of nursing homes with low concentrations of black residents as the reference group.

These models were sequentially adjusted for the clustering of residents in nursing homes using random effects (model 1), age and sex (model 2), other aforementioned patient characteristics (model 3), nursing home characteristics (model 4), and county characteristics and state indicators (model 5). All models were estimated through the generalized estimating equations approach[28] that assumed a binomial distribution and logit link function for the outcome, and incorporated an exchangeable correlation structure of error terms. All models were checked to confirm that colinearity or overfitting was not an issue. We also tested interactions between the key independent variables and age, sex, difficulties in activities of daily living, and Cognitive Performance Scale score but did not find significant interactive effects. The small number of observations with missing values (<3%) were not included in the multivariate models.

Sensitivity Analyses

We performed a number of sensitivity analyses. In particular, our primary analyses focused on pressure ulcers at stage 2 or higher due to the concern that stage 1 pressure ulcers are more likely to be underdiagnosed in black residents than in white residents. To confirm the robustness of our analyses, we redefined the outcome as to whether a resident had pressure ulcers at any stage and performed similar analyses on racial and site-of-care disparities. We further added back the excluded minority residents and recategorized nursing homes using the percentage of all nonwhite (not just black) long-term residents and determined the associations of minority race and ethnicity and site of care with the odds of pressure ulcers.

The statistical analyses were performed using SAS software version 9.2 (SAS Institute Inc, Cary, North Carolina) and Stata version 8 (StataCorp, College Station, Texas). All statistical tests were 2-tailed with a *P* value of less than .05 considered to be significant.

RESULTS

Our sample included 2.1 million white and 346 808 black long-term care residents during the period of 2003 through 2008 who were considered at high risk of having pressure ulcers. They represented a total of 4.3 million and 704 713 assessments, respectively. From 2003 through 2008, 49% of residents had 1 annual assessment, 24% had 2 assessments, and 27% had between 3 and 6 assessments. Our unit of analysis was each assessment. Of all high-risk nursing home residents, 10.5% of white residents (n=455 611 assessments) had pressure ulcers at stage 2 or higher and 15.9% of black residents (n=111 981 assessments) had pressure ulcers at stage 2 or higher, resulting in an overall unadjusted racial difference of 5.40% (95% confidence interval [CI], 5.38%-5.42%; $P<.001$). Among white and black residents, respectively, the rates for stage 1 pressure ulcers were 2.1%

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and 1.2%, 6.6% and 7.7% for stage 2 pressure ulcers, 1.5% and 2.7% for stage 3 pressure ulcers, and 2.4% and 5.5% for stage 4 pressure ulcers.

The pressure ulcer rate for other white and black long-term residents who were not considered at high risk (a total of 3.8 million assessments) remained low. Compared with high-risk residents, these low-risk residents tended to be younger and have better physical and cognitive functional performance. Their overall pressure ulcer rates decreased slightly over the study years ($P<.01$ for trend) but did not show clinically significant racial differences. For white and black residents, respectively, the prevalence rates were 2.9% and 2.4% in 2003, 2.8% and 2.4% in 2004, 2.7% and 2.2% in 2005, 2.6% and 2.3% in 2006, 2.4% and 2.0% in 2007, and 2.2% and 1.8% in 2008. The slightly lower rate for low-risk black residents may be partially caused by underidentification of pressure ulcers among patients with darkly pigmented skin.[4]

Compared with white residents at high risk, black residents at high risk were an average of 6 years younger (76 years vs 82 years) and more likely to be male (33% vs 26%; TABLE 1). Black residents were more likely to have had a stroke and diabetes, less likely to have dementia and musculoskeletal disease, and equally likely to have cardiovascular disease. For both white and black residents, the prevalence rates of diabetes increased over the study years ($P<.001$), while the rates of dementia and musculoskeletal disease showed decreasing trends ($P<.001$).

Persistent Racial Disparities

The pressure ulcer (stage ≥2) rate among black residents decreased from 16.8% (95% CI, 16.6%-17.0%) in 2003 to 14.6% (95% CI, 14.4%-14.8%) in 2008 ($P<.001$ for trend; TABLE 2) and the rate among white residents decreased from 11.4% (95% CI, 11.3%-11.5%) in 2003 to 9.6% (95% CI, 9.5%-9.7%) in 2008 ($P<.001$ for trend). Despite the lowered pressure ulcer rates over time for both races, racial disparity remained relatively unchanged; the unadjusted disparity rates were 5.4% (95% CI, 5.3%-5.5%) in 2003 and 5.0% (95% CI, 4.9%-5.1%) in 2008 ($P>.05$ for trend) and the overall risk-adjusted disparity rates were 4.5% (95% CI, 4.3%-4.7%) in 2003 and 3.9% (95% CI, 3.6%-4.1%) in 2008 (Table 2).

Associations With Sites of Care

Table 2 also shows that more than half of the risk-adjusted disparity between black and white residents in pressure ulcer rates for each year was found between sites rather than within sites of care. TABLE 3 shows that nursing home facilities with higher concentrations of black residents tended to have lower staffing levels of registered nurses and certified nurse assistants and to be larger for-profit and urban facilities. These facilities may be more financially disadvantaged when caring for patients predominantly receiving Medicaid.

The FIGURE shows that despite the improved pressure ulcer prevalence for

Table 1. Characteristics of Long-term Care Nursing Home Residents at High Risk for Pressure Ulcers From 2003 Through 2008

	2003-2004		2005-2006		2007-2008	
	Black (n = 224 791)[a]	White (n = 1 426 678)	Black (n = 235 961)[a]	White (n = 1 454 437)	Black (n = 243 961)[a]	White (n = 1 460 790)
Age, mean (SD), y	76.6 (15.7)	82.3 (12.6)	76.2 (15.6)	82.3 (12.5)	76.0 (15.6)	82.4 (12.5)
	Median (IQR)					
Difficulties in ADL	6 (6-7)	6 (6-7)	6 (6-7)	6 (6-7)	6 (6-7)	6 (6-7)
Cognitive Performance Scale score	3 (2-6)	3 (2-5)	3 (2-5)	3 (2-5)	3 (2-5)	3 (2-5)
	No. (%)					
Male sex	71 839 (32.0)	360 046 (25.2)	77 712 (32.9)	374 464 (25.8)	82 301 (33.7)	383 293 (26.2)
Disease diagnosis						
Dementia	38 439 (17.1)	305 309 (21.4)	36 810 (15.6)	286 524 (19.7)	36 350 (14.9)	273 168 (18.7)
Stroke	71 708 (31.9)	291 042 (20.4)	74 328 (31.5)	282 161 (19.4)	75 140 (30.8)	267 325 (18.3)
Diabetes	71 042 (31.6)	277 257 (19.4)	80 819 (34.3)	309 351 (21.3)	87 935 (36.0)	333 057 (22.8)
Other endocrine disease	6601 (2.9)	107 536 (7.5)	6703 (2.8)	106 951 (7.4)	6708 (2.8)	107 591 (7.4)
Cardiovascular disease[b]	66 428 (29.6)	425 336 (29.8)	69 685 (29.5)	434 352 (29.9)	71 797 (29.4)	435 192 (29.8)
Musculoskeletal disease	32 092 (14.3)	300 125 (21.0)	30 243 (12.8)	281 607 (19.4)	29 196 (12.0)	270 597 (18.5)
Cancer	5170 (2.3)	42 800 (3.0)	5191 (2.2)	39 270 (2.7)	4879 (2.0)	36 520 (2.5)
Malnutrition	26 525 (11.8)	186 895 (13.1)	27 371 (11.6)	184 713 (12.7)	27 080 (11.1)	178 216 (12.2)
Incontinence	199 390 (88.7)	1 194 129 (83.7)	208 118 (88.2)	1 199 911 (82.5)	213 466 (87.5)	1 194 926 (81.8)
Antipsychotic drug use	47 880 (21.3)	372 363 (26.1)	51 204 (21.7)	385 426 (26.5)	52 452 (21.5)	373 962 (25.6)
Physical restraint use	22 254 (9.9)	164 068 (11.5)	19 585 (8.3)	135 263 (9.3)	14 638 (6.0)	97 873 (6.7)
Hospital admission during past 90 d	71 259 (31.7)	516 457 (36.2)	67 957 (28.8)	477 055 (32.8)	66 845 (27.4)	452 845 (31.0)
At end stage of life (expectancy ≤6 mo)	5170 (2.3)	59 920 (4.2)	6135 (2.6)	65 450 (4.5)	6343 (2.6)	71 579 (4.9)

Abbreviations: ADL, activities of daily living; IQR, interquartile range.
[a] The *P* value was less than .001 for all comparisons (black vs white) unless otherwise indicated.
[b] For comparisons, the *P* value was less than .05.

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each racial and site-of-care group, both racial and site-of-care disparities persisted over the study years. For example, black residents in the nursing home facilities with the highest concentrations of black residents had the highest pressure ulcer rate (15.5% in 2008), which was about 7% higher than the rate for white residents in facilities with lowest concentrations of black residents (8.8% in 2008), which was the lowest among all groups.

Multivariate analyses of data for 2008 confirmed these disparities. Compared with white residents in nursing home facilities with primarily white residents, the odds ratio (OR) was 1.59 (95% CI, 1.52-1.67) for black residents in facilities with the highest concentrations of blacks (TABLE 4). The associations were reduced but largely persisted after adjusting for age, sex, and other patient characteristics. Further adjusting for nursing home or county and state covariates had minor effects on the associations. Results of multivariate analyses of other years were similar. In

Table 2. Pressure Ulcer Rates (Stage ≥2) and Racial Disparities for High-Risk Nursing Home Residents From 2003 Through 2008

	No. of Residents		Unadjusted Rate (95% CI), %			Risk-Adjusted Racial Disparity (95% CI), %			Overall Risk-Adjusted Disparity Due to Site of Care, %[e]
Year	Blacks	Whites	Black Residents	White Residents	Disparity[a]	Overall[b]	Within Sites of Care[c]	Between Sites of Care[d]	
2003	110 935	713 872	16.8 (16.6-17.0)	11.4 (11.3-11.5)	5.4 (5.3-5.5)	4.5 (4.3-4.7)	2.0 (1.7-2.3)	2.5 (2.2-2.8)	56
2004	113 856	712 806	16.7 (16.5-16.9)	11.2 (11.1-11.3)	5.5 (5.4-5.6)	4.4 (4.2-4.6)	2.1 (1.8-2.4)	2.3 (2.0-2.6)	52
2005	116 552	722 697	16.2 (16.0-16.4)	10.7 (10.6-10.8)	5.5 (5.4-5.6)	4.3 (4.1-4.6)	1.9 (1.7-2.2)	2.4 (2.1-2.7)	56
2006	119 409	731 740	15.9 (15.7-16.1)	10.2 (10.1-10.3)	5.7 (5.6-5.8)	4.5 (4.3-4.7)	2.2 (1.9-2.4)	2.3 (2.0-2.6)	51
2007	120 569	731 245	15.3 (15.1-15.5)	9.9 (9.8-10.0)	5.4 (5.3-5.5)	4.2 (4.0-4.4)	2.0 (1.8-2.3)	2.2 (1.9-2.5)	52
2008	123 392	729 545	14.6 (14.4-14.8)	9.6 (9.5-9.7)	5.0 (4.9-5.1)	3.9 (3.6-4.1)	1.8 (1.5-2.0)	2.1 (1.8-2.4)	54

Abbreviation: CI, confidence interval.
[a] Calculated as unadjusted rate for black residents minus unadjusted rate for white residents.
[b] Derived from a patient-level linear model of pressure ulcer status that had race as the independent variable and was adjusted for age, sex, difficulties in activities of daily living, Cognitive Performance Scale score, disease diagnoses (dementia, stroke, diabetes, other endocrine disease, cardiovascular disease, musculoskeletal disease, and cancer), whether the resident had malnutrition, incontinence, antipsychotic drug use, or physical restraint use, at end stage of life, or had hospital admissions during the past 90 days.
[c] Derived from a model similar to the overall risk-adjusted racial disparity that further adjusted for the fixed effects of nursing homes.
[d] Calculated as overall risk-adjusted racial disparity rate minus within site of care risk-adjusted racial disparity rate.
[e] Calculated as between sites of care risk-adjusted racial disparity divided by overall risk-adjusted racial disparity.

Table 3. Nursing Home and County Characteristics in 2008

	Nursing Homes by Concentration of Black Residents, Mean (Median) [IQR][a]			
Characteristics	Low (<5%) (n = 7231)	Medium (5%-14.9%) (n = 2322)	Medium-High (15%-34.9%) (n = 1603)	High (≥35%) (n = 1317)
Nursing home				
Black residents, %	1.0 (0) [0-1.8]	9.1 (8.6) [6.7-11.3]	23.1 (22.2) [18.1-27.4]	56.1 (51.3) [42.4-66.2]
No. of beds	100 (94) [60-120]	124 (118) [88-148]	130 (120) [91-152]	137 (120) [95-161]
Profit status, No. (%)				
For profit	4363 (60.3)	1836 (79.1)	1306 (81.5)	1032 (78.4)
Nonprofit	2332 (32.3)	394 (17.0)	238 (14.8)	207 (15.7)
Government	536 (7.4)	92 (4.0)	62 (3.9)	75 (5.7)
Affiliated chain	3750 (51.9)	1381 (59.5)	996 (62.1)	766 (58.2)
Medicaid residents, %	57.4 (60.7) [47.5-71.2]	65.1 (67.1) [56.5-76.1]	70.6 (72.1) [62.8-80.9]	77.0 (78.6) [70.9-85.8]
Care provided, h/resident/d				
By RN	0.6 (0.6) [0.4-0.8]	0.5 (0.5) [0.4-0.6]	0.5 (0.5) [0.3-0.6]	0.5 (0.4) [0.3-0.6]
By LPN/LVN	0.8 (0.8) [0.6-0.9]	0.8 (0.8) [0.7-1.0]	0.9 (0.9) [0.7-1.0]	0.9 (0.9) [0.7-1.0]
By CNA	2.4 (2.4) [2.1-2.8]	2.4 (2.3) [2.0-2.7]	2.3 (2.2) [2.0-2.6]	2.2 (2.2) [1.9-2.5]
No. of government-issued deficiency citations				
Total	11 (10) [6-15]	12 (11) [6-16]	12 (11) [6-16]	13 (11) [7-17]
Related to health care	7 (5) [3-9]	8 (7) [3-11]	8 (6) [3-11]	8 (7) [4-11]
County[b]				
Competition of nursing home care	0.7 (0.8) [0.7-0.9]	0.8 (0.9) [0.8-1.0]	0.8 (0.9) [0.7-1.0]	0.8 (0.9) [0.7-1.0]
Population ≥65 y, %	14.6 (14.1) [11.8-16.7]	13.3 (12.7) [10.7-14.8]	12.9 (12.6) [10.6-14.4]	12.5 (12.2) [10.7-13.9]
Urban area, No. (%)	4339 (60.0)	1880 (81.0)	1262 (78.7)	1037 (78.7)

Abbreviations: CNA, certified nurse assistant; IQR, interquartile range; LPN, licensed practical nurse; LVN, licensed vocational nurse; RN, registered nurse.
[a] Unless otherwise indicated. For comparisons of all characteristics across nursing home concentrations of black residents, the P value was less than .001 (χ^2 tests for categorical variables and analyses of variance for continuous variables).
[b] The unit of analysis is each nursing home in the county.

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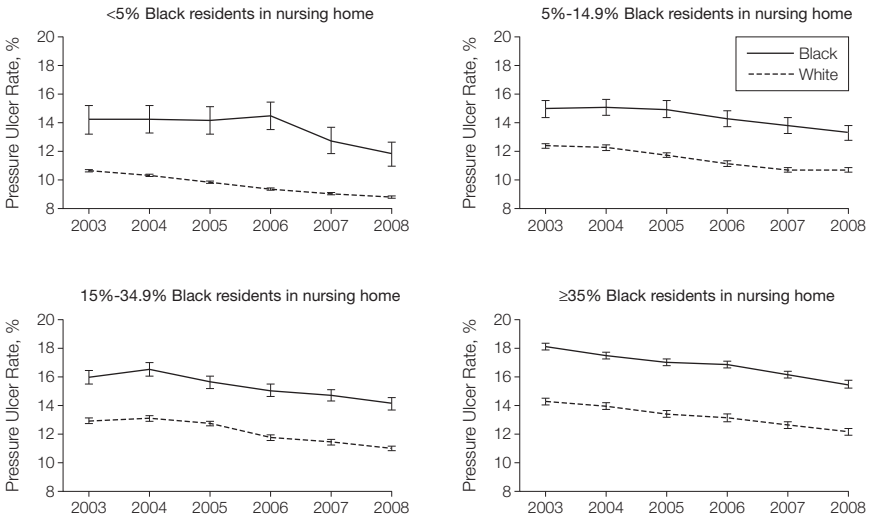
a reestimated model that adjusted for all resident, nursing home, county, and state covariates but included facility groups and race as separate variables and used nursing homes with low concentrations of black residents as the reference group, the main effect OR was 1.15 (95% CI, 1.12-1.19) for facilities with medium concentrations of blacks, the main effect OR was 1.20 (95% CI, 1.15-1.24) for facilities with medium-high concentrations of blacks, and the main effect OR was 1.33 (95% CI, 1.28-1.40) for facilities with high concentrations of blacks.

Sensitivity Analyses

In sensitivity analyses, we found that when the outcome was redefined as pressure ulcers of any stage, the longitudinal trends or disparities across race and site-of-care groups did not change substantially (eTable 1 and eFigure 1 at http://www.jama.com) and site-of-care disparities persisted after adjustment for resident, facility, county, and state covariates (eTable 2). Analyses comparing white with all nonwhite (black, Hispanic, Asian/Pacific Islander, and American Indian/Alaskan native) high-risk long-term residents showed similar results (eFigure 2, eTable 3, eTable 4, and eTable 5).

Figure. Pressure Ulcers by Race and Percentage of Black Residents in Nursing Home



All pressure ulcers were at stage 2 or higher. Error bars indicate 95% confidence intervals.

COMMENT

We found that among long-term care nursing home residents at high risk for pressure ulcers, black residents had higher prevalence rates than white residents from 2003 through 2008. The enduring disparity paralleled overall reduced rates across all resident and nursing home groups. Moreover, the disparity was largely related to the site in which care was delivered in addition to race itself; residents of both races and in nursing homes with the highest concentrations of blacks had at least a 30% increased risk-adjusted odds of pressure ulcers compared with residents in nursing homes caring for none or only a small percentage of black residents.

Nursing home quality remains to be poor despite the intensified govern-

Table 4. Risk-Adjusted Odds of Pressure Ulcers (Stage ≥2) Grouped by Race and Site of Care for 2008

Concentration of Black Residents in Nursing Home	Unadjusted Rate (95% CI), %	Adjusted Odds Ratio (95% Confidence Interval)[a]				
		Model 1[b]	Model 2[c]	Model 3[d]	Model 4[e]	Model 5[f]
Low (<5%)						
Whites (n = 389 150)	8.8 (8.7-8.9)	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]	1 [Reference]
Blacks (n = 5395)	11.8 (10.9-12.7)	1.33 (1.21-1.45)	1.25 (1.14-1.36)	1.20 (1.09-1.31)	1.17 (1.07-1.28)	1.14 (1.05-1.25)[g]
Medium (5%-14.9%)						
Whites (n = 128 563)	10.7 (10.5-10.9)	1.26 (1.23-1.30)	1.25 (1.21-1.29)	1.22 (1.19-1.26)	1.21 (1.17-1.25)	1.16 (1.12-1.20)
Blacks (n = 15 498)	13.3 (12.8-13.8)	1.59 (1.39-1.83)	1.47 (1.29-1.69)	1.46 (1.39-1.55)	1.41 (1.34-1.49)	1.35 (1.27-1.42)
Medium-high (15%-34.9%)						
Whites (n = 137 656)	11.0 (10.8-11.2)	1.27 (1.23-1.32)	1.27 (1.22-1.31)	1.22 (1.17-1.26)	1.22 (1.18-1.27)	1.19 (1.14-1.24)
Blacks (n = 27 652)	14.1 (13.7-14.5)	1.69 (1.48-1.94)	1.55 (1.35-1.77)	1.55 (1.48-1.62)	1.50 (1.43-1.57)	1.45 (1.38-1.52)
High (≥35%)						
Whites (n = 74 176)	12.1 (11.8-12.4)	1.45 (1.39-1.51)	1.42 (1.36-1.49)	1.34 (1.28-1.40)	1.35 (1.29-1.42)	1.33 (1.26-1.40)
Blacks (n = 74 847)	15.5 (15.2-15.8)	1.84 (1.60-2.11)	1.71 (1.64-1.77)	1.66 (1.45-1.90)	1.62 (1.56-1.69)	1.59 (1.52-1.67)

[a] For all comparisons, the *P* value was less than .001 unless otherwise indicated.
[b] Adjusted for the clustering of residents in nursing homes.
[c] Adjusted for model 1 plus age and sex.
[d] Adjusted for model 2 plus difficulties in activities of daily living, Cognitive Performance Scale score, disease diagnoses (dementia, stroke, diabetes, other endocrine disease, cardiovascular disease, musculoskeletal disease, and cancer), and whether the resident had malnutrition, incontinence, antipsychotic drug use, or physical restraint use, at end stage of life, or had hospital admissions during the past 90 days.
[e] Adjusted for model 3 plus nursing home covariates (number of beds, nonprofit facility, government facility, chain affiliation, percentage of Medicaid residents, care provided in hours per resident per day by registered nurse, licensed practical nurse/licensed vocational nurse, or certified nurse assistant, and deficiency citations).
[f] Adjusted for model 4 plus county characteristics (competition for nursing home residents, percentage of population ≥65 years, and urban vs rural county), and indicator variables for states.
[g] For the comparisons, the *P* value was equal to .003.

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ment regulations since the late 1980s.[30-32] In response, current policies have focused greater attention on nonregulatory approaches that rely on the public quality reporting,[11,12] the technical assistance or the quality improvement organization,[10,14,33] and pay-for-performance incentives.[34,35] To improve the prevention and treatment of pressure ulcers in nursing homes specifically, varied programs have also been implemented and evaluated.[5,13,15] Existing evidence suggests improved quality of care after program implementation.[5,10-12,15] Specifically, the national quality improvement organization approach and several state programs have been found to be successful in improving overall nursing home pressure ulcer care and outcomes.[10,13,14]

However, concerns arise about the color-blind feature of these initiatives and their potential unintended consequences to sustain or even widen existing racial disparities in nursing home care.[36,37] Because these quality improvement approaches incorporate no disparity-reducing mechanisms, nursing facilities and local authorities may have no incentive to address disparities beyond global quality improvement.[38] For example, the CMS's national quality publications judge all certified nursing homes by overall performance scores calculated from all residents in each facility. Thus, the public reporting tends to provide incentives to improve published scores but not disparities between racial groups or between facilities serving racially or socioeconomically diverse populations.

Research is scarce on the potential impact of generic quality improvement efforts on racial disparities. In particular, evaluations of major CMS and state initiatives have not focused on site-of-care differences such as differences between nursing homes caring for predominantly white and minority patients. To our knowledge, only 1 prior study reported that a staff education program implemented in 2 Pennsylvania nursing homes reduced both the overall pressure ulcer rate and racial disparities during a 12-week intervention period.[5] However, findings in this study may not be generalized to other nursing homes or other programs. Our analyses revealed that during the years after major CMS and state nursing home quality initiatives, pressure ulcer rates among long-term care residents improved overall and across racial and site-of-care groups but disparities persisted.

Given the widespread racial disparities in nursing home care, it is imperative to close the gap beyond industry-wide improvements. The first key step would be understanding why these disparities exist before appropriate efforts can be made to eliminate them. Given that nursing home care for minority residents is concentrated among a small number of nursing homes,[8,9,39] understanding how outcomes vary as a function of site of care can inform targeted interventions. We found that the enduring racial disparities were largely associated with the type of facilities, and that residents of both races showed substantially increased risk-adjusted odds of pressure ulcers when they received care in facilities with high concentrations of minority residents. This suggests that the disparities in pressure ulcer care are largely a system problem, and that the particular nursing home where a patient is served seems to be more important than patient race itself.

It is not entirely clear why nursing homes with high concentrations of black residents were associated with higher risk-adjusted odds of pressure ulcers. Adjustment for differences in nursing home managerial, staffing, financial, and geographic characteristics did not change these associations. It is possible that these measures were imperfect proxies for facilities' structural factors that directly affect resident care and outcomes. For example, the absence of appropriate pressure ulcer risk assessment programs may be more common in nursing homes with high concentrations of black residents. Thus, this and other underlying organizational, resource, and system-of-care deficits among these nursing homes may persist over time and perpetuate their worsened outcomes relative to other nursing homes.

Our findings suggest several policy implications. Importantly, future quality initiatives such as the renewed CMS quality improvement organization program could consider incorporating disparity-eliminating efforts. For example, targeting interventions for nursing homes with enduring outcome deficits may promote quality and equity of care more efficiently. Current nursing home quality reporting may contribute to the overall outcome improvement but does not seem to bring a concerted benefit of narrowed disparities. In the long term, the public reporting may show a discouraging effect on nursing homes that serve predominantly minority residents because the current reporting scheme spotlights their worse scores and disregards their similar amount of outcome improvement over time. Indeed, to achieve the same level of reduced pressure ulcer rate, nursing homes with high concentrations of minorities may have devoted more resource and staff inputs given the difficulties of early identification and prevention of pressure ulcers among patients with darkly pigmented skin. Future report cards should recognize outcome improvements of individual facilities. Similarly, the recently designed Medicare and Medicaid pay-for-performance programs[34,35] in nursing homes could reward both outcome superiority across facilities and secular improvement within a facility.

Our study has several limitations. The analyses focused on pressure ulcer prevalence and its persistent racial disparities; the results may not be generalized to other outcome and process-of-care disparities in nursing homes.[40-42] We may have had limited ability in the multivariate risk adjustment to account for variations in resident and site-of-care characteristics. Therefore, the persistent disparities may be partially mediated by unmeasured factors that affect pressure ulcer rates. Finally, we could not determine whether the over-

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all reduced pressure ulcer rate is attributable specifically to the CMS's or other quality improvement initiatives in nursing homes, although program-specific effects have been the focus of prior studies.[10-12]

CONCLUSIONS

Our study found that despite the reduced pressure ulcer rates among long-term nursing home residents across all race and nursing home groups from 2003 through 2008, racial disparities persisted. The persistent risk-adjusted disparities were largely related to the higher rates among nursing homes that disproportionately serve black residents. Future nursing home initiatives may need to devote more attention to disparity-reduction efforts beyond global quality improvement.

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Study concept and design: Li, Cai.
Acquisition of data: Li.
Analysis and interpretation of data: Li, Yin, Cai, Temkin-Greener, Mukamel.
Drafting of the manuscript: Li, Yin.
Critical revision of the manuscript for important intellectual content: Li, Cai, Temkin-Greener, Mukamel.
Statistical analysis: Yin, Cai, Mukamel.
Obtained funding: Li, Mukamel.
Administrative, technical or material support: Li.
Study supervision: Li, Cai.
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Online-Only Material: The eTables 1-5 and eFigure 1 and eFigure 2 are available at http://www.jama.com.

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