POWER OUTPUT IN SHORT VERSUS LONG DISTANCE MASTERS ATHLETES

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The purpose of this study was to determine the effect of age-decade, sex and athletic discipline on muscle power output in older adults. Participants (n=29) were invited to complete an IPAQ survey and complete a countermovement jump assessment on a force platform (AMTI OR6-7) while instrumented with motion capture technology (NDI 3D Investigator). Short distance master athletes demonstrated higher specific power output compared to long distance and active older adults. This research has demonstrated distinct benefits of short distance athletics. These findings will hopefully encourage older adults to maintain greater physical health in advancing age through exercise, including higher-power activities such as sprinting.

KEYWORDS: Jump, CMJ, Exercise, Aging, Health, Track

INTRODUCTION: Aging is accompanied by decreased muscle mass (1%/y) and decreased muscular strength (2%/y). Muscular power (3.5%/y) is known to decrease as well (Skelton et al., 1994), but these effects can be tempered by physical activity (Ramsey et al., 2021). This is important because lower body muscular power is a superior predictor of function in older adults (Balachandran et al., 2022; de Vos et al., 2005; Foldvari et al., 2000; Fragala et al., 2019; Skelton et al., 1994). Understanding the extent to which muscle power output deteriorates with age, with the influence of various modes of physical activity, is crucial for several reasons including improving quality of life in older adults, reducing stigmas surrounding athletics in older adults, and reducing healthcare burdens related to preventable chronic diseases. Therefore, the purpose of this study was to determine if there was a difference in muscular power output in non-athletes and masters athletes from short- versus long-distance athletics disciplines with sex and age-decade as additional factors.

METHODS: Data from 29 participants are presented here. Short distance events include sprinting (50-400m), hurdles, pentathlon, and decathlon. Long distance events include race walking or running distances greater than 3km. Athletic disciplines are self-reported by participants. All participants were individually considered moderately active or highly active via the IPAQ survey. Average activity levels are provided below in Table 1.

Table 1 - Participant age, athletic discipline, and activity level via IPAQ.

	Males			Females		
Sample size		n=18			n=11	
Mean age		66.3y			60.2y	
Mean IPAQ		2.72			2.91	
	Short	**Long**	**Non-Athlete**	**Short**	**Long**	**Non-Athlete**
Sample size	n=6	n=5	n=7	n=1	n=4	n=6
Mean age	65.6y	68.9y	65.2y	70.9y	63.2y	56.4y
Mean IPAQ	2.83	3.00	2.45	3.00	3.00	2.83

Participants provided their informed consent, completed the IPAQ questionnaire, then were invited to begin a warm-up involving treadmill walking at a self-selected pace and completed additional stretching if desired. Participants were configured with eight rigid bodies containing 40 active markers sampling at 80Hz (Northern Digital, 3D Investigator) covering bilateral feet, bilateral shank, bilateral thigh, pelvis, and the lumbar region **(Figure 1)**. Once configured, participants completed countermovement jump (CMJ) warm-up repetitions. After warming up to a perceived 90% effort CMJ, the first of three maximal CMJ was recorded. All jumps were

performed on a force plate sampling at 1200Hz (Advanced Mechanical Technology Inc., AMTI OR6-7). A minimum of 20 seconds rest was provided between successive jumps.
Data processing and analysis was conducted in Visual3D V6 (C-Motion Inc). First, motion capture data were interpolated with a third-order spline over a maximum gap of 0.1s, or 8 frames. Following interpolation, motion capture and ground reaction force data were both filtered with a fourth-order, bidirectional low-pass Butterworth filter with a cutoff frequency of 10Hz (Vliestra et al., 2014). Net Force (F_net_Z) during the push-off phase was calculated by subtracting weight in Newtons from the force signal and vertical velocity of the pelvis (V_pelvis_Z) was used as an analogue to vertical velocity of the whole-body centre of mass. Power was calculated as the product of these two quantities. That is:

Equation (1) $$P = F_{net_Z} \cdot V_{pelvis_Z}$$

Where the largest product of net force and velocity is considered the maximum power. Peak power may not necessarily coincide with peak net force, or peak velocity. Peak power was then divided by body mass in kilograms to yield specific power (W/kg).
A three-way ANOVA ($\alpha = 0.05$) was performed to compare the effects of age-decade (50-59, n=11; 60-69, n=10; 70-79, n=7; 80-89, n=1), sex (male, female), and athletic discipline (Short, Long, Non-Athlete) on specific muscular power output during the CMJ.

Figure 1 - Participant outfitted with NDI motion capture markers performing countermovement jump on an OR6-7 force plate.

RESULTS:

The three-way ANOVA found no statistically significant interaction effects but did uncover a significant main effect of athletic discipline on peak specific muscular power output (F=9.299, df=2, p=0.002). Tukey's pairwise comparison revealed a significant difference between short-distance athletes versus non-athletes (p=0.001), and short-distance athletes versus long-

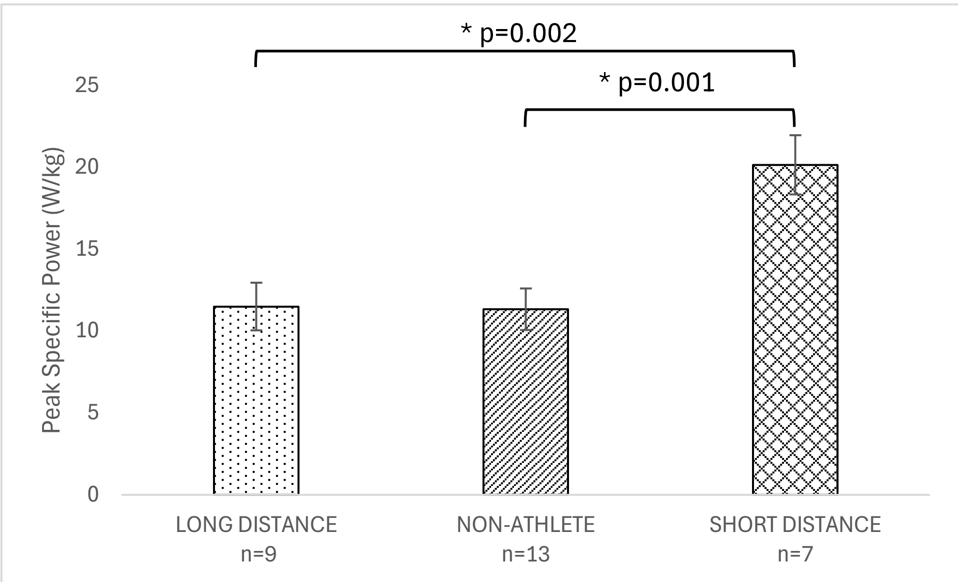

Figure 3 – Peak specific muscular power during a CMJ task. A three-way ANOVA revealed a significant difference in peak specific muscular power (W/kg) between short versus long distance athletes, and short versus non-athletes (F=9.299, df=2, p=0.002). Error bars show standard error.

distance athletes (0.002). No significant difference was found between non-athletes and long-distance athletes (p=0.937) (Figure 2).

The lack of an age-decade effect is surprising although it may be due to the low sample size in some decades, and the variable skill levels of the masters athletes within each decade. One female athlete holds multiple age-group world records, and as such, their power output which was more than twice that of other female athletes, and may be interfering with age-effects.

DISCUSSION:
Our findings suggest that not all masters athletes maintain greater muscular power output than their active age-matched peers. Previous research in masters athletes has shown greater relative power output in a mixed group of masters athletes (Glenn et al., 2016). The disagreement in our findings may be due to the diversity of athletes recruited by Glenn and colleagues (2016). Their cohort included short and long-distance runners, but also tennis players and CrossFit athletes. Our findings also suggest that short distance masters athletes do appear to maintain a higher level of muscular power output when compared to both active non-athletes and long-distance masters athletes. These findings agree with those presented by Grassi et al., in 1991 where sprinters and jumpers, on average, were shown to demonstrate higher lower body power output across the lifespan compared to endurance masters athletes, including runners, cyclists and skiers. On the other hand, a study by Piasecki and colleagues (2018) found that sprinting masters athletes had significantly higher specific power output compared to controls, but there was no significant difference in power between the short and long-distance masters athletes. In their study, Piasecki and colleagues (2018) categorized short distance as 800m and less whereas in our study, 400m or less was considered short distance. Our more stringent classification may explain why differences have been observed between long and short distance masters athletes in our study.

CONCLUSION:
Contrary to the findings of Piasecki et al., 2018, the findings here suggest that training for, and competing in short distance athletic disciplines such as sprinting and jumping, may induce higher power adaptation in older adults when compared to general physical activity or distance running. More generally, the research presented here supports the concept that higher power bursts of activity such as sprinting or jumping may benefit the older adult to a greater extent than distance running, at least in terms of maintaining higher power output, and functional capacity as a result. This data adds to a growing body of evidence which hopefully will encourage greater participation in sports such as sprinting, which typically have lower participation rates compared to distance running, despite offering distinct health benefits for the aging adult.

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