

# INFLUENCE OF LOWER EXTREMITY STRENGTH ON CHAIR RISE FUNCTIONAL DEMAND IN OLDER FEMALE CANCER SURVIVORS



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## ABSTRACT

Functional demand (FD) is the ratio of the muscular force required by a physical task to the maximal force capacity of the muscle, which is greater in older individuals. Measuring FD in older adult cancer survivors can determine whether functional activities, such as a chair rise, are more exhaustive than for healthy older adults without history of cancer diagnoses and treatments. **PURPOSE:** To quantify the differences in hip (HE) and knee extension (KE) strength, the primary muscles used to complete a chair rise, and FD during chair rise, between older female cancer survivors (CS) and older females with no history of cancer (NC). **METHODS:** Eleven NC (65.9±6.6 yr, 75.4±26.9 kg, 1.60±0.04m, 29.5±10.8 kg·m<sup>-2</sup>) and nine CS who completed chemotherapy and/or radiation treatments within 10 years (57.1±6.6 yr, 75.5±23.1 kg, 1.68±0.07 m, 27.0±9.2 kg·m<sup>-2</sup>) performed 3 maximal isokinetic contractions on a dynamometer at 30 deg·s<sup>-1</sup> to measure HE and KE strength. Retroreflective markers were placed on the lower extremity using the Helen Hayes model and a 3D video motion capture system and an in-ground force plate were used to record kinematic and kinetic data during chair rise. The HE and KE moments during chair rise were calculated by inverse dynamics using Visual3D software; FD was calculated as the ratio of joint moment during chair rise to available strength and expressed as a percentage. Analysis of Covariance was used to compare NC and CS with age and BMI as covariates. Data are reported as estimated population means (95% CI) adjusted for age and BMI. **RESULTS:** KE strength was similar in CS, 1.20 Nm·kg<sup>-1</sup> (0.84-1.56 Nm·kg<sup>-1</sup>), and NC, 1.67 Nm·kg<sup>-1</sup> (1.36-1.99 Nm·kg<sup>-1</sup>, p=0.082). HE strength was lower in CS, 2.12 Nm·kg<sup>-1</sup> (1.59-2.64 Nm·kg<sup>-1</sup>) than in NC, 3.01 Nm·kg<sup>-1</sup> (2.55-3.46 Nm·kg<sup>-1</sup>, p=0.029). Peak knee FD was greater in CS, 131% (92-171%), than in NC, 51% (17-86%, p=0.012). Peak hip FD was similar in CS, 78% (28-128%), and NC, 41% (-2, 85%, p=0.31). **CONCLUSIONS:** Compared to NC, older female CS had significantly lower HE strength and greater knee FD during chair rise, and had a trend for lower KE strength and greater hip FD, which may help explain the greater fall risk and mobility limitation observed in this at-risk clinical population. Resistance training should be incorporated in cancer rehabilitation programs to increase strength and functional reserve capacity.

## INTRODUCTION

- Older cancer survivors ≥ 65 years are nearly two times more likely to experience falls as similarly aged, healthy older adults
- Chemotherapy and radiation are associated with severe declines in muscular strength
- Functional demand (FD) is the ratio of an individual's muscular force during an activity to the available force of the muscle, providing a relative percentage of a subject's strength required by a given task

## PURPOSE

To quantify the differences in hip and knee extension strength, the primary movements used to complete a chair rise, and FD during chair rise, between older female cancer survivors and older females with no history of cancer.

## HYPOTHESES

- H<sub>1</sub> Older female cancer survivors will have significantly lower hip and knee extension strength compared to similarly aged older females with no history of cancer
- H<sub>2</sub> Chair rise functional demand of the hip and knee will be significantly greater in older female cancer survivors than older females with no history of cancer treatment or diagnosis

## METHODS

- Ten female cancer survivors 57.4±6.3 yr, 26.6 ±8.8 kg·m<sup>-2</sup> and eleven older females without a history of cancer 65.9±6.6 yr, 29.5±10.8 kg·m<sup>-2</sup>
- Completed 3 knee and hip extension maximal isokinetic contractions at 30 deg·s<sup>-1</sup> per side (Fig 1)
- Performed chair rises recorded with force plate and motion capture system after being fit with retroreflective markers (Fig 2)
- Data were imported into Visual3D where inverse dynamics was used to calculate joint torques (Fig 3)
- Chair rise knee and hip FD calculated as the ratio of chair rise torques to the muscle's maximal strength
- Analysis of Covariance was used to compare subject groups with age and BMI as covariates

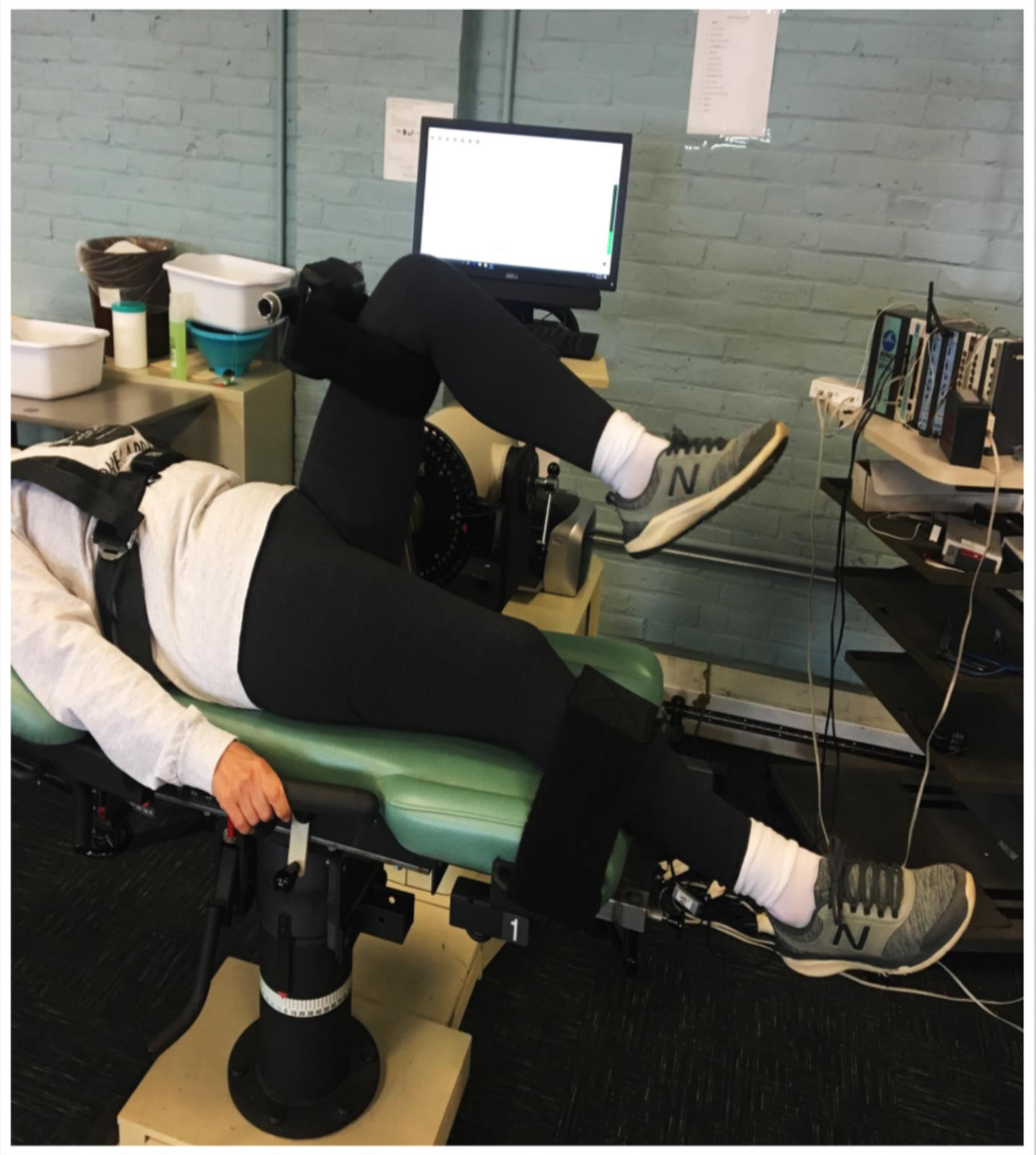


Figure 1. Hip extension strength measurement on isokinetic dynamometer

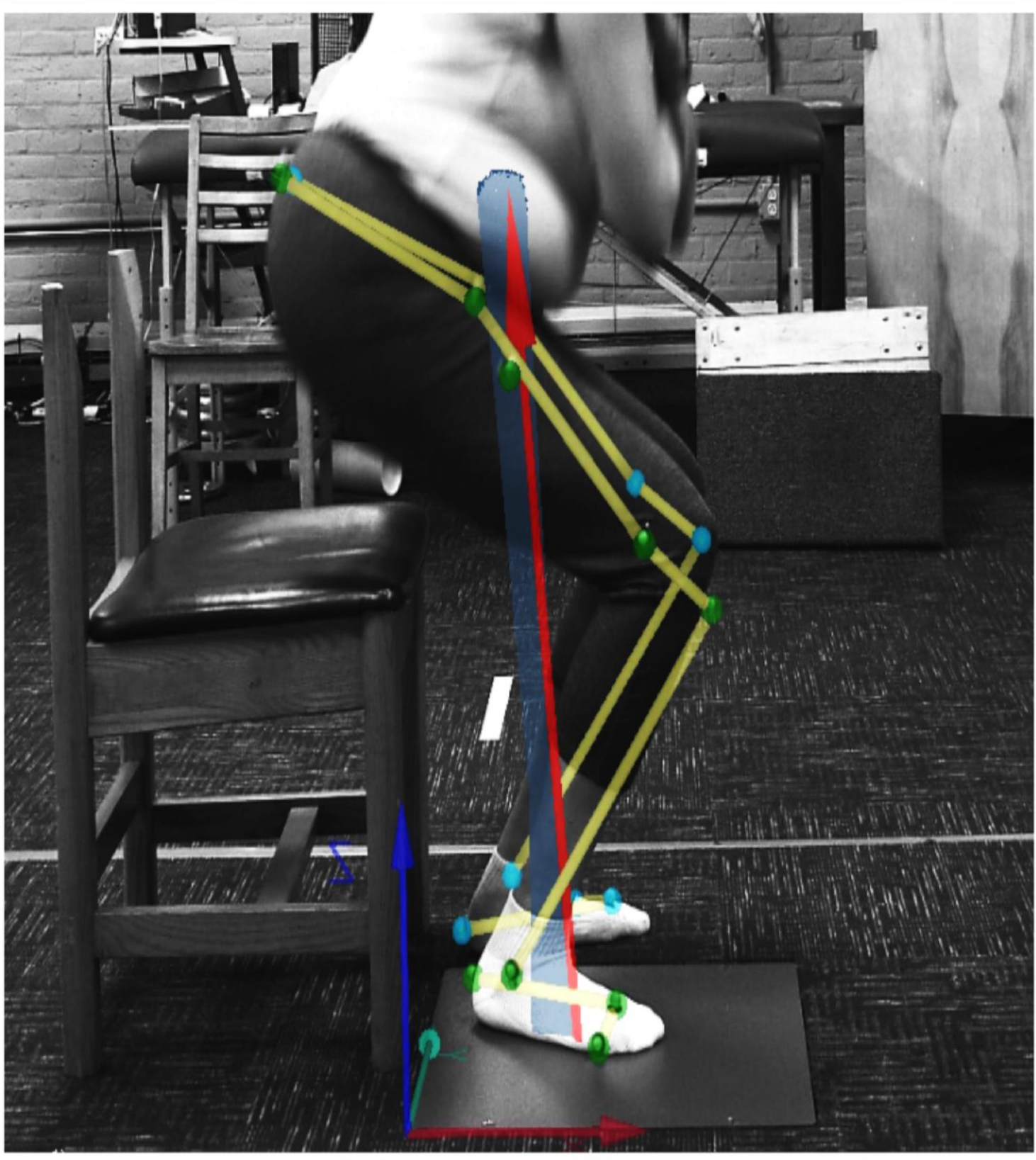


Figure 2. Chair rise experiment set up using Helen Hayes lower-extremity 3D model. Red arrow represents ground reaction force vector.

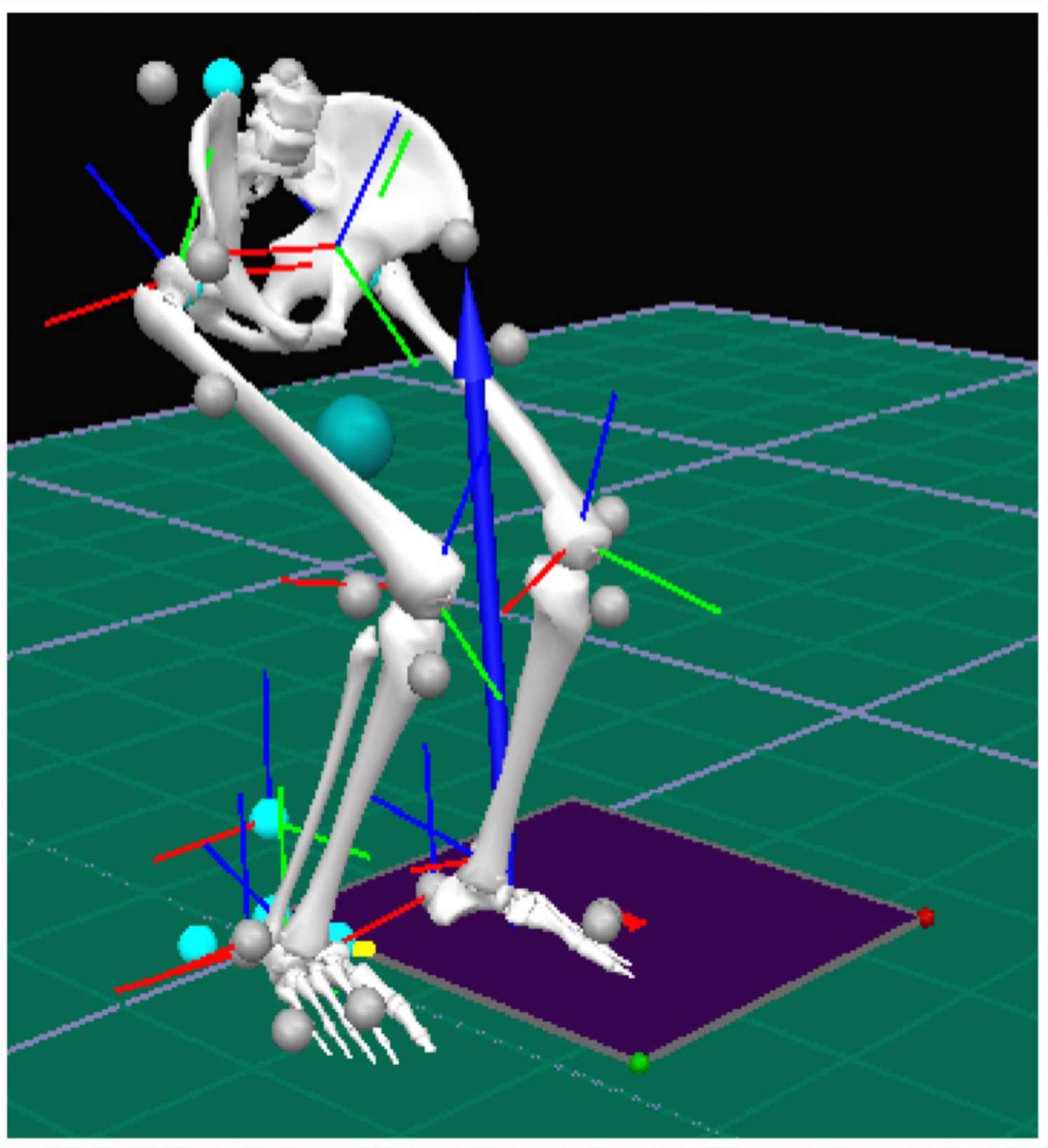


Figure 3. 3D data was imported into Visual3D and inverse dynamics were used to obtain joint torques

## RESULTS

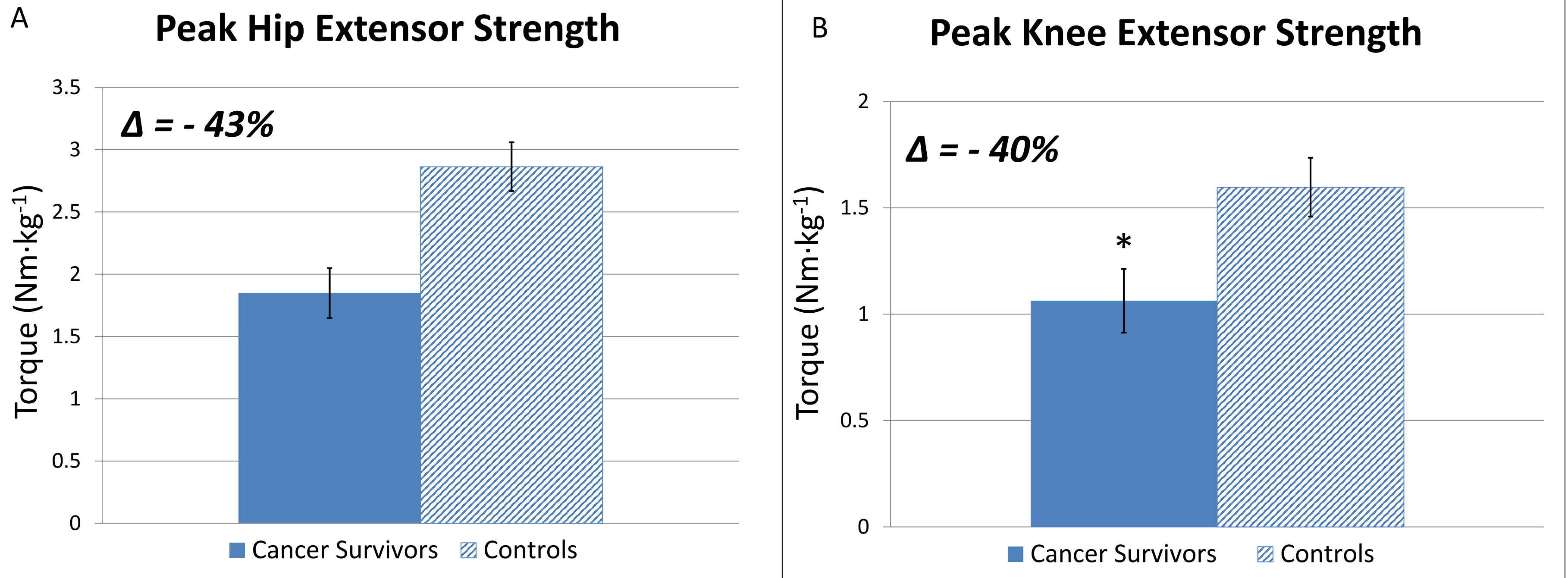


Figure 1. Hip extensor (A) and knee extensor (B) strength in older females with and without a history of cancer. Data are reported as mean ± standard error adjusted for age and BMI. \* = difference between groups, p < 0.05.

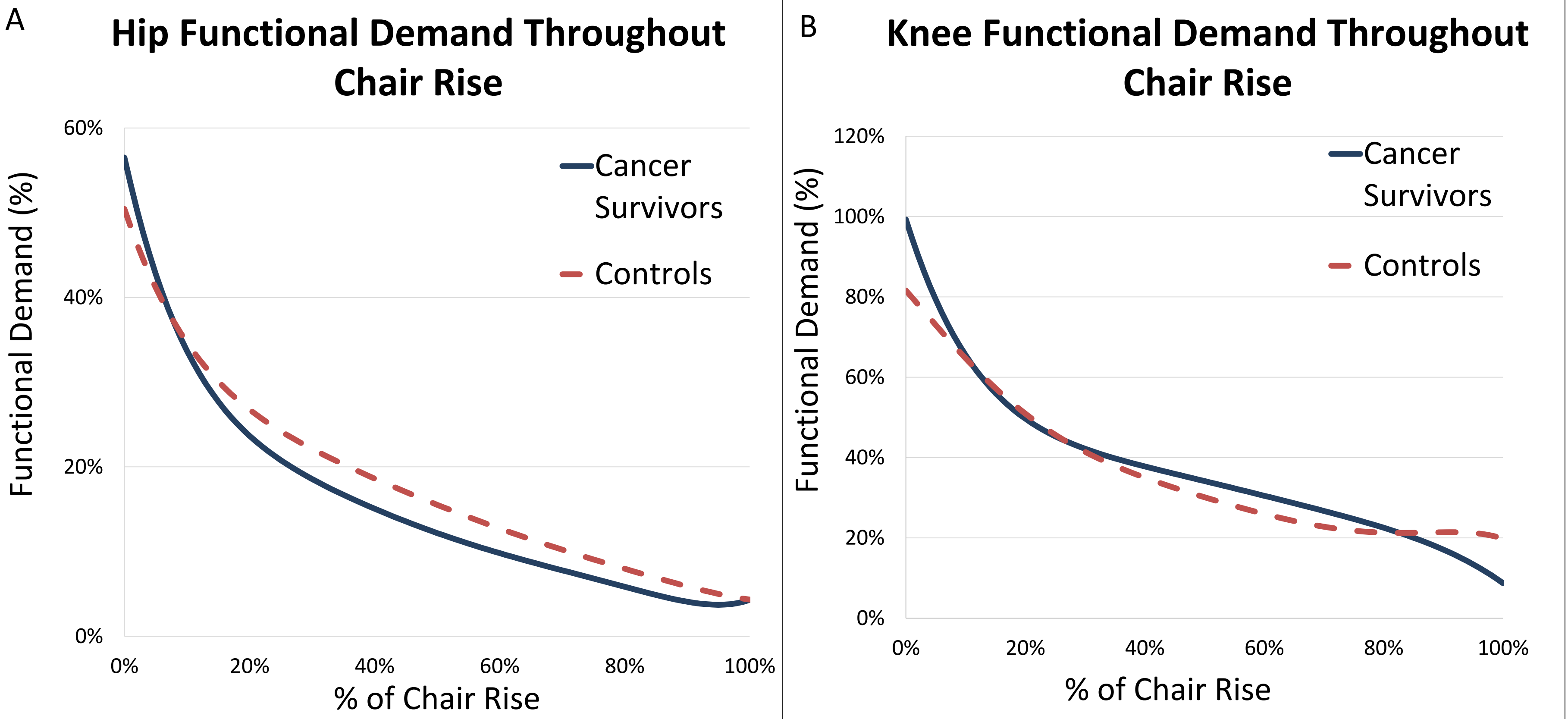


Figure 2. Mean hip (A) and knee (B) functional demand throughout a chair rise in older females with and without a history of cancer. \* = significant group difference for peak FD, p < 0.05.

## CONCLUSIONS

- Older female cancer survivors have lower hip and knee extension strength and greater functional demands in comparison to older females without a history of cancer
- Cancer rehabilitation programs should incorporate resistance training to increase strength and functional reserve capacity to potentially decrease functional demand during activities of daily living