

# Size-corrected bone mineral density is not affected by haematopoietic stem cell transplantation and total body irradiation in leukaemia survivors

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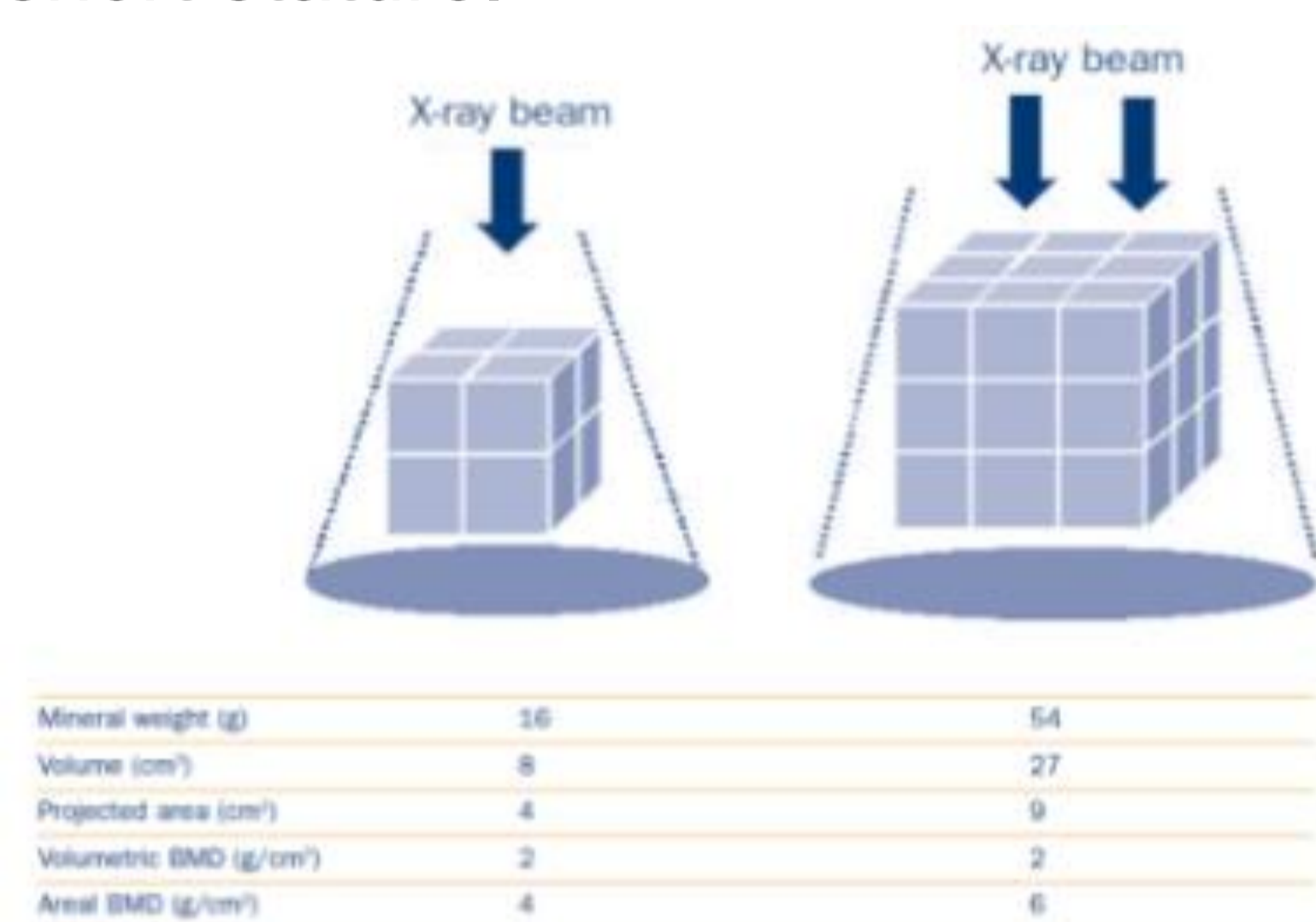
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## Background

- Childhood HSCT/TBI survivors have multiple risk factors for reduced bone mineral density (BMD) and poor growth.
- Reduced Z-scores from Dual energy X-Ray absorptiometry (DEXA) have been reported.
- However, smaller bones have apparently lower areal BMD than larger ones (figure 1). DEXA measurements may be difficult to interpret in childhood HSCT/TBI survivors who are often short.
- Bone mineral apparent density (BMAD) allows correction of BMD for size in patients with short stature.

**Figure 1:** DEXA BMD does not take into account of the depth of the bone. The smaller bone has an apparently lower areal BMD than the larger one despite having the same volumetric density (Carter et al).



## Aim

To investigate the influence of HSCT/TBI on size-corrected BMD in childhood leukaemia survivors

## Method

**Participants** 2 Groups (all post-pubertal):

- Group 1: BMT/TBI ALL survivors diagnosed at <18 yrs, in remission ≥3 yrs
- Group 2: Standard chemotherapy treated ALL survivors diagnosed at <18 yrs in remission ≥3 yrs

**Exclusion:**

- Currently on steroids, untreated endocrinopathies, pregnancy

**Assessments & definitions**

- Auxology: height, weight
- DEXA scanning(Lunar Prodigy® fan beam): BMD-Z-scores, bone mineral content (BMC), bone area (BA), bone width
- Vitamin D levels

**Definition of size-corrected BMD using BMAD:**

- Total-BMAD ( $BMD_T$ )= $BMC/\text{total body BA}^2/\text{height}$

(Ref: Katzman et al. J Clin Endocrinol Metab 1991;73:1332-1339)

- Lumbar spine-BMD ( $BMAD_{L2-4}$ )= $BMD_{L2-4} \times [4/(\pi \times \text{width})]$

(Ref: Carter et al. Bone Miner Res. 1992; 7: 137–145.)

**Analysis:** Student's t-tests, Pearson's correlations

**Approval:** Regional Research Ethics Committee

## Results

**Table 1: Demographics**

	HSCT/TBI (n=21, 11M)	Chemo-only (n=31, 13M)
Current age (years)*	21.5(16.2-26)	21.5(16.2-26)
Age at primary diagnosis (years) *	5.3 (1.0-10.8)	7.0 (1.6 -18.0)
Age of HSCT/TBI (years)*	9.3 (2.6-16.7)	NA
Endocrinopathies:		
Growth hormone Deficiency	12	0
Hypothyroidism	10	0
Hypogonadism	17	0

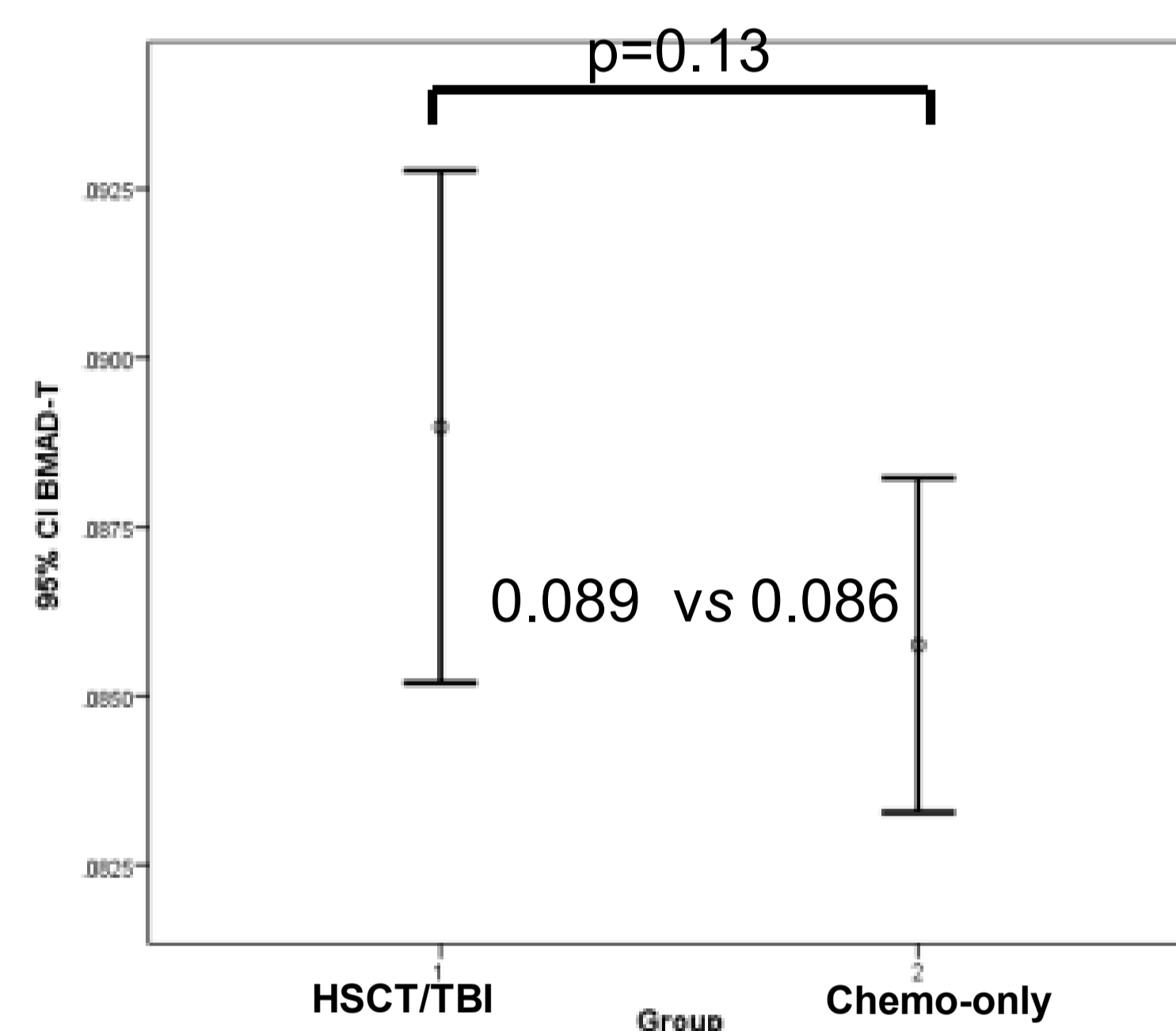
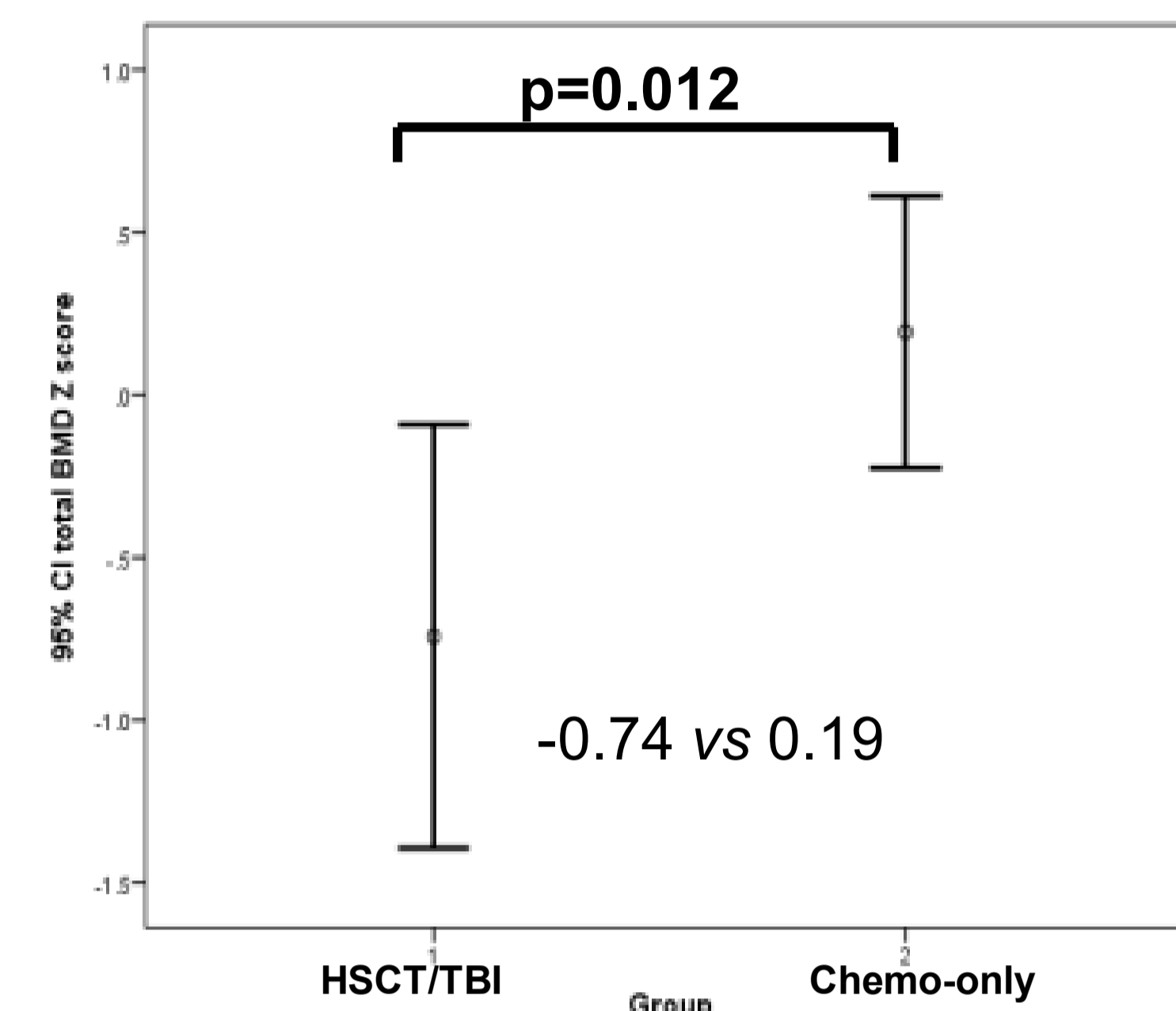
\* Median (range)

**Table 2.** Baseline measurements: HSCT/TBI survivors compared with are shorter with lower lean mass than chemotherapy-only survivors

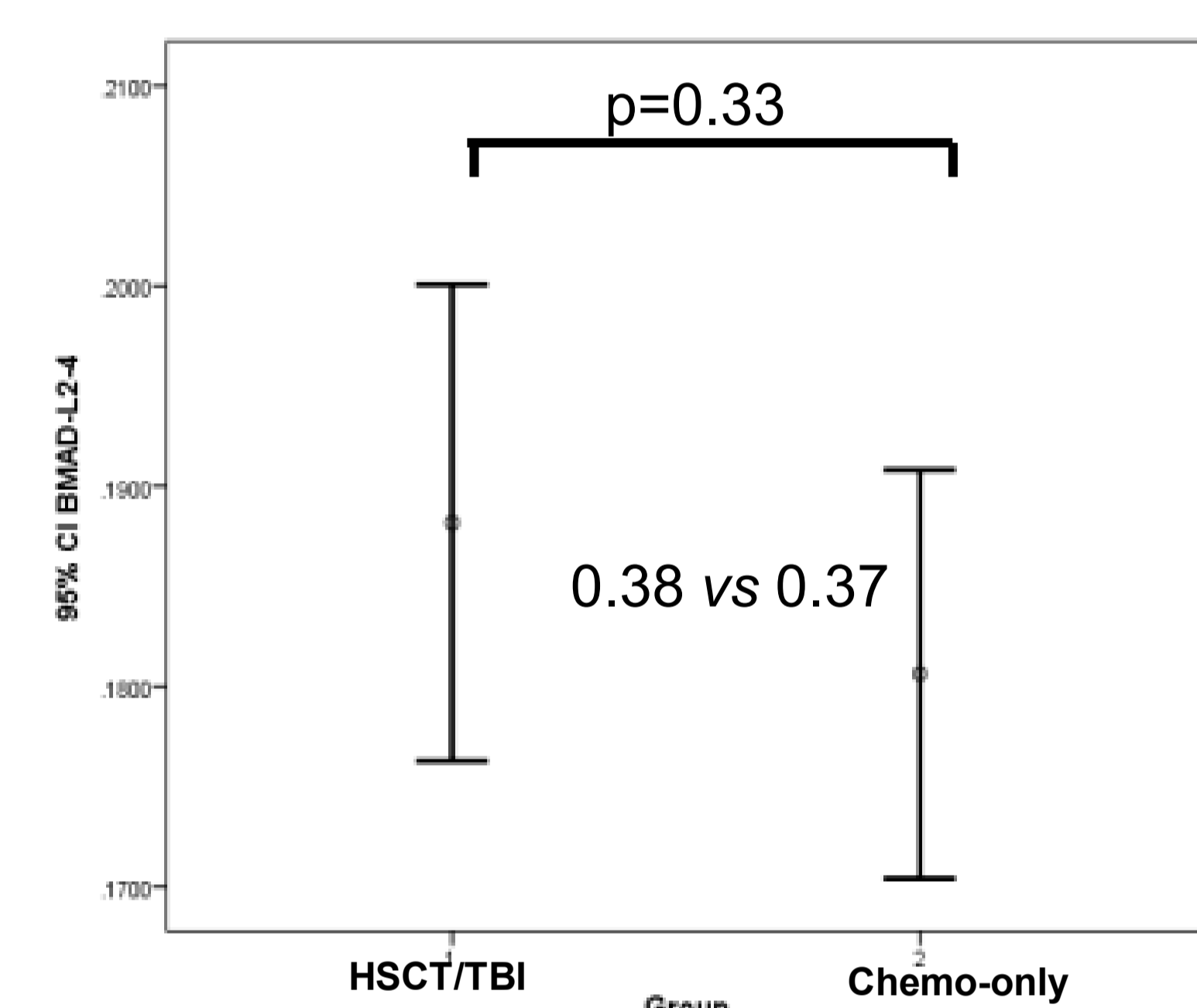
Group(s) Variable	HSCT/TBI (n=21)	Chemo-only (n=31)	t-test p
Height SDS	-1.4 (1.5)	0.2 (0.9)	<0.001
Weight SDS	-1.6 (2.5)	1.1 (1.3)	<0.001
Fat Mass (kg)	15.1 (10.1)	21.6 (10.4)	0.06
Lean mass (kg)	36.9 (10.2)	45.0 (10.8)	0.009

**Figure 2.** HSCT/TBI survivors had lower total-BMD Z scores

However, size corrected is needed for interpretation as total-BMD correlated positively with height-SDS, weight-SDS, fat and lean masses (all p<0.001).



**Figure 3 .** Total BMAD-Z scores



**Figure 4 .** Lumbar spine BMD Z scores

There were no mean(SD) differences in size-corrected BMD between HSCT and chemotherapy-only patients (figures 3 and 4).

**Table 3. BMAD was not associated with treatment factors, vitamin D levels or endocrinopathies in HSCT survivors identified**

	BMAD <sub>T</sub> p-value	BMD <sub>L2-4</sub> p-value
Age of primary treatment	0.36	0.67
Age of HSCT/TBI	0.23	0.68
HSCT before or after 8 years	0.35	0.75
Vitamin D levels	0.13	0.21
Endocrine disorders:		
Growth hormone deficiency	0.16	0.46
Hypothyroidism	0.53	0.58
Gonadal failure	0.33	0.43

## Summary and Conclusions

- Size of patient must be taken into account to avoid over diagnosis of osteopenia when assessing BMD in cancer survivors.
- Treatment effects on peak bone mass in survivors need further evaluation.

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