RESEARCH ARTICLE

Racial disparities in cancer-related survival in patients with squamous cell carcinoma of the esophagus in the US between 1973 and 2013

Alice Kim, Peter Ashman, Melissa Ward-Peterson, Juan Manuel Lozano, Noé C. Barengo

1 Herbert Wertheim College of Medicine, Florida International University, Miami, Florida, United States of America, 2 Department of Medical and Health Science Research, Herbert Wertheim College of Medicine, Florida International University, Miami, Florida, United States of America, 3 Department of Epidemiology, Robert Stempel College of Public Health & Social Work, Florida International University, Miami, Florida, United States of America

☯ These authors contributed equally to this work.

* nbarengo@fiu.edu

Abstract

Background

Esophageal cancer makes up approximately 1% of all diagnosed cancers in the US. There is a persistent disparity in incidence and cancer-related mortality rates among different races for esophageal squamous cell carcinoma (SCC). Most previous studies investigated racial disparities between black and white patients, occasionally examining disparities for Hispanic patients. Studies including Asians/Pacific Islanders (API) as a subgroup are rare. Our objective was to determine whether there is an association between race and cancer-related survival in patients with esophageal SCC.

Methods and findings

This was a retrospective cohort study using the National Cancer Institute’s Surveillance, Epidemiology, and End Result (SEER) database. The SEER registry is a national database that collects information on all incident cancer cases in 13 states of the United States and covers nearly 26% of the US population. Patients aged 18 and over of white, black, or Asian/Pacific Islander (API) race with diagnosed esophageal SCC from 1973 to 2013 were included (n = 13,857). To examine overall survival, Kaplan-Meier curves were estimated for each race and the log-rank test was used to compare survival distributions. Cox proportional hazards models were used to estimate unadjusted and adjusted hazard ratios with 95% confidence intervals. The final adjusted model controlled for sex, marital status, age at diagnosis, stage at diagnosis, ethnicity, and form of treatment. Additional analyses stratified by decade of diagnosis were conducted to explore possible changes in survival disparities over time. After adjustment for potential confounders, black patients had a statistically significantly higher hazard ratio compared to white patients (HR 1.08; 95% confidence interval (CI) 1.03–1.13). However, API patients did not show a statistically significant difference in survival compared with white patients (HR 1.00; 95% CI 0.93–1.07).
those diagnosed between 2000 and 2013 (HR 2.05, 95% CI 1.93–2.19). Patients diagnosed in 1980–1989 and 1990–1999 had HRs of 1.59 (95% CI 1.51–1.68) and 1.33 (95% CI 1.26–1.41), respectively. After stratification according to decade of diagnosis, the HR for black patients compared with white patients was 1.14 (95% CI 1.02–1.29) in 1973–1979 and 1.12 (95% CI 1.03–1.23) in 1980–1989. These disparities were not observed after 1990; the HR for black patients compared with white patients was 1.03 (95% CI 0.93–1.13) in 1990–1999 and 1.05 (95% CI 0.96–1.15) in 2000–2013.

Conclusions

Black patients with esophageal SCC were found to have a higher hazard of death compared to white and API patients. Survival disparities between races appear to have decreased over time. Future research that takes insurance status and other social determinants of health into account should be conducted to further explore possible disparities by race.

Introduction

Racial and ethnic minorities have been shown to have worse outcomes and receive a lower quality of healthcare than those of non-minorities. This has been attributed to decreased access to necessary health care due to socioeconomic status, language, geography, and cultural familiarity. There is a great need to educate healthcare professionals regarding racial disparities in order to better provide quality healthcare to minority patients [1].

Esophageal cancer makes up approximately 1% of all diagnosed cancers in the US [2]. Much of the advances in treatment options involving multimodality therapy—such as radiation, chemotherapy, or both before surgery—was developed in the mid-1980s. Despite improved treatment and survival rates, however, the 5-year relative survival has remained at 19% since 2000 [3–5].

Although there are declining overall mortality rates in cancer patients in the US, there is a persistent disparity in incidence and cancer-related mortality rates among different races/ethnicities for esophageal squamous cell carcinoma (SCC). In the US, black patients have more than five-fold higher incidence (16.8 per 100,000) of esophageal SCC than white patients (3 per 100,000) [6]. Black patients were more likely to be diagnosed at an advanced stage and less likely to have surgery compared to white patients [7, 8]. Studies describing esophageal cancer epidemiology found that black patients have a higher cancer-related mortality than white patients [9, 10, 11].

Most previous retrospective cohort studies investigated racial disparities between black and white patients [7, 9, 10–15], occasionally examining disparities for Hispanic patients [11]. Studies including Asians/Pacific Islanders (API) as a subgroup are rare [16, 17]. One of the few studies of esophageal cancer among API patients was done from 1930–1967, showing that Chinese and Japanese males had a higher all-cause mortality compared to white patients [16].

The objective of this study was to determine whether there are racial disparities in cause-specific survival among patients with esophageal SCC, and whether such disparities have changed over the last four decades.

Materials and methods

Study design

This was a retrospective cohort study and secondary data analysis using the National Cancer Institute's Surveillance, Epidemiology, and End Result (SEER) database (S1 File). SEER
registry is a national database that collects information on all incident cancer cases in 13 states of the United States and covers nearly 26% of the US population [18]. Adults ages 18 and over in 13 states diagnosed with SCC of the esophagus (ICD-O-3) from 1973 to 2013 with information on stage at diagnosis were included. After excluding those patients with a race category of “Other”, an unknown stage at diagnosis, and those without a primary tumor of esophageal SCC of the esophagus we were left with a sample size of 13,857. The main exposure of interest was race, defined as white, black, or API. The main outcome was survival using cause-specific mortality. Possible confounders included sex, age at diagnosis (18–49, 50–59, 60–69, 70–79, and 80 years or older), decade of diagnosis (1973–1979, 1980–1989, 1990–1999, and 2000–2013), ethnicity (non-Spanish/Hispanic/Latino and Spanish/Hispanic/Latino), stage at diagnosis (in-situ, localized, regional, or distant), form of treatment (radiation and surgery), marital status, and insurance status. Marital status was categorized as partnered (married or domestic partner) and un-partnered (single, separated, divorced, or widowed).

Statistical analysis
Exploratory analysis was conducted using frequency distributions. Chi-square tests were used to compare the distribution of possible confounders by race. Cox proportional hazards models were used to estimate unadjusted and adjusted hazard ratios with 95% confidence intervals; adjusted survival curves were generated from the adjusted analysis (Figs 1, 2, 3, 4 and 5). Variance inflation factors were used to assess for multicollinearity in the final adjusted model; the proportional hazards assumption was tested graphically. The final adjusted model controlled for sex, marital status, age at diagnosis, decade of diagnosis, ethnicity, stage at diagnosis, and form of treatment. Additional analyses stratified by decade of diagnosis were conducted to explore possible changes in survival disparities over time. SPSS 23 (IBM, Armonk, New York) was used for all analyses. P-values less than or equal to 0.05 were considered statistically significant.

Ethical considerations
Permission to use and access to the SEER database was obtained through the SEER website. Ethical approval was waived since the analysis was considered nonhuman subjects research by the Florida International University Health Sciences IRB.

![Adjusted survival curves, by race, for adult patients in the SEER database diagnosed with esophageal squamous cell carcinoma, 1973–2013.](https://doi.org/10.1371/journal.pone.0183782.g001)
Table 1 describes the demographic and clinical characteristics patients with esophageal SCC in the SEER registry from 1973 to 2013. Among all races, most patients were diagnosed between the ages of 60 and 69 years old (white 34.2%, black 33.5%, API 32.5%). However, a greater proportion of younger black patients (18–49 years-old) were diagnosed with esophageal SCC compared to other races. A higher proportion of men were diagnosed with esophageal SCC; API women represented the lowest proportion of cases (18.6%). Increasing proportions of cases among API patients were observed over time. In contrast to white and API patients, a
higher proportion of black patients were un-partnered (65.5%), uninsured (7.0%), receiving Medicaid (32.6%), and diagnosed at a later stage (36.4%). More than two-thirds of patients across all races received radiation, while less than a third underwent surgery.

The adjusted cumulative survival curve of the adjusted Cox regression model revealed a lower survival for esophageal SCC in black patients (Fig 1).

Table 2 shows unadjusted and adjusted hazard ratio (HR) estimations. After adjustment for potential confounders, black patients had a statistically significantly higher hazard ratio compared to white patients (HR 1.08; 95% confidence interval (CI) 1.03–1.13). However, API patients did not show a statistically significant difference in survival compared with white patients.
patients (HR 1.00; 95% CI 0.93–1.07). Additionally, as age at diagnosis increased, hazard ratios increased. Females had a lower hazard of death compared with males (HR 0.87; 95% CI 0.83–0.91). Un-partnered patients had an increased hazard compared with those who were partnered (HR 1.17; 95% CI 1.12–1.22). As the stage of diagnosis increased, the hazard of death increased. Patients who did not receive radiation therapy or undergo surgery had HRs of 1.78 (95% CI 1.70–1.87) and 2.17 (95% CI 2.05–2.28), respectively. Patients diagnosed between 1973 and 1979 had twice the hazard of death compared to those diagnosed between 2000 and 2013 (HR 2.05, 95% CI 1.93–2.19). Patients diagnosed in 1980–1989 and 1990–1999 had HRs of 1.59 (95% CI 1.51–1.68) and 1.33 (95% CI 1.26–1.41), respectively.

Table 1. Demographic and clinical characteristics, by race, of adult patients in the SEER registry diagnosed with esophageal squamous cell carcinoma, 1973–2003.

| Race                  | White | Black | Asian/Pacific Islander | p-value |
|-----------------------|-------|-------|------------------------|---------|
|                       | N (%) | N (%) | N (%)                  |         |
| Age (years)           |       |       |                        | <0.001  |
| 18–49                 | 406 (4.7) | 544 (13.7) | 94 (7.4)               |         |
| 50–59                 | 1653 (19.0) | 1317 (33.2) | 257 (20.2)             |         |
| 60–69                 | 2970 (34.2) | 1328 (33.5) | 415 (32.5)             |         |
| 70–79                 | 2524 (29.1) | 635 (16.0) | 335 (26.3)             |         |
| > = 80                | 1132 (13.0) | 139 (3.5) | 174 (13.6)             |         |
| Sex                   |       |       |                        | <0.001  |
| Male                  | 5638 (64.9) | 2856 (72.1) | 1038 (81.4)           |         |
| Female                | 3047 (35.1) | 1107 (27.9) | 237 (18.6)            |         |
| Decade of diagnosis   |       |       |                        | <0.001  |
| 1973–1979             | 1696 (19.5) | 670 (16.9) | 145 (11.4)             |         |
| 1980–1989             | 2331 (26.8) | 1219 (30.8) | 247 (19.4)             |         |
| 1990–1999             | 2076 (23.9) | 1031 (26.0) | 308 (24.2)             |         |
| 2000–2013             | 2582 (29.7) | 1043 (26.3) | 575 (45.1)             |         |
| Marital Status        |       |       |                        | <0.001  |
| Unpartnereda          | 3623 (43.1) | 2436 (65.5) | 436 (35.1)             |         |
| Partnereda            | 4788 (56.9) | 1283 (34.5) | 806 (64.9)             |         |
| Ethnicity             |       |       |                        | <0.001  |
| Non-Spanish/Hispanic/Latino | 8209 (94.5) | 3947 (99.6) | 1262 (99.0)           |         |
| Spanish/Hispanic/Latino | 476 (5.5) | 16 (0.4) | 13 (1.0)               |         |
| Stage at Diagnosis    |       |       |                        | <0.001  |
| In-situ               | 93 (1.1) | 16 (0.4) | 10 (0.8)               |         |
| Localized             | 2984 (34.4) | 1250 (31.5) | 319 (25.0)             |         |
| Regional              | 2950 (34.0) | 1253 (31.6) | 488 (38.3)             |         |
| Distant               | 2658 (30.6) | 1444 (36.4) | 458 (35.9)             |         |
| Received Radiation    |       |       |                        | 0.314  |
| Yes                   | 5734 (67.4) | 2556 (66.5) | 870 (68.7)            |         |
| No                    | 2775 (32.6) | 1290 (33.5) | 397 (31.3)            |         |
| Received Surgery      |       |       |                        | <0.001  |
| Yes                   | 2378 (30.1) | 982 (26.0) | 346 (27.5)            |         |
| No                    | 5525 (69.9) | 2799 (74.0) | 912 (72.5)            |         |

aUnpartnered: single, separated, divorced or widowed;
bPartnered: married or unmarried/domestic partner

https://doi.org/10.1371/journal.pone.0183782.t001
After stratification according to decade of diagnosis, the HR for black patients compared with white patients was 1.14 (95% CI 1.02–1.29) in 1973–1979 and 1.12 (95% CI 1.03–1.23) in 1980–1989. These disparities were not observed after 1990; the HR for black patients compared with white patients was 1.03 (95% CI 0.93–1.13) in 1990–1999 and 1.05 (95% CI 0.96–1.15) in 1990–1999.

### Table 2. Unadjusted and adjusted hazard ratios for cause-specific survival among adult patients in the SEER database diagnosed esophageal squamous cell carcinoma, 1973 and 2013.

|                  | Unadjusted Model 1 | Model 1 |
|------------------|--------------------|---------|
|                  | HR* (95% CI)       | HR (95% CI) |
| **Race**         |                    |         |
| White            | Ref                | Ref     |
| Black            | 1.15 (1.11–1.20)   | 1.08 (1.03–1.13) |
| Asian/Pacific Islander | 0.97 (0.91–1.04) | 1.00 (0.93–1.07) |
| **Age**          |                    |         |
| 18–49            | Ref                | Ref     |
| 50–59            | 1.08 (0.99–1.17)   | 1.05 (0.96–1.14) |
| 60–69            | 1.06 (0.98–1.14)   | 1.07 (0.99–1.17) |
| 70–79            | 1.10 (1.02–1.19)   | 1.15 (1.06–1.26) |
| >= 80            | 1.31 (1.19–1.43)   | 1.43 (1.30–1.59) |
| **Sex**          |                    |         |
| Male             | Ref                | Ref     |
| Female           | 0.86 (0.82–0.89)   | 0.87 (0.83–0.91) |
| **Date of Diagnosis** |                |         |
| 2000–2013        | Ref                | Ref     |
| 1990–1999        | 1.12 (1.07–1.18)   | 1.33 (1.26–1.41) |
| 1980–1989        | 1.30 (1.24–1.37)   | 1.59 (1.51–1.68) |
| 1973–1979        | 1.60 (1.52–1.69)   | 2.05 (1.93–2.19) |
| **Partnered**    |                    |         |
| Partnered        | Ref                | Ref     |
| Unpartnered      | 1.19 (1.14–1.24)   | 1.17 (1.12–1.22) |
| **Ethnicity**    |                    |         |
| Non-Spanish/Hispanic/Latino | Ref | Ref |
| Spanish/Hispanic/Latino | 0.92 (0.83–1.02) | 0.98 (0.88–1.09) |
| **Staging**      |                    |         |
| In-situ          | Ref                | Ref     |
| Localized        | 2.99 (2.24–3.99)   | 3.00 (2.18–4.12) |
| Regional         | 3.76 (2.82–5.01)   | 4.70 (3.42–6.45) |
| Distant          | 6.81 (5.11–9.09)   | 6.88 (5.01–9.45) |
| **Radiation**    |                    |         |
| Yes              | Ref                | Ref     |
| No               | 1.34 (1.28–1.39)   | 1.78 (1.70–1.87) |
| **Surgery**      |                    |         |
| Yes              | Ref                | Ref     |
| No               | 1.81 (1.73–1.90)   | 2.17 (2.05–2.28) |

*Hazard ratio;  
*Confidence interval;  
*Reference group;  
*Partnered: married or unmarried/domestic partner;  
*Unpartnered: single, separated, divorced or widowed

https://doi.org/10.1371/journal.pone.0183782.t002
Figs 2, 3, 4 and 5 display the adjusted survival curves by race for each decade of diagnosis.

**Discussion**

Overall, there appeared to be racial disparities in survival among patients with esophageal SCC patients when comparing white and black patients. However, in the stratified analyses, this disparity seemed to disappear after 1990. There was no observed disparity when comparing white and API patients.

Previous retrospective cohort studies mainly investigated the racial disparities between black and white patients [7, 9, 10–15] and occasionally, included Hispanics as well [11]. Only two studies included Asians/Pacific Islanders, one conducted between 1930 and 1967 [16] and the other one in British Columbia, Canada [17]. Many of the studies used the SEER database for their study, with years ranging from 1988–2003, 1991–2000 and 1973–1998 [7, 9, 13]. Our study is partially in agreement with previous scientific evidence that black patients with esophageal SCC have worse survival when compared to white patients. The majority of the studies showed that non-white racial and ethnic groups with esophageal cancer had lower survival rates when compared to white patients [7, 9–11]. One study found a 37% vs 60% 5-year survival rate in blacks vs whites, respectively [7]. Another revealed that age-adjusted mortality for black patients was nearly twice that of whites with a relative risk of 7.79 vs 3.96 [9]. Baquet et al included patients from the US Veterans Affairs (VA), and showed that mortality rates were increased for black patients with esophageal SCC, (Relative Risk 1.33), but not adenocarcinoma [10].

We found that survival was significantly lower for black patients only before the 1990s. This finding is somehow surprising as access to care has not improved much for blacks [19]. Inadequate health care access and insurance coverage are major factors that contributed to racial and ethnic disparities before the implementation of the affordable health care act (ACA) in 2014 [20–22]. In addition, it has been shown that even if blacks have access to care, it may not be timely and of good quality. Thus, the upcoming years will show whether the ACA will benefit racial and ethnic minorities who historically have experienced lower coverage rates and suboptimal access to care [21, 22].

As the decade of diagnosis progressed, overall survival improved, indicating a general improvement in treatment of esophageal SCC over time. Treatment and management protocols for esophageal cancer are regularly updated according to the best scientific evidence [23, 24]. The most recent, 7th edition of the AJCC Cancer Staging Manual for esophagus and esophagogastric junction cancers was developed based on a database of 4,627 esophagectomy patients who were not treated with induction or adjuvant therapy [24, 25]. The treatment of early-stage esophageal cancer and high-grade dysplasia of the esophagus has changed significantly in recent years [23]. Many early tumors that were traditionally treated with esophagectomy can now be resected with endoscopic therapy alone [23]. Finally, it has to be kept in mind that, it is difficult to assess when and whether the healthcare providers in the 13 SEER registry states adopt new treatment and management guidelines for esophageal SCC patients.

The finding of a substantial decrease in survival for those with increasing stage at diagnosis was unsurprising. Moreover, the findings that radiation and surgery improve survival are consistent with previous research in this patient population [7, 8]. Thus, radiation and surgery should be offered to patients who would benefit from this treatment to increase their survival time. Many previous studies also reported poorer outcomes (besides mortality) and treatment management in racial minorities compared with whites [7, 8]. Moreover, surgical interventions such as esophagectomies were conducted less in Hispanics and blacks [7, 10, 12].
Proportions of unknown regional lymph nodes status and pathologic review were higher among blacks than whites [8]. Blacks and Hispanics were also found to have a higher incidence of esophageal cancer and diagnosed at a later stage [7, 9, 13]. Numerous factors were speculated to play a role in such disparity in mortality—such as health care access, biological behavior of cancer, variation in socioeconomic status, lifestyle differences, alcohol consumption, nitrosamines, dietary deficiencies, and environmental exposures [14].

The lower survival among unpartnered SCC patients is consistent with the current scientific evidence. Previous studies have shown that married individuals are generally healthier than unmarried individuals, which includes people who were divorced, separated, widowed, never married, or living with a partner [26–28]. The general hypothesis between these studies was that married patients have a greater social support system, which improves overall health maintenance, including medication adherence [29]. Moreover, married patients seem to have a lower mortality compared to widowed patients, possibly due to greater social support and decreased stress [30].

Limitations of our study are worth noting. First, the SEER registry only includes data from 13 US states, which are not completely representative of the US population. Asian and Pacific Islanders may be very different in regard risk factors and genetic background. However, as the definitions used by SEER for Asian/Pacific Islanders were not used consistently over time, they could not be analyzed separately. It is noteworthy to mention that most studies indeed analyze them as a combine category allowing some comparisons between the results of previous studies with ours. Additionally, we were unable to adjust for insurance status in our final model. The SEER database only included data for those patients in the database from 2007 onwards. When we analyzed this sub-sample (n = 1802), using all covariates present in our final model except decade of diagnosis and adjusting for insurance status, results comparing black and white patients did not achieve statistical significance (HR 1.02; 95% CI 0.88–1.19). Furthermore, SEER does not provide important information related to lifestyle habits such as pack-year of smoking or known social determinants of health, including variables such as socioeconomic status and education. Insurance status and other social determinants may be the underlying factors in racial disparities of esophageal SCC survival, and future research should seek to explore these factors more fully. Finally, an important limitation using SEER data is that treatment data in the SEER registry is not complete and thus, some degree of bias cannot be ruled out.

In conclusion, black patients with esophageal SCC were found to have a higher hazard of death compared to white and API patients. Survival disparities between races appear to have decreased over time. Future research that takes insurance status and other social determinants of health into account should be conducted to further explore possible disparities by race.

Supporting information

S1 File. Data access. The data underlying this study are third party data. The authors gained access to the data by submitting a request to the National Cancer Institute’s Surveillance, Epidemiology, and End Results (SEER) Program through their website: https://seer.cancer.gov/seertrack/data/request/. Interested researchers may apply for access to these data in the manner described. (DOCX)

Author Contributions

Conceptualization: Alice Kim, Peter Ashman, Melissa Ward-Peterson, Juan Manuel Lozano, Noé C. Barengo.
Data curation: Melissa Ward-Peterson.

Formal analysis: Alice Kim, Peter Ashman, Melissa Ward-Peterson.

Methodology: Alice Kim, Peter Ashman, Juan Manuel Lozano, Noé C. Barengo.

Supervision: Noé C. Barengo.

Writing – original draft: Alice Kim, Peter Ashman.

Writing – review & editing: Melissa Ward-Peterson, Juan Manuel Lozano, Noé C. Barengo.

References

1. Smedley B, Stite A, Nelson A. Ch 3 Assessing Potential Sources of Racial and Ethnic Disparities in Care: Patient- and System-Level Factors. In: Unequal treatment: Confronting racial and ethnic disparities in health care. Washington, DC: National Academic Press. Washington, D.C. 2002; p125-159.

2. What are the key statistics about cancer of the esophagus? March 20, 2014. Available at http://www.cancer.org/cancer/esophagealcancer/detailedguide/esophageal-cancer-key-statistics. Cited January 11, 2017.

3. Eslick, Guy D. Esophageal cancer: a historical perspective. Gastroenterology Clinics of North America. 2009; 38 (1): 1–15. https://doi.org/10.1016/j.gtc.2009.01.003 PMID: 19327564

4. Cancer Stat Facts: Esophageal Cancer. Available at https://seer.cancer.gov/statfacts/html/esoph.html. Cited January 11, 2017.

5. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2016. CA Cancer J Clin. 2016; 66(1):7–30. https://doi.org/10.3322/caac.21332 PMID: 26742998

6. Brown LM, Hoover R, Silverman D, Baris D, Hayes R, Swanson GM, et al. Excess incidence of squamous cell esophageal cancer among US black men: role of social class and other risk factors. Am J Epidemiol. 2001; 153: 114–22.

7. Greenstein AJ, Litte VR, Swanson SJ, Divino CM, Packer S, McGinn TG, Winsivesky JP. Racial disparities in esophageal cancer treatment and outcomes. Ann Surg Oncol. 2008; 15(3):881–8. https://doi.org/10.1245/s10434-007-9664-5 PMID: 17987341

8. Polednak AP. Patients with squamous cell cancer of the esophagus. Journal of the National Medical Association. 2004; 96 (1):87–92. PMID: 14746357

9. Baquet CR, Comnisskey P, Mack K, Meltzer S, Mishra S. Esophageal cancer epidemiology in blacks and whites: racial and gender disparities in incidence, mortality, survival rates, and histology. J Natl Med Assoc. 2005; 97(11):1471–8. PMID: 16334494

10. Dominitz JA, Maynard C, Billingsley KG, Boyko EJ. Race, treatment, and survival of veterans with cancer of the distal esophagus and gastric cardia. Med Care. 2002; 40(1 Suppl):14–26.

11. Jinjuvadia R., Jinjuvadia K. & Liangpunsakul S. Racial disparities in gastrointestinal cancers-related mortality in the US population. Dig Dis Sci. 2013; 58: 236. https://doi.org/10.1007/s10620-012-2312-3 PMID: 22797822

12. Reveals SL, Morris AM, Reddy RM, Akateh C, Wong SL. Racial disparities in esophageal cancer outcomes. Ann Surg Oncol. 2013; 20(4):1136–41. https://doi.org/10.1245/s10434-012-2807-3 PMID: 23263780

13. Younes M, Henson DE, Ertan A, Miller CC. Incidence and survival trends of esophageal carcinoma in the United States: racial and gender differences by histological type. Scand J Gastroenterol. 2002; 37 (12):1359–65. PMID: 12523583

14. Bang KM, White JE, Gause BL, Leffall LD Jr. Evaluation of recent trends in cancer mortality and incidence among blacks. Cancer. 1988; 61: 1255–1261. PMID: 3342381

15. Miller J, Rege RV, Ko CY, Livingston EH. Health care access and poverty do not explain the higher esophageal cancer mortality in African Americans. The American Journal of Surgery. 2004; 188: 22–26.

16. Schoenberg BS, Bailar JC 3rd, Fraumeni JF Jr. Certain mortality patterns of esophageal cancer in the United States, 1930–67. J Natl Cancer Inst. 1971; 46(1):63–73. PMID: 5546194

17. Bashash M, Hislop TG, Shah AM, Le N, Brooks-Wilson A, Bajdik CD. The prognostic effect of ethnicity for gastric and esophageal cancer: the population-based experience in British Columbia, Canada. BMC Cancer. 2011; 11:186. https://doi.org/10.1186/1471-2407-11-164 PMID: 21554722

18. Surveillance, Epidemiology and Results Program. Surveillance, Epidemiology and Results Program. https://seer.cancer.gov. Cited January 26, 2017.
19. Feagin J, Bennefield Z. Systemic racism and U.S. health care. Soc Sci Med. 2014; 103:7–14. https://doi.org/10.1016/j.socscimed.2013.09.006 PMID: 24507906

20. Chen J, Vargas-Bustamante A, Mortensen K, Ortega AN. Racial and Ethnic Disparities in Health Care Access and Utilization Under the Affordable Care Act. Med Care. 2016; 54(2):140–146. https://doi.org/10.1097/MLR.0000000000000467 PMID: 26595227

21. Clemans-Cope L, Kenney G, Buettgens M, Carroll C, Blavin F. The Affordable Care Act’s coverage expansions will reduce differences in uninsurance rates by race and ethnicity. Health Aff. 2012; 31:920–930.

22. Sealy-Jefferson S, Vickers J, Elam A, Wilson MR. Racial and ethnic health disparities and the Affordable Care Act: a status update. J Racial Ethnic Health Disparities. 2015; 2:583–588.

23. McLaren PJ, Dolan JP. Surgical Treatment of High-Grade Dysplasia and Early Esophageal Cancer. World J Surg. 2017 Mar 3. doi: 10.1007/s00268-017-3958-y. [Epub ahead of print] PMID: 28258451

24. Berry MF. Esophageal cancer: staging system and guidelines for staging and treatment. J Thorac Dis. 2014; 6 Suppl 3:S289–9

25. Rice TW, Rusch VW, Ishwaran H, Blackstone EH; Worldwide Esophageal Cancer Collaboration. Cancer of the esophagus and esophagogastric junction: data-driven staging for the seventh edition of the American Joint Committee on Cancer/International Union Against Cancer Cancer Staging Manuals. Cancer 2010; 116:3763–73. https://doi.org/10.1002/cncr.25146 PMID: 20564099

26. Va P, Yang W-S, Nechuta S, Chow WH, Cai H, Yang G, et al. Marital Status and Mortality among Middle Age and Elderly Men and Women in Urban Shanghai. PLoS ONE 2011; 6(11): e26600. https://doi.org/10.1371/journal.pone.0026600 PMID: 22073174

27. Schoenborn C. Marital Status and Health: United States, 1999–2002. CDC Advance Data From Vital and Health Statistics. 2004; 351:2–3. [CDC Web site]. Available at: https://www.cdc.gov/nchs/data/ad/ad351.pdf. Accessed January 20, 2017

28. Robards J, Evandrou M, Falckingham J, Vlachantoni A. Marital status, health and mortality. Maturitas. 2012; 73(4):295–299. https://doi.org/10.1016/j.maturitas.2012.08.007 PMID: 23007006

29. Quinones PA, Kirchberger I, Amann U, Heier M, Kuch B, von Sch eidt W, Meisinger C. Does marital status contribute to the explanation of the hypercholesterolemia paradox in relation to long term mortality in myocardial infarction? Findings from the MONICA/KORA Myocardial Infarction Registry. Prev Med. 2015; 75:25–31 https://doi.org/10.1016/j.ypmed.2015.03.013 PMID: 25812782

30. Consuegra-Sánchez L, Melgarejo-Moreno A, Jaulent-Huertas L, Díaz-Pastor Á, Escudero-García G, Vicente-Gilabert M, et. al. Unraveling the relation between marital status and prognosis among myocardial infarction survivors: Impact of being widowed on mortality. Int J Cardiol. 2015; 185:141–3. https://doi.org/10.1016/j.ijcard.2015.03.113 PMID: 25795204