Dynamic Balance and Measures of Obstacle Clearance Performance in Individuals with High Body Mass Index

Yue Luo[1], Sol Lim[1], Sidnie Futerman[1], Joelle Grider[1], Sheila Ebert[2], Monica L. H. Jones[2], Oliver A. Varban[3], Clive R. D'Souza[1]

[1]Department of Industrial & Operations Engineering, University of Michigan, Ann Arbor, MI; [2]University of Michigan Transportation Research Institute, Ann Arbor, MI; [3]Division of Minimally Invasive Surgery, University of Michigan Health System, Ann Arbor, MI.

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Introduction

- Single leg standing is encountered in many occupational and daily activities such as walking [1], staircase climbing [2], and clearing obstacles.
- Body mass index (BMI) affects postural control in static single leg standing [3] .
- Less is known about the effects of BMI on balance control during dynamic tasks requiring prolonged single leg balance such in obstacle clearance that requires displacing ones' center of mass.

Objective:
To quantify performance and compensatory movements in individuals with BMI ≥ 30kg/m^2 during a simulated obstacle clearance task.

Hypothesis:
Increasing obstacle heights will increase:
1. Task completion time
2. No. of participants displaying compensatory movements.

Methods

Participants: N= 10 individuals with BMI > 30 kg/m^2

	Obese (30 < BMI < 34.99 kg/m^2)	Morbidly Obese (BMI > 40 kg/m^2)
Number of participants	5	5
Mean ± sd BMI (kg/m^2)	32.0 ± 1.2	47.2 ± 9.6

Procedure:

Clear Obstacles of 7 heights in 5cm increments

Min height: 36cm (14")

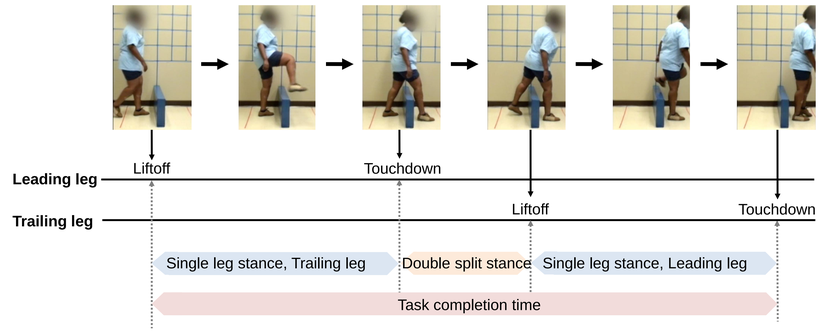
Max height: 66cm (26")

Video-based Task Analysis

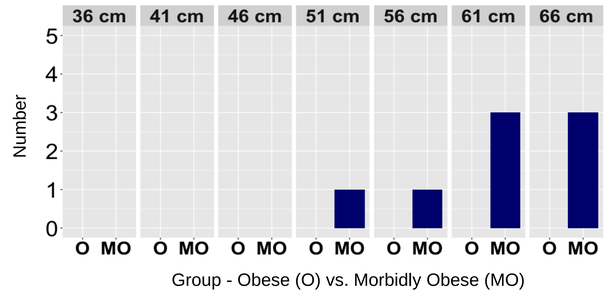
Identify the start & end time of stepping and compensatory movements using the software program ELAN v5.1 (The Language Archive)

1. Stepping movement | **2. Compensatory movements**

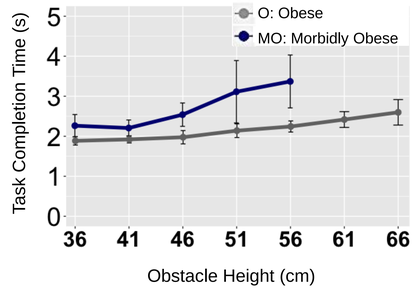
1. Stepping Movements



Number of unsuccessful trials increased with Obstacle Height among Morbidly Obese



Task Completion Time Increases with Obstacle Heights, and more among the Morbidly Obese

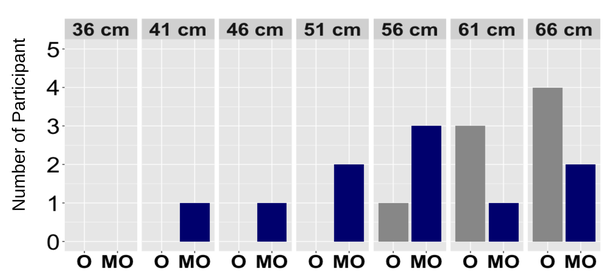


2. Compensatory Movements

By leg(s)

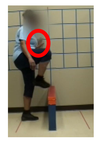
	Description	Leading leg	Trailing leg
Shuffle	Foot lifted off and down to the ground with a vertical displacement		
Hover	Foot off the ground showing a paused hovering motion		
Pivot	Foot rotated on the ground about the vertical axis of the shank		

Number of Participant Using Compensatory Movements with their Leg(s)

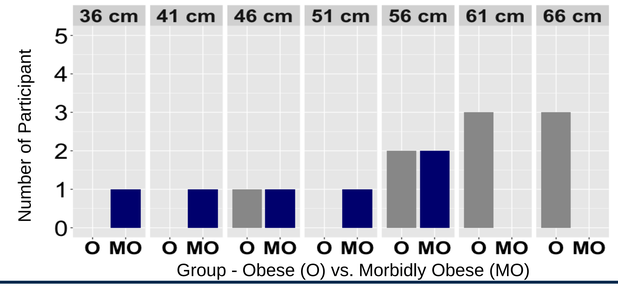


- More participants showed compensatory movements with their leg(s) with increasing obstacle height.
- Morbidly obese individuals performed compensatory movements at lower obstacle heights.

By hand(s)

	Description	One-handed	Two-handed
Contact the wall	Hand(s) contacts or braces against the wall		
Lift the leg	Hand lifts the swinging leg		

Number of Participant Using Compensatory Movements with their Hand(s)



- More participants showed compensatory movements with their hand(s) with increasing obstacle height.
- Morbidly obese individuals performed compensatory movements at lower obstacle heights.

Conclusion

- Longer task completion time and increased number of participants using compensatory movements were observed with the increasing obstacle heights. This effect was greater in the morbidly obese vs. obese group.
- Stepping movements and compensatory movements were identified as potential measures of postural control in dynamic task with prolonged single leg stance.
- **Ongoing analysis** involves the use of wearable inertial sensors to quantify subtle compensatory strategies performed with the torso and hips that cannot be easily detected in the video-based analysis.

Reference

[1] Drought, A. B., Murray, M. P., & Kory, R. C. (1964). Walking patterns of normal men. The journal of bone and joint surgery.

[2] Nadeau, S., McFadyen, B. J., & Malouin, F. (2003). Frontal and sagittal plane analyses of the stair climbing task in healthy adults aged over 40 years: what are the challenges compared to level walking? Clin Biomech (Bristol, Avon), 18 (10), 950-959.

[3] Hue O, Simoneau M, Marcotte J, Berrigan F, Doré J, Marceau P, Marceau S, Tremblay A, Teasdale N. Body weight is a strong predictor of postural stability. Gait Posture. 2007 Jun;26(1):32-8.

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