

# Metabolic Intensity and Stepping Cadence for Middle-aged and Older Adults during Competitive Walking Football

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## Abstract

### METABOLIC INTENSITY AND STEPPING CADENCE FOR MIDDLE-AGED AND OLDER ADULTS DURING COMPETITIVE WALKING FOOTBALL

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Walking football is a new sport popular with middle-aged and older adults, but relatively little is known about the determinants of metabolic intensity while playing. **PURPOSE:** This study was designed to measure and compare the average metabolic equivalent (MET) – a measure of metabolic intensity – and walking cadence (WC) with established thresholds associated with a moderate intensity. Specifically, it was hypothesized that average intensity would be  $\geq 3.0$  METs and WC  $\geq 100$  steps/min during competitive walking football matches.

**METHODS:** Quantitative observational data were collected during a tournament that included all members of four participating teams (22 women and 20 men) representing Australia, Malaysia, and Singapore – ( $Mean \pm SD$ ;  $51 \pm 11$  years old,  $27.3 \pm 5.2$  kg/m $^2$  BMI). Participants wore a neoprene waist pack with an accelerometry-based activity monitor (AM) that collected and summarized accelerometry data every 60 seconds. After the tournament, the data were downloaded to a computer and transformed into average METs and WC for each minute of game play. Mean METs and WC values for all players of each match were compared to their moderate intensity thresholds (i.e., 3.0 METs and 100 steps/min, respectively) using one-sample t-tests and a Bonferroni adjusted alpha of 0.006. Lastly, the linear relationship between METs and WC was evaluated using linear regression.

**RESULTS:** Mean METs for each match (3.2–3.9 METs) either met or exceeded the 3.0 METs threshold ( $P < 0.006$ ) as hypothesized, but mean WC of 44–63 steps/min were all significantly lower than the 100 steps/min threshold. The correlation between METs and WC for all matches was moderately strong ( $R = 0.78$ ;  $P < 0.001$ ). **CONCLUSIONS:** These results support the premise that competitive walking football is played at moderate intensity (or higher) in middle-aged and older adults. The unexpected lower walking cadence values, however, suggest that further research is warranted to understand the determinants of metabolic and cardiovascular intensity when playing this sport.

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## Background



Fig. 1 & 2  
Media Coverages of Walking Football4Health Asia  
Courtesy of Berita Harian Singapore & Mediabase Berita



Fig. 3  
Inaugural Walking Football4Health International Communities Games 2019 in Perth, Western Australia  
Research conducted on the mixed-gender teams from Australia, Malaysia and Singapore (Heil, Newton & Salle, 2021).

## Introduction



Fig. 4  
Inaugural Walking Football4Health International Communities Games 2019 in Perth, Western Australia  
Research conducted on the mixed-gender teams from Australia, Malaysia and Singapore (Heil, Newton & Salle, 2021).

Walking football is a community-friendly safe sport (1). A modified version of soccer, it is played on smaller pitches with smaller goalpost sizes, with strict rules against body contact, strict no-overhead-ball ruling, rule and no running. As a tool to combat sedentarism, can playing walking football help satisfy the WHO guidelines for weekly PA (2)?

Is the metabolic intensity of playing walking football high enough to satisfy the “moderate intensity” threshold specified in the WHO PA guidelines? In 2018, Heil et al. (5) reported values of 3.2–3.3 METs were statistically equal to the 3.0 MET threshold value commonly associated with an absolute “moderate” intensity (6). It was also reported that average heart rate values expressed relative to age-predicted maximal heart rate (HR% of 77–80% for one team and 91–95% for the another team) exceeded the HR% threshold value of 64% that is commonly used as a threshold measure of relative “moderate” intensity (6). Recently, Ayabe et al. (7) reported average intensity values of 82% and 8.0 METs for HR% and metabolic equivalents, respectively, for a group of middle-aged and older adults playing a single recreationally competitive match of walking football. Similarly, Reddy et al. (8) reported an average HR% of 76% during walking football match play. Thus, these small collection of studies has consistently reported that measures of both metabolic (4,5,7) and cardiovascular intensity (5,7,8) for walking football do meet or exceed the standard definitions for “moderate” intensity.

Another health outcome related to walking football is the measure of walking cadence (WC) – i.e., a measure of stepping or striding rate (strides/min). Walking cadence is a metric that evolved from the prolific use of pedometers as tools to monitor walking volume over the course of a day (i.e., accumulated steps/day). While the walking volume metric was easy to conceptualize and formulate into a motivational tool (e.g., 10,000 steps/day), walking volume by itself lacks an intensity definition that could relate back to the WHO PA guidelines.

Walking cadence (steps/min), in contrast, is a measure of a specific locomotor task that has direct physiological consequences. As such, walking cadence is now considered a reasonable indirect indicator of whole-body ambulatory intensity (10). According to a review by Tudor-Locke et al (10), a cadence of 100 steps/min is considered a clinically relevant threshold commonly associated with a “moderate” intensity for sustained bouts of walking. Despite not measuring walking cadence themselves, Harper et al. (11) suggested that the 100 steps/min threshold value (or an equivalent step volume for a specific amount of time – e.g., 1500 steps for 15 mins, or 3000 steps for 30 mins) could be used as an exercise prescription metric for those using walking football to improve measures of health and fitness. After reviewing the literature, it seems that only Ayabe et al. (7) has reported walking cadence for a walking football match. Using a group of middle-aged and older adults all classified as having “mild metabolic disorders”, Ayabe et al. (7) reported an average WC of 85 steps/min with no statistical comparison to the 100 steps/min threshold. Regardless, the current amount of WC data reported in the literature is very limited and should be expanded upon to better understand this metric as a potential tool for monitoring and evaluating walking football athletes.

This study was designed to measure and compare the average metabolic equivalent (MET) – a measure of metabolic intensity – and walking cadence (WC) with established thresholds associated with a moderate intensity. Specifically, it was hypothesized that average intensity would be  $\geq 3.0$  METs and WC  $\geq 100$  steps/min during competitive walking football matches.

## Methods

All measures took place on a single day at the inaugural 2019 Walking Football4Health Communities Games in Perth, Australia. Each match was played on the same 15.1 m x 30.4 m pitch located outdoors on a hard-surfaced astro court. Environmental conditions, were relatively stable across all matches with clear sunny skies that were cooler and more humid during the first match (20 °C, 55% relatively humidity, 27 KPH wind) that progressively became hotter and drier until the last match (26 °C, 30% relatively humidity, 24 KPH wind). Quantitative observational data were collected during a tournament that included all members of four participating teams (22 women and 20 men) representing Australia, Malaysia, and Singapore – ( $Mean \pm SD$ ;  $51 \pm 11$  years old,  $27.3 \pm 5.2$  kg/m $^2$  BMI). Participants wore a neoprene waist pack with an accelerometry-based activity monitor (AM) that collected and summarized accelerometry data every 60 seconds. After the tournament, the data were downloaded to a computer and transformed into average METs and WC for each minute of game play. Mean METs and WC values for all players of each match were compared to their moderate intensity thresholds (i.e., 3.0 METs and 100 steps/min, respectively) using one-sample t-tests and a Bonferroni adjusted alpha of 0.006. Lastly, the linear relationship between METs and WC was evaluated using linear regression.

## Results

Table 1. Summary of demographic measures (Mean $\pm$ SD) for each of four walking football teams. Also shown is the self-reported walking football experience (WFE).

Team	Gender	Sample Size	Age (years)	Body Height (m)	Body Mass (kg)	BMI (kg/m $^2$ )	WFE (years)
AUSa	Women	n=5	51 $\pm$ 5	1.59 $\pm$ 0.04	71.6 $\pm$ 12.2	28.4 $\pm$ 5.4	1.0 $\pm$ 0.7
	Men	n=6	50 $\pm$ 10	1.70 $\pm$ 0.09	74.1 $\pm$ 9.0	25.8 $\pm$ 2.3	1.3 $\pm$ 1.0
AUSb	Women	n=5	49 $\pm$ 6	1.61 $\pm$ 0.06	82.8 $\pm$ 17.5	31.7 $\pm$ 5.3	0.8 $\pm$ 0.3
	Men	n=7	46 $\pm$ 11	1.72 $\pm$ 0.05	82.1 $\pm$ 13.1	27.7 $\pm$ 3.4	0.8 $\pm$ 0.3
MYS	Women	n=8	57 $\pm$ 8	1.61 $\pm$ 0.05	67.5 $\pm$ 10.3	26.0 $\pm$ 4.2	1.7 $\pm$ 0.5
	Men	n=6	47 $\pm$ 10	1.54 $\pm$ 0.08	70.0 $\pm$ 19.0	29.6 $\pm$ 7.5	2.3 $\pm$ 1.0
SNG	Women	n=6	56 $\pm$ 11	1.63 $\pm$ 0.09	63.2 $\pm$ 17.9	23.4 $\pm$ 4.9	2.1 $\pm$ 0.8
	Men	n=6	56 $\pm$ 11	1.63 $\pm$ 0.09	63.2 $\pm$ 17.9	23.4 $\pm$ 4.9	2.1 $\pm$ 0.8

Abbreviations: BMI = Body Mass Index = [(body mass, kg) / (body height, m $^2$ )]; AUSa – Australian Team A; AUSb – Australian Team B; MYS – Malaysian Team; SNG – Singaporean Team.

While most of the players were decidedly middle-aged and older adults (39 of 43 players, or 91%, were  $\geq 40$  years old), there were two relatively young players on the AUS A and B teams (19 and 24 years old). Across all teams, 11 were classified as obese (BMI  $\geq 30$ ), 19 as overweight (25  $\leq$  BMI  $<$  30), while the remaining 12 were classified as having a normal weight (18.5  $\leq$  BMI  $<$  25). Two other players who were less than 18 years of age were not included within any analysis for this study. The AUS and MYS teams self-reported having played walking football for less than two years (0.8–1.3 years and 1.7 years, respectively; Table 1), while the most experienced team from SNG had been playing an average of only 2.2 years (Table 1). When asked how many days/week that they typically practiced walking football during the previous 3 months, 95% self-reported 1–2 days/week while only 5% reported 3 days/week. Finally, when asked about the typical weekly duration of walking football practices, most self-reported 1–3 hrs/week (68%), while remaining players reported either 4–6 hrs/week (22%) or  $< 1$  hr/week (10%).

The intraclass correlations (ICC) for reliability between outcomes computed from the waist packs with two AMs were both moderate in magnitude (15): 0.66 (95% CI: 0.51–0.78) for METs and 0.65 (0.50–0.72) for WC. Mean MET and WC values for each team and match are provided in Table 2 for descriptive purposes. Mean MET values for each match (after averaging across both teams) were significantly greater than the 3.0 MET threshold value (3.4–3.9 METs;  $P < 0.006$ ) except for match 2 which was statistically equal to 3.0 (3.2 METs;  $P = 0.100$ ).

Table 2. Average MET and walking cadence (WC) values for each team of each of eight walking football matches, as well as average MET and WC values for the teams combined. The first six matches were regular competition matches while the last two were unscheduled “friendly” matches. All values are expressed as Mean $\pm$ SD (95% CI).

Match Team1/Team2	Team 1		Team 2		Combined Values for Both Teams	
	METs	WC	METs	WC	<sup>a</sup> METs	<sup>a</sup> WC
Match 1 MYS/AUSa (n=11)	3.6 $\pm$ 0.5	58 $\pm$ 20	3.1 $\pm$ 0.4 (n=8)	45 $\pm$ 19	3.6 $\pm$ 0.5 (3.2–3.6)	52 $\pm$ 20 (45–61)
Match 2 SNG/AUSb (n=10)	3.3 $\pm$ 0.7	51 $\pm$ 23	3.2 $\pm$ 0.6 (n=9)	49 $\pm$ 24	* 3.2 $\pm$ 0.7 (3.0–3.5)	51 $\pm$ 26 (41–61)
Match 3 AUSa/SNG (n=9)	3.2 $\pm$ 0.4	50 $\pm$ 15	3.6 $\pm$ 0.6 (n=7)	58 $\pm$ 24	3.4 $\pm$ 0.6 (3.2–3.7)	55 $\pm$ 21 (46–64)
Match 4 AUSb/MYS (n=9)	3.3 $\pm$ 0.7	50 $\pm$ 22	3.5 $\pm$ 0.6 (n=7)	48 $\pm$ 22	3.4 $\pm$ 0.6 (3.2–3.7)	49 $\pm$ 22 (40–58)
Match 5 AUSa/AUSb (n=12)	3.3 $\pm$ 0.6	47.1 $\pm$ 16	3.8 $\pm$ 0.4 (n=9)	62 $\pm$ 19	3.5 $\pm$ 0.6 (3.2–3.7)	52 $\pm$ 18 (44–60)
Match 6 MYS/SNG (n=7)	3.9 $\pm$ 0.6	66 $\pm$ 28	3.7 $\pm$ 0.4 (n=7)	67 $\pm$ 28	3.8 $\pm$ 0.5 (3.6–4.0)	66 $\pm$ 27 (55–79)
Match 7 SNG/MYS (n=7)	3.8 $\pm$ 0.4	63 $\pm$ 22	4.1 $\pm$ 0.4 (n=7)	63 $\pm$ 19	3.9 $\pm$ 0.4 (3.7–4.1)	63 $\pm$ 20 (53–72)
Match 8 AUS/SNG (n=7)	3.3 $\pm$ 0.4	44 $\pm$ 21	4.0 $\pm$ 0.3 (n=7)	51 $\pm$ 11	3.7 $\pm$ 0.5 (3.5–4.0)	48 $\pm$ 16 (42–55)

Abbreviations: MET = metabolic equivalent; WC = walking cadence (strides/min); MYS = Malaysian Team; SNG = Singaporean Team; AUSa = Australian A Team; AUSb = Australian B Team; AUS = Australian team made up of both Team A and B women members.

<sup>a</sup> Game 2 mean MET value was equal to, but not greater than, 3.0 MET threshold.

<sup>b</sup> All mean MET values significantly  $>$  3.0 MET threshold ( $P < 0.10$ ) except for that of Game 2.

<sup>c</sup> All mean WC values significantly  $<$  100 steps/min threshold ( $P < 0.001$ ).

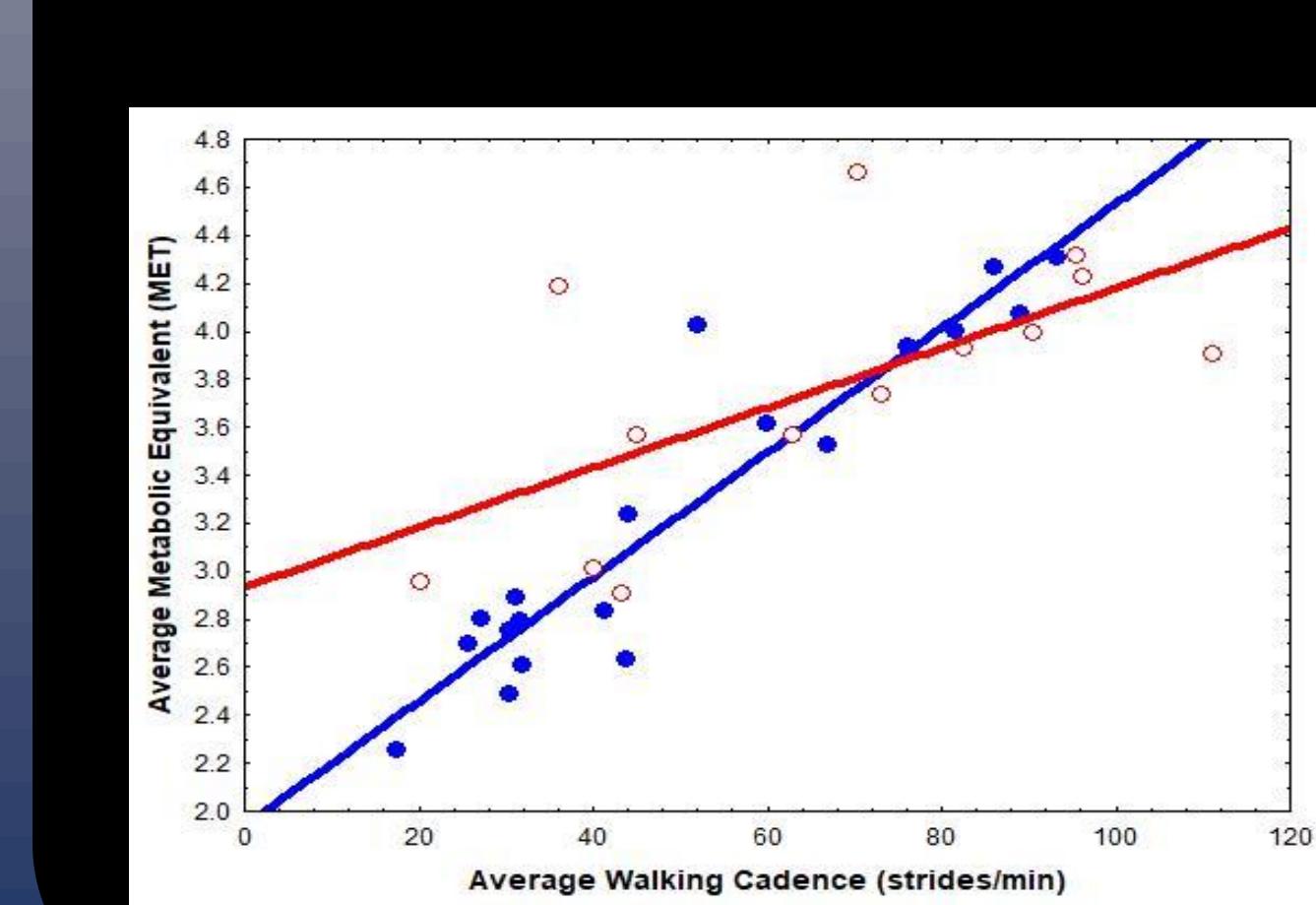


Figure 4.  
A visual comparison of linear regressions for walking cadence (WC) to metabolic equivalent (METs) for two walking football matches. The lines shown are those for the second match (Blue line and solid dots;  $R = 0.94$ , SEE =  $\pm 0.06$  METs) and the sixth match (Red line and open dots;  $R = 0.63$ , SEE =  $\pm 0.20$  METs) to illustrate the