Muscle performance contributes to tibia bone strength, area and mass deficits in children with autism spectrum disorder

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Introduction

- Children with autism spectrum disorder (ASD) have:
  - Lower bone mass, area and strength[1]
  - 10-39% lower muscle strength and estimated power[2-4]
- Lower muscle forces may prevent children with ASD from gaining stimulus required for optimal skeletal development
- The evidence of linking muscle strength or performance (estimate of power) to bone deficit is lacking

[1] Rostami Haji Abadi., 2021. Osteoporos Int. [2] Borremans et al., 2010. Adapted Physical Activity Quarterly [3] Kern et al., 2013. J. Strength Cond. Res. [4] Tyler et al., 2014. Autism Res Treat

Objectives & Hypothesis

- To compare bone and muscle properties between boys with ASD and typically developing (TD) boys
- To explore mediation effects of muscle strength and estimated power on bone differences
- We hypothesized that muscle strength and estimated power account for deficits in bone strength, area and mass in boys with ASD

Design and Participants

- Cross sectional pilot study
- Participants
  - ***ASD*: 16 boys aged 6–14 years with ASD (mean age 10.3, SD 2.7 yrs)
  - **Control**: 81 boys (11.1, 1.9) from a cohort study assessing bone development in TD children

Bone and Muscle Outcomes

Distal Radius and Tibia

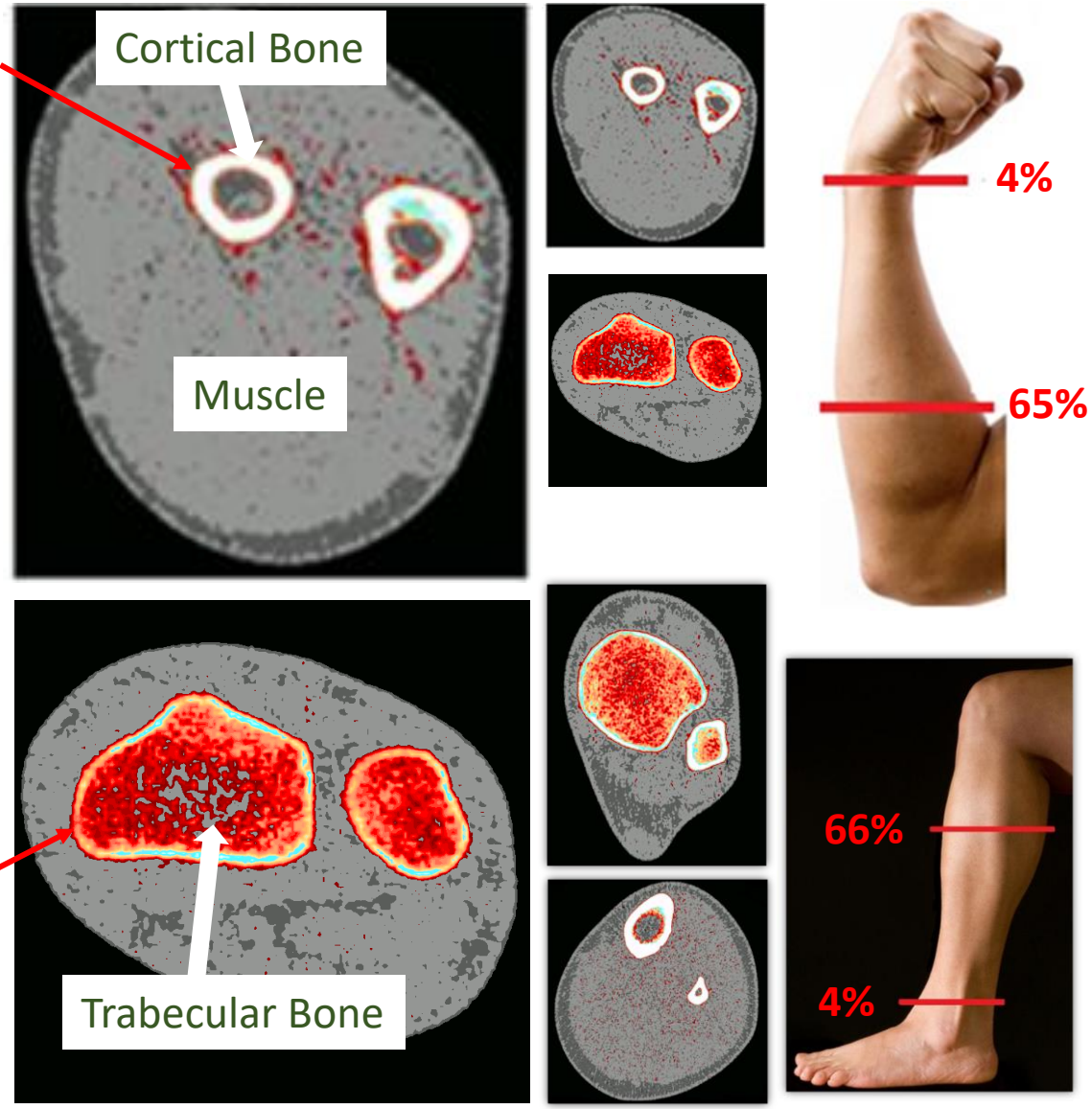
Total bone content, density and area, trabecular bone content, density and area and estimated bone strength

Radius and Tibia Shaft

Total bone area, cortical bone content, density and area, estimated bone strength and muscle cross-sectional area

Muscle strength and estimated power

- Handgrip
- Standing long jump



Statistical analysis

- Limb-specific ANOVA to compare muscle area
- ANOVA to compare the grip strength and Long jump distance
- Site-specific MANCOVA adjusted for limb length and muscle area to compare bone strength, structure and mass
- Mediation analysis to explore the mediation effects grip strength and long jump distance on bone difference between groups adjusting for limb length and muscle area

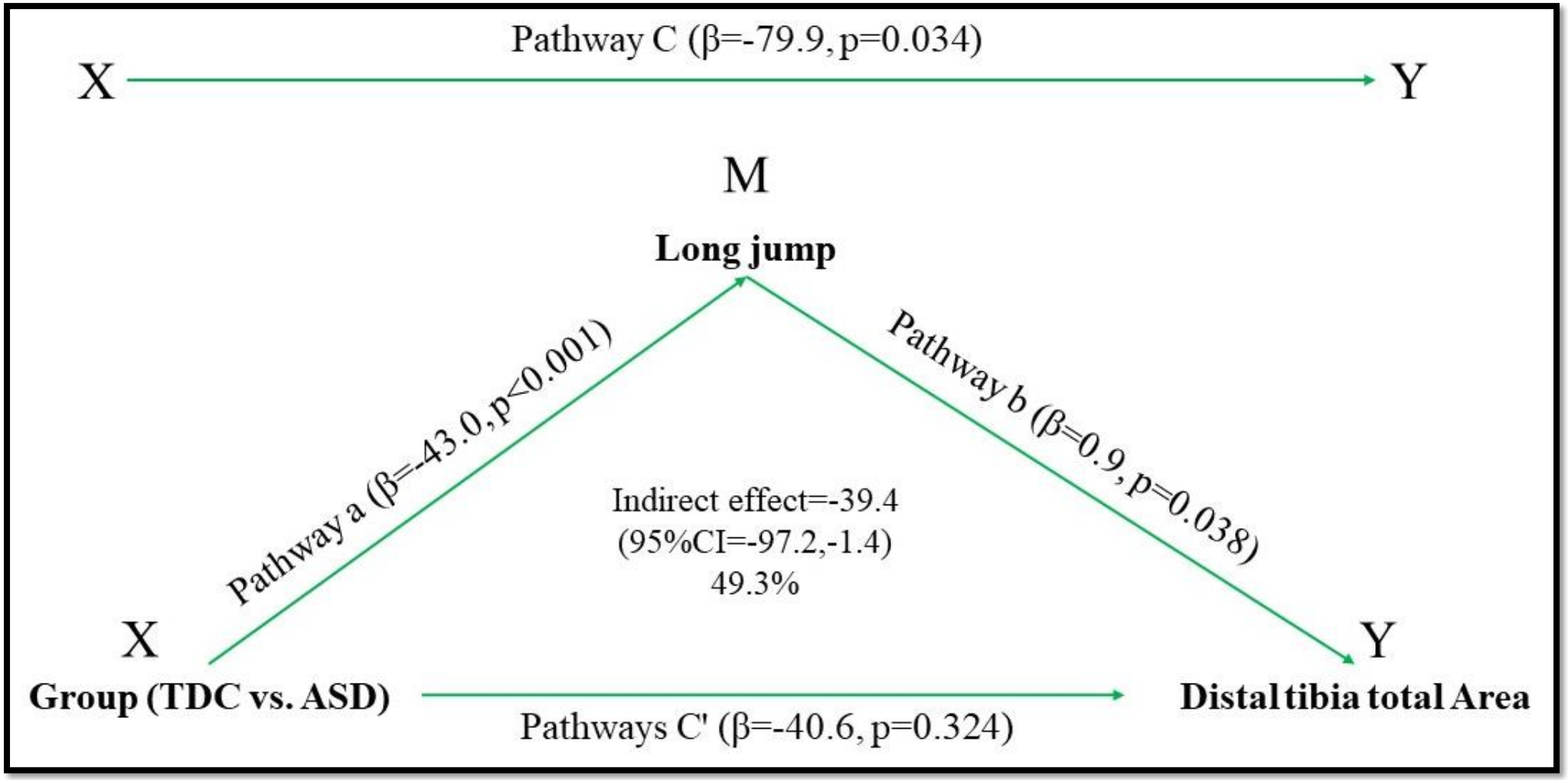
Results

Compared to TD peers, boys with ASD had:

- No differences in muscle area
- Lower grip strength (27%) and long jump distance (31%)
- No differences in bone outcomes at distal radius
- 11-18% lower bone strength, total area and cortical area at radius shaft
- 11-16% lower bone strength, total and trabecular content at the distal tibia.
- 9% lower total and cortical area at tibia shaft

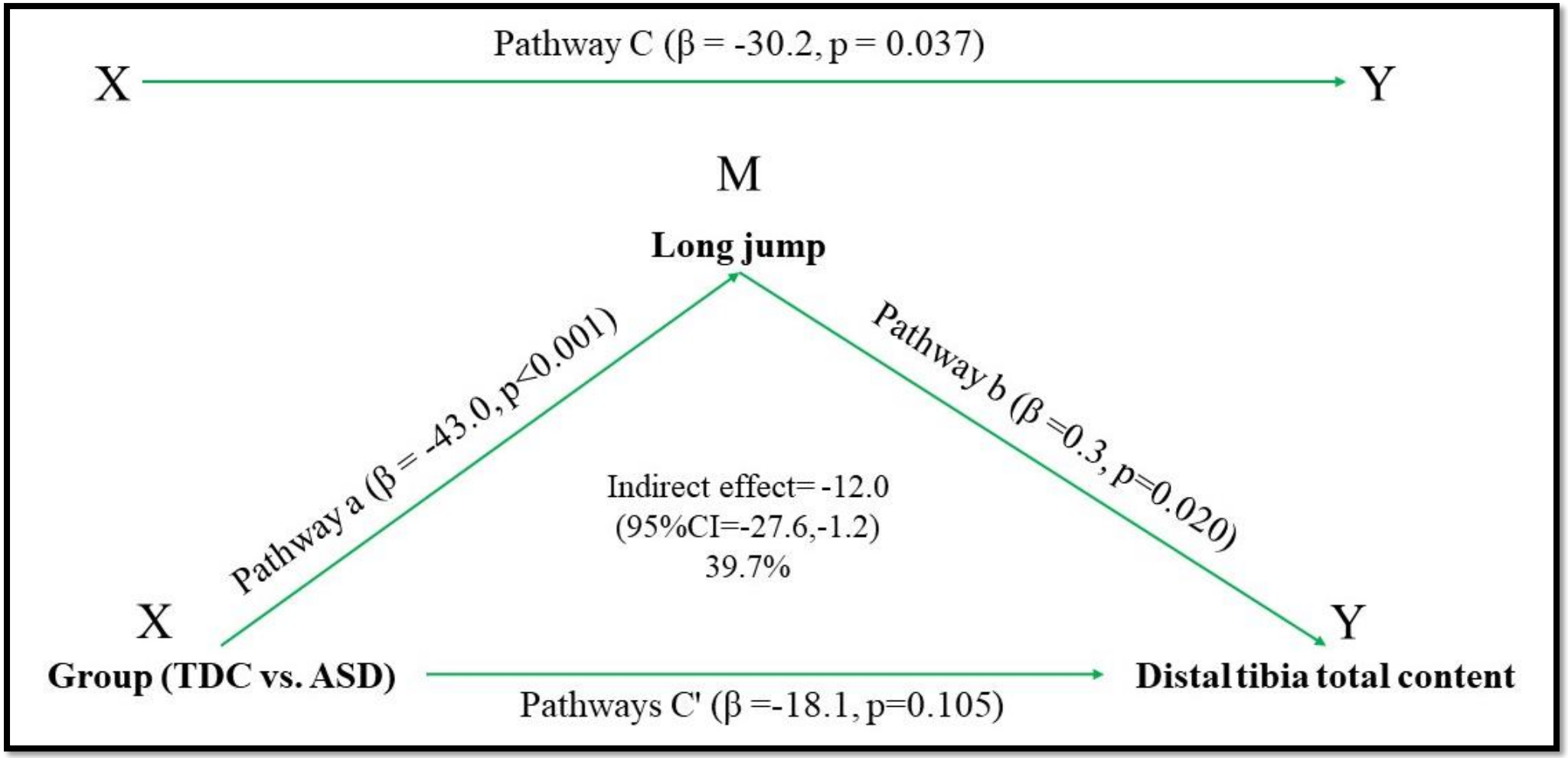
Results

- Long jump distance accounted for 49% of distal tibia total area deficits



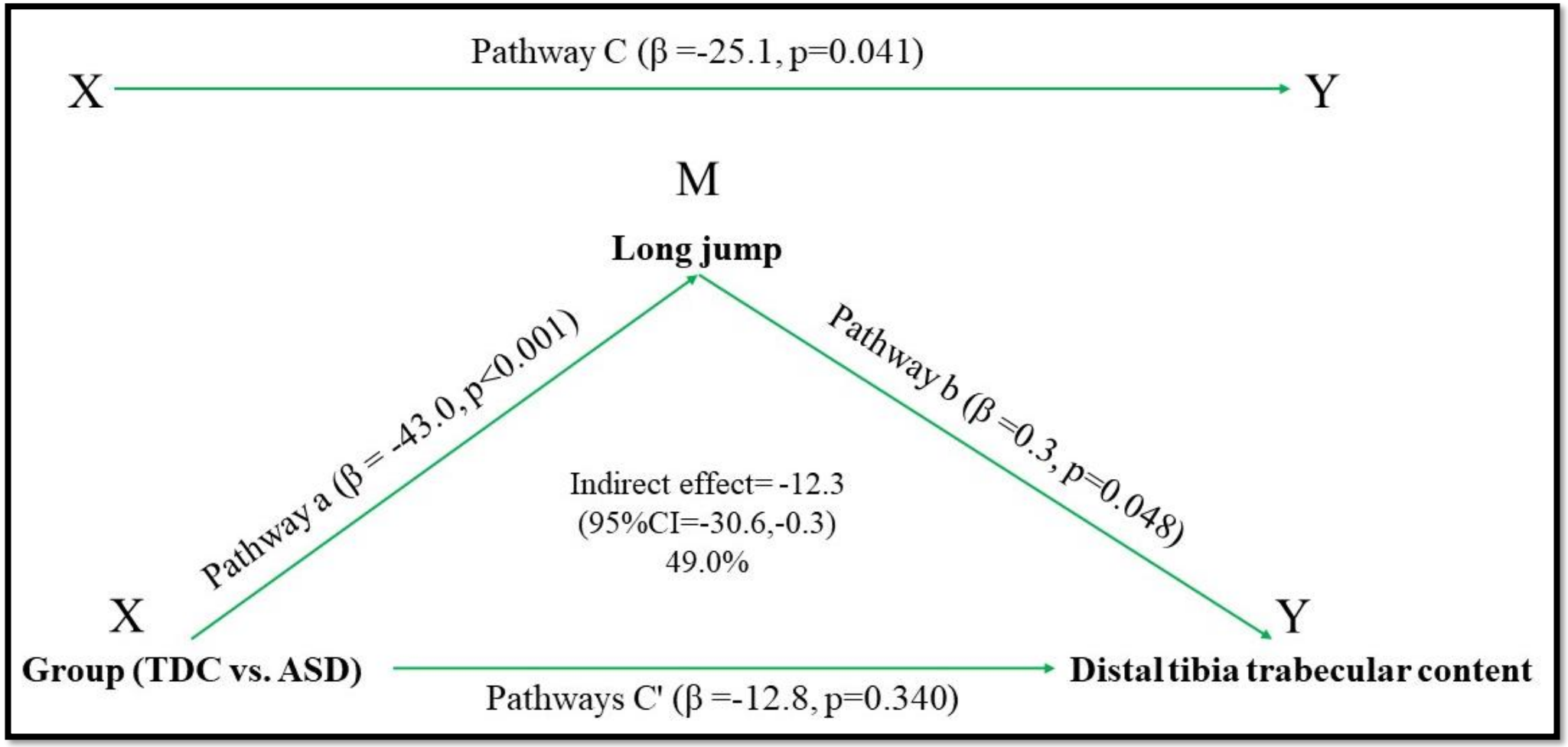
Results

- Long jump distance accounted for 40% of distal tibia total content deficits



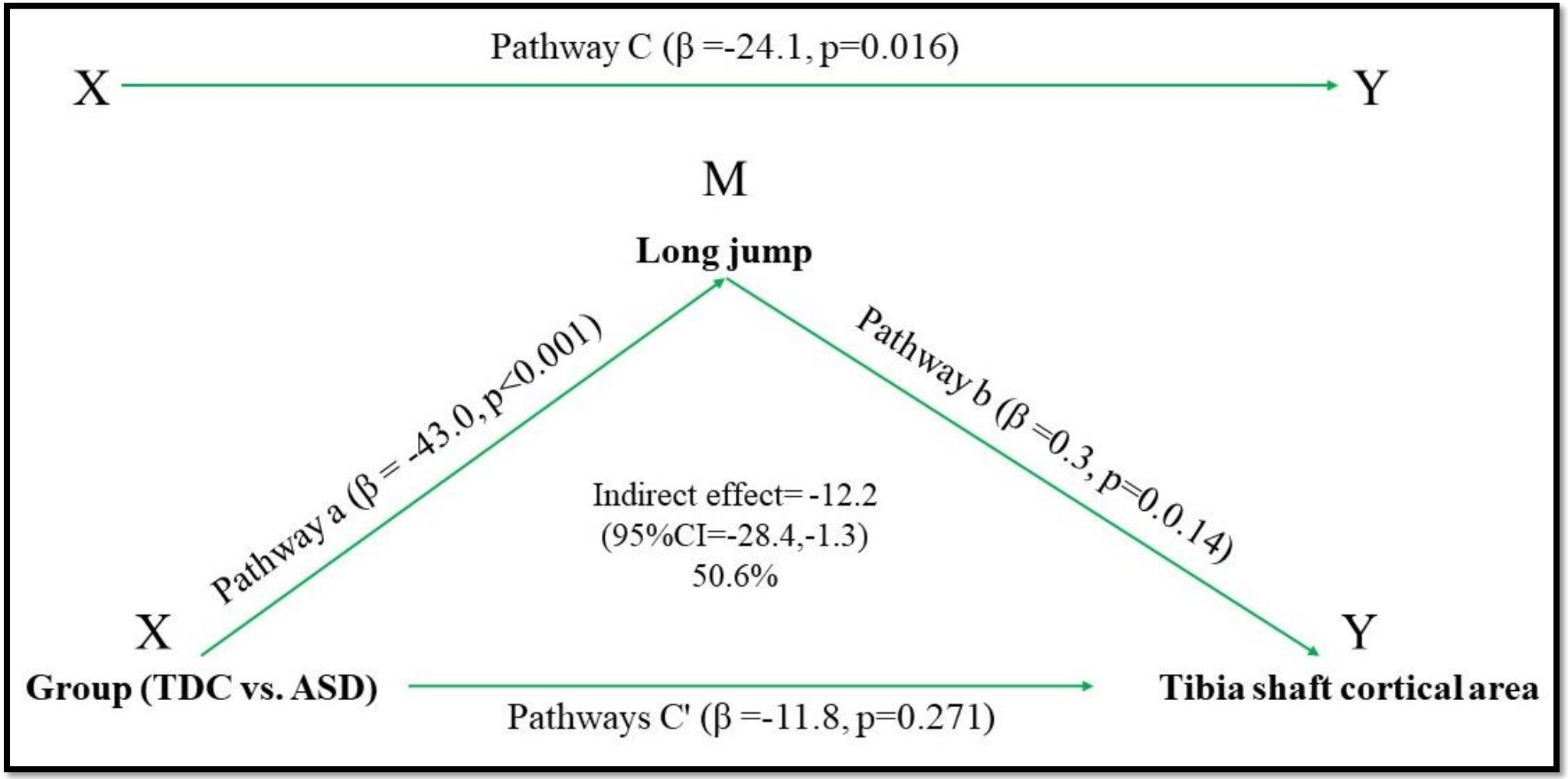
Results

- Long jump distance accounted for 49% of distal tibia trabecular content deficits



Results

- Long jump distance accounted for 51% of tibia shaft cortical area deficits



Discussion

- First to report bone deficit at the shaft sites of the tibia and radius
- Add to findings of 10–20% lower bone strength and cortical area and cortical and trabecular thickness at the distal radius and tibia
- 27-31% lower muscle strength and power may not provide sufficient stimulus for bone development
- Exercise interventions with games and activities including muscle strengthening are warranted to improve bone health

Conclusion

- Boys with ASD had 9-18 % lower bone strength, structure, and mass at the distal tibia and the shaft sites of radius and tibia than TD boys.
- Grip strength and long jump distance were 27-31% lower in boys with ASD, and long jump distance accounted for 40-51% of bone deficits at the distal and shaft sites of the tibia.

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