

# Disparities in social determinants of health outcomes and behaviours between older adults in Alaska and the contiguous US: evidence from a national survey

Steven A. Cohen, Ana X. Talamas and Natalie J. Sabik

Health Studies Program, University of Rhode Island, Kingston, RI, USA

## ABSTRACT

Few studies have focused on understanding how sociodemographic factors impact healthy ageing in the rapidly growing population of Alaskan older adults. Therefore, the objectives of this study are to compare the health of Alaskan older adults to those in the contiguous US, and determine how the associations differ between older adults in Alaska and the contiguous US. We abstracted 165,295 respondents age 65+ from the 2016 Behavioral Risk Factor Surveillance System. We used generalised linear models to assess the associations between sociodemographic factors and six health outcomes accounting for confounders and complex sampling. In the contiguous US, females were less likely than males to be obese (OR 0.96, 95%CI 0.96–0.97), while in Alaska, females were more likely to be obese (OR 1.24, 95%CI 1.19–1.29). In the contiguous US, Alaska Natives/American Indians were more likely than respondents of other races to be smokers (OR 1.62, 95%CI 1.60–1.63), while in Alaska, the association between race and smoking was not significant (OR 1.00, 95%CI 0.94–1.06). These differences between Alaska and the contiguous US results suggest that programs designed to reduce disparities and promote healthy behaviours may need to be tailored to meet the unique needs and challenges of older adults living in Alaska.

## ARTICLE HISTORY

Received 8 August 2018  
Revised 28 November 2018  
Accepted 6 December 2018

## KEYWORDS

Older adults; social determinants; Alaska natives; rural–urban disparities; general health; population health

## Introduction

The proportion of Alaska's population aged 65+ has grown more rapidly in Alaska than in the contiguous 48 states. The rate of growth of the 65+ population in Alaska is the highest among all age groups. This rapid growth is expected to continue in Alaska through the coming decades. This population currently makes up 11% of the state's population, compared to 13% in the lower 48 states [1]. However, few studies have studied the potentially unique needs of older adults living in Alaska and directly compared population health and health-seeking behaviours between older adults living in Alaska to those living in the contiguous US [2]. One study showed that older adults in Alaska had the lowest health-related quality of life as compared to the contiguous 48 states [3]. While another study identified that older adults in Alaska experience a unique set of barriers that provide challenges for successful ageing [4].

Geographic location plays a key role in determining population health, particularly in Alaska. Place-based factors such as living conditions, infrastructure, access to health care and other unhealthy characteristics of neighbourhoods and communities, can impact population health through complex pathways [5]. Other

geographic factors that affect health may be exacerbated in Alaska. For example, well-established rural–urban health disparities among older adults are exacerbated in Alaska due to the extreme remoteness of rural areas where many older adults live [6].

Additionally, the large population of Native Americans and Alaska Natives in Alaska raise other issues for ageing in Alaska. For example, in recent years many Alaska Natives/Native Americans have moved away from their reservations, which leads to decreased access to health care, since the majority of Alaska Natives/Native Americans get their health care from the Indian Health Service [7,8]. Also the study showed that there were higher rates of cigarette smoking, no leisure-time physical activity, obesity and diagnosed diabetes among older American Indian and Alaska Natives as compared to older white adults in Alaskan residents. Many of these disparities in health behaviours and health care access increase the risk for chronic disease.

Goins et al. stated that the five main barriers to health-care in Alaska were transportation difficulties, limited health care supplies, lack of quality health care, social isolation and financial constraints [4]. Native Americans have reduced access to health care and insurance coverage and many

of the older adults live below poverty-level incomes, lack telephones, and are more likely to live alone [9].

Therefore, there are two main objectives of this study. The first objective is to compare the associations between sociodemographic factors, including race/ethnicity (Alaska Native versus other) and rural–urban status, and health outcomes and behaviours between older adults living in Alaska and those living in the contiguous 48 states. The second objective is to assess the potential for place of residence (Alaska versus lower 48 states) to moderate potential associations between those social determinants (race/ethnicity, rural–urban status and others) and each health outcome.

## Methods

### Data source

Data were abstracted from the 2016 Behavioral Risk Factor Surveillance System (BRFSS), a national, telephone-based survey of adults aged 18 and above [10]. The BRFSS is conducted annually and administered by state health departments with oversight from the Centers for Disease Control and Prevention (CDC), reaching nearly 500,000 respondents across the USA, the District of Columbia and USA territories. For this analysis, the sample was restricted to survey respondents aged 65 and above and includes respondents living in the 48 contiguous US states, the District of Columbia and Alaska in 2016 (N=165,295, 774 from Alaska). Respondents living in Hawaii and US territories were excluded from this analysis.

### Measures

There were six representative outcome measures utilised in this study related to health, health behaviours, or quality of life: self-reported health (SRH), depressive symptoms, obesity, receipt of annual well visit and health literacy. SRH was obtained from the question asked of all participants: “Would you say that in general your health is excellent, very good, good, fair, or poor?” Responses were dichotomised into “fair or poor health” if responses were “fair” or “poor” and “good health” if responses were any of the other three. Current smoking status was assessed through the use of the question: “Do you now smoke cigarettes every day, some days, or not at all?” and dichotomised into “yes” or “no” based on responses. Depressive symptoms (yes versus no) were derived from the survey question: “Has your provider told you that you have a depressive disorder, including depression, major depression, dysthymia, or minor depression?” A respondent was classified as “obese” if they had a calculated body mass index (BMI) of 30 kg/m<sup>2</sup> or greater, and “not obese” otherwise.

Respondents were asked “About how long has it been since you last visited a doctor for a routine checkup? A routine checkup is a general physical exam, not an exam for a specific injury, illness, or condition.” Possible responses were “within past year”, “within past 2 years”, “within past 5 years”, “5 years or more” and “don’t know”. Respondents who answered that such checkups were not “within past year” were coded as not having had a routine checkup within the past year.

Health literacy was assessed through the use of a BRFSS module. In total, 15.8% of all BRFSS respondents were eligible to participate in this module, and had to reside in one of the following 13 states or districts: Alabama, Alaska, District of Columbia, Georgia, Illinois, Iowa, Louisiana, Minnesota, Mississippi, Nebraska, North Carolina, Pennsylvania and Virginia. Two questions were used to assess health literacy. The first was: “In general, how difficult is it for you to understand written health information?” The second was: “How difficult is it for you to understand information that doctors, nurses and other health professionals tell you?” Respondents could respond to these questions with “very easy”, “somewhat easy”, “somewhat difficult” and “very difficult”, as well as “don’t know/not sure”. For each survey respondent, if they answered as anything but “very easy” for either of the two questions, they were categorised as “lower health literacy” (48.7%); those who responded as “very easy” to both questions were categorised as “higher health literacy” (51.3%).

State of residence at the time of the survey (Alaska versus not Alaska) was used as both a primary exposure variable, as well as a moderator variable in this analysis. Another exposure variable used in the analysis was race/ethnicity, dichotomised to “American Indian or Alaskan Native only” versus other (included White, Black, Asian, Native Hawaiian or other Pacific Islander, Other, or multiracial). One key place-based sociodemographic factor used as a covariate in this analysis was rural–urban status. This variable was obtained from the BRFSS respondent’s place of residence. If the respondent lived “in the centre city of a metropolitan statistical area (MSA)”, “outside the centre city of an MSA but inside the county containing the centre city” or “inside a suburban county of the MSA”, they were considered “non-rural”. If the respondent lived “not in an MSA”, their place of residence was considered “rural”. Other sociodemographic covariates were gender, age category and education level (high school or less versus greater than high school).

### Data analysis

Descriptive statistics were obtained for all outcome and exposure variables and covariates. For continuous or

discrete variables, means and standard deviations or medians and interquartile ranges were obtained. For categorical variables, counts and percentages of counts were obtained. Bivariate associations between each predictor and outcome variable were assessed using chi-square tests for pairs of dichotomous variables, t-tests or Wilcoxon rank sum tests for associations between dichotomous and continuous variables, and Pearson or Spearman correlations between pairs of continuous variables. We then assessed the association between place of residence (Alaska versus not Alaska) and the six representative outcome measures: SRH, current smoking status, depressive symptoms, obesity, receipt of annual well visit and health literacy through chi-square testing. Generalised linear models (GLM) with a logit link function were used to test the associations between state of residence (Alaska versus lower 48 states) and each of the health outcomes, controlling for confounders and accounting for complex sampling. The logit link function was used because all outcome measures were dichotomous.

The main objective was to evaluate how potential associations between the six representative outcome measures and sociodemographic factors differ by state of residence (Alaska versus lower 48 states). This objective was assessed in two complementary types of models: stratified and interaction models. Both sets of models utilised GLM with a logit link function with each of the six representative outcome measures as the outcome variables and the main socioeconomic factors as the primary exposures. In the first set of models, data were stratified by state of residence (Alaska versus other). In the second set of models, all data were analysed together, but an interaction term was created as the product of an indicator variable for rural–urban status and the state of residence (Alaska versus not Alaska). This set of models allowed us to determine if the association between rural–urban status and each of the six outcomes was statistically different in Alaska compared to the lower 48 states. Both sets of models controlled for confounding and accounted for complex sampling by use of analytic sample weights.

For all models above, the harmful category (i.e. obese, current smoker, fair or poor SRH, etc.) was considered as having the outcome, and the more healthful category of outcome (i.e. not obese, good or better SRH, etc.) was considered as not having the outcome. To account for complex sampling, BRFSS sample weights were used in all descriptive, bivariate and multivariable analyses. Statistical significance was set to  $p < 0.05$  for all analyses. IBM SPSS version 24 (Armonk, NY) was used for all data analyses.

## Results

Bivariate associations, as assessed through chi-square testing, revealed that compared to respondents in the lower 48 states, respondents in Alaska were more likely to be male (49.4% male in Alaska versus 44.3% male in the lower 48 states), Alaska Native/American Indian (11.5% vs. 1.1%), younger (55.9% over age 70 vs. 66.7%) and more likely to have higher than a high school education (64.6% vs. 54.5%) (Table 1). Respondents living in Alaska were more likely to be obese (35.3% vs. 28.1%) and less likely to be a current smoker (8.1% vs. 8.7%), have fair or poor self-reported health (21.1% vs. 25.3%), have a depressive disorder (9.9% vs. 13.5%), have had a checkup within the past year (79.1% vs. 88.6%) and have low health literacy (44.1% vs. 51.0%). Of the respondents living in Alaska, 36.9% were living in a rural area, compared to 18.9% of residents living in the lower 48 states ( $p < 0.001$ ).

Table 2 shows the results of the multivariate models stratified by state of residence (Alaska versus the lower 48 states). Model results represent separate models, one set for respondents in Alaska and one set for those living in the lower 48 states, as indicated in the table. Among older adults living in Alaska, females were 24% more likely (95% CI 19–29%) to be obese than males (Table 2). However, in the lower 48, females were 4% less likely (95% CI 3–4%) to be obese than males. Females were 10% less likely to have

**Table 1.** Descriptive statistics for the 2016 BRFSS analytic sample, N (weighted percent) and p-values for group comparisons.

|                          |                               | Alaska | Lower 48 |
|--------------------------|-------------------------------|--------|----------|
| Gender                   | Female                        | 50.6   | 55.7     |
|                          | Male                          | 49.4   | 44.3     |
| Race/ethnicity           | White                         | 73.5   | 82.8     |
|                          | Black                         | 8.2    | 9.5      |
|                          | Asian                         | 4.1    | 2.8      |
|                          | Alaska Native/American Indian | 11.5   | 1.1      |
|                          | All other                     | 2.7    | 3.8      |
| Age category             | 65–69                         | 44.1   | 33.3     |
|                          | 70–74                         | 24.0   | 25.1     |
|                          | 75–79                         | 16.3   | 19.7     |
|                          | 80+                           | 15.5   | 21.9     |
| Education                | High school or less           | 35.4   | 45.5     |
|                          | Greater than high school      | 64.6   | 54.5     |
| Rural-urban status       | In or near MSA (urban)        | 63.1   | 81.1     |
|                          | Not in MSA (rural)            | 36.9   | 18.9     |
| Has obesity              | Yes                           | 35.3   | 28.1     |
|                          | No                            | 64.7   | 71.9     |
| Current smoker           | Yes                           | 8.1    | 8.7      |
|                          | No                            | 91.9   | 91.3     |
| Self-reported health     | Fair or poor                  | 21.1   | 25.3     |
|                          | Good, very good, or excellent | 78.9   | 74.7     |
| Depressive disorder      | Yes                           | 9.9    | 13.5     |
|                          | No                            | 90.1   | 86.5     |
| Checkup within last year | Yes                           | 79.1   | 88.6     |
|                          | No                            | 20.9   | 11.4     |
| Health literacy          | Low                           | 44.1   | 51.0     |
|                          | High                          | 55.9   | 49.0     |

**Table 2.** Weighted, adjusted odds ratios of each outcome (and 95% confidence intervals), and model fit statistics (higher is better) stratified by geography (Alaska versus lower 48 states).

|                     |          | Female            | AK Nat/Am Ind     | Age category      | LT HS education   | Rural             | Likelihood ratio chi-square value (compared to intercept-only model) |
|---------------------|----------|-------------------|-------------------|-------------------|-------------------|-------------------|--|
| Obesity             | Lower 48 | 0.96 (0.96, 0.97) | 1.62 (1.60, 1.63) | 0.74 (0.74, 0.74) | 1.42 (1.42, 1.42) | 1.05 (1.05, 1.06) | 885,513.5  |
|                     | Alaska   | 1.24 (1.19, 1.29) | 1.00 (0.94, 1.06) | 0.67 (0.66, 0.69) | 2.05 (1.96, 2.14) | 1.52 (1.46, 1.58) | 2,368.2  |
| Current smoker      | Lower 48 | 0.90 (0.90, 0.91) | 1.84 (1.82, 1.86) | 0.64 (0.64, 0.65) | 1.74 (1.73, 1.74) | 1.26 (1.25, 1.26) | 725,766.7  |
|                     | Alaska   | 1.05 (0.99, 1.13) | 0.93 (0.85, 1.03) | 0.57 (0.55, 0.59) | 2.28 (2.14, 2.44) | 1.15 (1.08, 1.24) | 2,507.7  |
| Poor SRH            | Lower 48 | 0.90 (0.90, 0.90) | 1.92 (1.91, 1.94) | 1.09 (1.09, 1.10) | 2.31 (2.30, 2.31) | 1.14 (1.14, 1.15) | 1,259,181.4  |
|                     | Alaska   | 0.90 (0.86, 0.94) | 1.81 (1.70, 1.92) | 0.90 (0.89, 0.92) | 2.66 (2.54, 2.78) | 0.79 (0.75, 0.83) | 2,367.4  |
| Depressive symptoms | Lower 48 | 1.57 (1.57, 1.58) | 1.37 (1.36, 1.39) | 0.78 (0.78, 0.78) | 1.15 (1.15, 1.15) | 1.04 (1.04, 1.05) | 498,836.6  |
|                     | Alaska   | 1.47 (1.39, 1.57) | 0.98 (0.89, 1.07) | 0.60 (0.58, 0.62) | 0.68 (0.64, 0.73) | 0.80 (0.75, 0.85) | 1,953.0  |
| No checkup          | Lower 48 | 0.87 (0.87, 0.88) | 1.46 (1.45, 1.48) | 0.86 (0.86, 0.86) | 1.02 (1.02, 1.03) | 1.34 (1.34, 1.35) | 182,991.2  |
|                     | Alaska   | 0.93 (0.89, 0.97) | 1.63 (1.53, 1.74) | 0.73 (0.71, 0.74) | 0.92 (0.87, 0.96) | 0.97 (0.92, 1.02) | 1,787.5  |
| Low health literacy | Lower 48 | 0.85 (0.84, 0.85) | 1.29 (1.26, 1.32) | 1.08 (1.08, 1.08) | 2.45 (2.44, 2.45) | 1.13 (1.13, 1.14) | 399,080.4  |
|                     | Alaska   | 0.88 (0.84, 0.91) | 2.61 (2.44, 2.79) | 1.14 (1.12, 1.16) | 1.32 (1.26, 1.37) | 0.98 (0.94, 1.03) | 1,369.5  |

fair or poor health than males, irrespective of state of residence. Females were significantly more likely than males to have depressive symptoms in both Alaska (OR 1.47, 95% CI 1.39–1.57) and in the lower 48 states (OR 1.57, 95% CI 1.57–1.58). Likewise, females were less likely to miss their annual medical checkup and less likely to have low health literacy than their male counterparts, regardless of state of residence. Although there was no significant association between race (Alaska Native/American Indian versus other) and obesity among older adults living in Alaska (OR 1.00, 95% CI 0.94–1.06), the association between race (Alaska Native/American Indian versus other) and obesity was statistically significant for those living in the lower 48 states (OR 1.62, 95% CI 1.60–1.63). Similarly, for those living in the lower 48, Alaska Natives/American Indians were 84% more likely than people of other races to be a current smoker (OR 1.84, 95% CI 1.82–1.86), while there was no significant association between race and smoking status among residents of Alaska. Alaska Natives/American Indians had a significantly higher risk of low health literacy compared to people of other races, regardless of place of residence. However, the strength of the association was notably and significantly stronger among residents of Alaska (OR 2.61) compared to residents of the lower 48 states (OR 1.29).

The results of the multivariate models for the entire sample both with main effects only and with interaction terms for rural\*living in Alaska are shown in Table 3. First, examining the models, living in Alaska itself was associated with a significant increase in the likelihood of a missed checkup (OR 2.44, 95% CI 2.39, 2.50) and low health literacy (OR 1.08, 95% CI 1.06, 1.11). However, in examining the interaction terms, the strength of the association between rural–urban status and health outcomes and behaviours was significantly higher in those living in the lower 48 compared to those living in Alaska for five out of six health outcomes. Living in a rural area of Alaska was associated with a significantly higher risk of obesity (interaction OR 1.38, 95% CI 1.33, 1.43).

## Discussion

The findings of this study suggest that the factors that contribute to poor health outcomes and behaviours vary by place of residence among older adults. These findings underscore the idea that the risk factors generally associated with health and health behaviours among older adults may be different in those older adults living in Alaska compared to those living in the lower 48 states. Such differences may be masked if geographic residence is not taken into account. Older adults living in Alaska have a risk profile for poor health outcomes that is somewhat distinct from the risk profile of older adults living in

**Table 3.** Weighted, adjusted odds ratios of each outcome (and 95% confidence intervals for two models, each using the entire sample: main effects only and with interaction terms for rural\*Alaska.

| Outcome             | Model type        | Alaska            |                   |                   |                   |                   |                   | Alaska*Rural interaction | -2 LL test chi-square |
|---------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------------|-----------------------|
|                     |                   | Female            | Alaska Native     | Age category      | Less than HS ed   | Rural             | Alaska            |                          |                       |
| Obesity             | Main effects only | 0.93 (0.93, 0.94) | 1.49 (1.48, 1.50) | 0.74 (0.74, 0.74) | 1.46 (1.45, 1.46) | 1.06 (1.06, 1.07) | 1.14 (1.12, 1.16) | 888,223.6                |                       |
|                     | Interaction       | 0.93 (0.93, 0.94) | 1.49 (1.48, 1.50) | 0.74 (0.74, 0.74) | 1.46 (1.45, 1.46) | 1.06 (1.06, 1.07) | 1.00 (0.98, 1.02) | 1.38 (1.33, 1.43)        | 888,542.1             |
| Current smoker      | Main effects only | 0.90 (0.90, 0.90) | 2.12 (2.10, 2.14) | 0.65 (0.65, 0.65) | 1.83 (1.83, 1.84) | 1.25 (1.24, 1.25) | 0.91 (0.88, 0.93) | 727,859.1                |                       |
|                     | Interaction       | 0.90 (0.90, 0.90) | 2.13 (2.11, 2.15) | 0.65 (0.65, 0.65) | 1.83 (1.83, 1.84) | 1.25 (1.24, 1.25) | 1.00 (0.97, 1.04) | 0.79 (0.75, 0.84)        | 727,923.8             |
| Poor SRH            | Main effects only | 0.94 (0.94, 0.94) | 2.12 (2.10, 2.13) | 1.11 (1.10, 1.11) | 2.28 (2.28, 2.29) | 1.13 (1.13, 1.14) | 0.96 (0.94, 0.98) | 1,261,280.0              |                       |
|                     | Interaction       | 0.94 (0.94, 0.94) | 2.12 (2.10, 2.13) | 1.11 (1.10, 1.11) | 2.28 (2.28, 2.29) | 1.13 (1.13, 1.14) | 1.00 (0.97, 1.02) | 0.91 (0.87, 0.94)        | 1,261,304.7           |
| Depressive symptoms | Main effects only | 1.55 (1.54, 1.55) | 1.43 (1.42, 1.44) | 0.78 (0.78, 0.78) | 1.13 (1.13, 1.14) | 1.03 (1.03, 1.04) | 0.76 (0.74, 0.78) | 500,141.9                |                       |
|                     | Interaction       | 1.55 (1.54, 1.55) | 1.43 (1.42, 1.44) | 0.78 (0.78, 0.78) | 1.13 (1.13, 1.14) | 1.03 (1.03, 1.04) | 0.85 (0.83, 0.88) | 0.74 (0.70, 0.78)        | 500,273.5             |
| No checkup          | Main effects only | 0.91 (0.91, 0.91) | 1.55 (1.54, 1.57) | 0.85 (0.85, 0.85) | 1.02 (1.02, 1.03) | 1.31 (1.30, 1.31) | 2.18 (2.14, 2.22) | 192,728.0                |                       |
|                     | Interaction       | 0.91 (0.91, 0.91) | 1.56 (1.54, 1.57) | 0.85 (0.85, 0.85) | 1.02 (1.02, 1.03) | 1.31 (1.31, 1.31) | 2.44 (2.39, 2.50) | 0.75 (0.73, 0.78)        | 192,943.5             |
| Low health literacy | Main effects only | 0.88 (0.87, 0.88) | 1.33 (1.31, 1.35) | 1.09 (1.09, 1.09) | 2.44 (2.43, 2.44) | 1.12 (1.11, 1.12) | 1.01 (0.99, 1.02) | 399,599.4                |                       |
|                     | Interaction       | 0.88 (0.87, 0.88) | 1.33 (1.31, 1.36) | 1.09 (1.09, 1.09) | 2.44 (2.43, 2.44) | 1.12 (1.12, 1.12) | 1.08 (1.06, 1.11) | 0.83 (0.81, 0.86)        | 399,704.6             |

the lower 48 states. Using a nationally representative sample of older adults in both Alaska and the lower 48 states, this analysis suggests that being female increases the risk of obesity among residents of Alaska, while females have a slightly reduced risk of being obese for those living in the lower 48 states. Furthermore, although the risks of both obesity and depressive symptoms are substantially higher in older adults of Alaska Native or American Indian descent in those living in the lower 48 states, being of Alaska Native or American Indian descent in Alaska residents imparts no additional risk of obesity or depressive symptoms.

Through examining the interaction models, there were substantial differences in the directionality, magnitude and significance of the association between rural-urban status and the six health outcomes. The association between living in a rural area and obesity was substantially stronger in Alaskan residents than in residents of the lower 48 states. Yet, living in a rural area was protective against all other health outcomes studies in Alaskan residents. Notably, Alaskan older adults, in general, were more likely than older adults living in the lower 48 states to have missed their annual checkup, yet living in a rural area of Alaska actually reduced the risk of missing an annual checkup. These findings both support and contradict studies that have suggested that rural older adults may be sicker and less able to seek medical care for routine preventive services, such as well visits, prevention of chronic disease and routine screening than their urban counterparts due to geographic isolation and distance to services [4,11,12]. Geographic isolation may contribute to social isolation that often precipitates mental health issues, such as depression, among older adults [13]. However, this study found evidence to support this idea among older adults in the lower 48 states, the opposite was true among older adults in Alaska: living in rural areas was protective against all six adverse health outcomes and behaviours, except obesity. The explanations for these findings are not entirely clear. However, it should be noted that in many parts of rural Alaska, health care is delivered by village health aides [14]. Furthermore, older adults living in those parts of rural Alaska may report higher health literacy than their counterparts in the lower 48 because health aides may present health information in ways that are easier to understand tailored to the dialect and customs of the population served [15]. It is also important to distinguish some of the cultural differences related to ageing in rural and remote parts of Alaska compared to rural parts of the lower 48 states. In many small, rural villages in Alaska, ageing is defined by the concept of "eldership", where older adults in those communities are valued and respected by the other residents. One study found four common domains of "eldership" in

rural Alaska villages: emotional well-being, community engagement, spirituality, and physical health [16]. As these communities continue to age and adapt to changing demographic and environmental conditions, it is essential to obtain a more nuanced understanding of health, health care delivery and health behaviours in these rural and remote older adults.

There are several important limitations to consider when interpreting the results of this analysis. First, as this is a cross-sectional analysis of secondary data, we cannot determine causality. Second, although we adjusted for several confounders in the analysis, due to the limited number of variables in BRFSS, as well as the small sample size of older adults living in Alaska, the analysis is subject to residual confounding by variables not used or available in this analysis. Third, all measures are self-reported and not confirmed by a medical professional. For instance, the BRFSS depression question does not measure actual depressive symptoms, but rather it measures whether a medical professional has ever informed the respondent that he or she has a depressive disorder, such as clinical depression. Therefore, the response would be affected both by whether or not the respondent has depressive symptoms, as well as whether the respondent has shared the information with a provider and disclosed that information to the BRFSS survey team. Next, the choice of rural–urban status variable (living in or near a metropolitan statistical area) does not take into account other aspects of what defines “rural” and “urban” [17,18]. To that end, an additional limitation is sampling bias: those living in the most remote areas of Alaska and the lower 48 states may be less likely to have reliable telephone service, either landline or mobile, and therefore less likely to participate in the BRFSS. Another important limitation is that, due to the relatively small sample size of older adults from Alaska, there was insufficient power to examine multiple sociodemographic categories simultaneously to address intersecting social identities and their impacts on health outcomes [19,20]. For example, it was not possible to determine if the rural–urban disparities were consistent across all gender and race/ethnicity subgroups. Lastly, although this analysis covered a wide range of health outcomes, including general health, health literacy and health care-seeking behaviours, the analysis only examined six such outcomes. Future studies can delve deeper into additional aspects of health, such as individual disease outcomes, risk factors and mental health outcomes, to obtain a more comprehensive picture of health among older adults and compare Alaskans to non-Alaskans more thoroughly.

Although these and other limitations serve as important caveats to the interpretation of these study results, this study also has notable strengths. This is among the

first such study to compare and contrast social determinants of health in Alaskan older adults and older adults living in the lower 48 states. While the study only examined six health outcomes, it should be noted that these health outcomes cover a wide breadth of health, health-related quality of life, and health behaviours among older adults. Relatedly, to examine the potential for the relationships between social determinants and health outcomes to vary by place of residence (Alaska versus lower 48 states) among older adults, the statistical analysis incorporated both stratification to facilitate interpretation of results and interaction to assess statistical significance of the potential moderation. Lastly, the BRFSS sample of older adults in this analysis was designed to be nationally representative of the US population. Therefore, subject to the caveats described above, study findings can be generalised to the entire US population of older adults.

The results of this study highlight the notion that the set of social factors that determine or contribute to health, health behaviours and health-related quality of life among older adults living in the lower 48 states may not be the same set of such factors that determine those health outcomes among older adults living in Alaska. These findings have potentially important implications both for policy and future research. In terms of policy, these findings suggest that there may be factors unique to the needs of older adults living in Alaska that need to be addressed to reduce health disparities in this vulnerable population. Future research is needed to better understand those place-based social determinants that drive health disparities among Alaskan older adults. As population ageing in Alaska outpaces the rests of the US, there is an urgent need to identify and address health disparities to ensure health equity, access to quality care and the ability to successfully age in place for all older adults regardless of geography.

### Disclosure statement

No potential conflict of interest was reported by the authors.

### Funding

The authors have not received any funding or benefits from industry or elsewhere to conduct this study.

### References

- [1] Alaska Department of Labor and Workforce Development. Alaska Economic Trends. 2017 June [cited 2018 Dec 17]. Available from: <http://labor.state.ak.us/trends/jun17.pdf>

- [2] Foutz JD, Cohen SA, Cook SK. Challenges and barriers to health care and overall health in older residents of Alaska: evidence from a national survey. *Int J Circumpolar Health*. 2016 Jan 1;75(1):30348.
- [3] Kachan D, Tannenbaum SL, Olano HA, et al. Peer reviewed: geographical variation in health-related quality of life among older US adults, 1997–2010. *Prev Chronic Dis*. 2014;11:E110.
- [4] Goins RT, Williams KA, Carter MW, et al. Perceived barriers to health care access among rural older adults: a qualitative study. *J Rural Health*. 2005.
- [5] Woolf SH, Braveman P. Where health disparities begin: the role of social and economic determinants – and why current policies may make matters worse. *Health Affairs*. 2011 Oct 1;30(10):1852–1859.
- [6] Monnat SM, Pickett CB. Rural/urban differences in self-rated health: examining the roles of county size and metropolitan adjacency. *Health Place*. 2011 Jan 31;17(1):311–319.
- [7] Kunitz SJ. The history and politics of US health care policy for American Indians and Alaskan Natives. *Am J Public Health*. 1996 Oct;86(10):1464–1473.
- [8] Goodkind JR, Ross-Toledo K, John S, et al. Promoting healing and restoring trust: policy recommendations for improving behavioral health care for American Indian/Alaska Native adolescents. *Am J Commun Psychol*. 2010 Dec 1;46(3–4):386–394.
- [9] Probst JC, Moore CG, Glover SH, et al. Person and place: the compounding effects of race/ethnicity and rurality on health. *Am J Public Health*. 2004 Oct;94(10):1695–1703.
- [10] Centers for Disease Control and Prevention (CDC). Behavioral risk factor surveillance system survey data. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2016.
- [11] Chan L, Hart LG, Goodman DC. Geographic access to health care for rural medicare beneficiaries. *J Rural Health*. 2006 Apr;22(2):140–146.
- [12] Rosenthal TC, Fox C. Access to health care for the rural elderly. *JAMA*. 2000 Oct 25;284(16):2034–2036.
- [13] Inder KJ, Lewin TJ, Kelly BJ. Factors impacting on the well-being of older residents in rural communities. *Perspect Public Health*. 2012 Jul;132(4):182–191.
- [14] Golnick C, Asay E, Provost E, et al. Innovative primary care delivery in rural Alaska: a review of patient encounters seen by community health aides. *Int J Circumpolar Health*. 2012 Jan 1;71(1):18543.
- [15] Sequist TD, Cullen T, Acton KJ. Indian health service innovations have helped reduce health disparities affecting American Indian and Alaska Native people. *Health Affairs*. 2011 Oct 1;30(10):1965–1973.
- [16] Lewis JP. Successful aging through the eyes of Alaska native elders. What it means to be an elder in Bristol Bay, AK. *Gerontologist*. 2011 Feb 28;51(4):540–549.
- [17] Waldorf B. 2007. What is rural and what is urban in Indiana. Purdue Center for Regional Development Report. p. 4.
- [18] Cohen SA, Cook SK, Sando TA, et al. What aspects of rural life contribute to rural–urban health disparities in older adults? Evidence from a national survey. *J Rural Health*. 2017;34(3):293–303.
- [19] Sabik NJ. Digging deeper: research practices and recommendations for exploring intersectionality and social and cultural influences on personality, identity, and well-being. In: Roberts T, Curtin N, Duncan LE, Cortina LM, editors. *Feminist perspectives on building a better psychological science of gender*. Cham: Springer; 2016. p. 143–160.
- [20] Bowleg L. The problem with the phrase women and minorities: intersectionality – an important theoretical framework for public health. *Am J Public Health*. 2012 Jul;102(7):1267–1273.