

Title: Socioeconomic measures influence survival in osteosarcoma: an analysis of the National Cancer Data Base

Authors: Benjamin J. Miller, MD, MS, Josef Tofte, MD, Yubo Gao, PhD, Kyle R Duchman, MD

**Background:** Prior work has established many patient- and tumor-related risk factors that increase the likelihood of mortality in osteosarcoma. Although low socioeconomic status has been found to be associated with an increased risk of presentation with metastatic disease, no clear relationship has been established with differences in overall survival. The National Cancer Data Base (NCDB) is a collaboration between the American College of Surgeons Commission on Cancer and the American Cancer Society and collects treatment and outcomes data from 1,500 hospitals, representing 70% of all new cancer diagnoses in the United States. This data source has not previously been used to investigate risk factors for survival in osteosarcoma.

**Methods:** We queried the NCDB from 1998-2012 and identified 3,503 patients aged <1-39 years with a diagnosis of high-grade conventional osteosarcoma. Zip code level quartiles of median household income and percent of high school graduates were combined to form a socioeconomic status (SES) composite variable. We investigated patient- (age, sex, race, insurance, rural/urban, distance to treating center, and SES composite score), tumor- (metastatic, site, size), and treatment- (margins) related factors to determine associations with 2-, 5-, and 10-year overall survival. Univariate relationships were investigated using Kaplan-Meier survival analysis and associated log-rank tests. Factors that demonstrated differences in univariate survival ( $p < 0.1$ ) were included in a multivariate Cox proportional hazard model of 3,107 patients to determine independent predictors of survival.

**Results:** Univariate analysis demonstrated differences with all predictor variables except for rural/urban and distance to the treating center (Fig 1). In order of decreasing magnitude, the independent risk factors in the multivariate analysis for 5-year survival were metastatic disease (HR 3.26, 95% CI 2.78-3.83), primary site in the pelvis or spine (HR 2.19, 95% CI 1.82-2.63), positive margins (HR 1.81, 95% CI 1.45-2.26), tumor size > 10 cm (HR 1.71, 95% CI 1.32-2.20), age  $\geq 18$  years (HR 1.29, 95% CI 1.13-1.47), and lowest quartile of SES composite (HR 1.25, 95% CI 1.03-1.52).

**Conclusions:** This investigation confirms that socioeconomic variables influence overall survival in osteosarcoma in the United States. The effect is similar to an older age at diagnosis ( $\geq 18$  years), and appears to be more significant than sex or race. However, the relative effects are not as great as the tumor- and treatment-related risk factors which remain the greatest threat to overall survival. Mitigation of low socioeconomic status is not easily achieved and the overall public health impact in a rare tumor is questionable. In addition, the exact cause of increased mortality is not clear and could be due to a number of individual, community, or environmental factors. Treating providers should be aware that some of their patients may have challenges unrelated to their diagnosis that make timely presentation, adherence to treatment, and continued close surveillance difficult.

Figure 1A. Univariate Kaplan-Meier survival curve for socioeconomic status composite variable

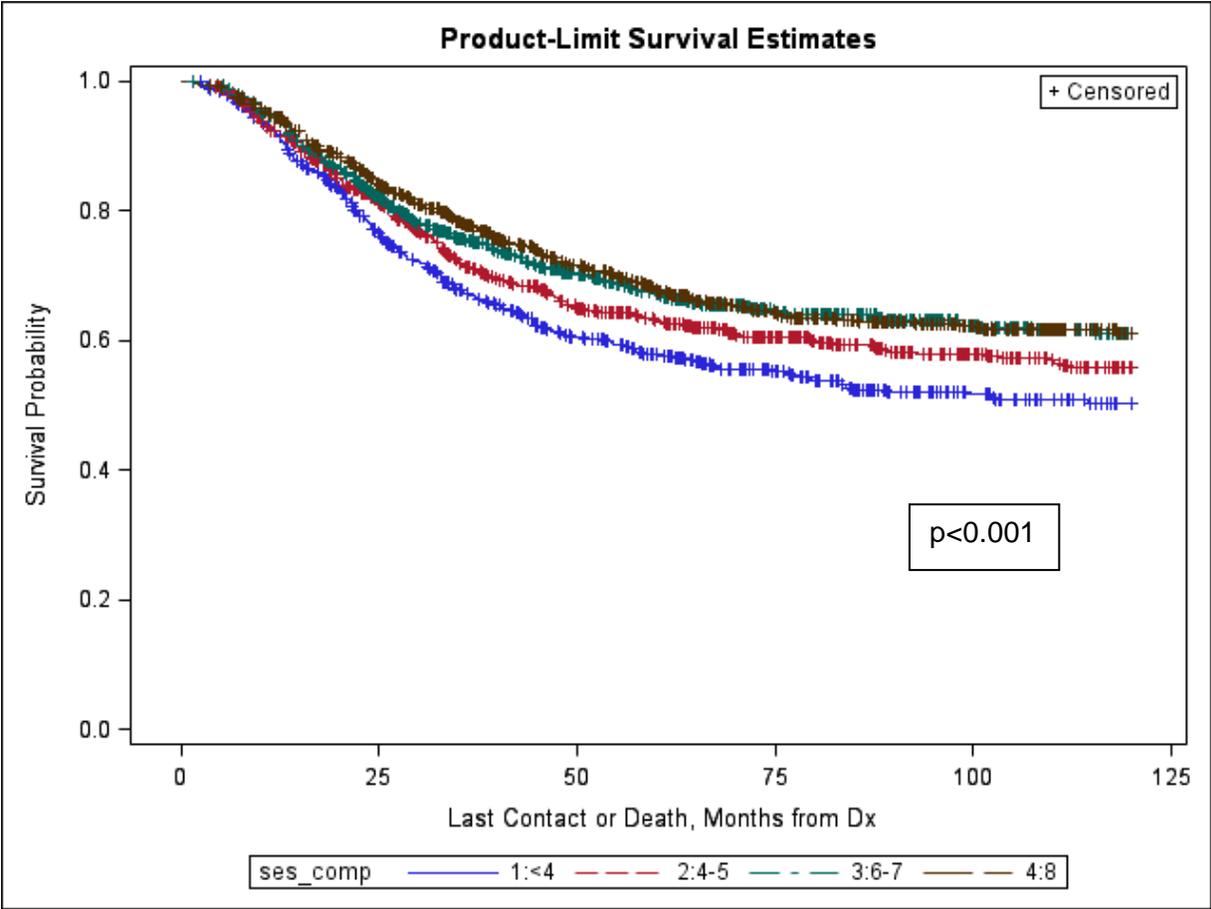


Figure 1B. Univariate Kaplan-Meier survival curve for insurance status

