Declines Noted in Cognitive Processes and Association With Achievement Among Children With Leukemia

Kathleen C. Insel, PhD, RN, Marilyn J. Hockenberry, PhD, RN, PNP-BC, FAAN, Lynette L. Harris, PhD, Kari M. Koerner, MPH, CHES, Zhenqiang Lu, PhD, Kristin B. Adkins, MA, LPA, Olga A. Taylor, MPH, Patricia M. Gundy, MS, and Ida M. (Ki) Moore, PhD, RN, FAAN

Insel is a professor in the College of Nursing at the University of Arizona in Tucson; Hockenberry is a professor in the School of Nursing at Duke University in Durham, NC; Harris is an associate professor in the College of Medicine at Baylor College in Houston, TX; Koerner is a senior research specialist in the College of Nursing at the University of Arizona; Lu is a staff biostatistician at Ventana Medical Systems, Inc., in Tucson; Adkins is a licensed psychological associate and Taylor is a clinical research manager, both in the College of Medicine at Baylor College; and Gundy is a principal research specialist and Moore is a professor and the director of the Biobehavioral Health Science Division, both in the College of Nursing at the University of Arizona.

This research was funded by a grant (R01NR010889, with Ida M. Moore as principal investigator) from the National Institute of Nursing Research at the National Institutes of Health.

Insel, Hockenberry, Harris, and Moore contributed to the conceptualization and design. Insel, Harris, Koerner, Adkins, Taylor, Gundy, and Moore completed the data collection. Insel, Koerner, Lu, and Moore provided statistical support. Insel, Hockenberry, Koerner, Adkins, and Moore provided the analysis. Insel, Hockenberry, Harris, Koerner, Adkins, and Moore contributed to the manuscript preparation.

Insel can be reached at insel@email.arizona.edu, with copy to editor at ONFEditor@ons.org.

Submitted August 2016. Accepted for publication November 30, 2016.

Keywords: longitudinal study; child development; neuropsychology; clinical; cognitive; academic outcomes

ONF, 44(4), 503–511
doi: 10.1188/17.ONF.503-511

Purpose/Objectives: To assess change in specific cognitive processes during treatment with chemotherapy only among children with acute lymphoblastic leukemia (ALL).

Design: A prospective, repeated measures design.

Setting: Pediatric oncology treatment centers at Banner–University Medical Center Tucson/Banner Children’s–Diamond Medical Center (University of Arizona) and Texas Children’s Cancer and Hematology centers (Baylor College of Medicine) in Houston.

Sample: 71 children with ALL, with a mean age of 6.18 years at the time of diagnosis.

Methods: Using mixed-effects latent growth curve modeling with time since diagnosis as a fixed effect, age-adjusted standardized measures of working memory, processing speed, executive function, and attention were obtained and repeated about one and two years later. A subsample was tested for academic achievement at the end of treatment.

Main Research Variables: Verbal working memory, visual spatial memory, processing speed, academic achievement, age, and gender.

Findings: A significant main effect was observed for age at diagnosis on decline in verbal working memory during treatment. Planned contrasts revealed greater decline in verbal memory among children who were diagnosed when aged younger than five years compared to those diagnosed when aged five years or older. Decline in verbal working memory and achievement in letter-word identification and calculation skills were associated, and decline in spatial memory was associated with calculation. A main effect of gender was observed on processing speed, with female patients showing greater decline than male patients.

Conclusions: Findings from this study may guide the timing of interventions that could improve school achievement among survivors.

Implications for Nursing: Children undergoing treatment for ALL may experience issues with verbal working memory and increased difficulty in school. Nurses are in a position to refer parents and children to school resources for additional academic support.

Neurocognitive sequelae associated with treatment for childhood acute-lymphoblastic leukemia (ALL) are well documented when treatment includes cranial radiation (Copeland et al., 1985; Edelmann et al., 2014; Fletcher & Copeland, 1988; Krull et al., 2013). Use of intrathecal and systemic chemotherapy has now largely replaced cranial radiation for presymptomatic treatment of the central nervous system (Richards, Pui, & Gayon, 2013) with evidence for improvement in neurocognitive outcomes. In a systematic review of literature from 1997 to July 2008 that reported outcomes among survivors of childhood ALL treated with chemotherapy only, 8 of 10 studies included measures of general intelligence and found no impairment in total intelligence quotient (IQ) (Buizer, de Sonneville, & Veerman, 2009). However, among the eight studies examined by Buizer et al. (2009) that featured measures