Competitive Golf and Energy Calculation

Subjects: Others
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Nutritional guidance for competitive golfers to improve performance is limited. A novel nutritional approach that incorporates carbohydrate supplementation to support aerobic fitness without sacrificing the ability to build strength is presented since longer courses require more stamina. Strategies for training, competition, and recovery are outlined based on different skill levels. American College of Sports Medicine (ACSM) guidelines for carbohydrates, protein, and hydration intake are tailored specifically for competitive golf based on this approach. Putting requires precise movement and can be affected by fatigue. Nutritional studies in golf and similar sports that require focused movements are presented, exhibiting an improvement with adequate hydration and carbohydrate status and caffeine use.

Keywords: sports nutrition ; golf ; distance insight report ; PGA

1. General Considerations

The cornerstone of performance nutrition is an evaluation of energy expenditure. There are three areas of analysis while playing golf: Club transportation, walking the course, and hitting the golf ball.

2. Club Transportation

The United States Golf Association (USGA) allows players 14 clubs in their bag including water, rangefinder, balls, and tees. Older studies measured the weight of golf bags from 8–30 kg (18–30 lbs), but this was prior to synthetic bags or did not include other necessary supplies [1][2]. According to Shipstix which transports golf clubs, “A golf bag equipped with clubs, balls, and accessories averages 20 lbs (9 kg)” [3].

In 2009, the USGA allowed the use of pushcarts as an alternative to carrying the golf bag in high school and collegiate golf tournaments for men and women athletes [4]. In 2019, 67% of all high school golfers used a pushcart in competition (94% girls/52% boys). At the college level, 2014 National Collegiate Athletic Association (NCAA) champion Cameron Wilson and most of his teammates at Stanford, and 50% of the men’s team at UNC used a cart [5]. The energy expenditure comparing the two forms of club transportation are similar. In both the Crowell and Dear studies, carrying clubs for 9 holes was 411kcal and 511 kcal, respectively. While using a pushcart expended 411 kcal in Crowell et al. [1][6].

Professional Golf Association (PGA) and Ladies PGA (LPGA) players use a caddy and club carriage should not be part of the energy calculation.

3. Distance

The United States Golf Association (USGA) and Royal and Ancient (R&A) mandates that all “Players shall walk at all times during a stipulated round” [4].

The distance walked by a golfer is affected by several factors and is increasing.

Each golf course is uniquely designed, and distance is variable based on gender and skill level by moving the tee box further from the flag. The current distances for the different competitive levels are listed in **Table 1** [7][8].

Table 1. Current distances for different competitive levels.

Skill Level	Gender	Distance (yds)	Distance (Meters)
High school	**Boys age 15–18**	**6500–7100**	**5943–6492**

Skill Level	Gender	Distance (yds)	Distance (Meters)
NCAA	Girls age 15–18	5600–5850	5120–5349
	Men	6500–7300	5943–6675
	Women	5800–6300	5303–5760
Professional	PGA	6800–7765	6217–7100
	LPGA	6200–6600	5669–6035

NCAA-National Collegiate Athletic Association; PGA—Professional Golfers Association; LPGA—Ladies Professional Golfers Association.

Distance from tee box to flag is not the actual distance walked since golf shot accuracy varies. Golf shot dispersion measures off-center shots when the ball is mishit by the golfer. A shot with a +4° error will finish 14 yds to the right of the target on a 200-yd shot and 21 yds to the right on a 300-yd shot. Golfmetrics data provided by Broadie et al. concluded that higher caliber golfers hit the ball straighter more consistently than less skilled golfers with higher dispersion [9]. The distance walked is reduced as skill improves. The Distance Insight Report, jointly authored by the United States Golf Association (USGA) and the Royal and Ancient (R&A), found that course length is also increasing. Due to improvements in technology and athleticism, the average driving distance by Professional Golf Association (PGA) Tour professionals is now 310 yards. This has increased the total course length by 400 yards since 1980.

The integration of golf courses with residential communities has increased the distance from the green of one hole to the tee box of the following hole and increased the total course footprint [10]. The USGA used aerial photography and compared an 80-course random sample of USGA-approved courses, including 15 championship courses. “Courses built during the 3 most recent decades had an average total footprint of 216.3 acres. Those built during the 1920’s through 1940’s had an average footprint of 152.3 acres a difference of 64 acres” [11]. In the championship course case study where the 5 most recently opened courses had an average footprint of 47 acres larger than the 5 oldest courses, 260 acres to 213 acres respectively [11].

A 2017 article on physical activity accrued while playing golf in the British Medical Journal by Luscombe et al. reviewed 19 studies. Five studies had both energy expenditure and distance walked during the round of golf with using either a cart or carrying the clubs as an endpoint [6][12][13][14][15]. The articles were reviewed for course yardage and a google search was used to find the current course length. **Table 2** is a summary from the BMJ article with the Energy Expenditure (EE), original course distance, distance walked during the round, and the currently published distance.

Table 2. Luscombe et al. summary table of distances and energy expenditure.

Study	Year Published	Gender	Holes	Club Transportation	Mean Distance Walked (Km)	TEE (kcal)	Article Course Distance (m)	Current Published Distances (m)
Crowell	1970	M	9	Pull cart	4.58 +/− 0.44	411	2982 *	3108–3550 **
			9	Carry	4.02 +/− 0.52	450	2982 *	3108–3550 **
Gabellieri	2011	M	18	Carry	8.7 +/− 0.6	1202	6067 *	6217–7100
Dear	2010	M	9	Carry	4.4 +/− 0.36	511	2504	3108–3550 **
Zunzer	2013	M	18	Mixed	10.5 +/− 0.94	926	5525–5919	6217–7100
		F	18		9.89 +/− 0.81	556	4871–5307	5669–6035
		M	9		5.32 +/− 0.48	520	2762–2959	3108–3550 **
		F	9		5.25 +/− 0.16	273	2435–2653	2834–3017 **

* Listed course yardages converted to meters and divided by 2 when 9 holes played. ** PGA published yardages converted to meters and divided by 2 for 9 holes played. M: male, F: female.

4. Hitting the Golf Ball

The energy required to hit a golf ball can be divided into the energy to swing the club and the athlete's contribution to torque their body through the swing plane.

Golf Laboratories manufactures robots to conduct independent testing of golf equipment for the United States Golf Association (USGA). In **Table 3**, the required amperages for the robot to swing the golf club at various velocities and subsequent conversion to energy in kcal/hour are listed (Personal Communication).

Table 3. Golf laboratories club velocity data.

Club Velocity (mph)	Power (amps)	Energy (kcal/hour)
70	12	10.3
75	15	12.9
80	19	16.3
85	22	18.9
90	25	21.5
95	28	24.1
100	31	26.7
105	34	29.2
110	37	31.9
115	40	34.4

Conversion to kilocalories/hour by multiplying by 0.8598.

Using a gyroscope or magnetometer attached to the body known as Inertia Measurement Units (IMU) Kim and Park measured the average golf swing to be approximately 2 s [16]. At 115 mph, the work for the robot to swing the club is approximately 0.02 kcal.

The athlete's contribution was measured by two studies varying either club choice or the athlete's experience. Outram and Wheat, using similar IMU technology to measure the total work required to swing the club, varied between 223 to 269 joules depending on the club used [17]. Nesbit and Serrano used a computer model of 4 different golfers with varying handicaps and work varied between 235 and 355 Nm with the higher work observed with the scratch golfer [18].

Nesbit and Serrano showed that a scratch golfer produced 355 Nm during a golf swing [18]. If the 355 Nm work produced is converted to kcal (multiplied by 0.00024) the golfer produced only 0.08 kcal per swing. If the athlete used 80 strokes to complete the round that's only 6.4 kcal. The majority of energy utilized during a round of golf is walking the course independent of the method of club transportation.

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