UNIVERSIDADE DE ÉVORA

RoboCorp Laboratório

CHRC COMPREHENSIVE HEALTH RESEARCH CENTRE

EFFECTS OF PHYSICAL ACTIVITY IN POSTURAL CONTROL OF ADULTS WITH ACHONDROPLASIA

Inês Alves[1,2], Maria António Castro[3,4], Sofia Tavares[5], Orlando Fernandes[1,2]

[1] School of Health and Human Development, University of Évora, Évora, Portugal; [2] Comprehensive Health Research Centre; [3] School of Health Sciences, CitechCare and CDRSP, Polytechnic University of Leiria; [4] RoboCorp lab, i2a – IPC; CEMMPRE University of Coimbra, Coimbra, Portugal; [5] Education and Psychology Research Center, Évora University, Évora, Portugal

ines.alves@uevora.pt

INTRODUCTION

Achondroplasia is a rare skeletal dysplasia occurring in 1 in 25 000 births [1]. It is characterized by disproportionate short stature, with lower and upper limbs proximal shortening, average size torso, macrocephaly and joints laxity. Final adult height is - 6.0 standard deviation score in both genders, ranging between 110 cm to 140 cm[1]. Human movement analysis has been generally derived from linear measures, as Mean Velocity (MV), yet these fail to describe the behaviour of the body systems [2], while nonlinear analysis, as Fractal Dimension (FD), approach variability, stability, complexity, and adaptability[3]. Previous studies in other populations have demonstrated that active lifestyle improves postural control and strength[4]. There is limited evidence on postural control in adults with achondroplasia, on habits of physical activity and how it may be related to posture and balance.

AIM

Quantify postural strategy of adults with achondroplasia through centre of pressure analysis of linear and nonlinear measures, while considering physical activity habits

METHODOLOGY

Sixteen adults with achondroplasia (11 women) participated in an exploratory cross-sectional study. Anthropometric data were collected including weight (53.7 ± 14.5 kg), height (125 ± 12.8 cm), and waist circumference (84.6 ± 13.8 cm).

Handgrip strength (HGS) was measured using a Jamar Plus+ Digital Hand Dynamometer. Postural data were acquired on a Bertec force plate (model FP4060-07-1000) at a sampling rate of 1000 Hz. Participants stood on the plate for 30 seconds in each of the following positions: bipedal with eyes open (O), bipedal with eyes closed (C), unipedal on the right foot (R), and unipedal on the left foot (L). The MV and FD measures were computed from the centre of pressure (CoP) time series [5], at the anteroposterior (AP) and mediolateral (ML) directions. Data processing was performed using a custom MATLAB code, with frequency downsampling to 100 Hz. Participants completed the International Physical Activity Questionnaire (IPAQ), which assesses energy expenditure in MET-min/week for vigorous, moderate, and walking activities.

Figure 1. Participant from PAL1, standing over the force plate, in unipedal right foot (R).

Measures	Direction and position	Standardize Mean difference
Mean Velocity (ms^{-1})	ML_C	0.16883
	ML_O	0.24052
	ML_L	0.41429
	ML_R	1.17957
	AP_C	0.74404
	AP_O	0.4475
	AP_L	0.77803
	AP_R	1.18653
Fractal dimension	FD_ML_C	0.04056
	FD_ML_O	0.10706
	FD_ML_L	0.39258
	FD_ML_R	0.13124
	FD_AP_C	0.00437
	FD_AP_O	-0.00131
	FD_AP_L	0.06933
	FD_AP_R	-0.04206

Figure 2. Standardize mean difference between groups (PAL 2 – PAL1) (p<o.o5, 95%CI)

Table 1. Participants (N=16) anthropometric characteristics and handgrip strength grouped by physical activity level (PAL). Values presented as mean and standard deviation.

Participants	PAL	Age (years)	Weight (kg)	Height (cm)	Waist circunf (cm)	Handgrip (kg)
N=10	1	39.1 ± 13.6	55.4 ± 17.3	121.0 ± 9.9	86.5 ± 16.0	10.8 ± 5.1
N=6	2	34.0 ± 14.1	51.0 ± 8.7	133.0 ± 14.1	81.3 ± 9.4	12.1 ± 6.8

Based on the IPAQ physical activity level (PAL) , 2 groups were formed: inactive or sufficiently active (PAL 1, n=10) and minimally active (PAL 2, n=6), with the latter requiring at least a score of 600 MET-min/week.

RESULTS

Descriptive (mean±SD) and non-parametric (Mann-Whitney and Spearman) statistical analyses were performed. Only MV_R presented a significant difference between groups (p=0.022) with a strong effect size (r=0.7). Additionally, PAL2 demonstrated subtly higher MV and FD in the AP direction in bipedal standing (MV_AP_C, MV_AP_O, FD_AP_C, FD_AP_O) compared to PAL1, though not reaching statistical significance. Correlations (p<0.01) were found between MV_ML_L and weight (0.618) and HGS (0.656) as well correlations between MV_AP_L with weight (0.691), HGS (0.735) and between MV_AP_L (p<0.05) with height (0.519) and waist circumference (0.549).

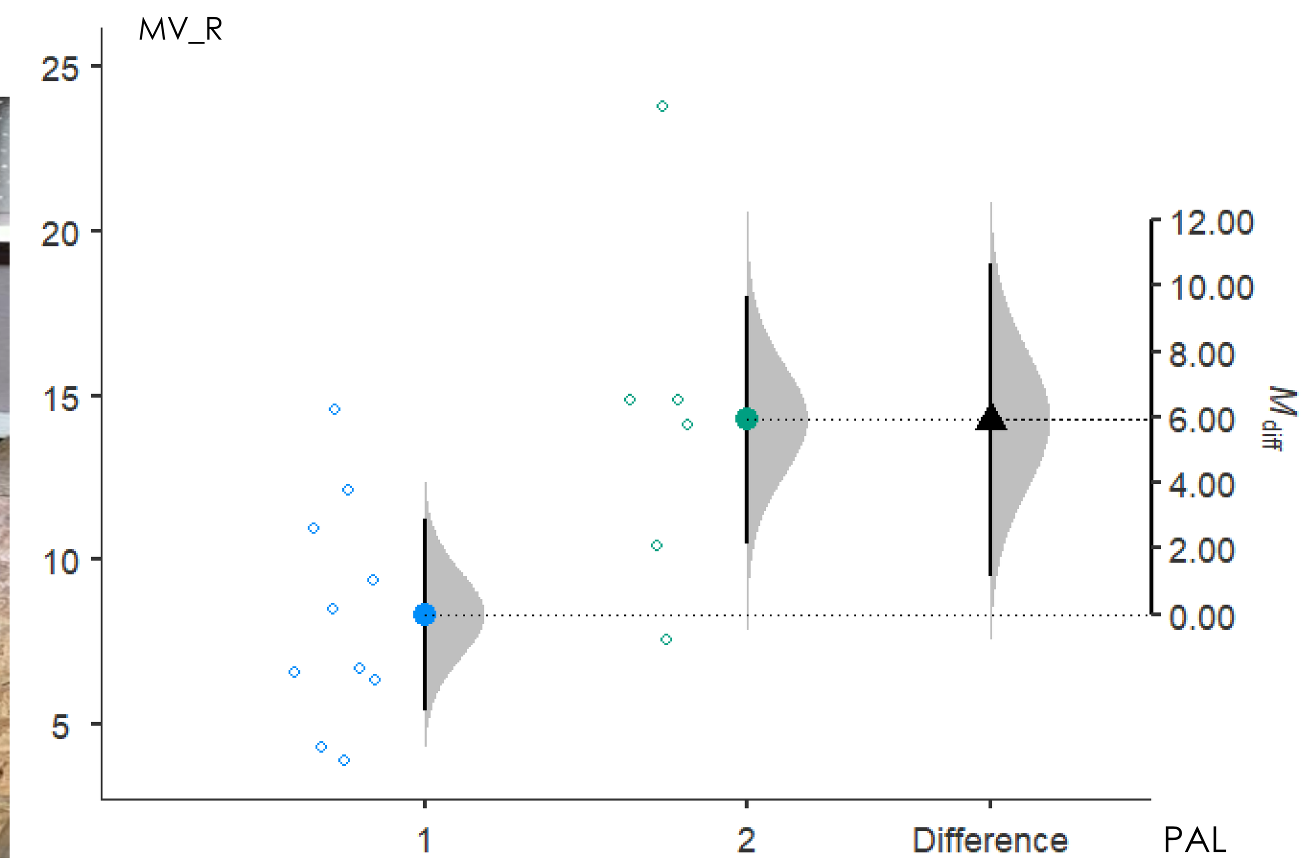

Figure 3. Difference between groups for MV_R (p<0.05, 955CI)

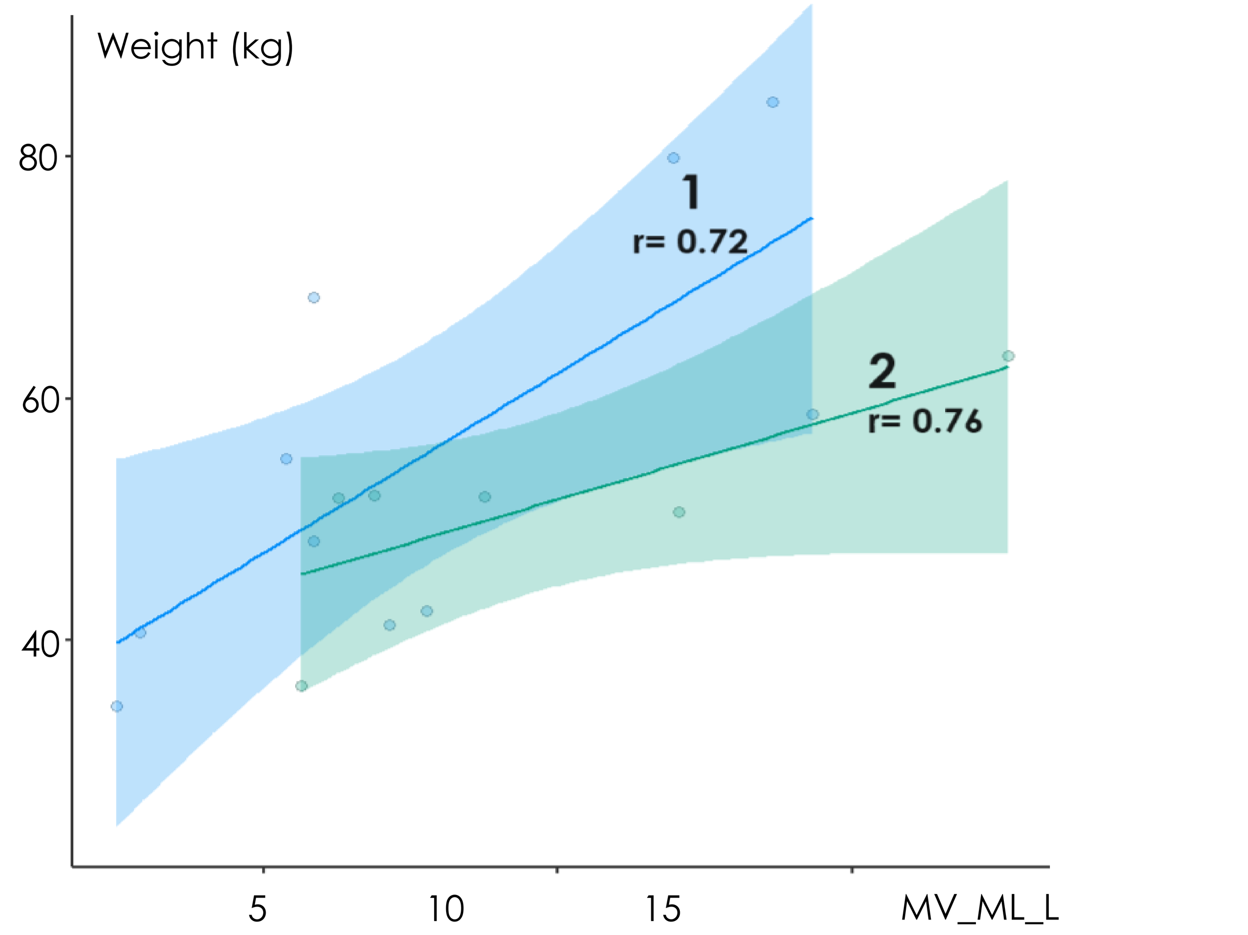

Figure 4. Scatterplot of the correlations for both PAL groups between MV_ML_L and weight (p<0.01).

DISCUSSION

This study provides initial insight into biomechanical challenges to balance in adults with achondroplasia. Minimally active adults (PAL 2) exhibit subtle enhancements in ML and AP directions postural stability compared to inactive adults, highlighted by statistically significant reduced sway only for the right limb, interestingly the dominant foot. PAL2 also showed slightly higher MV and FD in almost all conditions. These preliminary results suggest that more active adults have increased adaptability to control and adjust posture and that an active lifestyle may help overcome balance deficits in ACH and aid functionality and mobility.

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