



Original research

A randomized trial of traditional and golf-specific resistance training in amateur female golfers: Benefits beyond golf performance



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ABSTRACT

Objective: Compare golf-specific resistance training (GSRT) with traditional resistance training (TRAD) with regard to golf performance and other outcome measures.

Design: Randomized controlled study.

Setting: Outpatient gym.

Participants: 45 female golfers were randomized into TRAD or GSRT, both of which targeted muscles active during the golf swing. Participants performed supervised training 3d·wk⁻¹ for 10 weeks.

Outcome Measures: Golf performance, bone density, body composition, and physical performance tests.

Results: 29 individuals (58.1 ± 2.1y; 15 TRAD, 14 GSRT) completed training. Completers were older ($p = 0.048$) and played golf more frequently than non-completers ($p = 0.002$), but were not otherwise different. Training decreased whole body fat mass ($p = 0.013$) and visceral fat mass ($p = 0.033$) across groups, but did not influence lean mass ($p = 0.283$) or bone mineral density ($p = 0.205$). Training increased driver speed ($p = 0.001$), driver distance ($p = 0.020$), and 71 distance ($p < 0.001$), but not 71 speed ($p = 0.160$), but no group or interaction effects were present. Training increased all physical performance tests ($p \leq 0.005$) regardless of group, but the seated medicine ball throw was most related to baseline driver speed ($r^2 = 0.384$), and also most responsive to training ($r^2 = 0.250$).

Conclusion: 10 weeks of supervised TRAD and GSRT provided similar improvements in body composition, golf performance, and physical performance in amateur female golfers.

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1. Introduction

According to the National Golf Foundation report on golf participation in the United States, 24.7 million people played one or more rounds of golf in 2013 ([Golf Participation in the United States, 2014](#)). One sector where the game of golf continues to grow is with females, 5.3 million of whom played one or more rounds of golf in 2013. Although an exact number is not known, many of these female participants will engage in resistance training in an effort to improve their golf game.

A number of studies have found that resistance training benefits golf performance, generally measured by changes in club head speed or driving distance. Early research in this realm concentrated on traditional resistance training and flexibility, with reports of 2.5–6.3% improvements in club head speed ([Hetu, Christie, & Faigenbaum, 1998](#); [Thompson & Osness, 2004](#)). Improvements in club head speed and driving distance were also noted when plyometric training was combined with traditional weight training ([Fletcher & Hartwell, 2004](#)). More recent studies, which have focused on targeting factors known to be associated with golf performance and incorporating sport-specific movements, have also reported similar improvements in golf parameters in collegiate athletes ([Doan, Newton, Kwon, & Kraemer, 2006](#)), middle aged males ([Lephart, Smoliga, Myers, Sell, & Tsai, 2007](#)), and senior citizens ([Thompson, Cobb, & Blackwell, 2007](#)).

While studies have shown that both a traditional resistance training program and a golf-specific training program can improve

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golf performance, there is a lack of literature comparing these two training programs using golf-specific outcomes. Only one golf training study has included a comparison of traditional versus golf-specific training, and this was performed as part of a periodized program in young low-handicap male golfers, and resistance training volume greatly differed between groups (Alvarez, Sedano, Cuadrado, & Redondo, 2012). Furthermore, this study is typical with regard to gender in that most of what is known about strength training pertains to male golfers despite the fact that there are sex-specific differences in the golf swing (Horan, Evans, & Kavanagh, 2011) as well as the metabolic requirements (Zunzer, von Duvillard, Tschakert, Mangus, & Hofmann, 2013) and psychological components of golf (Hayslip & Petrie, 2014; Kim, Park, Kim, Jun, Park, & Kim, 2010).

Therefore, the primary purpose of this study was to compare the effects of a 10-week traditional resistance training program to a functional, golf-specific resistance training program on golf performance parameters, specifically driver and 7-iron club head speed and shot distance, in recreational female golfers. In addition, we aimed to determine whether these training programs improved selected health-related outcomes, including bone density and body composition, and whether there was any relationship between physical performance tests and golf performance parameters. Our main hypothesis was that there would be no between group differences for golf performance, physical performance, and health-related outcomes but both groups would show improvement.

2. Materials and methods

2.1. Participants

Amateur female golfers were recruited through postings at local country clubs and public golf courses, as well as through emails to state and local women's golf associations. Inclusion criteria were: females ≥ 18 years of age, and an official handicap or completion of at least 5 rounds of golf within the last year. Exclusion criteria were current episode of musculoskeletal pain, unable to stand and swing a golf club independently, systemic disease including but not limited to rheumatologic disease or cancer, or psychological or other cognitive impairment. This randomized, prospective, longitudinal study was approved and conducted under xxx University IRB protocol.

2.2. Protocol overview

After providing their written informed consent, subjects completed a medical and golf history questionnaire. Golf-specific information gathered via the history form included self-reported number of years playing golf, handicap, frequency of play, and frequency of practice. Baseline testing in the human biomechanics and physiology laboratory followed, consisting of measurement of height and weight using a stadiometer, bone density and body composition using dual energy X-ray absorptiometry (DXA), 7-iron and driver club speed and total ball distance using a golf simulator (High Definition Golf, Interactive Sports Technologies, Vaughan, Ontario), and physical performance tests. The golf simulator calculates distance through the use of overhead cameras that monitor the club-ball contact zone and high speed cameras that monitor ball flight from impact to screen. The system captures multiple frames from the cameras producing a ball velocity measurement that is combined with launch angle and spin measurements in a proprietary formula that calculates distance. Participants were then randomly assigned by choosing a sealed envelope that contained group assignment: traditional resistance training group (TRAD) or golf-specific resistance training group (GSRT). The research

assistants then opened the sealed envelopes so that subjects remained masked to their assignment. Resistance training was conducted 3 days per week for 10 weeks. Each training session was directly supervised by at least one of the researchers, such that correct technique and appropriate resistance could be monitored. Following the 10 weeks of training, participants repeated the testing procedures under similar conditions as baseline testing.

2.3. Training programs

Both groups focused on training muscles that electromyography studies have identified as being highly active during the golf swing including the erector spinae, abdominal obliques, pectoralis, latissimus dorsi, levator scapulae, rhomboids, gluteus medii, hamstrings, and wrist flexors (Marta, Silva, Castro, Pezarat-Correia, & Cabri, 2012). The TRAD group completed traditional resistance training techniques to strengthen these muscle groups. These exercises predominantly involved the use of unidirectional resistance with stability provided by the apparatus on which the lifting was conducted. The GSRT group completed strengthening exercises for these same muscle groups that incorporated dynamic movement, balance and stability, and multi-plane resistance. The exception to these exercises was the shoulder shrug, used in both groups to target the levator scapulae. Both groups completed 3 sets of 9 exercises in each session. A complete description of the exercises performed by each group is found in [Appendices A and B](#). The target number of repetitions for each set was 10. Participants recorded the weight and number of repetitions for each exercise into a personal log. When the participant was able to complete 3 sets of 10 at a given resistance, the resistance was increased so that the participant could not complete 10 repetitions for the third set.

2.4. Testing procedures

2.4.1. Health-related outcomes

Body composition and bone mineral density were measured using DXA (Discovery W, Hologic Inc., Bedford MA). All DXA procedures were performed in accordance to manufacturer recommendations. Daily calibration was performed using a manufacturer-supplied phantom with components of known density. Height and body mass were measured on a digital stadiometer and scale system (284, Seca GMBH, Hamburg). A whole body scan was performed, during which participants were requested to lie motionless in the supine position. The images of all scans were then visually evaluated by one of the research team members to ensure there were no issues that could lead to error (e.g., metallic objects, altered body positions, etc.). Analysis of exams was performed in Hologic Apex v4.0 software using NHANES reference standards.

2.4.2. Golf-performance

For determination of 7-iron and driver club speed and total ball distance, participants were allowed 5 warm-up hits with each club and then completed 5 trial hits with each club using the golf simulator and their own golf clubs. Participants were allowed to choose which club (7-iron or driver) they wanted to be tested with first. This same order was then used during the post-test. Participants were informed that the mean of the three trials with the longest distance for each club would be used for analysis. Because the reliability of the golf simulator used has not been previously evaluated, data were gathered initially and again within 48 h to determine the reliability of the swing parameters. Club speed was selected as a key dependent variable because it may be considered a golf-specific indicator of human performance independent of club-ball interactions (e.g., site of contact between club head and ball, angle of contact, spin rate). Total ball distance was selected as

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