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Review Article

Racial Segregation Across U.S. Nursing Homes: A Systematic Review of Measurement and Outcomes

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Abstract

Background and Objectives: Nursing homes remain subjected to institutional racial segregation in the United States. However, a standardized approach to measure segregation in nursing homes does not appear to be established. A systematic review was conducted to identify all formal measurement approaches to evaluate racial segregation among nursing home facilities, and to then identify the association between segregation and quality of care in this context.

Research Design and Methods: PubMed, Scopus, and Web of Science databases were searched (January 2018) for publications relating to nursing home segregation. Following the PRISMA guidelines, studies were included that formally measured racial segregation of nursing homes residents across facilities with regional-level data.

Results: Eight studies met the inclusion criteria. Formal segregation measures included the Dissimilarity Index, Disparities Quality Index, Modified Thiel's Entropy Index, Gini coefficient, and adapted models. The most common data sources were the Minimum Data Set (MDS; resident-level), the Certification and Survey Provider Enhanced Reporting data (CASPER; facility-level), and the Area Resource File/ U.S. Census Data (regional-level). Most studies showed evidence of racial segregation among U.S. nursing home facilities and documented a negative impact of segregation on racial minorities and facility-level quality outcomes.

Discussion and Implications: The measurement of racial segregation among nursing homes is heterogeneous. While there are limitations to each methodology, this review can be used as a reference when trying to determine the best approach to measure racial segregation in future studies. Moreover, racial segregation among nursing homes remains a problem and should be further evaluated.

Keywords: Aged, Healthcare disparities, Long-term care, Quality of care, Race/ethnicity, Residential segregation

Introduction

History

The term segregation often describes the extent of spatial separation between individuals of at least two groups in disparate parts of a larger macro region (Massey & Denton, 1988; Michael Oakes & Kaufman, 2006; Reardon & O'Sullivan, 2004). These groups are considered different from each other on the basis of a socially constructed denomination, such as race. In the United States, residential segregation on the basis of race dates back decades (Tischauser, 2012). In 1986, the U.S. Supreme Court ruled to permit racial segregation if "separate but equal," enabling an era of lawful discrimination (Plessy v. Ferguson, 1896). In practice, predominantly black neighborhoods and facilities were not equal to those

inhabited by whites as local municipalities allocated fewer resources to them (Hanes, Hanes, Rudd, Hermsen, & Thomson Gale (Firm), 2007; Tischauser, 2012). While the Title VI Civil Rights Act, passed in 1964, prohibited racial discrimination in institutions that receive federal funding, national enforcement was difficult due to poor compliance by local governments (Tischauser, 2012). When the nationwide Medicare and Medicaid health insurance programs passed a year later, hospitals were held accountable for civil rights compliance. However, nursing homes remained largely unregulated, and segregated both across and within facilities (Smith et al., 2007). As a result, access to nursing homes was not equal, with a greater proportion of whites using these facilities, at the time and well after Medicare/Medicaid was implemented. While there is evidence to suggest that nursing home facilities remain segregated today (Rahman & Foster, 2015; Smith et al., 2007), the best methods for measuring this segregation are unclear. Systematically reviewing how racial segregation has been measured in previous nursing home studies can elucidate the quality of these methodological approaches.

Measuring Segregation

Conceptual framework

Measures of segregation regardless of the unit of analysis (e.g., neighborhoods or nursing homes) appear to largely follow the same conceptual framework. Massey and Denton describe five conceptual dimensions of segregation in their landmark paper (Massey & Denton, 1988). This includes: evenness (extent of evenness in the distribution of groups in an area), exposure (extent of potential interaction between groups in a given area), clustering (extent of clustering of neighborhoods with similar profiles), concentration (extent of space coverage by the group of interest), and centralization (extent to which a group of interest is near the urban center; Kramer & Hogue, 2009; Massey & Denton, 1988). Those most relevant to racial/ethnic segregation across nursing homes are unevenness (in this case, the extent to which nursing homes in a region have uneven racial/ethnic compositions) and exposure/isolation (the extent to which residents of a given race/ethnicity interact with the same or other groups in nursing homes). Some common indexes used for each measure are the following: unevenness (Index of Dissimilarity, Gini Index, Entropy/Information Index), exposure (Isolation Index, Interaction Index, Correlation Ratio), concentration (Duncan's Delta Index, Absolute Concentration Index, Relative Concentration Index), centralization (Central City Proportion, Absolute Centralization Index, Relative Centralization Index), and clustering (Absolute Clustering Index, Spatial Proximity Index, Relative Clustering Index (Massey & Denton, 1988).

In practice

Determining how to measure residential segregation for any purposes is challenging since there is not one standardized approach to do so. Moreover, many studies that report to measure segregation, often resort to measuring the proportion of the sample that is a given race/ethnicity (racial composition). These compositional measures of a population are single, individual level estimations. Therefore, the approach to measure racial composition is relatively straightforward. However, only focusing on single level approaches can lead to false conclusions or an "atomistic fallacy" (Alker, 1969) that fails to consider the effect of the context in which these findings occur. Alternatively, racial segregation (distinct from racial composition) is a more complex, multilevel approach, which estimates racial hierarchy across multiple units relative to a macro level environment (Oakes & Kaufman, 2006). Formal segregation measurements include two levels of data: (a) *subareas* such as facilities within (b) *larger geographic regions* such as cities or metropolitan statistical areas (MSAs). The resulting segregation value is a weighted population average comparing subareas to a greater region (Kramer & Hogue, 2009). The availability of data for geographic areas complicates the measurement of racial segregation. For example, census tracts are often used as proxies for neighborhoods, yet census tracts may be too imprecise to accurately estimate segregation. To account for this, some researchers have expanded the commonly used Dissimilarity and Isolation Indices to address concerns with proximal neighborhood spatial orientation and scale (Kramer & Hogue, 2009).

In nursing homes

While literature to guide how to measure residential segregation by race in neighborhoods exists (Kramer & Hogue, 2009; Massey & Denton, 1988; Michael Oakes & Kaufman, 2006; White & Borrell, 2011), specific guidance for nursing homes (to the best our knowledge) does not. Relative to other healthcare facilities, evaluating segregation in nursing homes is unique in that these measurements are confined to discreet facilities *with residential populations*. Unlike other long-term care residential facilities (e.g., assisted livings), nursing homes are federally regulated with standardized procedures and assessments, enabling resident- and facility-level comparisons. These features make nursing homes an important environment to measure and regulate segregation. Yet to date, there are no summaries of what segregation measures have been used in nursing home research and the impact of this segregation on the quality of care.

Aims

Due to the lack of cohesion from existing literature on segregation in nursing homes, the goals of this systematic literature review were twofold: (a) to compile a summary of measures that have been used to measure racial segregation in nursing homes and (b) to summarize the extent of racial segregation across U.S. nursing homes and its association with facility-level quality outcomes.

Methods

This review followed the guidelines outlined by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Liberati et al., 2009) in addition to the updated Preferred Reporting Items for Systematic Review and Meta-analysis Protocols (PRISMA-P; (Moher et al., 2015) This protocol was registered in PROSPERO (registration ID 83930) in December 2017.

Databases and Search Strategy

Articles were identified through searches of PubMed, Web of Science, and Scopus databases. A preliminary list of search terms was derived from variations of the terms "segregation" AND "nursing homes" based on synonyms and PubMed MeSH terms in consultation with a research librarian. After preliminary searches, additional terms were derived from relevant articles using key words or MeSH terms. Relevant articles continued to be searched until a saturation point of key words and MeSH terms was reached. A finalized list of search terms was compiled for each database (Supplementary Table 1). All lists were run in January of 2018 for all articles dated before January 1, 2018.

Data Management

The order in which the databases were searched was the following: (a) PubMed, (b) Web of Science, and (c) Scopus. All citation information (author, publication year, title, abstract etc.) from the formal search results of each database was transferred into EndNote X8.1. Duplicate articles were deleted from most to least recently added. Number of citations before and after duplicate articles were removed was documented. All articles were reviewed using an exported Microsoft Excel spreadsheet.

Eligibility Criteria

For inclusion in this systematic review, articles must have met the following initial criteria: (a) related to racial/ethnic segregation of individuals, (b) included a measure of segregation (verified via full-text review), (c) setting included nursing home(s), (d) reported original research from a peer-reviewed journal, and (e) written in the English language. If all of the above criteria were met, articles must have met the following secondary criteria: (a) United States population; and (b) used a formal or direct measure of segregation (i.e., standardized indices or adapted models) with a regional-level data source. Articles that reported to measure segregation, but did not include regional data, were excluded (e.g., racial composition alone).

Screening

Title and abstract blinded (author and journal de-identification) reviews followed by full-text reviews were conducted by two independent reviewers (D. S. Mack and K. L. Lapane). For title and abstract reviews, all papers identified from the initial search results were evaluated for inclusion based on relatedness to racial segregation, inclusion of nursing home setting, and if an original article from a peer-reviewed journal. Results were compared, and any article with discordant decisions was included in the full-text review. Articles with missing abstracts were automatically included in the full-text review. One reviewer (D. S. Mack) conducted the full-text review. Any articles with unclear appropriateness were marked. All articles identified as appropriate or with unclear appropriateness received a full text review by the second reviewer (K. L. Lapane). Any discrepancies about final article inclusion in this review were settled by consensus from further investigation and discussion.

Data Extraction

Process

Full-text articles included were then subject to data abstraction. A data abstraction form was piloted with several articles and extracted data items were adjusted to best summarize the information. All data were extracted by one reviewer (D. S. Mack) and verified by a second reviewer (P. S. Michener).

Data and outcome items

The primary outcomes in the context of nursing homes were: (a) the extent of racial/ethnic segregation and (b) resulting disparities. Final items extracted from full-text articles based on these outcomes included: study design, study years, study location, population race/ethnicities, population description, sample size (number of facilities, number of residents), segregation measure, macro unit of analysis (regional scale), data sources (resident, facility, regional), segregation dimension, description of segregation measure, outcome disparity measure, and summary of findings. Segregation dimensions were based on those outlined by Massey and Denton (1988): unevenness, exposure/isolation, concentration, clustering, or centralization.

Data analysis and risk of bias

This systematic review was designed to provide a summary of segregation measures and outcomes used with nursing home data. Outcomes included the extent of segregation and resulting quality-related disparities. When possible, this review used measures of association (e.g., odds ratios, correlation coefficients etc.) to evaluate disparities resulting from segregation for each article. Due to the heterogeneous nature of the studies included in the review, we did not attempt to statistically combine the extracted data. Rather, we synthesized the information as a cohesive body of literature. To avoid over-generalizing the findings, results were assessed in the context of their study location. Quality on the basis of sample size, reliability/validity of

segregation measurement, and reliability/validity of primarily analysis variables (race/ethnicity, outcome) was informally reviewed based on the extent of information provided in respective papers.

Results

Study selection

A total of 731 articles were generated from the search algorithm, with 492 remaining after removing duplicates. The title and abstract review excluded 295 articles and the remaining 197 articles received a full-text review against the eligibility criteria. A total of 38 articles met the inclusion criteria and used either a formal (direct) or compositional (proxy) measure of segregation. After excluding all studies that used compositional measures of segregation without regional data sources (n = 30), a total of eight studies remained and were included in this systematic review. See Figure 1 for a detailed overview of the study selection results.

Study Characteristics

A summary of the study characteristics is detailed in Table 1. Six studies examined nursing home data on a national scale. The remaining two studies examined nursing homes within a single state. Six studies compared non-Hispanic black nursing home residents to non-Hispanic white residents, while two studies compared white residents to U.S. racial minorities (non-Hispanic blacks, Hispanics, etc.). Seven studies included facility sample size, ranging from 511 to 18,259 nursing homes. Five studies included nursing home resident sample sizes, ranging from 2,665 to 1,466,471 residents. Five studies used standardized indices or measures to quantify segregation, while the remaining three studies used multilevel models to capture segregation.

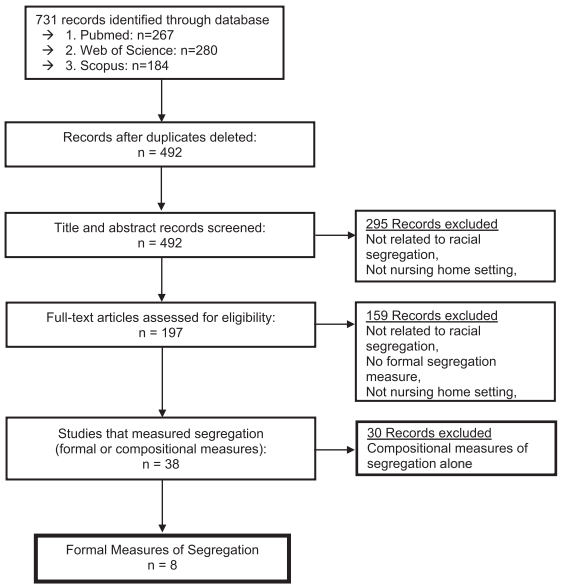

Figure 1. Flow diagram of preferred reporting of items for systematic reviews and meta-analysis (PRISMA) documenting article selection process

Data Sources

Table 2 shows the data sources used for each study evaluating formal segregation measures in nursing homes. Most studies (n = 5) used the following combination of data sources: the Minimum Data Set (MDS, version 2.0) for resident data, the Certification and Survey Provider Enhanced Reporting (CASPER) dataset or the Nursing Home Compare website data for facility-level data, and U.S. Census data (usually Area Resource File) for regional-level data.

Resident-level

The most common resident-level data used (n = 6) was the minimum data set (MDS version 2.0; CMS, 2019a), a comprehensive database of nursing home resident assessments from Medicare/Medicaid-certified nursing homes in the United States. Variables that were used from the MDS dataset included race/ethnicity, clinical information, and health-related outcome data such as prevalence of pressure ulcers, restraint use, vaccine administration use, antipsychotic use, etc. The instructions for the MDS 2.0 indicate that residents should select the race/ethnicity category that most closely represents their race. The MDS was used for study years between 1995 and 2005. Other resident-level data sources included claims data from the Center for Medicare & Medicaid Services (CMS) + the MDS (n = 2), the U.S. National Nursing Home Survey (CDC, 2019; n = 1), and the Medical Expenditure Panel Survey Nursing Home Component (MEPS-NHC; AHRQ, 2019; n = 1).

Facility-level

Most studies (n = 5) used the CMS Online Survey, Certification and Reporting (OSCAR) dataset for facility-level data, which was replaced in 2012 by Certification and Survey Provider Enhanced Reporting (CASPER) dataset. State agencies collect administrative CASPER data, maintained by CMS, for every Medicaid- or Medicare-certified nursing home provider during annual facility inspections. Variables abstracted from CASPER data included organizational factors (e.g., facility ownership [government vs nonprofit vs for-profit], occupancy, bed-size, etc.), nurse staffing (hours per nursing home resident per day), and inspection deficiencies. The Nursing Home Compare website data (file publicly available to download free of charge; CMS, 2019b), includes some resident characteristics from MDS, CMS's health inspection database, and quality metrics from Medicare claims data (e.g., emergency room visits and hospital readmissions). This website was used in addition to or instead of CASPER data. The two studies that did not use CASPER or Nursing Home Compare data for facility information used either the U.S. National Nursing Home Survey (CDC, 2019b) or the MEPS-NHC (AHRQ, 2019).

Table 1. Summary of All Articles Used in This Systematic Review on Measuring NH Segregation and Health-Related or Quality Subsequent Outcomes

Reference	Design, years	Location	Population	Sample size		Measure of segregation	Health or quality outcome measure	Summary of findings
				Residents	Facilities*			
Chang and colleagues (2012)	Cross-sectional, 2009 (2007–2008: MDS data)	Missouri (MO; United States)	All long-term and short-term care Medicare/ Medicaid NH residents; black and white residents alone for the Dissimilarity Index calculation	N/A	*n* = 511	Standardized indices	Facility healthcare quality measures (high-risk pressure ulcer, physical restraint, influenza vaccination, pneumococcal vaccination, disparities quality index)	A high percentage of black residents are concentrated in few MO NHs; more segregated NHs had more observed disparities and poorer outcomes in quality measures. The percentage of black residents was the strongest predictor variable of poor quality outcomes, Disparities in quality appeared in three of the four measures: high-risk pressure ulcers, influenza vaccines, and pneumococcal vaccines.
Davis and colleagues (2014)	Cross-sectional, 2004 (2000: Census data)	National (USA)	All Medicare/ Medicaid certified NHs	N/A	*n* = 8,950	Standardized indices	NH market competition/ quality (segregation, bed occupancy)	The mean distribution of racial/ethnic minorities in U.S. NHs is less than that in the community (MSAs). NH markets appear to be halfway between integration and segregation (DI mean ± *SD* = 0.51 ± 0.11). NHs in more segregated regions were less racially/ethnically diverse. Organizational NH factors (e.g., ownership) and competition (e.g., occupancy) were also associated with racial/ ethnic diversity. NHs with more empty beds (higher excess capacity) had more diversity.
Feng, Lepore, and colleagues (2011)	Longitudinal, 1999–2008, (2000: Census data)	National (USA + Washington DC)	All Medicare/ Medicaid NHs	N/A	*n* = 18,259	Standardized measure	NH closures (concentration of and clustering patterns) and changes in bed supply	A higher rate of NH closures and greater amount of net beds lost was observed in zip codes with a higher percentage black/Hispanic population or higher rate of poverty. The weighted Gini coefficient indicated more inequalities on the local zip code level (0.71) and a more equal distribution of closures when evaluating disparities on the larger MSA scale (0.55).
Miller and colleagues (2006)	Cross-section, 1995, (1989/1990: Area Resource File)	New York (urban regions)	Black, white NH residents	*n* = 60,932 (restraint use outcome); *n* = 58,763 (antipsychotic use outcome)	*n* = 716 (restraint use outcome); *n* = 806 (antipsychotic use outcome)	Non-standardized model	Quality indicators (QIs; daily restraint use and antipsychotic drug use in the absence of psychotic conditions among low and high-risk patients)	NH care is different among facilities with higher proportions of black residents. Both black and white NHs residents in higher proportion black facilities were shown to have a higher likelihood of antipsychotic drug use and lower likelihood of restraint use (characteristics also associated with lower NH staff ratios) compared to facilities with lower proportions of black residents. Additionally, NHs with higher proportions of black residents also had higher percentages of Medicaid beneficiaries, were more likely to be for-profit, and were in facilities in counties that also had relatively high proportion of black residents.

Table 1. *Continued*

Reference	Design, years	Location	Population	Sample size		Measure of segregation	Health or quality outcome measure	Summary of findings
				Residents	Facilities*			
Smith and colleagues (2007)	Cross-sectional, 2000	National (United States)	Black, white NH residents	*n* = 1,466,471	*n* = 14,374	Standardized index	Facility quality measures (inspection deficiencies, staffing, financial viability)	NHs appear to be segregated with a DI that averages up to 0.73 in the Midwest. Black NH residents are more likely to be in lower quality NHs (more deficiencies, lower staffing ratios, more financial strain) than white residents.
Strully (2011)	Cross-sectional, 2004	National (United States)	Black, white NH residents	*n* = 12,501	*n* = 1,140	Standardized index, proxy measure	Receipt of influenza vaccination	Segregation of black NH residents across all sample facilities is relatively high (DI = 0.71 from 0 [lowest] to 1 [highest]). Black residents are less likely to receive an influenza vaccine by a ~20% margin than white residents, but after adjusting for racial composition, this effect becomes nonsignificant. Black residents are also more likely to be in larger capacity NHs, for-profit NHs, and in facilities in metropolitan areas. For every one-point increase in percentage of black residents in each NH, vaccination odds decrease by 1.3%.
Troyer and McAuley (2006)	Cross-sectional, 1996	National (United States)	Black, white NHs residents	*n* = 2,665	*n* = 730	Non-standardized model	Documentation of advanced directives	White NH residents are more than twice as likely to have a documented advanced directive compared to black residents with a 37% gap between them. Almost half of the gap could be attributed to county-facility characteristics with black residents more likely to be in facilities in metropolitan areas (vs rural) or in counties with high rates of poverty than white residents. Residents in facilities of those characteristics were predicted to be less likely to have advanced directives.
Rahman and Foster (2015)	Cross-sectional, 2004–2005, (2002: Medicare enrollment), (2000: Census data)	National (United States)	Black, white Medicare free-for-service beneficiaries entered NH for SNF care as new admits post-hospitalization	*n* = 646,494	N/A	Non-standardized model	Facility quality measures (number of nursing staff / bed)	Blacks from mostly white neighborhoods travel longer distances to NHs with a higher percentage of black residents and lower care quality than whites from the same neighborhoods; "strong evidence of race-based sorting," (Rahman & Foster, 2015) yet parameters for distance and quality preference are similar across race.

Notes: NH = Nursing homes; SNF = skilled nursing facility; MSA = Metropolitan Statistical Area; DI = Dissimilarity Index; N/A = Not available.
*Facilities are Nursing homes unless otherwise noted.

Table 2. Detailed Summary of the Measurement of Segregation via Formal Measures (Massey & Denton, 1988) Included in This Systematic Review

Reference	Measure of segregation	Dimension of segregation*	Data sources†			Macro unit of analysis‡	Description of segregation measure
			Resident	Facility	Regional		
Chang and colleagues (2012)	Dissimilarity index (DI; Massey & Denton, 1988) and Disparities quality index (DQI; Siegel et al., 2009)	Unevenness	Resident-level quality measure dataset provided by CMS; Healthcare Center (HD QIOSC) - MDS, Medicare enrollment data	NH Compare website	U.S. Census Data, CMS dataset (urban/rural)	MSA, rural/urban	The DI was selected to represent segregation via dissimilarity, while the DQI was selected to measure the extent of disparities in quality of care among a sub-population (in this case black residents) compared with the total population (all residents).
Davis and colleagues (2014)	Modified Thiel's entropy index, Dissimilarity Index (DI)	Unevenness	MDS	OSCAR/ CASPER	Area Resource File (drawn from U.S. Census Data), Residential segregation data	Degree of residential segregation (DI via MSA bottom 25%, middle 50%, top 25%)	Thiel's entropy index was used a dependent variable to represent NH racial/ethnic diversity in ordinal least squares regression modeling, comparing each ethnic group in an MSA vs in NHs. The DI (independent variable) was used to represent residential segregation within MSAs, while the Herfindahl and Hirshman Index (independent variable) was used to quantify market concentration in the model.
Feng, Lepore and colleagues (2011)	Gini Coefficient, Geographic Information System (GIS)	Unevenness (Gini Coefficient), clustering (GIS)	N/A	OSCAR/ CASPER	U.S. Census Data	State, MSA, zip codes	The Gini coefficient (ranging from low (0) – high (1) inequality, weighted by the total number of NHs to ever exist) was used to represent racial/ethnic inequalities in concentration of NH closures by facility-matched regional characteristics (proportion minority and poverty rate). GIS was used to illustrate clustering of NH closures across zip codes.
Miller and colleagues (2006)	Multilevel modeling	Racial composition (proxy measure), clustering	MDS, CMS claims data	OSCAR/ CASPER, NHCompare	Area Resource File (U.S. Census Data)	County	A multilevel modeling approach was used to assess the effect of the percentage of blacks in NHs (and in the respective NH facility counties) on use of physical restraint and antipsychotic drug use. Beta-binomial distribution (via William's method) was used to calculate the facility-level quality indicator (QI) outcomes dependent on respective county. Stratified by race (black/white), GEE logistic regression models were used to calculate the effect of QIs given the racial composition of NHs and the county of the NH. An overdispersion parameter was used to address within facility correlation with individual outcomes and an independence correlation matrix was used with county clustering to address within county correlation in facility-level outcomes.
Smith and colleagues (2007)	Dissimilarity Index (DI)	Unevenness	MDS	OSCAR/ CASPER	U.S. Census data (MSA boundaries), MDS	MSA	The DI was used to measure racial segregation by indicating the proportion of residents needed to make a facility have an equal percentage of black and white residents. Measures of quality were calculated relative to the MSA region.
Strully (2011)	Dissimilarty Index (DI), racial composition	Unevenness, Racial composition (proxy measure)	U.S. National NH Survey	U.S. National NH Survey	U.S. National NH Survey	NH-level	The DI was calculated with both resident- and NH- level variables including racial composition (%black residents/ NH) to quantify the level of overall racial segregation in the sample. Logistic regression models with receipt of influenza vaccination as the outcome were run starting with individual level covariates and adding the percentage of black resident variables and then adding other facility characteristics (NH bed capacity, location, ownership).

Table 2. *Continued*

Reference	Measure of segregation	Dimension of segregation*	Data sources†			Macro unit of analysis‡	Description of segregation measure
			Resident	Facility	Regional		
Troyer and McAuley (2006)	Probit model	Unevenness	MEPS-NHC; MDS supplemented with medical record information	MEPS-NHC	Area Resource File	County	Probit model estimates were used to evaluate the role of characteristics relating to race on the gap between the percentage of NH blacks and whites with documentation of advanced directives. Probability (via marginal effect) of documentation by race was estimated with individual-, facility-, and regional-level characteristics. Characteristics included facility-level metropolitan or non-metropolitan locale and county-level racial composition, poverty level, proportion aged ≥65 years etc. The difference of two subsample models (for black and white residents) were broken down to determine the amount of the gap attributable to each specific characteristic.
Rahman and Foster (2015)	Multidimensional spatial segregation model	Unevenness, clustering	Medicare enrollment records; Medicaid Analytical eXtract (MAX); Medicare Part A Claims; MDS; choice sets (created by authors)	OSCAR/ CASPER, American Hospital Association data	U.S. Census Data	zip codes	A multidimensional spatial modeling approach was used to evaluate the role in race-based vs distance-based NH sorting, by taking into account residential racial composition and NH quality with weights for preferences of certain NH characteristics. The Haversine formula was used to calculate distance variables. Primary parameters of interest were racial composition (race-based sorting) and distance parameters (distance-based sorting) using zip codes of pre-NH admission residences and zip codes surrounding respective NHs. The importance of each parameter in the relationship between segregation and facility quality of care was tested using choice-based simulations and counterfactual modeling. Specifically, instrumental variables were used to account for the racial differences in NH preferences.

Notes: NH = nursing home.

*Segregation dimensions based on (Massey and Denton 1988) include unevenness, exposure/isolation, concentration, clustering, centralization.

†Data Source abbreviations: CMS = Center for Medicare/ Medicaid, MDS = Minimum Data Set, OSCAR = Online Survey, Certification and Reporting, replaced in 2012 by CASPER = Certification and Survey Provider Enhanced Reporting, Residential segregation data from the Lewis Mumford Center for Comparative Urban and Regional Research from the State University of New York at Albany, MEPS-NHC = Medical Expenditure Panel Survey NH Component.

‡Macro unit of analysis abbreviations: MSA = metropolitan statistical area.

Regional-level

All but one study (n = 7) used U.S. Census data to capture regional-level data. Four of which conducted an analysis with MSA as the macro unit of analysis, while two used county-level data and one study used zip code-level data. Most studies used the Area Resource File, which is derived from U.S. Census data, this file includes regional demographic information (e.g., age, sex, race/ethnicity), health facility characteristics/utilization (county, state, national data), and economic properties of a region (e.g., Medicare expenditures and per capita income; HRSA, 2019; Stambler, 1988). One study (Strully, 2011) used the U.S. National Nursing Home Survey facility data to determine the location-based metropolitan status of facilities (metropolitan vs micropolitan vs neither).

Segregation Measures and Analysis

Details of segregation measures are given in Table 2. Overall, all measures were heterogeneous to each other in some way. Three out of the eight studies used MSA as a macro-scale of analysis, one of which used MSA in addition to state data and zip codes for this analysis. Of the five remaining studies: two used county, two used zip codes, one used nursing home level data for the macro of the analysis. All studies except for one (Miller, Papandonatos, Fennell, & Mor, 2006) applied a measure of segregation via the unevenness (Massey & Denton, 1988) dimension of segregation. Five studies used formal indices or measures to quantify segregation, while the remaining three studies adapted outcome-specific models (multilevel logistic, multidimensional spatial, and probit).

Dissimilarity Index (+Disparities Quality Index)

The most common measure used was the Dissimilarity Index(Massey & Denton, 1988)—implemented by four studies. The Dissimilarity Index represents the percent or proportion of individuals of one racial/ethnic minority in a given area (e.g., neighborhood, community) that would have to move in order to parallel the racial composition of a larger macro area (e.g., city, county, or MSA; Davis, Weech-Maldonado, Lapane, & Laberge, 2014; Kramer & Hogue, 2009) The resulting value ranges from 0 (complete integration) to 1 (complete segregation). Only one study (Smith et al., 2007) used the Dissimilarity Index without any other additional measures of segregation. A different study (Strully, 2011) used nursing home racial composition (percent black residents in a nursing home) not only in the calculation of the Dissimilarity Index, but also as an independent variable in logistic regressions modeling influenza vaccination status. Another article (Chang, Siegel, & Wilkerson, 2012) used the Dissimilarity Index in addition to the Disparities Quality Index (Siegel, Bear, Andres, & Mead, 2009) to measure segregation of nursing homes (via distribution of black vs black and white residents) and to measure disparities in quality of care (via distribution of black vs all residents). The Disparities Quality Index was created to identify the extent of facility-level disparities in care considering a minority subgroup relative to the whole facility population. The resulting value is directional, in which a negative value represents less care for the minority subgroup under study than the general population. A more negative value indicates more disparities and less care for the subgroup under study (Chang et al., 2012).

Modified Thiel's Entropy Index

One study (Davis et al., 2014) included the Modified Thiel's Entropy Index and the Dissimilarity Index. In this case, the Modified Thiel's Entropy Index was used to calculate the extent of multiracial diversity between nursing home facilities and respective MSA regions by race, enabling a decomposition of the analysis by race. This study used an ordinal least squares regression model with the Modified Thiel's Entropy Index as the dependent variable and the Dissimilarity Index as an independent variable to represent residential segregation within MSAs.

Gini coefficient (+ Geographic Information System)

One study (Feng et al., 2011) used the Gini coefficient, which was used in addition to Geographic Information System modeling, to measure segregation. The Gini coefficient (racial/ethnic) was used as a measure of dispersion to quantify concentration or inequality of, in this case, nursing home closures across MSA and zip code regions. The coefficient's value ranges from 0 (completely equal distribution or no concentration) to 1 (most unequal distribution or highest level of concentration). Geographic Information System mapping was used as a supplemental visual tool to evaluate regional patterns and spatial clustering of nursing home closures across state- and zip code-level gradients. (Feng et al., 2011)

Adapted models

The three studies that did not use any standardized measure or index to quantity segregation, each adapted their own modeling approach. One study (Miller, Papandonatos, Fennell, & Mor, 2006) used a multilevel approach with generalized estimating equations logistic models to estimate facility-level quality outcomes dependent on nursing home racial composition and respective county. One study (Troyer & Mcauley, 2006) used a probit modeling approach to estimate the probability of the outcome via marginal effects by race with individual-, facility-, and regional-level variables. The remaining study (Rahman & Foster, 2015) used a spatial and simulation modeling approach that took into account residential racial composition variation and nursing home quality with weights to account for factors associated with nursing home selection and placement.

Outcomes

All studies included in this review first measured the extent of segregation on some level across U.S. nursing homes.

All also evaluated the resulting disparities from the effect of segregation on some type of facility-level outcomes. Half of the studies (n = 4) evaluated health-related quality outcomes that included facility rates of high-risk pressure ulcers, physical restraint use, receipt of pneumococcal vaccination, receipt of influenza vaccination, antipsychotic drug use in the absence of psychotic conditions, and documentation of advanced directives. The other half of included studies (n = 4) evaluated facility quality outcomes that included nursing home closures, changes in bed supply, bed occupancy, market competition, inspection deficiencies, staffing ratios, and financial viability.

Extent of segregation

All studies found that racial segregation exists across nursing homes facilities. In terms of nursing home placement, Rahman and Foster (2015) demonstrated "strong evidence of race-based sorting" with preference parameters (distance and quality) consistent across race. All studies specifically evaluating black–white segregation found extensive segregation rates. For example, Strully (2011) estimated an average Dissimilarity Index value of 0.71, indicating a relatively high rate of segregation of black nursing home residents across the United States. In addition, Smith and colleagues (2007) found that nursing homes appear to be segregated in general, but most segregated in the Midwestern United States, with an average Dissimilarity Index value of 0.73 in this region. Chang and colleagues (2012) findings corroborated this claim as they found that a high proportion of black nursing home residents are concentrated in a small number of Missouri nursing homes. On a different note, Miller and colleagues (2006) found that nursing homes with a higher percentage of black residents also had higher percentages of U.S. Medicaid insurance beneficiaries and were also more likely to be in counties that had a relatively high percentage of black residents. Two papers that evaluated racial/ethnic minority segregation also demonstrated extensive segregation through different approaches. Davis and colleagues (2014) found that the distribution of racial/ethnic minorities in nursing homes is less than that in outside communities, as the nursing home market appears relatively segregated with an average Dissimilarity Index value of 0.51. Feng, Lepore, and colleagues (2011) estimated a weighted Gini coefficient of 0.71 on the local level, indicating a relatively unequal distribution of nursing home closures across zip codes within what macros areas.

Resulting disparities

The effect of segregation varied based on the specific facility-level outcome of interest, but most showed a negative impact of segregation for minority racial/ethnic groups in facility quality. One study (Smith et al., 2007) found that black nursing home residents were more likely to be in lower quality nursing homes that have more deficiencies, lower staffing ratios, and more financial strain than were white nursing home residents. This association between more racial/ethnic segregation and decreased resources is consistent with findings from two other studies (Miller et al., 2006; Troyer & Mcauley, 2006). In terms of the nursing home market, one study (Davis et al., 2014) found that nursing homes in more segregated areas were less racially/ethnically diverse and consequently have less market competition indicated by lower excess capacity (fewer empty beds). In terms of nursing homes closures, Feng, Lepore, and colleagues (2011) found a higher rate of nursing home closures and net bed lost in zip codes that had higher percentages of black and Hispanic residents or higher poverty rates. Rahman and Foster (2015) demonstrated that race-based nursing home placement may be one significant driving force behind nursing home segregation and quality disparities. The authors found newly admitted black nursing home residents from mostly white neighborhoods travel longer distances to nursing homes with a higher percentage of black residents and receive a lower quality of care than newly admitted white residents from the same neighborhoods.

Quality of Included Studies

All studies included robust national samples with the exception of the two studies with state-based samples (Chang et al., 2012; Miller et al., 2006). The reliability/validity of the measures of segregation employed were not extensively discussed in any of the studies. The reliability/validity of racial and ethnic categorization, derived from the MDS in most cases, was also not discussed. The validity of the operational definition of outcome measures was discussed in some, but not all studies. The study by Feng, Lepore, and colleagues, (2011) has the most notable threat to validity regarding the potential misclassification of their outcome of nursing home closures, operationally defined as closure of Medicaid/Medicare-certified nursing home facilities.

Discussion

While 30 studies used compositional measures of inequality, we found far fewer (n = 8) that directly measured segregation with regional-level data. Formal segregation measures were heterogeneous and used a combination of the following measures: the Dissimilarity Index, the Disparities Quality Index, the Modified Thiel's Entropy Index, the Gini coefficient, Geographic Information System spatial modeling, or adapted models. Overall, each paper used different techniques and outcomes to measure segregation among nursing homes facilities, which is to be expected since the conceptual goals of the analyses were not uniform. This made it difficult to compare measures across studies. However, each measure or the components of the measure can be discussed independently. Of note, none of the segregation measures used appeared to be validated in its application of measuring racial segregation among nursing homes facilities.

Segregation Measures

The Dissimilarity Index

Consistent with another systematic review on measurement of segregation in relation to health outcomes, the Dissimilarity Index was the most common measure employed by health researchers (Kramer & Hogue, 2009). It has been suggested that the Dissimilarity Index is often used because of the relative ease of its interpretation, even though its conceptual complexities are often overlooked given the use of different measurements. (Acevedo-Garcia, Lochner, Osypuk, & Subramanian, 2003; Kramer & Hogue, 2009) It has been noted that the Dissimilarity Index could conceptually be the weakest tool to measure the negative impact of segregation on a health outcome as it could provide deceiving results on the basis of measuring evenness without considering other dimensions of segregation. For example, at times when segregation is measured via evenness, it can appear as though it is health-protective, but this effect goes away with adjustment for isolation (Kramer & Hogue, 2009). Dissimilarity is appropriate when researchers are concerned about quantifying the hierarchical nature of race relations in a macro area, whereas isolation or exposure measures may be more relevant when approaching the study from the "contact hypothesis" (Allport, 1954). The "contact hypothesis" posits that intergroup contact can result in positive effects if people engaged in interactions have equal status, common goals, cooperate, and are supported by their institutions.

Modified Theil's Entropy Index and Gini coefficient

This issue with the Dissimilarity Index could also apply to the use of the Modified Theil's Entropy Index and Gini coefficient since they are also both measures of evenness. However, in the Feng, Lepore, and colleagues (2011) paper, the authors did not use the Gini coefficient alone, they used it in addition to Geographic Information System spatial modeling to evaluate segregation via the clustering dimension (Massey & Denton, 1988). Furthermore, Davis and colleagues (2014) used the Modified Thiel's Entropy Index along with the Dissimilarity Index to calculate the extent of multiracial diversity by race, but did not explore trends of segregation using intergroup comparison. Of note, it does not appear as though the Modified Thiel's Entropy Index or the Gini Coefficient are frequently used in health research as the other systematic review (Kramer & Hogue, 2009) of 39 studies only had one paper with either measure, the measure being the Gini Coefficient in a paper published in 2004 (Fabio, Li, Strotmeyer, & Branas, 2004). Theil's Entropy Index, while infrequently used in health literature to date, has the potential advantage of being decomposable along several characteristics. This includes across all racial/ethnic groups vs between specific racial/ethnic groups, or into components of segregation between the states and the nation vs nursing homes within states. In contrast, some exposure/isolation measures can be decomposed only with regard to across versus between racial/ethnic groups, and Dissimilarity Indices cannot be decomposed across any factor (Reardon & O'Sullivan, 2004).

The Disparities Quality Index

When considering the Dissimilarity Index used with the Disparities Quality Index as in the Chang and colleagues (2012) paper of this review, this approach also had major limitations. First, the Disparities Quality Index was never used before in nursing home data; it was only previously used with hospital data. Furthermore, the two scales were compared, but used different populations; the Dissimilarity Index included black residents versus black and white residents and the Disparities Quality Index included black residents versus all residents (of any race).

Spatial and Multilevel Modeling

One of the major limitations of using standardized indices that measure one dimension of segregation is the dependence on United States Census tract data as proxies for community and neighborhood regions. Even when the smallest unit of analysis is used (e.g., zip codes), segregation often occurs among neighborhoods with substantial spatial patterns within and between town lines or neighborhood boundaries. Therefore, the ideal scale to capture the health effects of segregation may have a mechanism different from the boundaries defined from census data (Krieger, Waterman, Lemieux, Zierler, & Hogan, 2001; Lee et al., 2008). One strategy suggested has been to modify and combine traditional indices to include multiple dimensions such as unevenness, isolation, and concentration (Reardon & O'Sullivan, 2004). Also suggested have been spatial versions of standard indices that use Geographic Information System technology to estimate segregation by neighborhoods (Wong, 2003). As mentioned previously, Feng, Lepore, and colleagues (2011) used Geographic Information System technology to visualize segregation, but not to quantify it. The use of multilevel modeling in measuring segregation holds promise. Although the paper by Rahman and Foster (2015) used multidimensional spatial modeling and the paper by Miller and colleagues (2006) used multilevel modeling, the authors both relied on U.S. Census Data boundaries. Overall, using multilevel modeling and neighborhood boundaries would be ideal in addition to applying indices that capture multigroup segregation (not seen in this review), modeling the interaction of segregation on the racial and economic scale (a trend seen by the Troyer and McAuley, 2006 paper), and further developing conceptual models (Acevedo-Garcia et al., 2003; Kramer & Hogue, 2009).

Analytic Considerations

Studies included in this review used racial segregation measures that varied in model specifications. The variation in model specifications was likely due to (a) hypotheses

regarding variables that mediate the effect of racial segregation; (b) analytic decisions; and (c) variable availability due to differences in data sources used. Most studies included models that included individual-level demographic and nursing home-level organizational characteristics (e.g., ownership, staffing), while some included economic proxy variables such as percent of residents on Medicaid. Since all studies were nonexperimental using secondary observational data, all were limited by the potential bias that could result from unmeasured confounding. Unmeasured causal factors affecting nursing home placement and selection forces was a consistent limitation in all studies except one. The Rahman and Foster (2015) paper specifically evaluated the mechanisms behind nursing home placement and segregation, so bias resulting from the exclusion of nursing home selection variables was not an issue in this paper. The potential unmeasured confounding that were concerns in the Rahman and Foster paper included variables related to the geographic distribution and racial composition of nursing home closure locations, which was a variable directly evaluated by Feng, Lepore, and colleagues (2011). Additional unmeasured confounders that were discussed, yet not captured in any of the studies included facility-level variables that represented: discrepancies between racial composition of staff and residents, existing training or infrastructure regarding management of health-related outcomes or quality measures, administrative and staff culture/attitudes towards quality measure outcomes, implicit bias of healthcare providers etc.

Data

Since measuring segregation of nursing home facilities often requires resident-, facility-, and regional-level data, most studies included in this review used multiple data sources for their analyses. A recurring issue was the discordance between the time of data collection among merged data sources. Discordance in this context ranged from a few months to several years. For some studies, the year of the U.S. Census data used did not match that of the other data sources. The datasets included were dated—ranging from 1995 to 2009. The studies that used these data sources were able to have a large and robust nationally representative samples of nursing home residents. Because most studies included national data, the results could be considered geographically representative of the United States. Six studies used national datasets. Two studies limited their analysis to one U.S. state, leading to statements about the limited generalizability of their results. A similar concern about generalizability was noted among studies that were limited to nursing homes in metropolitan areas. Risk of bias from small sample sizes among studies that used more granular units of analysis (e.g., counties or zip codes) was also cited as potential concerns when comparing inter- and intra-facility differences even before potential race stratification.

Outcomes

The way in which segregation was measured was informed by the types of outcomes evaluated. For example, Rahman and Foster's (2015) multidimensional model was built around the evaluation of facility quality due to segregation resulting from several potential selection forces. The quality- and health-related outcomes of the papers in this systematic review were quite different than those measured when evaluating the effect of segregation in other health-related settings (Kramer & Hogue, 2009; White & Borrell, 2011). The outcome measures in those studies centered around mortality, chronic diseases/overall health, and infant health, whereas the measures from papers in this review mostly centered around facility quality outcomes.

Overall, most of the studies showed that racial segregation among nursing homes is extensive, and there is a negative effect of segregation on racial/ethnic minorities and facility quality. Studies in this review cited multiple mechanisms to attempt to describe the driving forces behind ongoing racial segregation in nursing homes, and subsequent disparities in facility quality that included: race-based facility preferences, systemic racism, disparities in funding, unequal distributions of ancillary support staff etc. Specifically, Rahman and Foster (2015) demonstrated that black residents tend to be admitted into nursing homes with higher proportions of other black residents. Black nursing home residents are also more likely to have U.S. Medicaid insurance (program for low-income households with few assets) compared to white residents (Mor, Zinn, Angelelli, Teno, & Miller, 2004). Because Medicaid payments for nursing home care are often less than private pay or long-term care insurance payments (Cohen, 2000), nursing homes with more minority residents may have worse healthcare management, less staff, and poorer facility quality outcomes relative to nursing homes with fewer minority residents (Grabowski et al., 2004; Gruneir, Miller, Feng, Intrator, & Mor, 2008; Hyer et al., 2011). Because socioeconomic disadvantage is highly correlated to race/ethnicity in the United States, future studies should explore the extent to which people of color from higher socioeconomic position are affected by nursing home segregation.

Strengths and Limitations

This review is consistent with the methods recommended in a recent publication on methodological guidance for high-quality review articles (Heyn, Meeks, & Pruchno, 2019). A thorough search strategy with the help of a research librarian enabled a comprehensive list of articles related to this topic to be identified, limiting the possibility of missed studies. Although PubMed, Web of Science, and Scopus are vast multidisciplinary databases, the use of additional databases such as the Cochrane and Cumulative Index to Nursing and Allied Sciences (CINAHL) and PsychInfo could have further reduced the possibility of missed references. Nevertheless, following the PRISMA guidelines enabled

this review to follow rigorous methodological standards including a clear execution and thorough review process, straightforward reporting, and comprehensive conclusions. Two reviewers verified all included articles, helping to mitigate the potential for information bias. Furthermore, given the complexity of measuring segregation, the studies included in this review had several limitations including potential unmeasured confounders, possible bias from data sources, and conceivable threats to external validity. Regardless of these limitations, this is the first study, to the best of our knowledge, to compile a systematic review of racial segregation measures among nursing home facilities and report on their associated outcomes. This study could be used as a reference when planning to evaluate racial segregation among nursing home facilities or similar settings.

Conclusion

Overall, multiple studies have measured racial segregation among nursing homes across the United States. The selection of a particular measure of segregation should be informed by the analytic goals of the study, such as whether segregation is being measured to describe of the extent of racial/ethnic hierarchy (dissimilarity indices or Theil's Index), or as a measure of the degree of isolation nursing home residents experience (exposure/isolation measures). The selection of geographic units is equally important: *at the macro level* of nations, states, MSAs, counties or customized definitions of nursing home markets, and *at the meso level* of neighborhoods (census tracts, block groups, zip codes), nursing homes, or even divisions within nursing homes such as units or wards. Segregation measures that are decomposable (such as Theil's indices, or in some regards the exposure/isolation indices) may be particularly informative about mechanisms leading to nursing home segregation and/or the downstream effects of nursing home segregation on quality of nursing home care. Care should be taken to assess the complex interplay between markers of socioeconomic conditions and racial/ethnic segregation, keeping in mind that racial/ethnic disparities in socioeconomic conditions are highly influenced by racial/ethnic segregation occurring decades, even generations, before residents enter the nursing home setting. Furthermore, more work should be done to validate existing and future segregation measures when applying them to health-related outcomes.

This systematic review can be used as a reference of measurement strategies that have been used to quantify racial segregation among nursing home residents. The results of the papers included in this review indicate that racial segregation in this setting remains extensive. More work should be done to evaluate the causes and effects of nursing home segregation in order to work towards eliminating it.

Supplementary Material

Supplementary data are available at *The Gerontologist* online.

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Conflict of Interest

None reported.

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