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Energy expenditure of golf range practice: A beta investigation

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Abstract

How does Energy Expenditure (EE) in golf practice compare to golf play? Golf has demonstrated a moderate level of EE during play, especially when walking, which can contribute to health. Golf practice on the driving range has never been assessed. Can driving range practice qualify as meaningful exercise?

Ten subjects regularly participating in golf performed two short-range/practice sessions while connected to a portable metabolic system to determine potential benefits. Data points were recorded and averaged for O2/L/min and converted to kcal per hour, oxygen consumption in VO2 ml/kg/min, and heart rate (HR).

Subjects performed their regular physical warm-up routine and hit range balls using their standard progression of clubs and pace. Sessions ranged from 10-19 minutes, followed by a short break, with another session of the same time and progression. Using oxygen consumed to measure energy expenditure, the group averaged 3.5 kcal per minute for the first session/3.71 kcal per minute for the two sessions. MET values were 2.31/2.59, respectively, below the required 3.0 met level for moderate activity. Statistical analysis revealed a significant relationship between subject weight and EE of p=0.0001. From this beta study, golf practice can contribute to overall health as part of a weekly exercise and recreation schedule. Further rigorous study is needed to explore this form of activity's quantity further.

Keywords: Golf; Energy Expenditure; VO2 Max; Kilocalories; Golf Practice; Driving Range

1. Introduction

Golf has surged over the last ten years as a recreational sport activity. Its growth spurted upward as it allowed participants to spend time outside in a recreational environment with a robust set of perceived health and social benefits [1, 2]. One of the fastest-growing dimensions of golf is the use of driving ranges and simulators. Many golf participants feel they need extensive time for 9 or 18 holes, and a range session of 30-60 minutes gets them outside and golfing.

Limited studies have concluded that golf play, especially when walking, has health benefits. Prior investigations have used metrics such as steps, distance, heart rate, movement patterns, and, in rare cases, actual energy expenditure via expired gases to view health or fitness benefits [3-7]. Golf is a complex activity with many dimensions of play, and investigations have strongly indicated that golf contributes to health as a moderate-exertion physical activity [4-9]. It is better than just walking, mainly due to the increased metabolic demands of the terrain, total energy expended, and the golf swing itself using a large amount of the body's musculature in both stability and swing movement. While golf

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participation is significant in terms of health benefits, the results are determined by skill, course difficulty, and mode of locomotion/transport [6-13], yet does lag in total compared to other sports and sports practice.

However, no investigation to date exists for golf practice, whether outdoors on a traditional range or indoors with a simulator. The first goal of this beta study was to define and gain a physiological understanding of golf practice as a potential health-building activity. A few investigations have investigated tennis and soccer in practice versus game requirements, while some studies have focused on the EE of referees [14-18].

A related and interesting question that has yet to be researched or reported in the literature is whether golfers are accurate in understanding both the speed of practice/number of shots and the actual progression used in each session. One would venture that regular golfers would have a strong sense of these practice metrics and tendencies.

2. Material and methods

Subjects were recruited from regular golfers in the Denver, Colorado area. The requirements were regular play at least once per week, regular practice in some form once per week, and maintaining a golf handicap. Practice was defined as a separate session not connected to golf play or a session right before a round where the golfer would hit at least 15 balls before play.

Applicants completed health history questionnaires and participatory consent and waiver, which the Colorado Center for Health & Sports Science (CCHSS) IRB reviewed. Applicants received a summary of study specifics, the flow of the study session, and a description of the measurement equipment. Any subjects with medical issues that would interfere with testing were removed from the consideration pool. Upon final review, ten (n=10) subjects, seven males (n=7) and three females (n=3), were prospectively selected. Age range was from 43 to 73 years old, median age was 56 years of age.

To standardize test conditions, the subjects received a set of trial guidelines. This included setting a test time like their regular practice or play time. The subjects were instructed to set testing times/dates after a day or more of rest or cessation from golf play to ensure they entered the trial in a rested state with optimum awareness of mental focus.

On-range testing used a VO2 Master metabolic analyzer (VO2 Master, Vernon, Canada) and a standard Hans-Rudolph mask. This system is depicted in Figure 1.

Figure 1 Metabolic measurement system used in the investigation

A Wahoo heart rate monitor/strap was integrated into the unit. The measurement device was used because of the very minimal weight, and the field of vision was reasonable, given the size of the mask/analyzer on the subject's face. Use of the metabolic system with minimal visual disruption is depicted in Figure 2.

Figure 2 Use of the metabolic system in golf swing practice

Testing previously to EE on the actual golf course revealed that the VO2 Master had the same O2 and primary respiratory data, yet with less encumbrance and interference with the golf swing than the OxyconMobile [19-21]. An additional factor included the focus on just O2 in the study for EE, and not CO2, as the subjects were extremely unlikely to reach the threshold/anaerobic threshold, so measuring this point via gas exchange was unnecessary. Masks and subsequent head straps were fitted to the subject using a Hans-Rudolph sizing tool. Figure 3 shows the metabolic system during range practice.

Figure 3 Another subject in range practice

Subjects could practice in the metabolic sensing unit with minor impairment and distraction. The unit was powered up for their trial and underwent its standard calibration sequence. The subjects wore the unit for their physical warm-up before hitting a golf ball, and the unit was powered up again for the first trial. Example of another subject in metabolic measurement, Figure 4.

Figure 4 Metabolic measurement example on the driving range

The temperature varied between 72- and 83 degrees Fahrenheit during the actual trial. If the temperature was above that 85-degree Fahrenheit mark, the trial was moved to another day/time where the temperature would not result in undue mask discomfort and distraction. If the humidity was an issue during a trial, as determined by the subject, the sensing system was paused briefly, and the mask interior was wiped dry and then re-started. After completion, data was averaged for actual VO2 in ml/kg/min and O2 in liters. The physiological results included an O2 measure per minute converted to kcal per hour (using the accepted five kcal per liter of O2 consumed), VO2 per minute, and average heart rate.

3. Results

As the study focused on EE during golf practice, the actual O2 consumed was converted to kcal using the accepted 5 kcal per liter of O2. The data is presented in Table 1. The first trial had subjects expending a mean of 3.5 kcal per minute, with the second trial expenditure of 3.74 kcal per minute, the mean value. The O2 per kg of body weight per minute in kilograms was then converted to met levels. The first trial mean was 2.31 METs, while the second was 2.59 METs. HR did not significantly correlate with either kcal per minute or METs.

However, the subjects expended energy with a strong relationship to weight with simple t-testing revealing a p = 0.0001 for both trials.

Table 1 Overall results

Subject	Weight/lb	VO2L-1	VO2L-2	Mean	VO2ML-1	VO2ML-2	HR1	HR2	Mean
1	156	0.880	0.876	0.878	13.1	12.36	123	125	124
2	160	0.484	0.560	0.522	5.5	7.2	104	116	110
3	200	0.441	0.429	0.435	4.84	4.74	98	102	100
4	150	0.431	0.536	0.4835	6.3	9.45	98	99	98.5
5	200	0.904	0.941	0.9225	8.7	10.5	83	98	90.5
6	190	0.357	0.605	0.481	4.41	7.47	103	95	99
7	220	1.159	1.123	1.141	11.5	11.29	89	88	88.5
8	240	0.792	0.795	0.7935	7.26	7.23	82	84	83
9	220	1.092	1.05	1.071	11.37	10.9	120	118	119
10	116	0.447	0.536	0.4915	7.87	9.45	97	99	98
Mean	185.2	0.699	0.745		8.09	9.059	100.0	102.0	101
Significance		P=0.0001		P=0.0001					
EE Conversion		3.5 kcal/m	3.74 kcal/m		2.31 mets	2.59 mets			

4. Discussion

The primary conclusion from this study is that golf practice occurs just below the threshold of moderate exercise. Thus, it is likely to contribute to an EE and activity total for a week and can be an addition to daily/weekly energy expenditure, resulting in better health. However, it does not replace formal exercise, such as an aerobic activity at the prescribed 3-6 MET level.

There was a strong relationship between golfer weight and EE. This reinforces the concept that the golf swing is a whole-body activity, and the higher the weight, the more muscle mass is used. Thus, EE is in direct proportion to the weight shift, control, and movement through the swing.

Another concept that interfaces with golf and golf practice is what individuals over 60 require in terms of EE for health and fitness [22-27] is reduced compared to younger individuals. Recently, it has been proposed that instead of the standard 3.5 ml/kg/min value for MET, it is more appropriate for older individuals to calculate METs based on a 2.7 ml/kg/min level. Less functional capacity at max/VO2 and a decreased threshold/anaerobic threshold means it takes less training load to elicit a fitness or health benefit. Golf, in general, is an activity where EE is constantly specific to forms of play and transport.

Range practice may have a higher health benefit for senior golfers because of their diminished capacity. This same concept of threshold reached compared to maximum endurance capacity is likely applicable to those in rehabilitation from surgery or cancer survivors. The average 3-6 MET activity level required for fitness/health gain does not apply to individuals with significantly reduced maximal capacity [28-33].

Golfers of similar weights with similar play and transport specifics will use energy within a narrow band in actual golf play. Thus, golf can have a moderate effect on an older individual and a light effect or result on a younger individual.

An older individual who has a higher-than-average pace on the driving range may work at a level where golf practice is classified as a moderate activity and has a higher health benefit. And, even at a moderate or standard pace, it likely is more prominent in total EE and health benefits for the week than for a younger golfer. Those with some aspect of recovery or a medical condition may work at a significantly reduced pace of hitting golf balls, yet with their diminished overall capacity, that level of participation may still be meaningful from a health and fitness perspective.

Golf practice routines were not assessed. For all golfers, their hitting/practice rate was faster than the golfer's perception. In addition, there was variation in how golfers switched between clubs. Observation during the trials led to an informal conclusion that longer clubs have a slightly higher energy cost per swing than shorter clubs.

5. Conclusion

While not at the accepted EE needed for health and fitness improvement, golf practice can contribute to health as part of an overall activity addition. It may also prove a fitness development activity for those with lower-level fitness, such as seniors or those in health condition rehabilitation. Further study should investigate the link between practice styles/hitting speed and energy expenditure. In addition, various practice protocols should be determined and categorized, and then those approaches quantified in terms of exercise intensity. This highlights the need for investigating the effects of golf on fitness and health by age/fitness parameters as well as special populations for example, for those with rehabilitation considerations.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors report no conflicts of interest.

Statement of ethical approval

This study was conducted in accordance with the Declaration of Helsinki and was approved by the ethics committee and the IRB of the Colorado Center for Health & Sports Science, Denver, Colorado.

Statement of informed consent

Informed written consent was obtained from each participant after a clear explanation of the study objectives and procedures.

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