The impact of pediatric sarcopenic obesity on kinetics strategies during jumping tasks

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Summary

Sarcopenic obesity (SO) is characterized by the presence of obesity and sarcopenia at the same time and can negatively impact biomechanics in children. Here, we compared kinetic differences between children with and without SO in a jumping task. Children with SO presented lower JH, higher nGRF, and higher nLR. Despite no significant differences in absolute forces or vertical stiffness, children with SO demonstrated less efficient biomechanics, requiring more force for poorer results and absorbing less impact.

Introduction

Pediatric obesity is a public health challenge, often linked to biomechanical constrains during locomotor tasks, which may lead to muscle-skeletal problems [1]. Most studies consider only the Body Mass Index to assess children's obesity [1] and do not consider that children with similar body mass and height can present a different muscle and fat body distribution [2]. This condition is known as sarcopenic obesity (SO). SO is a clinical condition highly prevalent in children [3] and is characterized by a low muscle-to-fat ratio (MFR) [2]. Although this condition may predict adverse health outcomes in a pediatric population [3], it is unclear how the OS impacts biomechanics strategies to produce and dissipate forces experienced in motor tasks. Therefore, this study determines the kinetic differences between children with and without OS considering jump landing tasks.

Methods

A group of 29 children visited the laboratory twice. On day 1 the iDXA (GE Healthcare Lunar, Madison, USA) measurement was performed to calculate the MFR and determine the OS [2], which served to classify children in two groups (Table 1). On day 2, they performed 3 countermovement jumps (CMJ) and 3 drop landings (DL) in a randomized order, while kinetic data were sampled at 1 kHz using a force plate (Bertec, Model FP4060-15). The vertical ground reaction force (GRF), GRF normalized by the individual lean body mass (nGRF), and jump height (JH) were determined in the CMJ. Loading rate (LR), loading rate normalized by lean body mass (nLR), and vertical stiffness were determined in the DL. GRF signals were smoothed using a 4th-order Butterworth low-pass filter (cutoff: 25 Hz). Independent samples t-test compared JH, aGFR, aLR, and nLR, while the Mann-Whitney U test compared nGRF and vertical stiffness, between groups using SPSS 21 (SPSS Inc., Chicago, IL, USA) with alpha set at 5%. All participants and their legal guardians signed a consent form. This study was approved by the local ethics committee (IRB: 669-2023).

Results and Discussion

Sarcopenic obese group (SOG) and control group (CG) differed regarding MFR (Table 1).

Table 1. Characteristics of participants (mean and standard deviation and median and interquartile range).

Groups	SOG (n = 14)	CG (n = 15)	P-value
Age (years)	11.64 ± 1.33	12.31 ± 1.35	0.131
Body mass (kg)	56.00 ± 14.78	43.92 ± 9.39	0.124
Height (m)	1.57 ± 0.08	1.52 ± 0.10	0.167
Muscle to fat ratio (MFR)	0.70 IQR 0.29	1.14 IQR 1.30	0.000

In the CMJ, the CG presented a higher JH than SOG (33.06 ± 5.75 cm vs. 27.01 ± 4.90 cm, $t_{(28)} = 3.076$, $p<0.01$). GRF did not differ between groups ($p>0.05$), but nGRF in the SOG was higher than in the CG (98.06 IQR 22.18 N/N vs. 82.53 IQR 19.20 N/N, U= 168.00, $p<0.01$). In the DL, LR did not differ between groups ($p>0.05$). However, nLR was higher in the SOG than CG (3372.06 ± 876.39 $N\cdot s^{-1}\cdot kg^{-1}$ vs. 2268.92 ± 1297.35 $N\cdot s^{-1}\cdot kg^{-1}$, $t_{(28)} = -2.687$, $p<0.05$). Vertical stiffness did not differ between groups (16.69 IQR 13.34 kN/m vs. 16.75 IQR 6.86 kN/m, U = 111.000, $p>0.05$). Our findings suggest that children in the SOG group used less efficient biomechanical strategies to jump and manage impact forces in jump landing tasks. Furthermore, normalizing GRF data to the lean body mass allows to better identify group differences.

Conclusions

We conclude that SO negatively affects children's ability to generate force and absorb impact during jumping tasks. These alterations in the long term may increase the risk of developing structural injuries and reduce adherence to exercise programs.

References

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