Body Composition After Bone Marrow Transplantation in Childhood

Kathy Ruble, RN, CPNP, AOCN®, PhD, Matthew Hayat, PhD, Kerry J. Stewart, EdD, and Allen Chen, MD, PhD, MHS

Purpose/Objectives: To describe the body composition and fat distribution of childhood bone marrow transplantation (BMT) survivors at least one year post-transplantation and examine the ability of the Centers for Disease Control and Prevention criteria to identify survivors with elevated body fat percentage.

Design: Cross-sectional, descriptive.

Setting: Pediatric oncology program at a National Cancer Institute–designated comprehensive cancer center.

Sample: 48 childhood BMT survivors (27 males and 21 females).

Methods: Measurements included dual-energy x-ray absorptiometry scan, height, weight, and physical activity. Descriptive statistics were reported and mixed-model linear regression models were used to describe findings and associations.

Main Research Variables: Total body fat percentage and central obesity (defined as a ratio of central to peripheral fat of 1 or greater).

Findings: Fifty-four percent of survivors had body fat percentages that exceeded recommendations for healthy body composition and 31% qualified as having central obesity. Previous treatment with total body irradiation was associated with higher body fat percentage and central obesity, and graft-versus-host disease was associated with lower body fat percentage. The body mass index (BMI) criteria did not correctly identify the BMT survivors who had elevated body fat percentage.

Conclusions: Survivors of childhood BMT are at risk for obesity and central obesity that is not readily identified with standard BMI criteria.

Implications for Nursing: Nurses caring for BMT survivors should include evaluation of general and central obesity in their assessments. Patient education materials and resources for healthy weight and muscle building should be made available to survivors. Research is needed to develop appropriate interventions.

Obesity and altered body composition, including central obesity (abdominal obesity), have been identified as complications after treatment of childhood cancer (Garmey et al., 2008; Miller et al., 2010; Nysom et al., 2003; Oeffinger et al., 2003). In addition, obesity in the general population is a growing public health concern; a threefold increase of obesity in children has occurred since 1976, and more than a third of American adults are overweight or obese (Flegal, Carroll, Ogden, & Curtin, 2010; Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Excess body fat and central obesity in childhood are risk factors for cardiovascular disease, insulin resistance, compromised pulmonary function, musculoskeletal dysfunction, altered gonadal hormone levels, and psychological compromise (Baer, Colditz, Willett, & Dorgan, 2007; Daniels et al., 2005; Eisenmann, DuBose, & Donnelly, 2007; Gonzalez-Barcala et al., 2007; Raitakari, Juonala, & Viikari, 2005; Schiel et al., 2007). Similar complications are seen in adults, where obesity carries an increased mortality rate from cardiovascular and kidney disease, diabetes, and cancers considered obesity-related (Flegal, Graubard, Williamson, & Gail, 2007). Although general and central obesity are significant concerns for the general population, they may have even more harmful consequences for bone marrow transplantation (BMT) survivors who may have preexisting health conditions.

Cranial radiation at higher doses, such as those used to treat brain tumors, is the most common treatment associated with obesity (Garmey et al., 2008; Lustig et al., 2003; Pietilä et al., 2009). Damage to the hypothalamus, including disruption of growth hormone, thyroid, and gonadal function, as well as changes in sensitivity to leptin, ghrelin, and insulin, are mechanisms by which cranial radiation may contribute to obesity (Schwartz, Woods, Porte, Seeley, & Baskin, 2000). Moderate doses of cranial radiation (1,200–2,400 cGy) used to treat childhood acute lymphoblastic leukemia (ALL) have been associated with obesity, including central, liver, and visceral obesity (Janiszewski et al., 2007; Oeffinger et al., 2003).

Energy imbalance, or consuming more calories than burned, is another possible contributor to obesity in childhood cancer survivors, with decreased physical activity documented in this population (Warner, 2008). In ALL survivors, decreased energy expenditure was