

Wearables for Running Gait Analysis: A Systematic Review

Rachel Mason¹, Liam Pearson¹, Gillian Barry¹, Fraser Young³, Oisin Lennon², Alan Godfrey³ and Samuel Stuart^{1,4}

¹Department of Sport, Exercise and Rehabilitation, Northumbria University, Newcastle, UK

²DANU Sports Ltd., Ireland

³Department of Computer and Information Sciences, Northumbria University, UK

⁴Northumbria Healthcare NHS foundation trust, UK

DANU

R⁶



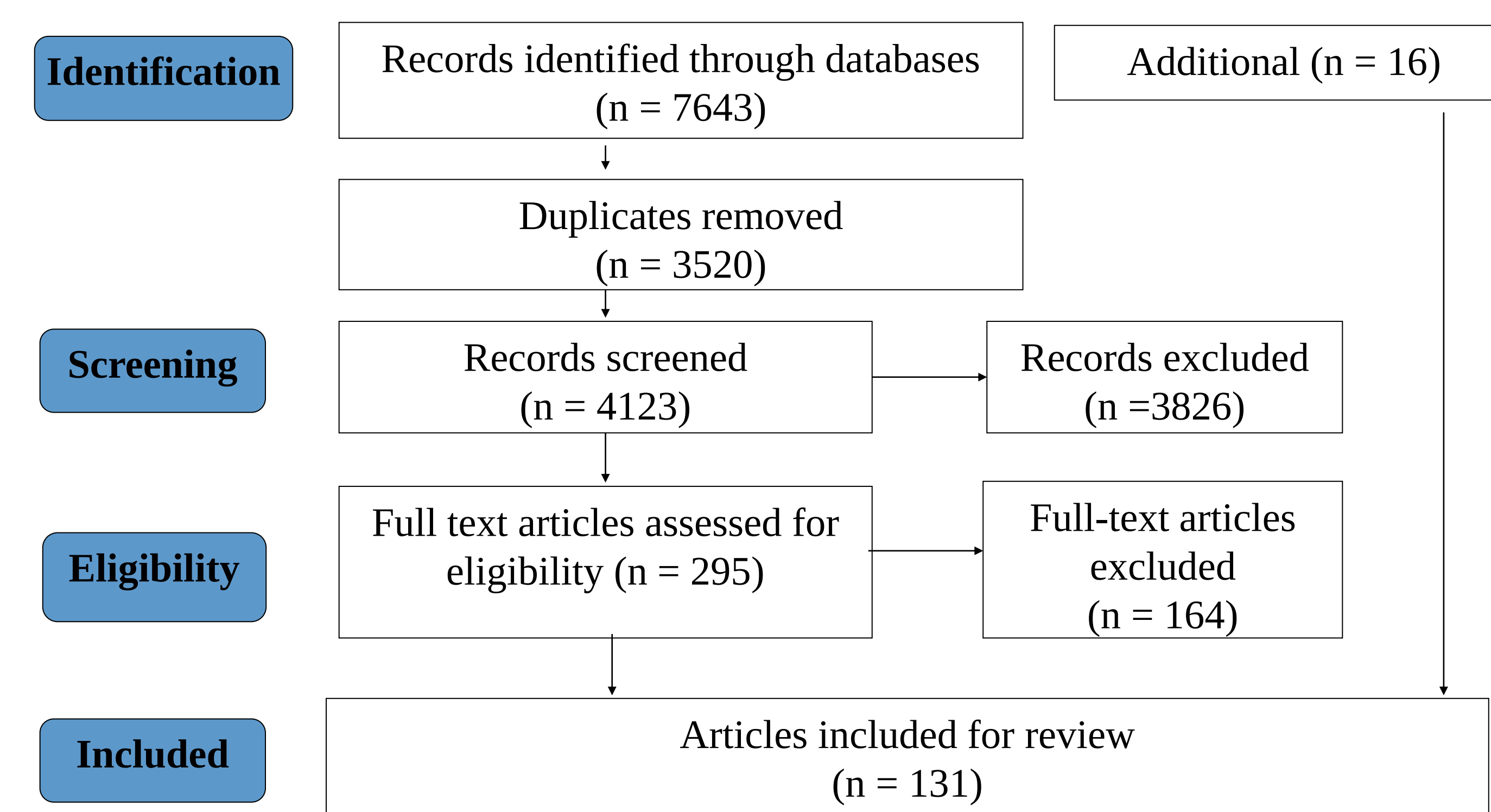
BACKGROUND

- Running gait assessment previously limited to traditional laboratory-based measures.
- Wearable technology allows for the assessment of running gait in natural environments.
- Wearables such as IMUs and ‘pressure-sensitive’ insoles are able to quantify a combination of temporospatial, kinetic, and kinematic variables (dependent upon the device).¹
- Wearable technology fulfils a need to assess effectiveness of biomechanical interventions in altering abnormal running gait

OBJECTIVES

To assess 1) methodologies employed to assess validity and reliability of wearables for running gait assessment; 2) application of wearables to assess running gait (i.e., aims, participants, environment, sensor type / location, protocol); and 3) commonly reported running gait outcomes and findings.

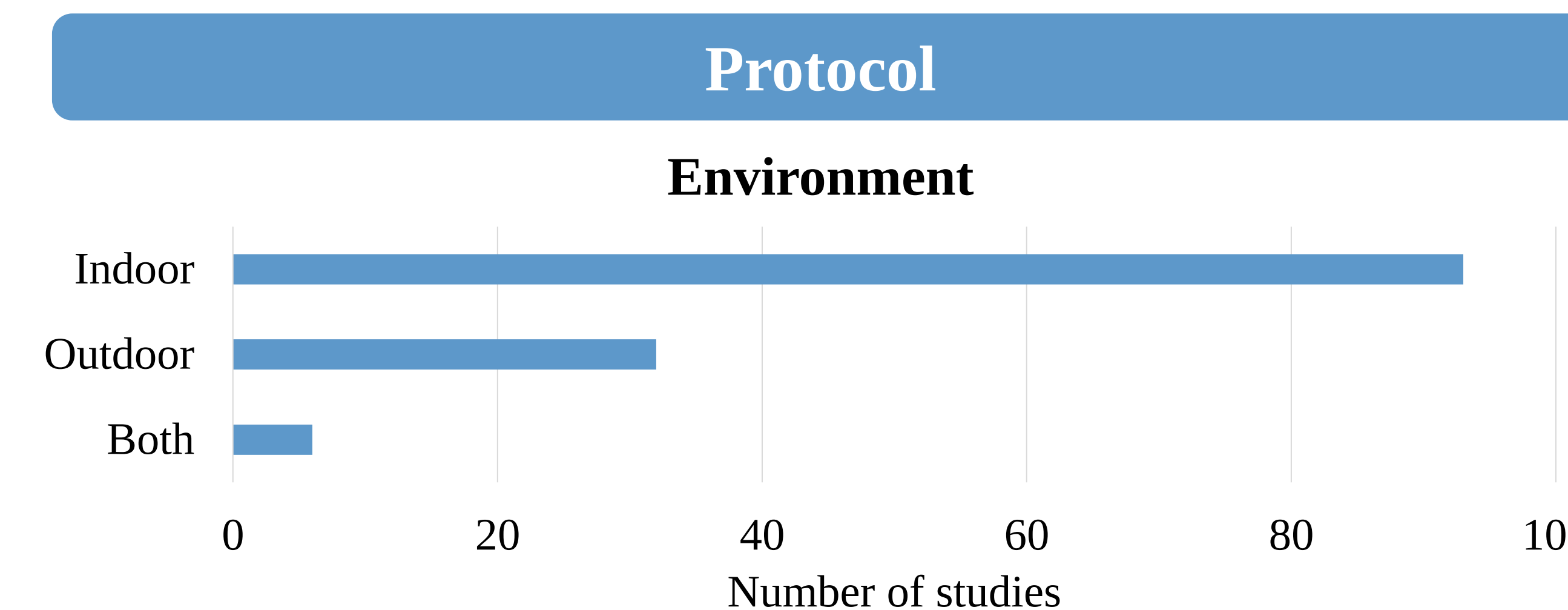
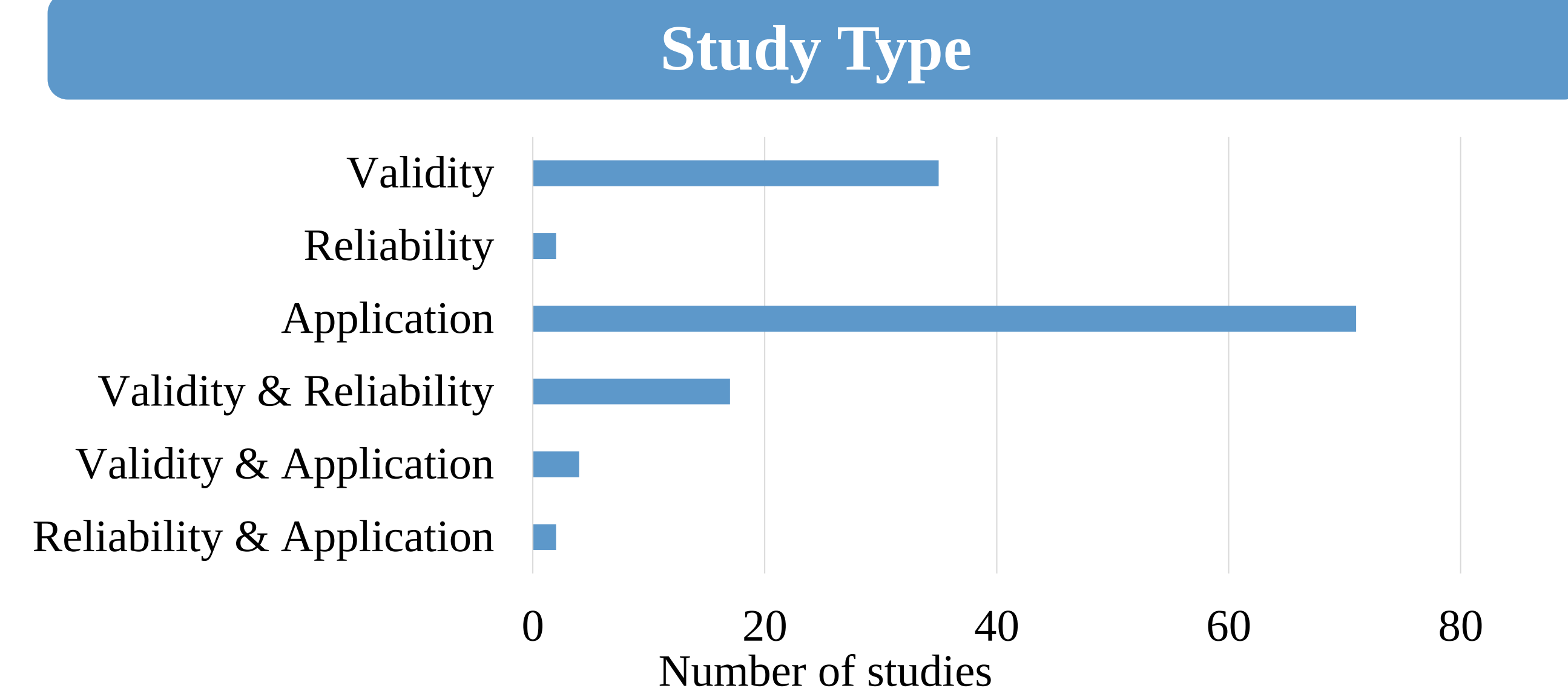
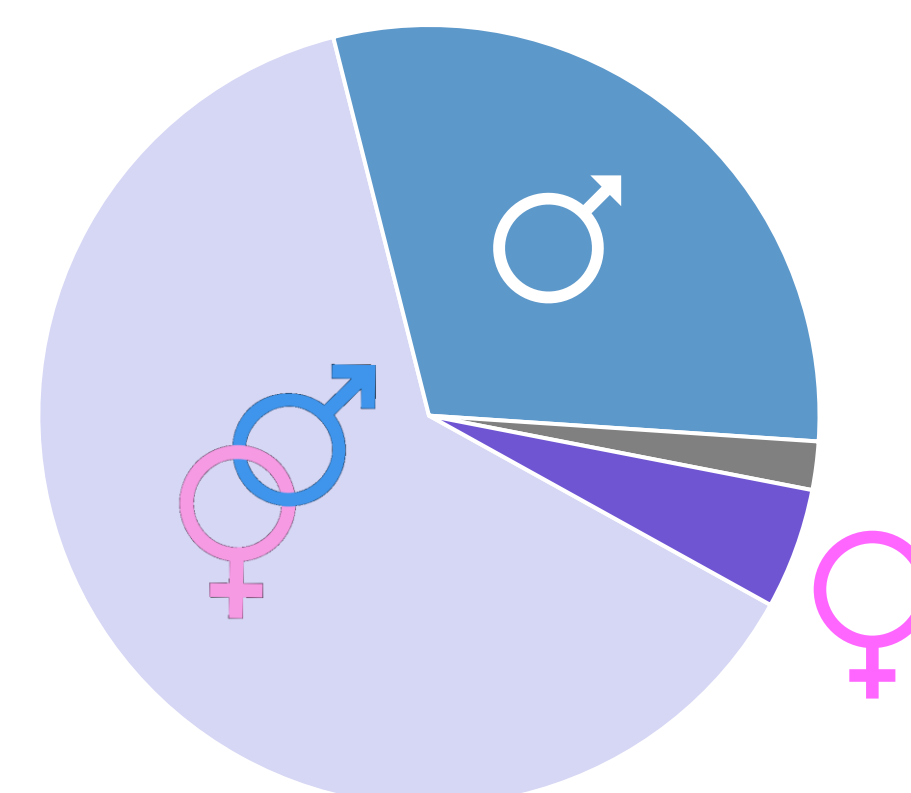
METHODS



RESULTS

Participant Characteristics

Participants	
Minimum	3
Maximum	187
Average Number (± SD)	26 (± 27)
Average Age (± SD)	28.3 (± 7.0)



77 studies



16 studies

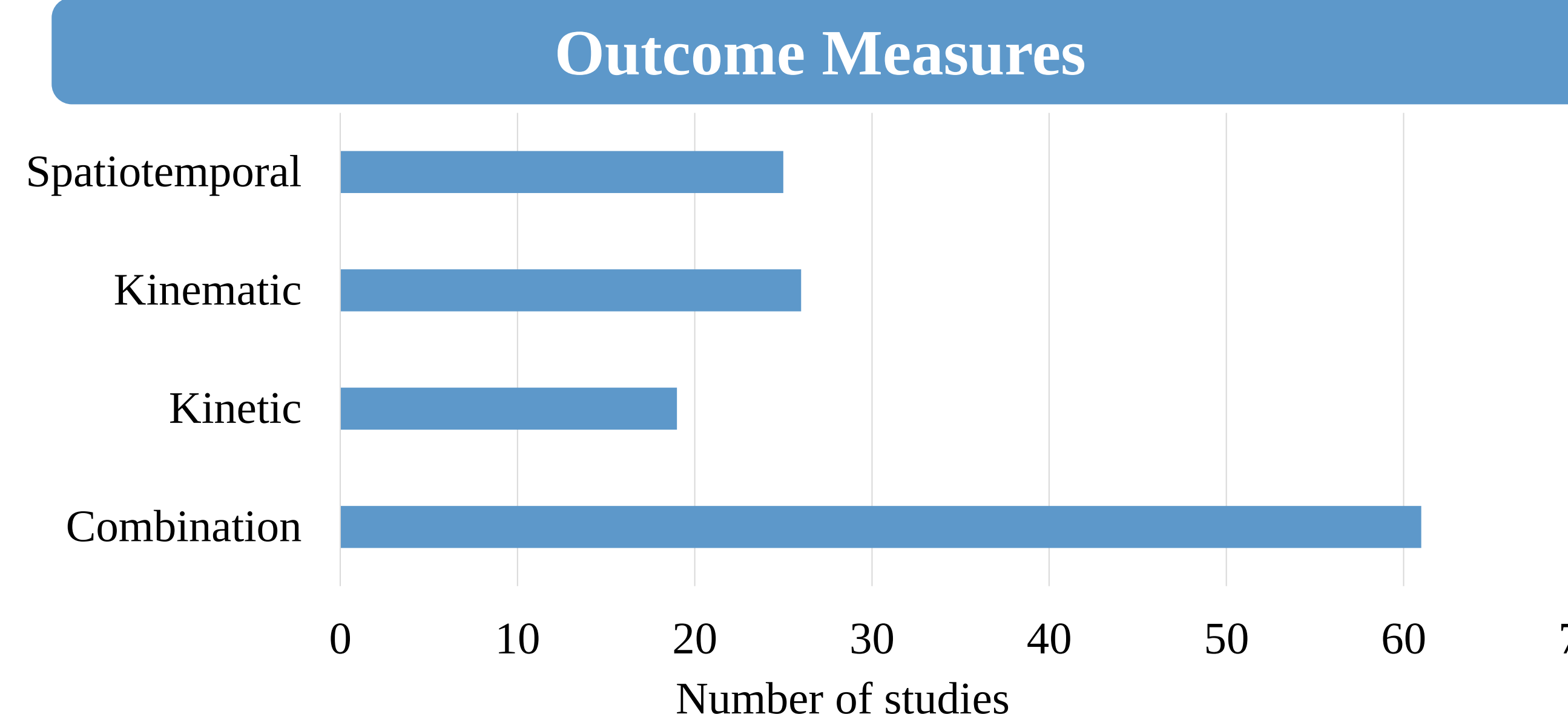


43 studies used standardised footwear

Speed: 77 used controlled speeds, 55 self-selected speeds, 8 combination

- 46 studies included ≥ 2 speeds in their protocol
- Maximum speed = 26km/hr

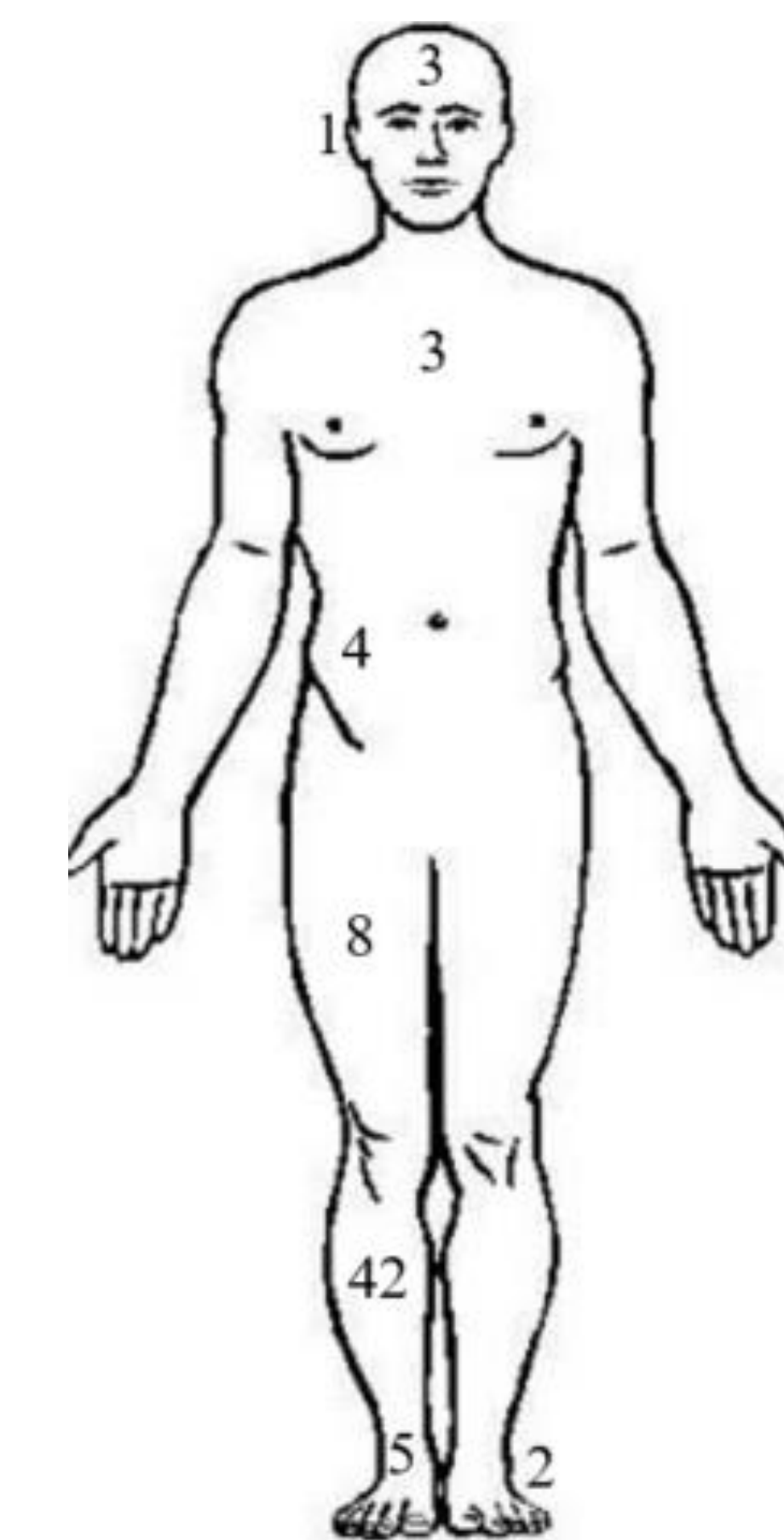
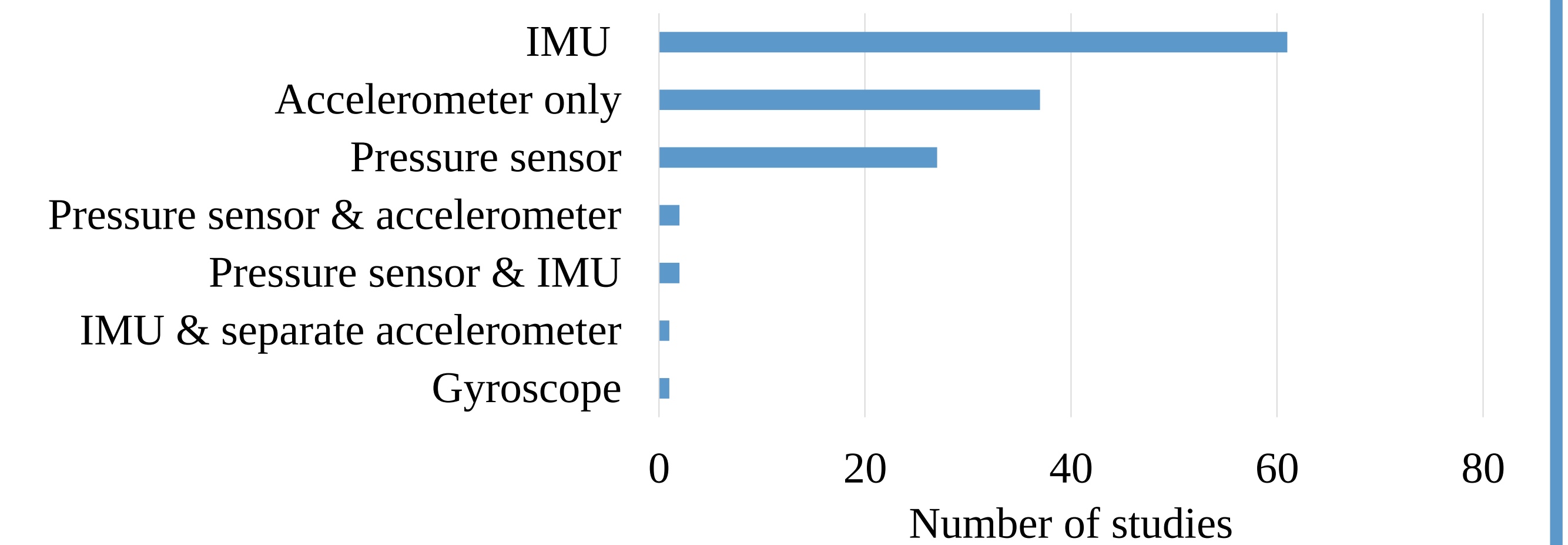
Gradient: 16 studies commented on gradient



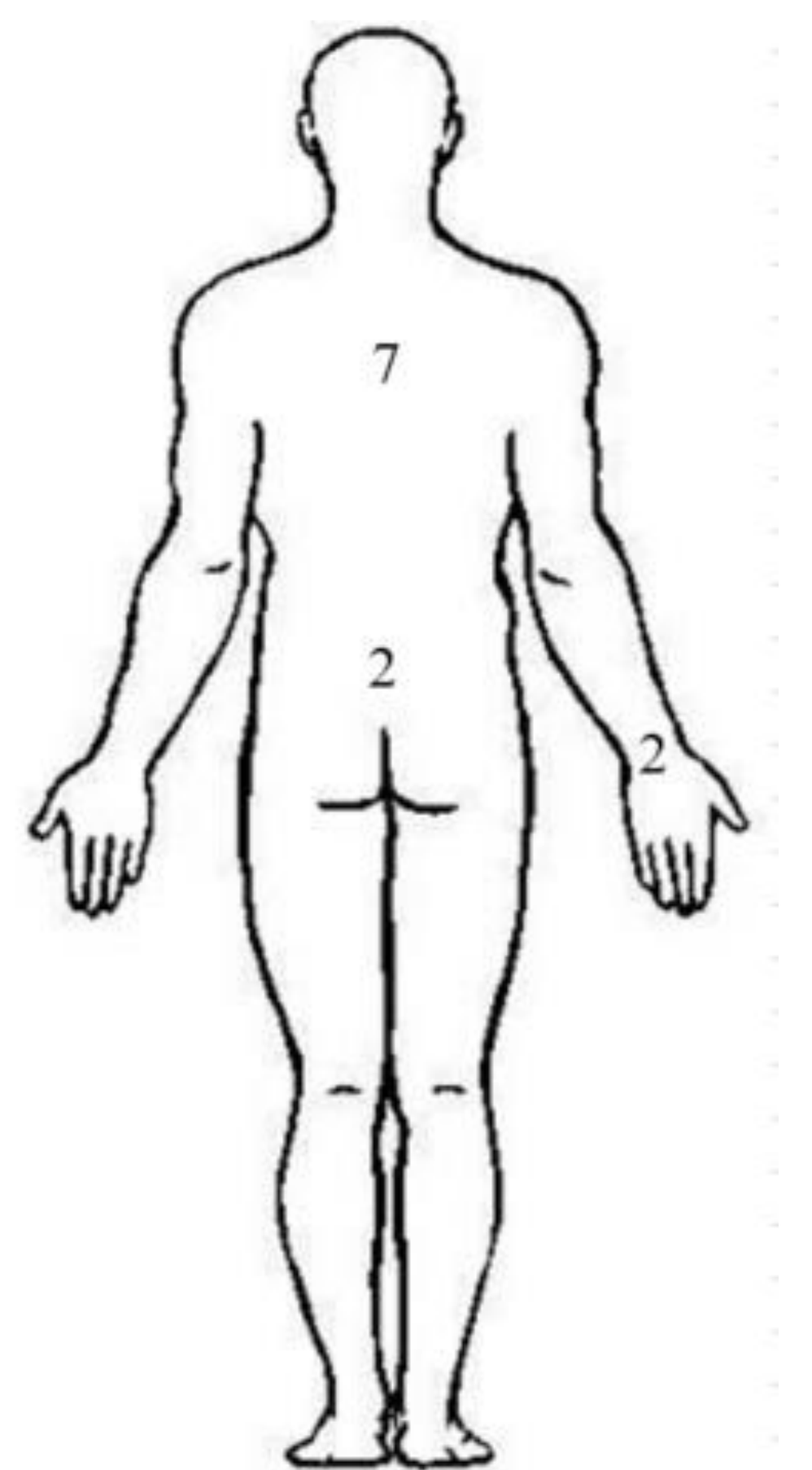
ACKNOWLEDGEMENTS

This project received collaborative funding from Northumbria University and DANU Sports Ltd. (Grant Number 120162), the Parkinson's Foundation (PF-FBS-1898, PF-CRA-2073) and Private Physiotherapy Educational Foundation (#368 #373, PI: Stuart).

Wearable Instrumentation



Sensors worn on the shoe



Pressure insoles

CONCLUSIONS

- Most studies that have examined running gait using wearable sensors have done so with young adult recreational runners, using one IMU sensor (on shoe or tibia), with participants running on a treadmill at controlled speeds and reporting outcomes of GCT, SF, SL and tibial acceleration.
- Future studies are required to obtain consensus regarding terminology, testing validity and reliability of devices and suitability of performance outcomes.

REFERENCES

- [1] Willy (2018). Phys Ther Sport. 29, pp. 26-33.
[2] Mason et al. In Review