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Walking football for Health – physiological response to playing and characteristics of the players

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ABSTRACT

Walking Football (WF) is one type of recreational football increasing in popularity, targeting older adults. Further knowledge on the intensity and physical workload of WF, characteristics of the players, the social context, and reasons for playing WF is needed. Thus, the aim of the study was to characterize the individuals that regularly play WF and their experience of WF, and the physiological characteristics of the sport. Sixty-three players from three clubs taking part in organised WF in Sweden were included. The players participated in up to four WF-games and underwent performance tests and answered a questionnaire. The participants mean age was 70.9 years, ranging from 63 to 85 years with 71% (n = 27) of the men and 68% (n = 13) of the women having a BMI > 25. Fifty-one percent (n = 27) of the players had hypertension, and 73% (n = 39) regularly used prescription drugs due to illness. During WF, the players covered on average 2,409 m (2,509 m for men and 2,205 m for women, p = .001). Expressed in percentage of their age-estimated maximal heart rate, mean heart rate represented 80 ± 9 and 80 ± 8% of max for men, and 78 ± 9 and 79 ± 9% of max for women in the first and second halves, respectively, hence WF can be considered a moderate intensity activity for older adults. The main reason for WF participation was to socialize. WF includes a considerable number of accelerations and decelerations, making it more energetically and mechanically demanding than walking.

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KEYWORDS
Fitness; exercise; physiology; team sport; ageing

Introduction

Regular physical activity (PA) is linked to a decreased risk of several common endemic diseases (Blair et al. 1996; Lee 2003). Adults worldwide are recommended to be physically active for at least 150 min per week at moderate intensity (Bull et al. 2020), however only few adults meet these recommendations (Ekblom-Bak et al. 2015). Recreational team sports are physical activities that can be an alternative for inactive older adults (Castagna et al. 2020), and more modified sports to suit older adults are being developed, e.g. floorball (Pedersen et al. 2018). To be active in sports as an older adult have shown to be associated with higher strength compared to non-physically active older adults (Jordre and Schweinle 2020). One type of activity that has increased in popularity during the last decade is football for recreational purposes, which has shown positive effects on health (Bangsbo et al. 2015). Walking Football (WF) is one type of recreational football, mainly targeting older adults of 60 years or older (Krustrup et al. 2010). WF is played on a smaller pitch with fewer players per team, compared to regular football and limited to walking-tempo (contact with the ground with at least one foot during play is mandatory) and no tackling is allowed. This makes WF suitable for older adults that may not be able to play regular football.

A limited number of small sample studies, mainly constituting older men, have shown positive effects of WF on both physical and psychological health characteristics, as well as general increased PA levels and social contacts (Arnold et al. 2015; Cholerton et al. 2019; Barbosa et al. 2021; Madsen et al. 2021). This indicates that WF may be one activity suitable for exercise interventions and as a treatment alternative in health care, especially in older adults and in those with underlying risk factors and/or disease. However, extended knowledge on the intensity and physical workload of WF is needed, especially in women especially in women who generally have a higher prevalence of obesity compared to men (Perissinotto et al. 2002). Also, gaining information of the characteristics of men and women participating regularly in WF as well as the social context and reasons for participating in WF would be relevant. Any such knowledge would contribute to enabling WF as

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a recommended PA alternativefor example, when prescribing PA within the healthcare sector (Persson et al. 2013).

Thus, the overarching aim of the study was to characterize the individuals that regularly participate in WF and their experience of WF, as well as the physiological characteristics of the sport (movement and speed on the pitch, and workload on the player). A secondary aim was to study if there were any significant differences between male and female players for the examined parameters.

Materials and methods

Study design

The study was conducted during the autumn of 2021 and included 63 WF-players (29% women, $n = 19$) from three clubs taking part in organised WF in Sweden, two in central Sweden and one in southern Sweden. The recruitment of players was conducted by advertising through Walking football clubs in respective region. The WF-players participated in up to four WF-field games ($n = 63$), whereof 57 also visited the test lab at the Swedish School of Sport and Health Sciences in Stockholm, or the temporary field lab run by the University of Gothenburg in Borås. The study was conducted and performed according to the declaration of Helsinki (undefined), and was approved by The Swedish Ethical Review Authority (Ref. number 2020–05212).

Laboratory tests and questionnaire

The participants received written information of the test procedures and information regarding a standardization procedure including limiting vigorous training the day before lab tests, avoiding a large meal, caffeine intake and nicotine within three hours prior to the tests. The domains cardiorespiratory fitness, motor fitness and musculoskeletal fitness, was tested using easily administered fitness tests. The specific tests are commonly used tests and was chosen to be able to characterize and compare physical fitness of WF players with community dwelling older adults (Silverman and Deuster 2014). On the lab test day, the participants signed a health declaration on current symptoms, relevant disease, and medications. If ongoing symptoms or contraindicating disease, the participant would have been excluded ($n = 0$) and written informed consent and received oral instructions on how the tests would proceed. All tests were conducted at daytime with a lab temperature 20 degree Celsius with 40% humidity. All participants underwent performance tests consisting of a balance test, estimation of cardiorespiratory fitness, strength, and a vertical jump test. Before the performance tests, the participants were seated for 10 min where resting heart rate was noted, and blood pressure was measured two consecutive times with an automatic blood pressure cuff (GIMA 35,111, Gima S.p.A, Gessate, Italy). Weight was measured without heavy clothes and shoes, with 0.1 kg accuracy on a Tanita BC-545, Tanita Corporation, Japan, weight scale, height was measured without shoes and with 0.5 cm accuracy using a wall attached centimetre-scale. Waist circumference was measured in a standing position with one decimals precision, midway between the lower rib margin and the iliac crest. The participants performed a balance test with their self-selected foot on a 3 cm-wide and 5 cm high beam, they were instructed to stand on the balance beam and hold their balance for 60 s. The number of ascensions was accumulated, where the best result was '1' for the initial ascent on the board (Tsigilis et al. 2002; Granacher et al. 2012).

A cycle ergometer test (Monark 828 Varberg, Sweden) was used to estimate maximal oxygen uptake (VO_2max) (Ekblom-Bak et al. (2014); Bjorkman et al. (2016); Väisänen et al. (2020); Schultz et al. (2020)). Mean steady-state heart rate was registered during the last minute on both work rates (Polar RS400, Polar Electro Oy, Kempele, Finland), and VO_2max was estimated by using the sex-specific Ekblom-Bak equation (Bjorkman et al. 2016).

After a short rest, a grip strength test was performed, according to standards (Hamilton et al. (1994); Stevens et al. (2012); Mehmet et al. (2020)) (Jamar® Hydraulic Model 5030J1, Sammons Preston Rolyan, Bolingbrook, IL, USA). Three trials were performed sitting down, 90° in elbow joint, using the dominant hand, with one minute of rest between the trials. The highest result was noted.

Thereafter, a vertical squat jump was performed where the participants were instructed to assume a position of 90° at the knee joint with their hands resting on the hips (Argaud et al. 2019). From this position the participants were instructed to jump as high as possible and to land on their toes. One trial jump was conducted before three consecutive jumps were registered with one minute rest between jumps. The jumping height was registered by video recording of the feet with the software My Jump 2 (Stanton et al. 2015) on a portable unit (iPad or iPhone) which subsequently calculated the jumping height (time in the air between take-off and landing manually marked by the test leader in the software). The highest value of the three jumps were used for the analysis.

At the end of the laboratory test procedure, the participants answered a written questionnaire regarding sociodemographic, health experiences, PA habits and experiences of WF (for the full questionnaire, see supplementary material).

Assessment of physical activity patterns

On testing occasion, the participants received a tri-axial accelerometer (ACTi Graph model GT3X+, wGT3X+, wGT3X-BT, ACTi Graph LCC, Pensacola, FL, USA), to be worn in an elastic belt over the right hip during all waking hours for seven days, except during water-based activities. The accelerometer recorded raw data (sample rate 30 Hz) from three axes, which were combined into a resulting vector, extracted as 60-s epochs, and expressed in counts per minute (cpm). ActiLife v.6.13.4 software was used for analyses. Non-wear time was defined as ≥60 consecutive minutes with no movement (0 cpm), with allowance for maximum 2 min of counts between 0 and 199 cpm. Wear time was calculated as 24 hours minus non-wear time. A valid day had to consist of a minimum of 600 min of valid daily wear time. Total PA was expressed in daily mean tri-axial vector magnitude cpm, sedentary time was defined as <200 cpm (Aguilar-Farias et al. 2014), low intensity PA (LIPA) as 200–2689 cpm, moderate intensity PA

(MPA) as 2690–6166 cpm, and vigorous PA (VPA) as ≥6167 cpm (Sasaki et al. 2011). For one male participant the accelerometer did not register any data and his results were therefore excluded from analysis.

Walking football field tests

The football pitch was measured to 30 m wide and 40 long on artificial turf. Goal areas were marked with flat cones (in a half circle with 3 m to closest post) and the 1.5 m-wide goals were demarcated with a rope with a height of 1 m from the ground, all according to standard WF regulations (Fotbollsförbundet 2023). The participants were instructed to arrive 30 mi before the start of the WF-sessions. They were equipped with a heart rate monitor (Polar H10, Polar Electro Oy, Kempele, Finland) and a GPS-unit (Vector X7, Catapult Sports, Australia) with accompanying vest, and were instructed to sit down and rest for 10 min. After 10 min, baseline blood pressure, lactate, rate of perceived exertion (RPE), as well as an approximation of their general well-being on a visual analogue scale (VAS) (Crichton 2001) were measured. A standardized warm-up was conducted on the pitch prior to the start of the WF-sessions, which consisted of walking one lap around the pitch at an easy pace, followed by another lap at moderate pace.

The participants played a game of WF 6 v 6 without substitutions, 2 × 20 min with a 10-min pause between the first and second half outdoor on artificial turf. The players played at shifting positions and shifted teams, resulting in different co-players and opponents during the game. The participants refereed the games themselves as normally during their training sessions. No goalkeepers were used. During the WF-sessions, heart rate and movement pattern via GPS was measured continuously. The GPS tracking system was based on 10-Hz GPS technology, and measured distance covered, top speed, acceleration (>0 to 3 m/s^2), deceleration (>-0 to −3 m/s^2) and two speed zones: walking (0–3.99 km/h) and fast walking (>4.00 km/h) based on normal walking speed in older adults (Bohannon and Andrews 2011). These parameters were chosen as they are indicative of both volume and intensity (Schimpchen et al. 2021). Data were downloaded using the manufacturer's software (Openfield, Catapult Sports, Australia) and exported to Excel where means were calculated. In addition, the estimated Player Load (PL) was measured. PL is an instantaneous rate of change of acceleration divided by a scaling factor, and in coaching terms, it is a measure of an athlete's workload. It is expressed in arbitrary units (a.u.) (Bush et al. 2015). Triaxial PL values are obtained and calculated from the summation of the vertical anterior – posterior (PL – AP), mediolateral (PL –ML), and vertical (PL – V) planes of motion (White and MacFarlane 2015). PL was measured with an incorporated 3D accelerometer in the GPS unit.

Blood pressure, lactate, and rate of perceived exertion (RPE) according to the Borg-scale (Borg 1970) (from 6 'No exertion' to 20 'Maximal exertion') were measured directly after the end of the first half (half-time) and at the end of the second half (end of game) from a sub-sample of players. After the game was finished the participants once again approximated their general well-being on the VAS-scale.

Statistical analyses

The results from the three clubs are presented combined. Data were analysed for the whole study population as well as on men and women separately. Data were assessed for normality using the Shapiro–Wilk test. Data is presented as mean values ± standard deviation, range, effect size, coefficient of variation in % and 95% confidence interval. To interpret the effect sizes (ES), we used Cohen's d divided into three categories: small (ES = .20), medium (ES = .50) and large (ES = .80) (Cohen 1988). For the participants who participated in more than one WF-field test, the mean value was used. Statistical significance was set at $p \leq 0.05$. To evaluate the statistical significance independent samples t tests and the Mann-Whitney U test were used to assess differences between men and women for certain parameters. All data was collected in Microsoft Excel version 16.29.1 (Microsoft Corporation, Redmond, WA, USA) and subsequently transferred to SPSS for additional analysis. The statistical software SPSS (IBM Corp. Released 2022. IBM Statistics for Windows, Version 29.0. Armonk, NY: IBM Corp) was used for all statistical analyses.

Results

Walking football-player characteristics

Mean age of participants were 70.9 years, ranging from 63 to 85 years. Fifty-one percent ($n = 27$) of the players had known hypertension, and 73% ($n = 39$) stated that they regularly use prescription drugs due to illness/disease. Almost half (47%) ($n = 25$), considered their general well-being as very good or excellent. In total, 71% ($n = 27$) of the men and 68% ($n = 13$) of the women had a BMI > 25, and 47% ($n = 18$) of the men and 63% ($n = 12$) of the women had a waist circumference considered as abdominal obesity (>88 cm for women, >102 cm for men) (Table 1). None experienced their well-being as poor or very poor (see supplementary material). Two of the 63 participants were active smokers. Men had significantly stronger hand grip strength measuring, 44.3 ± 7.0 kg, compared to women, 30.7 ± 4.3 kg ($p < .001$). Men also jumped significantly higher than women, with a mean jump height of 17.5 ± 5.0 cm compared to 14.6 ± 3.7 cm for women ($p < .023$). The participants spent on average 8 hours in sedentary, 5 hours in light intensity PA, 53 min in moderate PA and 3 min in vigorous intensity PA (Table 2). Men were significantly more sedentary than women ($p < .019$).

Experiences of WF participation

Participants reported that they on average participate in organized WF six times per month, and that they had been playing WF for a mean of 3.2 ± 0.8 years for men and 2.5 ± 1.6 years for women. Thirty-four percent ($n = 18$) of the participants answered that they had never suffered an injury at a WF session in their career, while 66% had suffered at least one injury ($n = 35$). Prior to the game, the participants estimated their well-being at an average of 8.6 compared to 9.1 directly after the

Table 1. Characteristics of the study participants.

	All ($n = 57$)	Male ($n = 38$)	Female ($n = 19$)	ES	95% CI	%CV	p Value
Age (year)	70.9 ± 4.6 (63–85)	71.9 ± 47 (63–85)	68.7 ± 3.6 (63–76)	0.74 (M)	(0.8–5.7)	8.0	.011#
Weight (kg)	80.0 ± 15.3 (54.4–128)	85.8 ± 13.9 (57.1–128)	68.7 ± 11.2 (54.4–93.0)	1.32 (L)	(10.2–25.4)	27.8	.001#
Height (cm)	173 ± 10.6 (150–195)	179 ± 7.36 (162–195)	162 ± 5.1 (150–170)	2.55 (L)	(13.3–20.8)	18.4	.001#
BMI ($kg{\cdot}m^{-2}$)	26.6 ± 3.9 (18.1–35.3)	26.7 ± 3.8 (18.1–35.3)	26.2 ± 4.0 (19.8–34.4)	0.19	(−1.6–3.2)	15.5	.498
BMI >25 $kg{\cdot}m^{-2}$	70% ($n = 40$)	71% ($n = 27$)	68% ($n = 13$)	0.23 (S)	(−1.5–3.1)	8.3	.506
Waist circumference (cm)	97.5 ± 12.6 (67.5–127)	100 ± 12.1 (76.0–127)	91.8 ± 11.9 (67.5–111)	0.71 (M)	(1.8–15.3)	22.1	.015#
WC >88 cm women, >102 cm men	52% ($n = 30$)	47% ($n = 18$)	63% ($n = 12$)	1.44 (L)	(5.5–17.7)	32.5	.001#
Resting heart rate (bpm)	69.4 ± 10.7 (53–106)	69.3 ± 11.0 (55–106)	69.5 ± 10.3 (53–89)	−0.02	(−6.2–5.8)	15.2	.826
Age-predicted max heart rate (bpm)	165.6 ± 2.9 (156.6–170.7)	165.0 ± 3.0 (156.6–170.7)	167.0 ± 2.3 (162.4–170.7)	−0.73 (M)	(−3.6 - −0.5)	5.1	.011#
Blood pressure Systolic (mmHg)	144 ± 16.9 (117–196)	142 ± 13.6 (118–182)	149 ± 21.5 (117–196)	−0.44 (S)	(−16.6–2.0)	29.4	.123
Blood pressure Diastolic (mmHg)	83.6 ± 10.3 (61.5–108)	83.7 ± 10.5 (61.5–108)	84.1 ± 9.8 (69.5–105)	−0.07	(−6.6–5.1)	18.0	.804
Data from Health questionnaire ($n = 53/35/18$)							
Known hypertension (self-reported)	51% ($n = 27$)	49% ($n = 17$)	52% ($n = 10$)				
Use of prescribed drugs	73% ($n = 39$)	80% ($n = 28$)	61% ($n = 11$)				
Very good/excellent perceived physical health	47% ($n = 25$)	37% ($n = 13$)	66% ($n = 12$)				

Note: Means ± SD are presented. Range in parenthesis. # = significant sex-difference. ES = Effect Size. S = Small, *M* = Medium, L = Large. CI = Confidence interval. %CV = Coefficient of variation in percentage. WC = Waist circumference.

Table 2. Lab test data and accelerometer data.

	All ($n = 57$)	Male ($n = 38$)	Female ($n = 19$)	ES	95% CI	%CV	p Value
Lab test data							
Estimated VO_2max (l/min)	2.44 ± 0.53 (1.54–3.50)	2.69 ± 0.41 (1.82–3.50)	2.01 ± 0.44 (1.54–3.00)	1.60 (L)	(0.4–0.9)	21.6	.001#
Estimated VO_2max ($ml{\cdot}min^{-1}{\cdot}kg^{-1}$)	31.0 ± 6.2 (17.7–48.2)	31.9 ± 6.5 (17.7–48.2)	29.5 ± 5.3 (21.3–41.3)	0.35 (S)	(−1.4–5.7)	20.1	.230
Estimated VO_2max ≥32 ml (women) and ≥35 ml (men) ($n = 54/35/19$)	29% ($n = 16$)	31% ($n = 11$)	26% ($n = 5$)				
Balance (number of footrests)	13.0 ± 6.7 (2-29)	14.0 ± 6.8 (2-29)	11.3 ± 6.1 (2-29)	0.38 (S)	(−1.3–6.4)	52.6	.185
Grip strength (kg)	39.6 ± 8.9 (24.0–66.0)	44.3 ± 7.0 (30.0–66.0)	30.7 ± 4.3 (24.0–36.5)	2.10 (L)	(9.7–16.8)	22.5	.001#
Vertical jump (cm)	16.5 ± 4.5 (8.2–29.7)	17.5 ± 5.0 (9.3–29.7)	14.6 ± 3.7 (8.20–19.6)	0.69 (M)	(0.5–5.5)	27.2	.020#
Accelerometer data ($n = 56/37/19$)							
Sedentary/stationary (min/day)	479 ± 80 (211–611)	496 ± 75 (312–611)	445 ± 80 (211–567)	0.66 (M)	(7.3–94.5)	16.7	.019#
Light physical activity (min/day)	308 ± 75 (170–597)	306 ± 81 (180–597)	313 ± 64 (170–434)	0.25 (S)	(−69.3–14.8)	24.3	.058
Moderate physical activity (min/day)	53.2 ± 25.6 (20.5–149)	55.6 ± 28.6 (20.5–149)	48.7 ± 18.5 (24.0–93.3)	−0.50 (M)	(−26.9–1.6)	48.2	.158
Vigorous intensity physical activity (min/day)	3.0 ± 9.1 (0.0–57.1)	3.3 ± 9.8 (0.0–57.1)	2.6 ± 7.9 (0.0–34.2)	0.14	(−4.4–6.0)	300	.290
Total Physical activity (counts)	640 ± 175 (370–1406)	654 ± 199 (370–1406)	612 ± 117 (453–885)	0.21 (S)	(−186.2–8.3)	27.4	.117

Note: Means ± SD are presented. Range in parenthesis. # = significant sex-difference. ES = Effect Size. S = Small, *M* = Medium, L = Large. CI = Confidence interval. %CV = Coefficient of variation in percentage.

game (of maximal 10.0 which constitutes highest well-being). Thirty-nine percent ($n = 21$) of the participants had found WF through a friend and 28% ($n = 15$) through social media. The main reasons to participate in organized WF was to meet and socialize (63%) ($n = 34$) and to exercise (57%) ($n = 31$). All the participants expressed that they would continue with WF.

Characteristics of WF

During the 2×20 min WF-game the players covered on average 2,409 m in total distance (2,509 m for men and 2,205 m for women, $p < .001$). During the first half, the players had on average a maximal speed of 12.9 ± 1.8 km/h, a Player Load of 92.4 ± 26.8, and 34.9 ± 21.4 number of accelerations and 32.8 ± 20.2 decelerations, with a slight decrease in the second half. Men covered significantly longer distance ($p < .001$), had a significantly higher max speed ($p < .010$), Player Load ($p < .001$) and a greater number of accelerations ($p < .003$) and decelerations ($p < .002$) than women during the first half. Similar results could be seen during the second half (Figure 1).

Physiological workload of playing WF

From pre- to post game both RPE and lactate increased among the participants with men having significant higher RPE prior to game ($p < .001$) while BP was decreased Both the average and peak heart rate increased slightly from the first to the second half with no

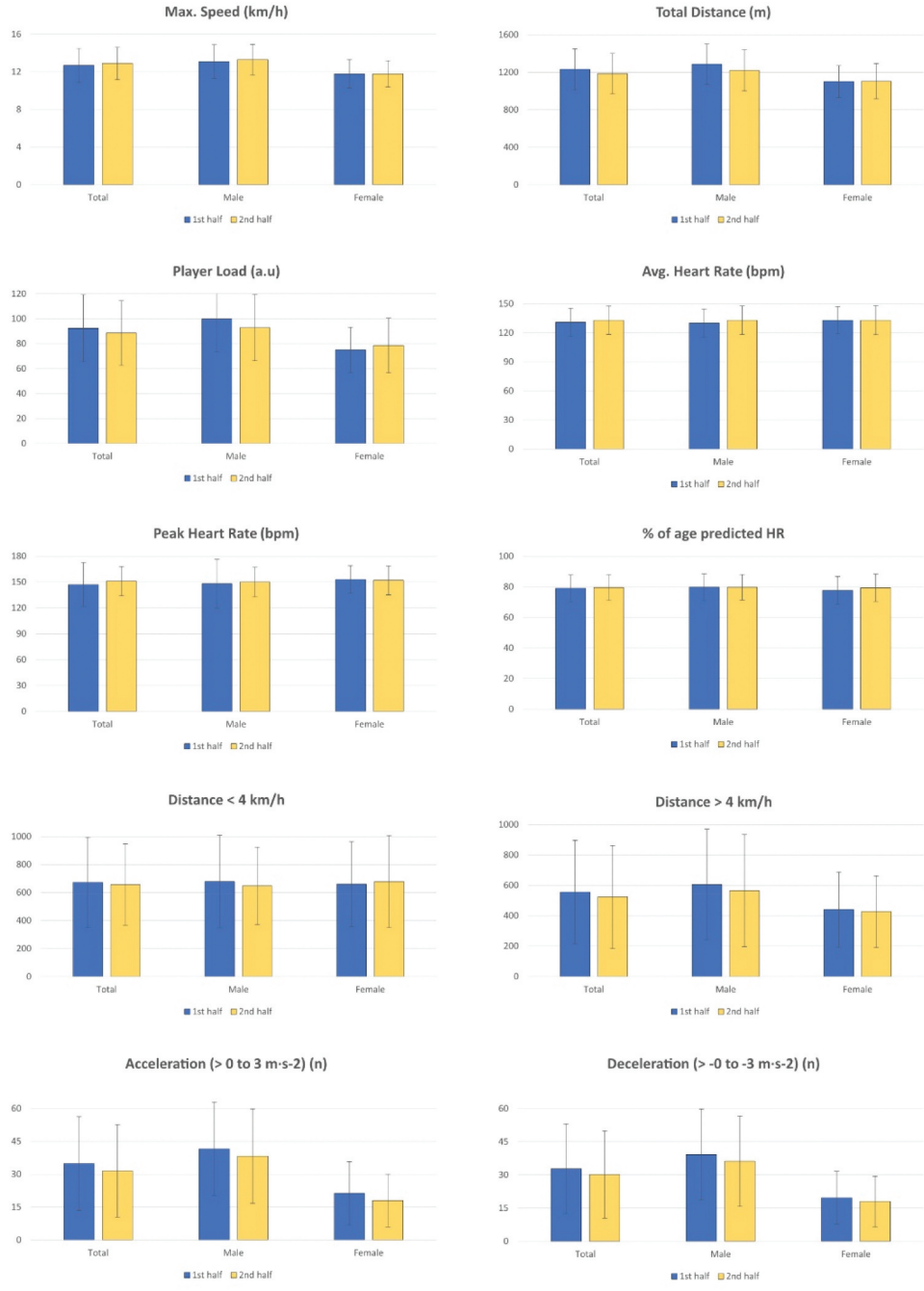

Figure 1. GPS-data and physiological data from WF-sessions.

Table 3. Physiological data collected during WF-sessions.

	n	All	n	Male	n	Female	ES	95% CI	%CV	p Value
Prior to game										
Systolic BP (mmHg)	29	148 ± 18.9 (111–188)	21	147 ± 19.3 (111–187)	8	150 ± 18.9 (128–188)	−0.12	(−18.7–14.0)	12.8	.770
Diastolic BP (mmHg)	29	91.5 ± 15.5 (70.0–132)	21	89.2 ± 14.3 (70–122)	8	97.3 ± 18.0 (78.5–132)	−0.53 (M)	(−21.2–5.0)	16.9	.217
RPE	63	7.5 ± 1.4 (6.0–11.0)	44	7.8 ± 1.4 (6.0–11.0)	19	6.6 ± 0.9 (6.0–9.0)	−0.41 (S)	(0.5–1.9)	18.5	.001#
Lactate (mmol)	55	1.36 ± 0.37 (0.56–2.19)	38	1.34 ± 0.41 (0.56–2.19)	17	1.39 ± 0.27 (0.78–1.86)	−0.13	(−0.3–0.2)	27.2	.671
After 1:st half										
Systolic BP (mmHg)	29	148 ± 20.5 (111–193)	21	146 ± 21.0 (111–193)	8	152 ± 19.8 (123–184)	−0.27 (S)	(−23.2–12.1)	13.9	.523
Diastolic BP (mmHg)	29	89.2 ± 14.0 (54–120)	21	87.3 ± 14.3 (54–118)	8	94.4 ± 12.7 (79–120)	−0.51 (M)	(−19.0–4.8)	15.7	.231
RPE	63	12.1 ± 1.7 (8.0–17.0)	44	12.0 ± 1.7 (8.0–17.0)	19	12.4 ± 1.8 (9.0–16.3)	−0.22 (S)	(−1.3–0.5)	14.0	.412
Lactate (mmol)	55	2.87 ± 1.33 (0.76–6.37)	38	2.89 ± 1.30 (0.76–6.37)	17	2.83 ± 1.45 (1.14–5.18)	−0.04	(−0.7–0.8)	46.3	.750
After 2:nd half										
Systolic BP (mmHg)	26	140 ± 14.6 (110–167)	20	138 ± 16.1 (110–167)	6	145 ± 6.00 (133–149)	−0.46 (S)	(−20.7–7.3)	10.4	.334
Diastolic BP (mmHg)	26	83.6 ± 13.3 (49–122)	20	82.2 ± 12.0 (49–100)	6	88.2 ± 17.7 (71–122)	−0.45 (S)	(−18.8–6.9)	15.9	.347
RPE	63	12.9 ± 1.6 (9.0–16.3)	44	13.0 ± 1.5 (9.0–16.3)	19	12.8 ± 1.7 (9.0–16.0)	−0.06	(−0.6–1.1)	12.1	.636
Lactate (mmol)	55	2.71 ± 1.38 (0.61–6.21)	38	2.67 ± 1.28 (1.00–5.94)	17	2.82 ± 1.63 (0.61–6.21)	−0.03	(−0.9–0.7)	50.9	.848

Note: Means ± SD are presented. Range in parenthesis. # = significant sex-difference. ES = Effect Size. S = Small, *M* = Medium, L = Large. CI = Confidence interval. %CV = Coefficient of variation in percentage. BP = Blood pressure. RPE = Rating of perceived exertion.

significant differences between the sexes. The mean heart rate was 130 ± 15 and 133 ± 15 bpm for men and 133 ± 14 and 133 ± 15 bpm for women in the first and second half, respectively, and the peak heart rate was 148 ± 28 and 150 ± 17 bpm for men and 153 ± 16 and 152 ± 17 bpm for women in the first and second half, respectively. Expressed in percentage of their age-estimated maximal heart rate (211–0.64 × age) (Nes et al. 2013), mean heart rate represents 80 ± 9 and 80 ± 8% of max for men, and 78 ± 9 and 79 ± 9% of max for women in the first and second half, respectively. This is considered to be moderate physical activity intensity. Heart rate together with GPS data, lactate and what the participants themselves estimated according to Borg's RPE-scale (12.1 & 12.9 for the 1st and 2nd half, respectively) indicates that a 40-min WF-game is a moderate intensity activity (Table 3).

Discussion

The aim of the study was to characterize the individuals that regularly participate in WF and their experience of WF, as well as the physiological characteristics of the sport. The main findings in this study were that individuals regularly playing WF were older adults with similar cardiovascular risk profile and movement patterns in free living as the general Swedish population, however, with somewhat better fitness and strength performance profile. The main reasons for WF participation were linked to socializing with others and having fun. WF were found to be an on average moderate intensity aerobic activity, with a considerable number of accelerations and decelerations. The average distance covered during 40 min of WF was 2,409 m with no difference between the first and second halves.

We add to the current knowledge by describing the characteristics of regular WF-players as well as the physiological characteristics of WF. Among the individuals included, the grip strength for the group was higher than usual for their respective age group, and higher than the norm values of 38 kg and 24 kg for men and women aged 65–75 (Bohannon et al. 2006). During the one-min balance test, the participants needed on average 14.0 (men) and 11.3 (women) ascensions. In a previous study on older age adult men, who had trained football their entire life, (mean age 69.6, *n* = 10) 15 ascensions were needed on average, and for untrained older age adult men (mean age 70.5, *n* = 8) 33 ascensions were needed. This indicate that the participants in the present study had good balance (Sundstrup et al. 2010). For the squat jump, the mean jump height was 17.5 ± 5.0 cm (men) and 14.6 ± 3.7 (women) which is higher than a group of physical active older age adult men (mean age 74.6 ± 4.6), who had a mean jump height of 12 ± 4 cm (Argaud et al. 2019). In conclusion, the laboratory tests show that the participants had relatively good physical fitness for their age group.

Moreover, most of the participants were recruited to WF by a friend, or by ads in social media. On average, the participants played WF six times per month and had been actively playing for three years. The most common rationale for engaging in WF was to socialize with other people, to have fun and enjoy oneself, and to get fitter. To meet, socialize and have fun has also been given as reasons for playing WF from cohorts examined by Reddy et al. (Reddy et al. 2017) and Taylor et al. (Taylor and Pringle 2021). WF seems to have a positive mental effect on players, and all participants in the present study indicated that they were going to continue playing organized WF.

The distance the players covered at a speed above or below 4 km/h was evenly distributed during a WF-game. The study results indicate that WF is of moderate intensity as almost half the distance the players covered was faster than 4 km/h. In a study by Madsen et al. it was reported that adults over 60 years moved 568 ± 84 m (men) and 412 ± 15 m (women) during a 10-min WF-game (5 vs. 5) (Madsen et al. 2021). This corresponds to our results of 2,509 m (men) and 2,205 m (women) during 40 min of game play.

Mean heart rate in relation to age-estimated max heart rate during game play indicated moderate intensity. This is at a comparable level to Madsen et al., who reported their participants heart rate 112 ± 19 bpm (men) and 133 ± 22 bpm (women) during 10 min of game play 5 vs 5 (Madsen et al. 2021). Peak heart rate during game play was 148–153 bpm in the present study which is slightly higher than what Madsen et al. reported (Madsen et al. 2021). The present study lactate values from the players were similar to what Harper et al. reported from game play (Harper et al. 2019). WF could thus be categorized as mainly a moderate (with some vigorous activity included) sporting activity for old age adults. The

same conclusion was drawn by Reddy et al. (Reddy et al. 2017) who concluded that WF is mostly a moderate activity with elements of vigorous activity.

Clinical implications

WF seems to be of moderate intensity, mainly aerobic activity. The intensities of WF corresponds well with those of the current guidelines, which recommend at least moderate intensity aerobic activity for individuals with cardiovascular risk factors, e.g. hypertension and/or hyperlipidaemia (Jansson et al. 2021). Although higher intensity activity may achieve a greater yield, in terms of effects on blood glucose and blood lipids, the risk-benefit analysis for such activity is more complex. Even in the presence of higher risk profiles, moderate intensity aerobic activity has few or no contraindications (Jansson et al. 2021). Thus, WF could be ideal for use in health-related interventions among inactive people in the form of physical activity on prescription (Onerup et al. 2019). In addition, it should be considered that WF includes a considerable number of accelerations and decelerations, which makes the sport more energetically and mechanically demanding than e.g., walking or running at a constant speed level.

Limitations and strengths

A limitation in the present study is the lack of record on doses of prescription drugs (only yes or no is possible to answer in the questionnaire) being used by the participants, e.g., beta-blockage use that might have influenced HR-responses in tests and/or measurements conducted. Even though the participants were fitted with accelerometers, we did not measure sleep time (or quality of sleep) which could be of importance for their health and overall well-being. Further, no information was collected on whether the participants participated in other sports than WF. As the top speed for some players reach above 12 km/h it is questionable whether the players walked all the time. A videorecording of the match play would have been optimal to analyse movement in high speeds. However, as we studied the participants in their ordinary WF-sessions, the short periods of high-top speeds may be a normal occurrence within a WF-session. A further limitation is that we used fixed thresholds rendering us unable to classify the participant's based on their different characteristics. Strengths include the high number of participants (three times the size of comparable studies) and the relatively high number of female participants. Furthermore, in contrast to previous studies, both females and males were playing together in most of the WF-sessions.

Conclusion

Individuals regularly playing WF display similar cardiovascular risk profile and movement patterns in free living as the general population, but with somewhat better physical fitness profile. The main reason for WF participation were linked to socializing and having fun. The average distance covered during 40 min of WF was 2,409 m with no difference between the first and second half, mainly at moderate intensity. Thus, WF may be a relevant alternative in physical activity on prescription for health in clinical practice. Noteworthy, there are a considerable number of accelerations and decelerations while playing WF, which makes the sport more energetically and mechanically demanding than e.g., walking. Implementation studies in previously physical inactive older-age pensioners, with estimated health measured pre- and post-intervention, are needed.

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Data availability statement

The data that support the findings of this study are available from the corresponding author, AC, upon reasonable request.

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