J Nutr Health Aging. 2021;25(7):862-868
Published online April 1, 2021, http://dx.doi.org/10.1007/s12603-021-1626-2

Original Research

County-Level Characteristics Driving Malnutrition Death Rates among Older Adults in Texas

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Abstract

OBJECTIVES: This study aims to identify older adult malnutrition in Texas, examine county-level characteristics associated with crude malnutrition death rates, and describe assets and opportunities available to address and improve malnutrition among the older population.

DESIGN: Secondary data analysis using the Centers for Disease Control and Prevention's WONDER online database, the U.S. Census 2014-2018 American Community Survey, and the U.S. Department of Agriculture's Food Access Research Atlas data.

SETTING: All 254 counties in the state of Texas.

PARTICIPANTS: Individuals aged 65 years and older.

MEASUREMENT: The dependent variable was the proportion of county-level malnutrition crude death rates. Independent variables included Health Provider Shortage Area designations, rurality, poverty status, food access, age, race, ethnicity, and education.

RESULTS: The overall malnutrition crude death rate in Texas was 65.6 deaths per 100,000 older Texans, ranging from 0 to 414.46 deaths per 100,000 depending on the county. Higher malnutrition crude death rates were associated with non-metropolitan counties (P=0.018), lower education (P=0.047), greater household poverty (P=0.010), and low food access (P<0.001).

CONCLUSION: Socioeconomic disadvantages at the county-level appear to be one of the root causes of malnutrition crude death rates in Texas.

Key words: Malnutrition, death rates, Texas, older population, assets.

Introduction

More than four million people ages 65 years or older live in the 254 counties that form the state of Texas in the United States (U.S.) (1, 2). In the past 12 months, close to 20% of older adults living in Texas were considered food insecure and experienced food intake disruptions because of lack of money or other resources financial constraints and lack of resources (3, 4). Consequently, food insecurity significantly increases the risks of malnutrition among older adults (5, 6).

Defined as deficiencies, excesses, or imbalances in a person's consumption of nutrients (7), malnutrition is caused by a combination of social, psychological, physical, and medical factors, including impaired oral health and polypharmacy (8–12). Malnutrition can have severe consequences on older adults' health, causing diminished physical health, loss of independence, increased hospitalizations and healthcare costs, and related death (13–18). Malnutrition and related risk factors can be detected in many ways at the individual-level, including the use of several validated screening tools for older adults (19–21). However, not much is known on related factors associated with county-level malnutrition death rates among older adults living in Texas.

As the older population grows and continues to age, more attention is needed to better understand older adult malnutrition and the factors that contribute to malnutrition-related death at the Texas county-level. While the individual-level contributors to and consequences of malnutrition are known and important (as referenced above), less is known about the community-level influences on malnutrition death among older adults (22). An abundance of available studies about malnutrition examine school-aged youth (23–25); however, when older adults are specifically examined, studies typically target individual-level variables among mostly community-dwelling older adults (26). Unfortunately, such studies do not consider the totality of the aging population in a particular geographic area within the context of available resources and young and middle aged adults residing in the same geographic area. A community's composition of residents by sociodemographics, affluence, and utilization of subsidized benefits and programs can reveal protective and harmful community-level aspects for malnutrition risk and associated death (27–29). Because resource and service availability and accessibility differ by community such that older adults may experience longer distances and drive times to access food in rural communities (30, 31), and are driven in part by available funding and population need (32), research is needed that examines malnutrition in a community context.

The purposes of this study were to identify the overall crude malnutrition death rates among older adults ages 65 years and older living in Texas, and examine county-level characteristics associated with the related death rates. Texas was purposively selected for this investigation because of its large geospatial

Received February 18, 2021
Accepted for publication March 9, 2021

region, diverse population, and large number of counties. This "state of the state" on malnutrition of older adults living in Texas can be used to guide and inform future state-level public health and nutrition programs, services, and policy efforts. The present study also reveals assets and opportunities available to address and improve malnutrition among the older population. Therefore, the present study serves as a potential model to be replicated by other U.S. States states to better understand the risks, disparities, and inequities associated with malnutrition and associated deaths among older adults.

Methods

Data were gathered from secondary, publicly available sources and compiled into a single dataset. Counties served as the unit of analysis, of which there are 254 in Texas. Data available by Census track were aggregated at the county-level for consistency. Considering Census tracks do not cross county boundaries, summing these more granular components was capable of accurately yielding county-level totals.

Measures

Malnutrition

The dependent variable for this study was the proportion of county-level malnutrition crude death rates. Malnutrition deaths counts were obtained from the Centers for Disease Control and Prevention's WONDER online database (33). County-level 2018 malnutrition death counts and crude death rates for individuals ages 65 years and older were identified using International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) Codes E40-E46 (34). Statistical tertiles were calculated by county-level crude death rates to divide the counties for comparison purposes.

Rural and underserved designations

Of the many available designations to classify rural and underserved areas (35), two were selected: 1) Health Provider Shortage Areas (HPSA) and 2) Rural-Urban Continuum Codes (RUCC). HPSA, developed by the U.S. Health Resources Administration, are calculated based on the ratio of primary care providers to the population (36). HPSA are used as an indicator of access to healthcare services and can be applied to the entire county or specific parts of a county (i.e., any census tract or minor civil division). As a conservative measure and for ease of interpretation, partial and full county HPSA designations were collapsed into one category for analyses (i.e., 0=no HPSA designation; 1=partial/full county HPSA designation). RUCC, developed by the U.S. Department of Agriculture, are calculated based on commuting distance and proximity to populated areas (37). This 9-point scale categorizes counties into three metropolitan and six non-metropolitan rankings. Analyses treated RUCC as a binary variable comparing metropolitan (=0) to non-metropolitan (=1) areas.

Population demographics

U.S. Census data from the 5-Year American Community Survey (ACS, 2014-2018) were used for population-level age, race, ethnicity, and education level (38). Data were available at the Census Track level, but aggregated to the county-level. Given the present study focus on older adults, age was examined in two ways: the percent of the county population 1) ages 65 years and older; and 2) ages 85 years and older. For race, percentages for race were identified for: white, Black/African American, American Indian/Native American; Asian/Pacific Islander, Native Hawaiian/Alaska Native; other race, and two or more (i.e., multiple) races. Similarly, percentages were identified for the Hispanic population and adults who did not graduate from high school.

Poverty status

U.S. Census data from the 5-Year ACS (2014-2018) were also used for household-level poverty status and receipt of Supplemental Nutrition Assistance Program (SNAP) benefits (38). The percentage of households in poverty, i.e., living at or below the poverty level threshold in the past 12 months, was identified and calculated while considering household size and composition (39). The percentage of households with a resident age 60 years or older that received SNAP benefits was also identified (40).

Food access

Food Access Research Atlas data from the U.S. Department of Agriculture Economic Research Service was used to identify the percentage of adults age 65 years and older with low access to food stores. This proportion was calculated in two ways: those that resided 1 mile or farther from a food store; those that resided 10 miles or farther from a food store.

Other Data

In addition to the variables identified above, additional organizations were identified to assist in the development of a risk and asset map for malnutrition risk. Using available data sources, asset addresses were gathered for purposes of geospatial mapping. More specifically, addresses were compiled for the Texas Area Agencies on Aging (n=28), foodbanks and food pantries across the state (n=72), and all retail food stores (n=6,476). Food stores were identified by their standard industrial classification (SIC) code and included retailers labeled as food markets, grocers, meat, fruit/vegetable/produce, farm markets, and health/diet foods (41).

Statistical Analyses

Data were analyzed using SPSS version 27. Descriptive statistics were created for all variables of interest, which were compared across malnutrition crude death rate tertiles.

Pearson chi-square tests were used for categorical variables and one-way analysis of variance (ANOVA) tests were used for continuous variables. Then, an ordinal regression model was fitted to examine county-level factors associated with higher malnutrition crude death rates. Statistical significance for all analyses was identified at P<0.05.

Results

Overall, across the 254 counties in Texas, there were 25,195 malnutrition-related deaths among adults ages 65 years and older. The average number of malnutrition deaths by county was 99.19 deaths, which ranged from 0 to 3,796 deaths. As seen in Figure 1, the overall malnutrition crude death rate in Texas was 65.6 deaths per 100,000 older adults, which ranged by county from 0 to 414.46 deaths per 100,000 older adults.

Of the 254 counties, 67.7% were classified as non-metropolitan areas, and 81.5% were determined as a HPSA in parts of the county (5.5%) or the entire county (76.0%). In addition to depicting malnutrition risk, Figure 1 also displays the various assets available in these geographic areas.

Figure 1. Risk and asset map for malnutrition

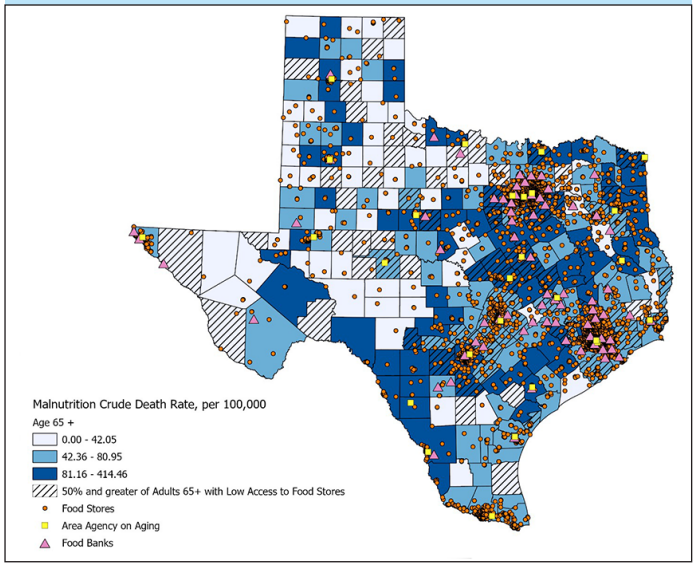

Table 1 displays county-level characteristics. On average, 17.53% (±5.31) of county residents were ages 65 years or older and 2.00% (±0.82) were ages 85 years or older. On average, 83.90% (±10.20) of county residents were white and 6.34% (±6.61) were Black/African American; 34.84% (±23.27) were of Hispanic origin. On average, 21.20% (±9.37) of county residents had less than a high school education, 61.58% (±9.37) of county households were at or below the poverty threshold, and 33.64% (±13.68) of county households with one or more resident age 60 years or older received SNAP benefits. On average, 62.37% (±21.25) and 19.06% (±26.58) of county residents ages 65 years and older had low access to food stores within 1 mile and 10 miles of their residence, respectively.

Table 1 also compares county-level characteristics across malnutrition crude death rate tertiles. Tertile 1 consisted of 84 counties with the lowest malnutrition-related crude death rates, which ranged from 0 to 42.05 malnutrition deaths per 100,000 older adults living in Texas. Tertile 2 consisted of 85 counties with moderate malnutrition-related crude death rates, which ranged from 42.36 to 80.95 malnutrition deaths per 100,000 older adults living in Texas. Tertile 3 consisted of 85 counties with the highest malnutrition-related crude death rates, which ranged from 81.16 to 414.46 malnutrition deaths per 100,000 older adults living in Texas.

When comparing county-level characteristics by the three statistical tertiles for malnutrition crude death rates, a significantly larger proportion of non-metropolitan counties were in Tertile 1 ($\chi 2$=14.43, P=0.001). Relative to Tertiles 2 and 3 with higher malnutrition crude death rates, on average, Tertile 1 had a larger proportion of residents ages 65 years and older (f=5.01, P=0.007) and without a high school education (f=8.55, P<0.001).

Relative to Tertile 1, Tertiles 2 and 3 with higher malnutrition crude death rates, on average, had larger proportions of residents who identified as Black/African American (f=20.25, P<0.001), Asian/Pacific Islander (f=8.65, P<0.001), and Native Hawaiian/Alaska Native (f=3.67, P=0.027). Conversely, on average, Tertile 1 had a larger proportion of residents who identified as another race not listed than Tertiles 2 and 3 (f=7.00, P=0.001). On average, compared to Tertiles 2 and 3, Tertile 1 had a larger proportion of households receiving SNAP benefits (f=4.49, P=0.012) and a larger proportion of residents ages 65 years and older with low access to food within 10 miles of their residence (f=40.12, P<0.001).

Table 2 shows the results of the ordinal regression model that assessed the association between county-level characteristics and levels of malnutrition crude death rates. Across Tertile levels, non-metropolitan RUCC classifications were associated with higher malnutrition crude death rates (β=0.86, P=0.018). Counties with larger proportions of residents who identified as another race (β=0.05, P=0.025), did not obtain a high school education (β=0.07, P=0.047), and lived in households at or below the poverty threshold (β=5.69, P=0.010) had higher malnutrition crude death rates. Counties with larger proportions of residents ages 65 years and older with low access to food stores within 10 miles had higher malnutrition crude death rates (β=0.04, P<0.001). Counties with larger proportions of residents ages 85 years and older (β=-0.52, P=0.015), and those who identified as Black/African American race (β=-0.12, P<0.001) and of Hispanic origin (β=-0.03, P=0.025) had lower malnutrition crude death rates.

Discussion

The current study demonstrates that malnutrition remains an important issue for older adults living in Texas. Findings expand on previous research (3) and offer a deeper understanding of the context of malnutrition-related deaths by examining county-level characteristics, which may be addressed to mitigate the burden.

While malnutrition-related deaths occurred in many Texas counties, crude death rates showed related deaths are particularly higher in non-metropolitan counties. Findings also

Table 1. County-Level Characteristics by Malnutrition Crude Death Rates (in tertiles)

		County Malnutrtion Crude Death Rates for Age 65+				
	Total (n = 254)	Tertile 1 (n = 84)	Tertile 2 (n = 85)	Tertile 3 (n = 85)	χ2 or f	P
Malnutrition						
Number of Malnutrition Deaths (65+ years)	99.19 (±324.26)	3.35 (±9.37)	92.21 (±147.62)	200.89 (±524.51)	8,33	<0.001
Malnutrition Crude Death Rates (65+ years)	65.62 (±60.39)	4.93 (±12.94)	63.08 (±11.24)	128.14 (±55.21)	287,27	<0.001
Rural-Urban Continuum Code (RUCC)					14,43	0,001
Metro	32,30%	16,70%	42,40%	37,60%		
Non-Metro	67,70%	83,30%	57,60%	62,40%		
Health Provider Shortage Area (HPSA)					5,67	0,059
None	18,50%	10,70%	20,00%	24,70%		
Partial/Full	81,50%	89,30%	80,00%	75,30%		
Percent of County Population Older Adult						
Age 65 Years and Older	17.53 (±5.31)	19.01 (±5.54)	16.86 (±5.50)	16.75 (±4.59)	5,01	0,007
Age 85 Years and Older	2.00 (±0.82)	2.06 (±0.92)	1.88 (±0.78)	2.05 (±0.75)	1,32	0,268
Percent of County Population by Race						
White	83.90 (±10.20)	85.66 (±12.25)	83.66 (±9.07)	82.40 (±8.80)	2,22	0,111
Black/African American	6.34 (±6.61)	2.96 (±3.57)	7.25 (±6.73)	8.78 (±7.44)	20,25	<0.001
American Indian/Native American	0.58 (±0.56)	0.53 (±0.62)	0.53 (±0.43)	0.67 (±0.62)	1,67	0,191
Asian/Pacific Islander	1.09 (±2.01)	0.45 (±0.59)	1.70 (±3.03)	1.11 (±1.36)	8,65	<0.001
Native Hawaiian/Alaska Native	0.06 (±0.14)	0.03 (±0.13)	0.06 (±0.09)	0.09 (±0.19)	3,67	0,027
Other Race	5.77 (±8.00)	8.38 (±12.17)	4.43 (±4.53)	4.53 (±3.94)	7,00	0,001
Two or More Races	2.27 (±1.48)	1.99 (±1.70)	2.38 (±1.15)	2.43 (±1.53)	2,25	0,107
Percent of County Population Hispanic	34.84 (±23.27)	37.94 (±23.74)	33.54 (±23.44)	33.06 (±22.58)	1,13	0,325
Percent of County Population Without High School Education	21.20 (±9.20)	24.46 (±11.58)	19.16 (±7.39)	20.01 (±7.16)	8,55	<0.001
Percent of County Households In Poverty	61.58 (±9.37)	62.17 (±10.07)	62.74 (±9.48)	59.83 (±8.35)	2,33	0,099
Percent of County Households Receiving SNAP Benefits (60+)	33.64 (±13.68)	37.21 (±19.77)	32.26 (±7.05)	31.47 (±10.42)	4,49	0,012
Percent of County Population 65+ with Low Access to Food						
Within 1 Mile of Residence	62.37 (±21.25)	66.44 (±25.40)	61.04 (±18.41)	59.69 (±18.91)	2,41	0,092
Within 10 Miles of Residence	19.06 (±26.58)	37.62 (±36.68)	9.44 (±11.05)	10.32 (±12.66)	40,12	<0.001

suggest that proxies of lower, community-level socioeconomic status including less educated and more impoverished communities in rural areas in Texas were more vulnerable to food insecurity (i.e., low access to food within 10 miles) and other issues contributing to malnutrition deaths. A recent systematic review and meta-analysis of factors associated with malnutrition and malnutrition risk among older adults found that low education level and low socioeconomic status were strongly associated with malnutrition risk (42). Poor rural households often have lower access to food in general (43), and lower utilization of the redistribution economy, which are government programs and charities that provide food resources such as food stamps, food banks, and senior meal programs (43). Interestingly, in this study, more older adults in Tertile 1 with the lowest malnutrition-related mortality received SNAP benefits compared to Tertiles 2 and 3. However, access to SNAP does not appear protective of malnutrition deaths. This may be attributed to the proportion of households seeking this benefit relative to those eligible, the composition of the household, and other challenges and resources that the household experiences (44–46). Further investigation at the family- and household-levels is needed to better understand the household circumstances associated with receiving SNAP benefits, and how these household characteristics influence malnutrition death among older adults.

Findings also indicate that the community infrastructure such as food access and household income may be more predictive of malnutrition death than access to healthcare services (4, 47). While parts of most counties were considered to be HPSA where access to healthcare facilities and professionals are partially or fully scarce, socioeconomic disadvantages were found to be at the root causes of malnutrition crude death rates in Texas (48).

Communities with larger proportions of older adults aged 85 years and over were found to have lower malnutrition crude death rates. While this may seem counterintuitive, it is possible that other supports or characteristics help the oldest county residents meet their nutrition needs. This older age group may have greater access to home-delivered meals such as Meals on Wheels (49). Those who are not homebound may attend senior centers or adult day cares where they can partake in congregate or individual meals. A 2010 Institute of Medicine workshop summary revealed that in 60 percent of the cases, the meals provided by a senior center or at home represents more than

Table 2. Ordinal Regression for Malnutrition Crude Death Rate Tertiles

	Beta	SE	Wald	P	95% CI	
					Lower	Upper
RUCC: Non-Metro	0,86	0,36	5,56	0,018	0,14	1,57
HPSA: Partial/Full	0,22	0,36	0,36	0,546	-0,48	0,92
Percent of County Population: Age 85+	-0,52	0,21	5,88	0,015	-0,93	-0,10
Percent of County Population: Black/African American	-0,12	0,03	17,62	<0.001	-0,17	-0,06
Percent of County Population: American Indian/Native American	-0,39	0,27	2,16	0,142	-0,91	0,13
Percent of County Population: Asian/Pacific Islander	0,06	0,07	0,62	0,430	-0,09	0,20
Percent of County Population: Native Hawaiian	-1,20	1,05	1,31	0,253	-3,27	0,86
Percent of County Population: Other Race	0,05	0,02	5,04	0,025	0,01	0,10
Percent of County Population: Two or More Races	-0,08	0,10	0,64	0,424	-0,28	0,12
Percent of County Population: Hispanic	-0,03	0,01	5,00	0,025	-0,05	-0,01
Percent of County Population: Without High School Education	0,07	0,04	3,95	0,047	0,01	0,14
Percent of County Households In Poverty	5,69	2,22	6,56	0,010	1,34	10,04
Percent of County Households with 60+ Resident: Receiving SNAP Benefits	0,02	0,01	3,15	0,076	0,00	0,05
Percent of County Population 65+: Low Access to Food within 10 Miles	0,04	0,01	20,34	<0.001	0,02	0,06

Nagelkerke $R^2 = 0.426$

half of the older person's daily food intake (50). Adults ages 85 years and older may also be residing in multigenerational households (51, 52), or have caregivers or family members who help them with meal shopping and preparation to stay well nourished (51). Some communities with large populations of adults ages 85 years and older may have specific resources and policies in place that better support older adults. This may include the needs of the oldest old, contributing to their longevity while protecting them against malnutrition risk and related death. Such examples may include a greater sense of community, coherence, and inclusion of older people (53–55), as well as informal support networks where meals are encouraged and modeled (56).

Communities with larger proportions of Black/African American and Hispanic residents also seemed protected against malnutrition death. One potential explanation is that food is an important symbol associated with cultural and social identities of African Americans and Hispanics (57). For example, prior research found that food is an opportunity for African American women to express their cultural values of responsibility, caretaking, and social connection with others (58), which may help to buffer malnutrition risk and associated deaths among the older population as seen in this study. Multigenerational living arrangements, which are more common among minority populations (59, 60), may also play a key role in lowering malnutrition death rates.

The current study is not without limitations. First, the study focused specifically on older adults ages 65 years and older. Examining malnutrition crude death rates before entering older adulthood may help to better understand specific upstream socioeconomic status factors needed for prevention. Second, additional variables associated with food access, such as transportation, may have helped to provide a more comprehensive overview of the root causes of malnutrition crude death rates. Future studies should consider adding additional relevant individual-level measures and data sources. Third, because secondary data from 2018 were used, findings may not represent the most current situation in these counties. Further, the state of malnutrition risk examined in these counties was before the COVID-19 pandemic; therefore, additional investigation is needed to identify the protective and risk characteristics associated with community changes (e.g., increasing poverty and death rates generally, closing of retail stores).

Despite these possible shortcomings, this study maps malnutrition crude death rates across all 254 counties in Texas, to identify county-level factors associated with malnutrition among the older adult population. Findings can be useful for simultaneously identifying county-level malnutrition risk alongside protective community aspects. This "state of the state" about malnutrition older adults experience in Texas can be used to guide and inform funding and service allocation for public health and nutrition programs across the state. It can be used to proactively identify need and support communities and organizations to better serve their older adult residents, especially among those residing in disadvantaged counties as identified in this study. Further, this study serves as a potential model to be replicated by other states to better understand the county-level risks, disparities, and inequities associated with malnutrition and associated deaths among older adults.

Ethical standards: The research team followed ethical standards based on the publicly available and accessible data sources used for the analyses.

Funding: None.

Acknowledgement: None.

Disclosure: Caroline D. Bergeron has no conflict of interest to disclose. Jessica Mary John has no conflict of interest to disclose. Mitali Sribhashyam has no conflict of interest to disclose. Gloria Odonkor has no conflict of interest to disclose. Oluyomi Oloruntoba has no conflict of interest to disclose. Ashley L. Merianos has no conflict of interest to disclose.

Scott Horel has no conflict of interest to disclose. Matthew Lee Smith has no conflict of interest to disclose.

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How to cite this article: C.D. Bergeron, J.M. John, M. Sribhashyam et al. County-Level Characteristics Driving Malnutrition Death Rates among Older Adults in Texas. J Nutr Health Aging. 2021;25(7):862-868; http://dx.doi.org/10.1007/s12603-021-1626-2