Assessing the Five-Year Baseline Prevalence of Metabolic Bone Diseases in the Total Knee Arthroplasty Patient Population

George Beyer, Adam J Wolfert[1], Jared Newman, Harleen Kaur[2], Eugene J Dolphin, David H Mai, Neil V Shah, Aditya V Maheshwari[2], Qais Naziri[3]
[1]SUNY Downstate Health Sciences University, [2]SUNY Downstate Medical Center, [3]SUNY DOWNSTATE MEDICAL CENTER

INTRODUCTION: The rates of metabolic bone disease (MBD) increase with age and represent a threat to successful outcomes in total knee arthroplasty (TKA) due to their well-documented deleterious effects on bone quality, remodeling, and healing. Given the rising elderly population and higher prevalence of MDB with age, this area is of increasing interest. The etiologies of MBD are poorly documented around TKA patients. Thus, we sought to describe the most common etiologies across demographic subgroups. We hypothesized that osteoporosis (OP) would be the most prevalent MBD and that overall MBD prevalence would increase with age.

METHODS: The New York Statewide Planning and Research Cooperative System (SPARCS) was queried to identify all patients who underwent non-traumatic THA between 2009 and 2013. Patients were compared by age in years (<45; 45-64; and >64), sex, and race. MBD etiologies were recorded for each age and sex, with prevalence calculated for each group. Univariate analysis was used to compare demographic variables, in tandem with post-hoc analysis using the Bonferroni correction.

RESULTS: Of 90,613 patients identified (n=87,547 with and n=3,066 without MBD), the most prevalent MBDs were: OP 8%, vitamin D deficiency (VDD) 2.2%, post-surgical hypothyroidism (PSHT) 1.2%, non-toxic uninodular goiter (NUG) 0.6%, and specified acquired hypothyroidism (SAH) 0.4%. A disproportionate number of MDB patients undergoing TKA were Black (14.6% vs. 9.5%) and females (83.5% vs. 64.3%) relative to patients without MBD (both, $p<0.001$) (Table 1). There were proportionately fewer Whites, Hispanics, and other racial groups who underwent TKA with MBD than did not (73.7% vs. 76.4%, 5.9% vs. 7%, 5.8% vs. 7%; all, $p<0.001$, respectively). With respect to the Black cohort, OP rates were lower (4.9% vs. 8.3% White; 8.1% Hispanic; 9% other; $p<0.001$). Patients with MBD had a higher mean Deyo index at the time of TKA (0.83 vs. 0.63), mean total surgical charges ($48,169 vs. $43,756), and mean length of stay (LOS) (4.1 vs. 3.8 days) (all, $p<0.001$). The <45-year age cohort showed the lowest incidence of OP and VDD (both, $p<0.001$). The <45-year-old age cohort had the highest incidence of sickle cell disease (SCD) ($p=0.005$), although this difference was only significant between the <45 and >65-year age cohorts, and trait (SCT) ($p<0.001$). The >65-year age cohort showed the highest incidence of OP and VDD (both, $p<0.001$), and the lowest incidence of Cushing syndrome, SCT (both, $p<0.001$) and SCD ($p=0.005$) among age cohorts.

DISCUSSION AND CONCLUSION: Our study describes MBD etiologies across various demographic subgroups of patients who underwent TKA. Across all subgroups, OP is the most common MBD etiology. Specifically, these rates are higher in females, and represent a higher proportion of Black patients in the <45-year subgroup undergoing TKA. The higher rates of SCD and SCT in the younger subgroup <45 years is expected given the lower average life expectancy of patients with SCD and SCT and the relative frequency of these diagnoses for patients undergoing a primary joint arthroplasty early in life. Patients with MBD had significantly higher total surgical charges and LOS, which may be reflective of overall increased comorbidities in patients with MBD as indicated by a significantly higher mean Deyo index at time of arthroplasty. This data may also underlie the trend of rising rates of VDD within the Northern hemisphere. Our study underscores the need for effective preoperative screening for MBD and relevant treatment.

Table 1. Comparing the baseline prevalence of the most frequent metabolic bone diseases across age, sex, and race sub-groups.

Age (Years)	<45	45-64	>65	p-value
Osteoporosis	2.4%a	3.5%b	11.3%c	<0.001
Vitamin D Deficiency	1.6%a,b	2.0%b	2.4%a	0.001
Nontoxic Uninodular Goiter	0.1%a	0.5%a	0.7%b	<0.001
Post Surgical Hypothroidism	0.7%a	1.0%a	1.4%b	<0.001
Specified Acquired Hypothyroidism	0.4%a,b	0.3%b	0.4%a	0.004
Sickle Cell Trait	0.7%a	0.3%b	0.1%c	<0.001

Sex	Male	Female	p-value
Osteoporosis	1.50%	11.60%	<0.001
Vitamin D Deficiency	1.40%	2.60%	<0.001
Nontoxic Uninodular Goiter	0.20%	0.80%	<0.001
Nontoxic Multinodular Goiter	0.10%	0.50%	<0.001
Post Surgical Hypothroidism	0.50%	1.60%	<0.001
Sickle Cell Trait	0.10%	0.30%	<0.001

Race	White	Black	Hispanic	p-value
Osteoporosis	8.3%a	4.9%b	8.1%a	<0.001
Vitamin D Deficiency	2.3%a	2.4%a	1.4%b	<0.001
Post Surgical Hypothroidism	1.3%a	1.2%a,b	0.8%b,c	<0.001
Sickle Cell Trait	0%a	1.6%b	0.2%c	<0.001
Sickle Cell Disease	0%a	0.2%b	0%a	<0.001