Social determinants of health and neurocognitive and psychosocial outcomes in adult childhood cancer survivors: a report from the Childhood Cancer Survivor Study (CCSS)

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Background: Limited data exist on the impact of social determinants of health on neurocognitive, psychological, and quality of life (QOL) outcomes in adult childhood cancer survivors.

Methods: We examined patient-reported outcomes (PROs) of neurocognitive function, psychological symptoms, and QOL in association with the Area Deprivation Index (ADI) and neighborhood ambient air quality in 5,131 survivors (52.1% female, mean [SD] age 29.9 [7.1], mean [SD] age at diagnosis 7.9 [6.2], 81.5% White, and 42.3% leukemia) from the Childhood Cancer Survivor Study. The ADI, which reflects neighborhood socioeconomic deprivation, was coded using survivors' residential 9-digit ZIP codes; neighborhood ambient air quality was coded by the NASA Satellite-based pollution measures $PM_{2.5}$ and NO_2 by ZIP codes. Impairment on PROs was identified from scores on the Neurocognitive Questionnaire ($\leq 10^{th}$%ile), the Brief Symptoms Inventory (BSI;

$\geq$90th%ile), the pain survey (yes vs. no), and the Medical Outcomes Study Short Form-36 (<16th%ile). Multivariable logistic regression assessed associations between social determinants and PROs with odds ratios (OR) and 95% confidence intervals (CI), adjusting for demographic and treatment (chemotherapy and radiation) factors.

Results: Among survivors, impaired neurocognitive function was reported in 26.5% for task efficiency, 25.4% memory, 15.4% emotional regulation, and 11.6% organization. For the BSI and pain survey, 56.7%, 11.3%, 8.3%, and 7.3% reported total pain, depression, somatization, and anxiety, respectively. Poor physical and mental domains of QOL were reported by 10.9% and 17.0% of survivors, respectively. Survivors with an ADI in the top deprived 20% neighborhoods (compared to the bottom 80% neighborhoods) reported worse neurocognitive function (task efficiency, OR 1.89, 95% CI 1.45-2.46; emotional regulation, OR 1.74, 95% CI 1.30-2.34; and memory, OR 1.67, 95% CI 1.29-2.17), more severe symptoms (pain, OR 1.34, 95% CI 1.05-1.70; somatization, OR 1.55, 95% CI 1.05-2.28; and depression, OR 1.70, 95% CI 1.19-2.44), and poorer QOL (physical, OR 1.75, 95% CI 1.28-2.38; mental, OR 1.79, 95% CI 1.35-2.36), controlling for treatment factors. Survivors from the 20% most deprived neighborhoods showed worse task efficiency (OR 1.50, 95% CI 1.03-2.17), adjusting for all confounders. $PM_{2.5}$ and NO_2 levels were not associated with impairment on PROs, adjusting for all confounders.

Conclusions: Social determinants, particularly living in the top deprived neighborhoods, are adversely associated with neurocognitive, psychological, and QOL outcomes in adult childhood cancer survivors. These findings indicate the critical need of evaluating childhood cancer survivors' area-level deprivation and tailoring support and interventions for survivors based on their social and structural contexts.

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