

# The relationship between muscle strength and bone outcomes in ageing UK men

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## Introduction

- Ageing is associated with sarcopenia, osteoporosis and increased fall risk, which together contribute to increased fracture risk
- Muscle strength is a composite term composed of mass, anatomy (fibre type and distribution) and force generating capacity and power
- Muscle contractions create peak forces which exert loads on bone resulting in adaptations in mass, geometry and strength
- The increased risk of falls with ageing has been associated with a decline in muscle power, reflecting the ability of how fast muscles produce force
- Mechanically, bones change in strength through adaptations to alter stiffness and mass in response to peak muscle forces; while mobility and locomotion are dependent on muscle power in order to prevent falls and consequent fractures
- There are few data describing the associations between functional measures of muscle and bone during ageing

## Aim

To examine the associations between:

- Lower-limb muscle strength and age
- Tibial bone outcomes and muscle force

## Study Design

• **Participants:** men aged 40+ yrs and living in Manchester, UK were recruited. Participants were of European White, Afro-Caribbean Black and South Asian (Indian, Pakistani, Bangladeshi) ethnicity. Recruitment was stratified by 10 year age band

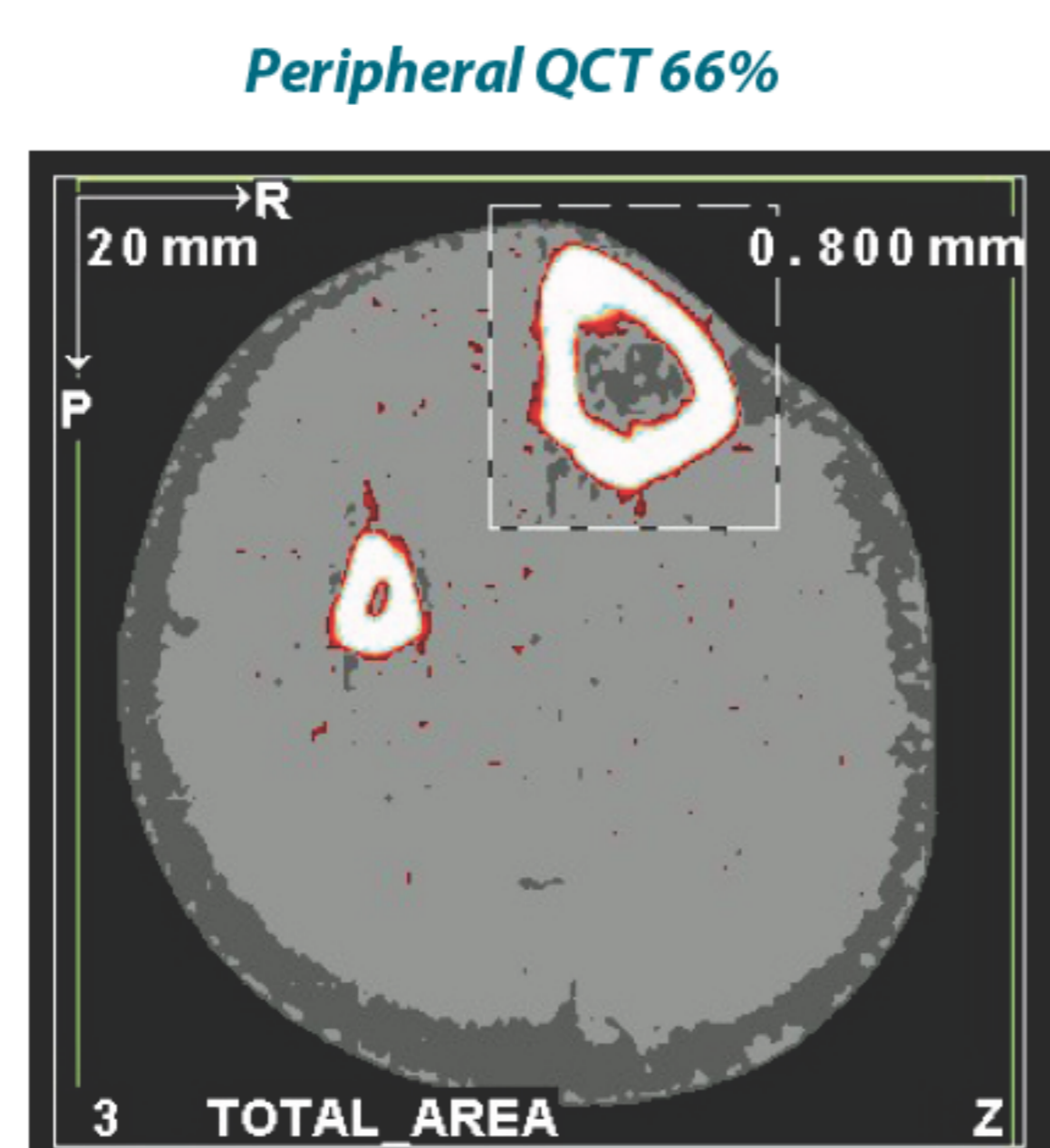
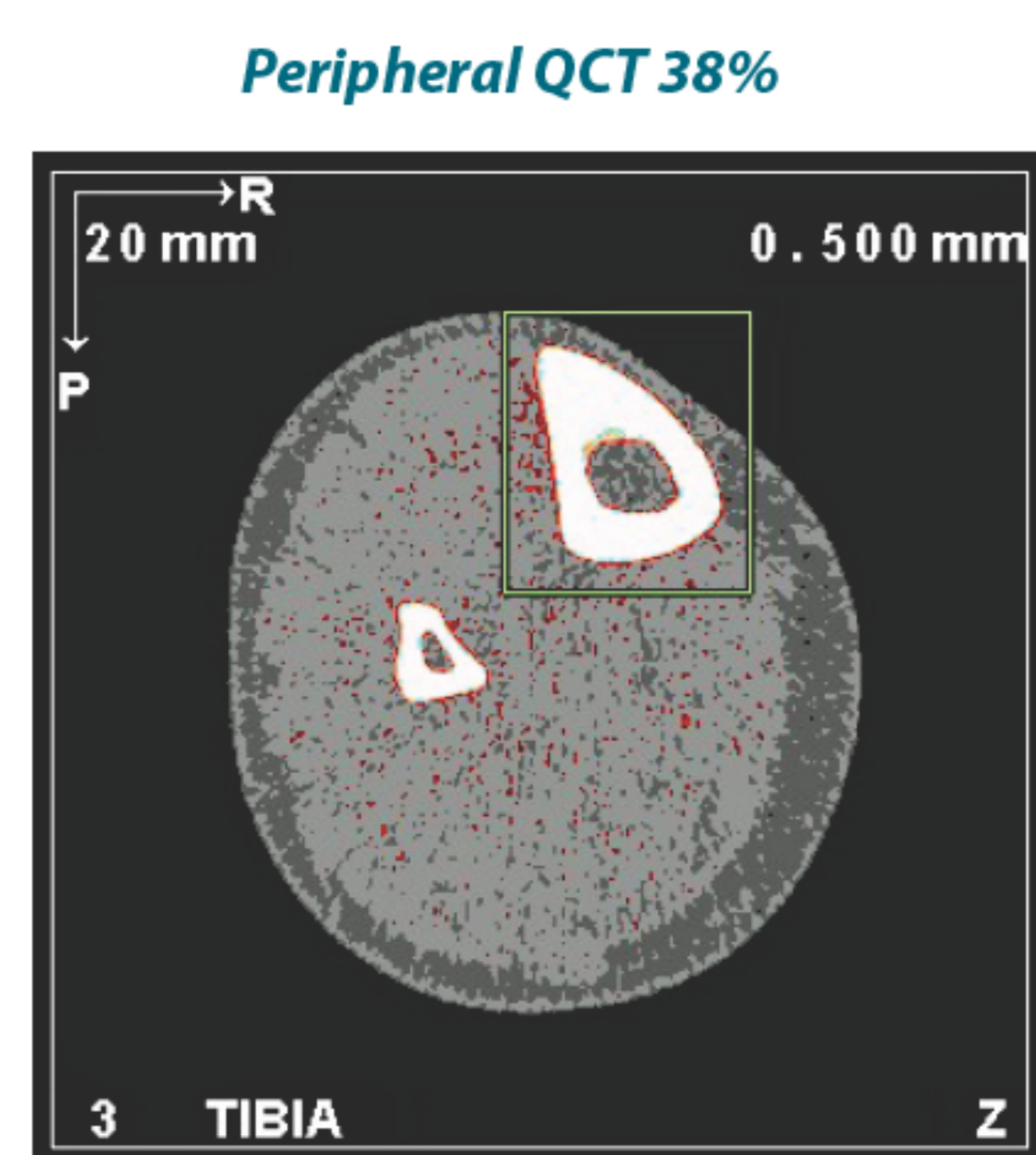
• **Peripheral QCT:** performed at the 38% and 66% tibia

- Outcome measures: 38% cortical vBMC (Ct. vBMC), cross-sectional area (CSA), cortical area (Ct. Area), cross-sectional moment of inertia (CSMI); 66% cross-sectional muscle area (CSMA)

• **Jumping mechanography:** single two leg jump (s2LJ) was performed on the Leonardo Ground Reaction Force Platform to measure muscle force (kN) and power (kW)

• **Statistical analyses:**

- Linear regression analyses were used with adjustments for age, ethnicity, weight and height
- Muscle force was log transformed to normalise the distribution,  $\beta$ -coefficients were converted to percentages by multiplying with 100

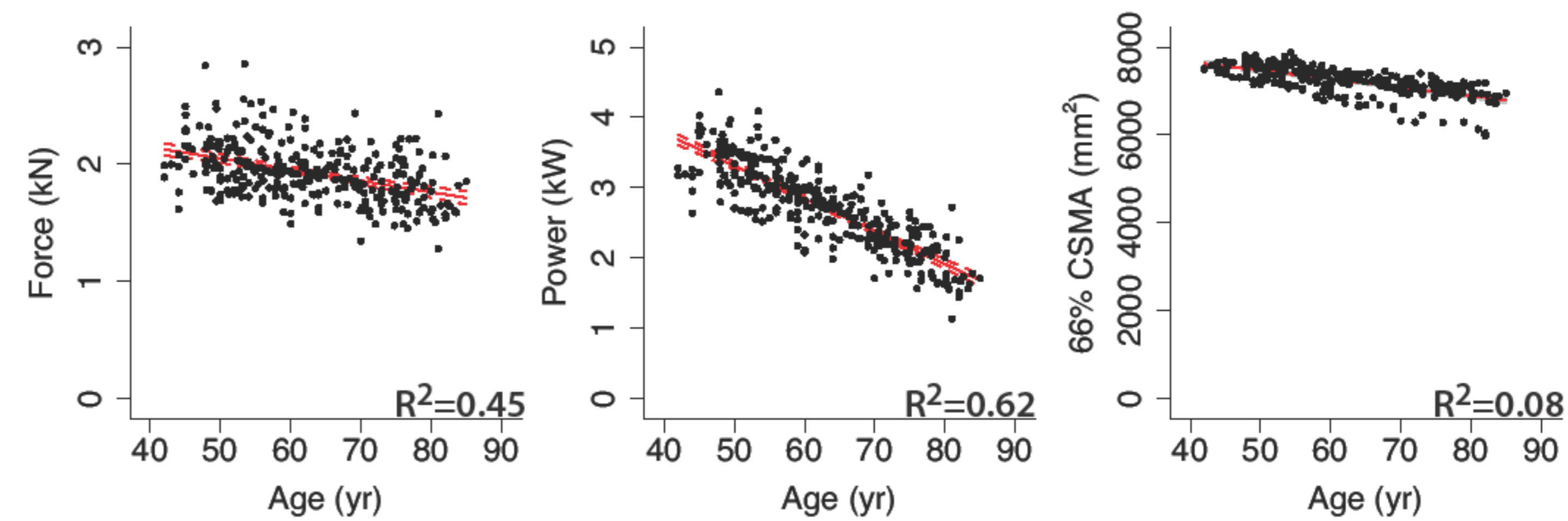


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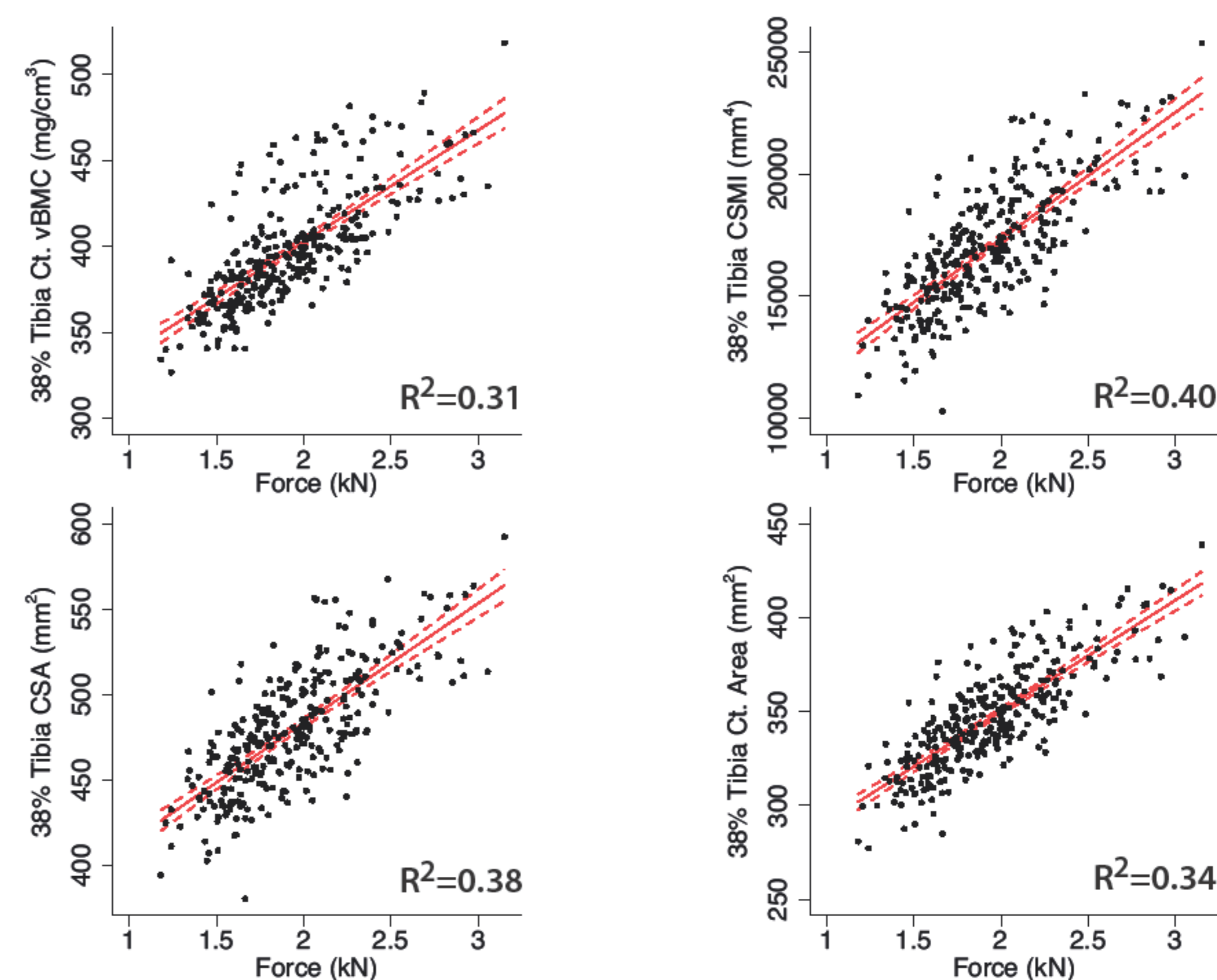
## Results



The relationship between muscle parameters and age

	unadjusted		adjusted	
	B (%)	p value	B (%)	p value
Force (kN)	-0.5 (-0.7, -0.3)	<0.0001	-0.4 (-0.5, -0.2)	<0.0001
Power (kW)	-1.9 (-2.1, -1.7)	<0.0001	-1.8 (-2.0, -1.6)	<0.0001
66% CSMA (mm <sup>2</sup> )	-0.3 (-0.5, -0.2)	<0.0001	-0.4 (-0.54, -0.20)	<0.0001

**Table 1:** All values are  $\beta$ -coefficients expressed as a percentage unit change in age with 95% confidence intervals. Adjusted values are from a linear regression model with adjustments for ethnicity, weight (kg) and height (cm), bold indicates  $p < 0.05$ .



The relationship between muscle force and diaphyseal bone outcomes at the tibia

	unadjusted		adjusted	
	B (%)	p value	B (%)	p value
Ct. vBMC (mg/cm <sup>3</sup> )	15.8 (11.8, 19.8)	<0.0001	8.5 (3.6, 13.4)	<b>0.001</b>
CSA (mm <sup>2</sup> )	14.5 (11.2, 17.7)	<0.0001	9.3 (5.4, 13.2)	<0.0001
Ct. Area (mm <sup>2</sup> )	16.7 (13.1, 20.3)	<0.0001	9.3 (4.8, 13.8)	<0.0001
CSMI (mm <sup>4</sup> )	29.9 (23.6, 36.2)	<0.0001	18.6 (11.1, 26.2)	<0.0001

**Table 2:** All values are  $\beta$ -coefficients expressed as a percentage unit change in muscle force with 95% confidence intervals. Adjusted values are from a linear regression model with adjustments for ethnicity, age (yr), weight (kg) and height (cm), bold indicates  $p < 0.05$ . Ct, cortical; vBMC, volumetric bone mineral content; CSA, cross-sectional area; CSMI, cross-sectional moment of inertia.

## Conclusions

- Muscle force positively predicts diaphyseal bone outcomes at the tibia reflecting mass, geometry and strength
- Lower limb muscle strength is negatively associated with age
- Important area to focus on for prevention of sarcopenia and consequent falls and fracture
- Strategies should not only be focused on increasing bone strength but also preventing falls and maintaining muscle function by increasing muscle power

