



# Comparison of the External Load Between Matches Played at Sea-Level and Moderate-Altitude in Cerebral Palsy Footballers

Matías Henríquez, Aitor Iturricastillo, Daniel Castillo, Javier Yanci, & Raúl Reina



# Background

- **Worldwide** football competitions sometimes take place in **altitude locations** where teams face **hypoxic conditions** that impact **physical and technical performance**.
- These particularities are **not exclusive** to **conventional football** and are extended in tournaments for **para-footballers with cerebral palsy (CP)** organized in **moderate-altitude** sports venues.



Levine et al. (2008)

# Aim of this Study

To compare the **physical response** of para-footballers with CP in **official international** football matches played at **moderate altitude** and **sea-level locations**

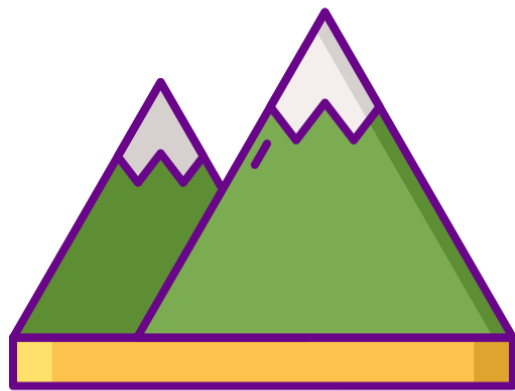


# Material and Methods: Participants

1



87 International para-footballers from 21 national teams



2



Zeist, Netherlands  
(4 m)



Kish Island, Iran  
(30 m)

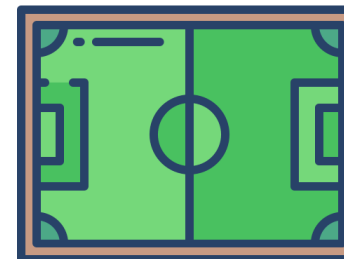


Quito, Ecuador  
(2550–2850 m)

3

Sea Level Group (SLG)  
46 observations;  
18 matches (randomized)

Moderate Altitude Group (MAG)  
46 observations;  
11 matches

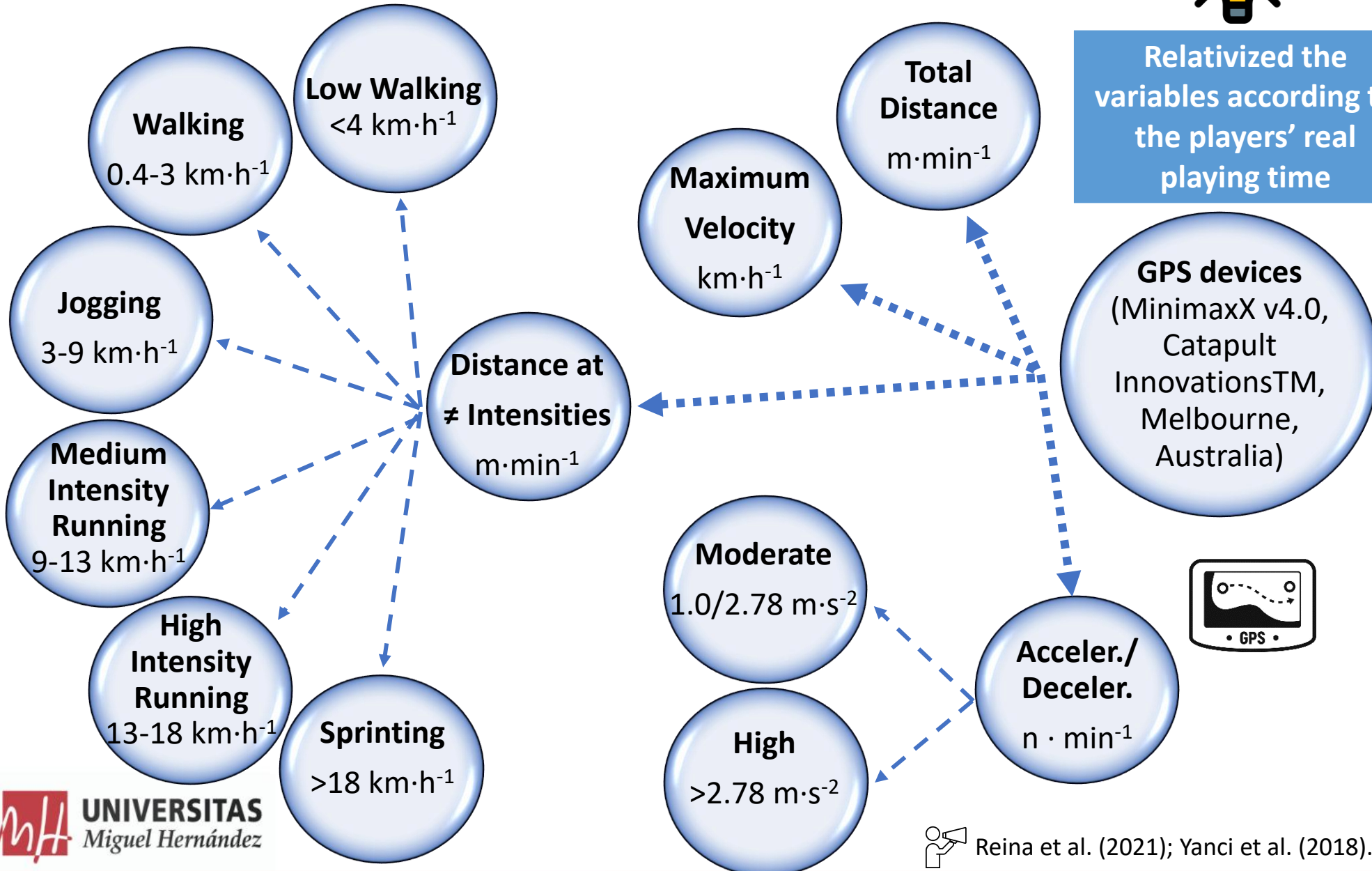


- 70 x 50 m.
- Official matches.
- Physical response.
- Global Position Devices (GPS)

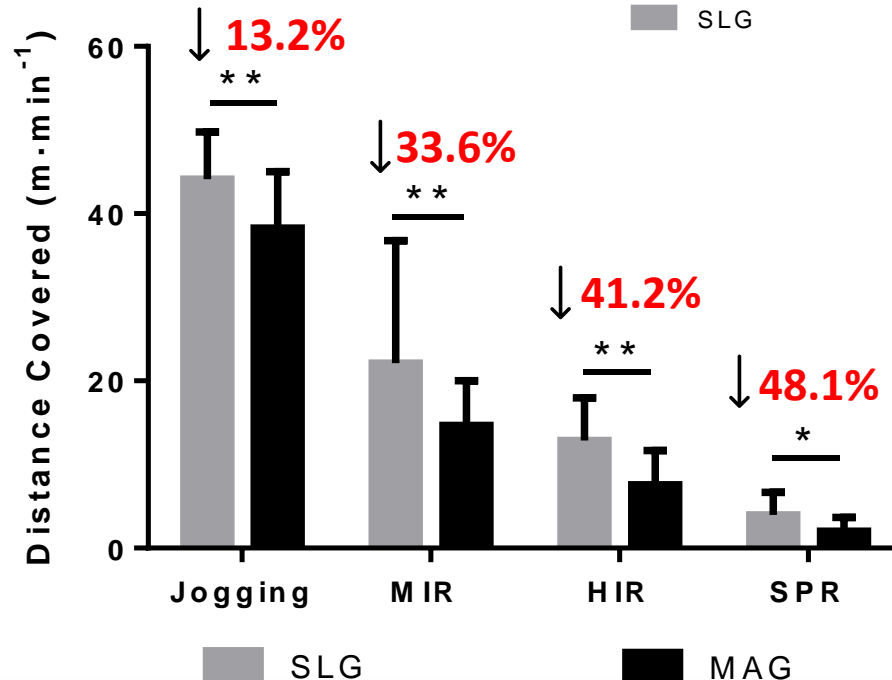
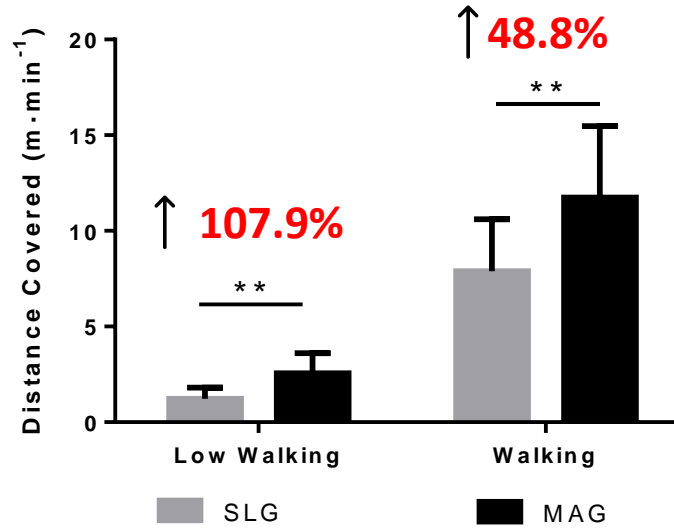
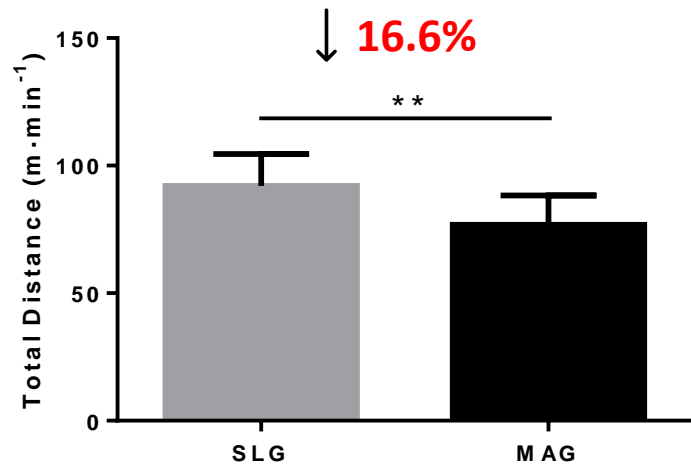
# Material and Methods: Measures



Relativized the variables according to the players' real playing time

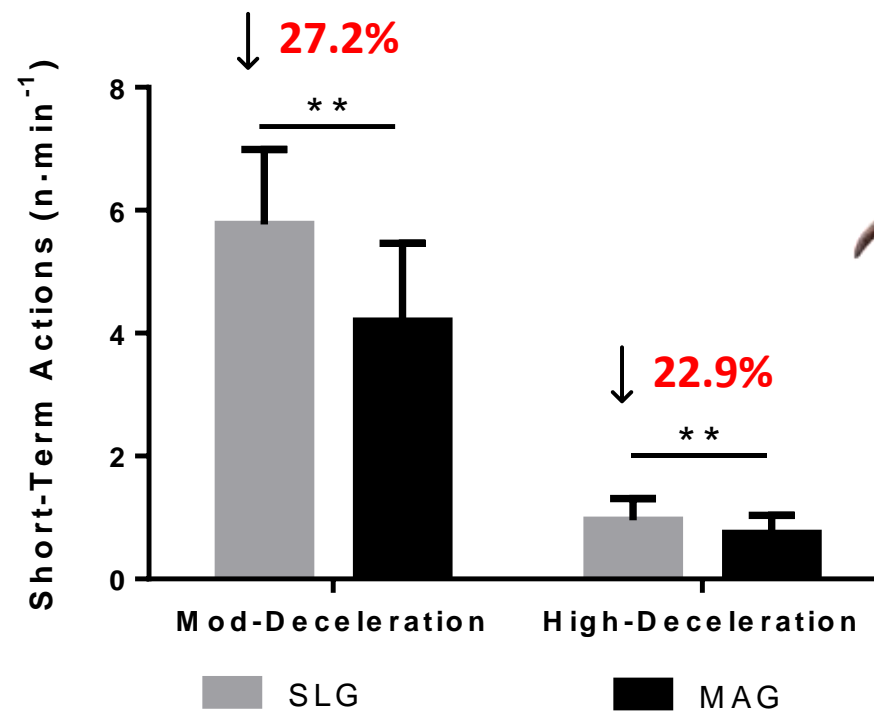
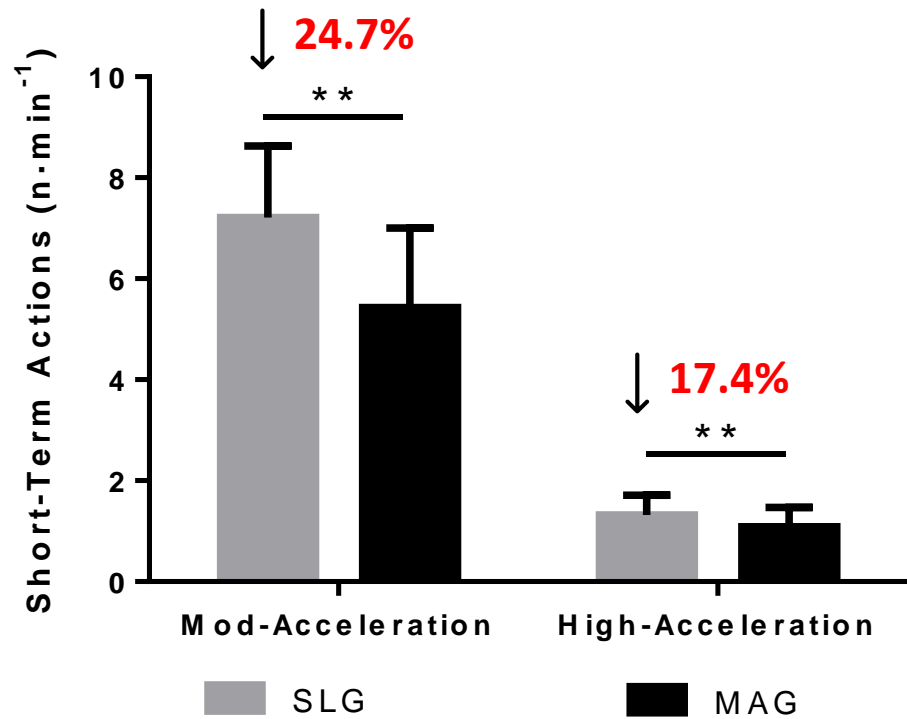


# Results (1/2)



\*  $p < 0.05$   
 \*\*  $p < 0.05$

# Results (2/2)

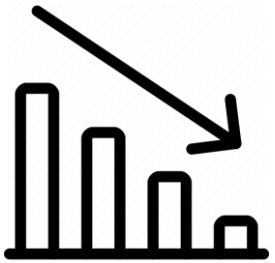


\* $p < 0.05$   
\*\* $p < 0.05$

# Discussion & Conclusions (1/2)



MAG had **lower match physical response**, represented on **total distance covered**, **distance covered at different intensities** (i.e., Jogging, MIR, HIR, SPR), and **short-term actions** (i.e., accelerations and decelerations).



The reduction of physical response during altitude matches is possibly due to the **altitude-induced impact** on endurance performance.



**Low-Walking** and **Walking intensities** showed **more distance covered** in matches at moderate altitudes. **Pacing strategies** could preserve the **capability** of realizing **high-intensity actions** to **mitigate fatigue** and the **adverse effects** under environmental **altitude** strains.





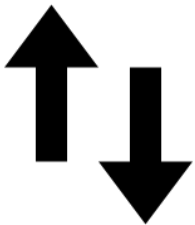
# Discussion & Conclusions (2/2)



Kamaraj et al. (2013) describe a **higher occurrence** of **mountain sickness, fatigue, and headache** at moderate to high altitudes in para-athletes with brain injuries.



**Countermeasures for the competition** must include **acclimatization days** to ensure the best possible condition to approach optimal performance. Further studies could incorporate a **physical assessment, hematological analysis, and cardiorespiratory parameters.**



This study **evidences differences** in the match **physical responses** where para-footballers with CP presented a **lower activity profile** in **moderate-altitude** than in **sea-level locations.**



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# References

- Aughey, R. J., Hammond, K., Varley, M. C., Schmidt, W. F., Bourdon, P. C., Buchheit, M., ... Gore, C. J. (2013). Soccer activity profile of altitude versus sea-level natives during acclimatisation to 3600 m (ISA3600). *British Journal of Sports Medicine*, 47 (Suppl. 1), 3–9. <https://doi.org/10.1136/bjsports-2013-092776>
- Billaut, F., & Aughey, R. J. (2013). Update in the understanding of altitude-induced limitations to performance in team-sport athletes. *British Journal of Sports Medicine*, 47 (Suppl. 1). <https://doi.org/10.1136/bjsports-2013-092834>
- Bohner, J. D., Hoffman, J. R., McCormack, W. P., Scanlon, T. C., Townsend, J. R., Stout, J. R., ... Fukuda, D. H. (2015). Moderate altitude affects high intensity running performance in a collegiate women's soccer game. *Journal of Human Kinetics*, 47(1), 147–154. <https://doi.org/10.1515/hukin-2015-0070>
- Garvican, L. A., Hammond, K., Varley, M. C., Gore, C. J., Billaut, F., & Aughey, R. J. (2014). Lower running performance and exacerbated fatigue in soccer played at 1600 m. *International Journal of Sports Physiology and Performance*, 9(3), 397–404. <https://doi.org/10.1123/IJSP.2012-0375>
- Levine, B. D., Stray-Gundersen, J., & Mehta, R. D. (2008). Effect of altitude on football performance. *Scandinavian Journal of Medicine & Science in Sports*, 18(1991), 76–84. <https://doi.org/10.1111/j.1600-0838.2008.00835.x>
- Reina, R., Iturricastillo, A., Castillo, D., Roldan, A., Toledo, C., & Yanci, J. (2021). Is impaired coordination related to match physical load in footballers with cerebral palsy of different sport classes? *Journal of Sports Sciences*, 1–10. <https://doi.org/10.1080/02640414.2021.1880740>
- Yanci, J., Castillo, D., Iturricastillo, A., Urbán, T., & Reina, R. (2018). External match loads of footballers with cerebral palsy: a comparison among sport classes. *International Journal of Sports Physiology and Performance*, 13(5), 590–596. <https://doi.org/10.1123/ijssp.2017-0042>



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