WHEY PROTEIN AND HIGH-VOLUME RESISTANCE TRAINING IN POSTMENOPAUSAL WOMEN

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Abstract: Objectives: To examine the combined effects of whey protein supplementation and low intensity, high-volume resistance training in healthy postmenopausal women. Design, setting and subjects: Postmenopausal women (n=12; age: 57 ± 4.7 years, weight: 75 ± 17.4 kg, height: 163 ± 5.5 cm, body mass index: 28.3 ± 7.0) consumed whey protein (4 x 10 gram aliquots) or placebo (maltodextrin) during unilateral resistance training sessions 2 days per week (Monday, Thursday) and consumed the opposite beverage during training the other side of the body on alternating days (Tuesday, Friday) for 10 weeks. Participants performed 3 sets at 30% baseline 1-repetition maximum (1RM) to volitional muscle fatigue for 4 exercises (leg curl, biceps curl, leg extension, triceps extension). Prior to and following training, assessments were made for upper and lower limb lean tissue mass (dual energy x-ray absorptiometry), muscle thickness of the elbow and knee flexors and extensors (ultrasound) and muscle strength (1RM leg curl, biceps curl, leg extension, triceps extension). Results: There was a significant increase over time for muscle strength (biceps curl, leg extension, triceps extension; P = 0.006) and muscle thickness (elbow flexors and extensors; P = 0.022) with no differences between whey protein and placebo. Conclusions: High volume resistance training is effective for improving some indices of muscle mass and strength in postmenopausal women, but the strategic ingestion of whey protein during training sessions does not augment this response.

Key words: Aging, unilateral, muscle, strength, volitional fatigue.

Introduction

Females typically experience accelerated muscle loss after menopause (1) which has a negative effect on strength (2, 3). The age-related decline in muscle mass and strength is partially due to an attenuated response to anabolic stimuli (e.g., resistance training and dietary protein), known as aging anabolic resistance (4, 5). Therefore, interventions which augment the physiological response to resistance training and dietary proteins are needed to increase aging muscle health.

Mechanical stimuli from resistance training promotes numerous adaptations in skeletal muscle, many of which may help prevent or reverse age-related declines in muscle mass and strength (3, 6, 7). The American College of Sports Medicine recommends that resistance training should be performed at training intensities ≥ 70% 1RM to achieve muscle accretion (8). However, postmenopausal women may find it difficult to consistently train at high intensities due to potential co-morbidities (i.e. arthritis) associated with aging (4). Two recent studies have shown that low intensity (30% 1RM), high-volume leg resistance training (performing 3-4 sets to volitional fatigue) increases the rates of muscle protein synthesis, muscle size and strength in young males (n =15-18; 21 ± 1 yr; refs. 9, 10). Furthermore, this mode of training produced similar increases in muscle protein synthesis (≤ 4 hours post-exercise) and muscle hypertrophy, after 10 weeks of training (3x/week), compared to high intensity training (80-90% 1RM to volitional fatigue; 9). Therefore, based on these preliminary findings in young adults, it is plausible that low intensity, high-volume resistance training may be an effective intervention to increase muscle mass and strength in postmenopausal women.

The addition of whey protein to low intensity, high-volume resistance training may further increase the rates of muscle protein synthesis which could lead to greater muscle mass and strength over time in postmenopausal women. Whey protein has a high essential amino acid profile (i.e. leucine) (11), which are quickly absorbed leading to rapid amino acid delivery to skeletal muscles (12) and increases the rates of muscle protein synthesis following resistance training (13). Therefore, the purpose of this study was to determine the effects of whey protein combined with low intensity, high-volume resistance training on muscle mass and strength in postmenopausal women. It was hypothesized that low intensity, high-volume resistance training would increase lean tissue mass and strength and the addition of whey protein would further augment these gains compared to placebo.

Materials and Methods

Participants

Seventeen females, who verbally confirmed they were postmenopausal (i.e. defined as having their last menstrual cycle ≥ 1 year prior to the start of the study) and were not performing supervised resistance training for at least 3 months prior to the start of the study were enrolled. Non-resistance trained postmenopausal women were selected to potentially maximize the physiological adaptations from resistance training. Participants indicated that they performed mild-
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intensity physical activity 1-3 times per week (i.e. walking, gardening) prior to the start of the study. Participants were required to fill out a Physical Activity Readiness Questionnaire which assessed their readiness to participate in the resistance training program and included questions related to heart conditions, angina at rest or during physical exercise, as well as balance and bone or joint problems that may affect exercise performance. Participants were excluded if they had previously taken medications that affect muscle biology (i.e. glucocorticoids, hormone replacement therapy), suffered from severe osteoarthritis, had consumed ergogenic aids (i.e. creatine supplements) for ≤ 6 weeks prior to the start of the study, if they were vegetarians, if they were smokers or if they had pre-existing kidney or liver abnormalities. Participants were instructed not to change their diet or engage in additional physical activity that was not part of their normal daily routine during the study period, to refrain from food and drink for one hour post-exercise so that a valid estimate on the effects of protein supplementation could be made (water was permitted ad libitum) and not to consume non-steroidal anti-inflammatory drugs during the study, as these interventions could affect muscle protein synthesis (14) and potentially influence our outcome measures. The study was approved by the Research Ethics Board at the University of Regina. Participants were informed of the risks and purposes of the study before written consent was obtained.

Experimental Design

The study used a double-blind, repeated measures, within-subject (placebo control) design where postmenopausal women were randomized to consume whey protein or placebo during unilateral (dominant side of the body was also randomized as all participants were right hand dominant) resistance training 2 days per week (Monday, Thursday) and consume the opposite beverage while training the other side of the body on alternating days (Tuesday, Friday) for 10 weeks. This unique design allowed for the direct comparison of whey protein vs. placebo within the same participant which increased our statistical power and internal validity.

At baseline and after the study, the primary dependent variables assessed included: (1) upper and lower limb lean tissue mass (dual energy x-ray absorptiometry; DXA), (2) muscle thickness of the elbow and knee flexors and extensors (ultrasound) and (3) unilateral muscle strength (1-repetition maximum leg curl, biceps curl, leg extension, triceps extension). A secondary dependent variable was habitual dietary intake. Participants filled out a 3-day food diary at baseline and after 10 weeks of training to determine whether total energy (kcal) and macronutrient intake changed over time.

Supplementation

Whey protein (40 grams; ISOWhey BreezerTM lemon iced tea flavoured powder, Interactive Nutrition; manufactured by NutrMix Laboratories under current Good Manufacturing Practises and Natural Health Products certifications) and placebo (30 grams of cornstarch maltodextrin and 10 grams of lemon iced tea flavoured sucrose) were identical in energy content (180 Kcal), taste, texture, volume and appearance. Protein and placebo were provided to each participant in separate plastic bags with detailed supplement instructions. Participants consumed the protein or placebo in the presence of an exercise supervisor (i.e. certified personal trainer) to ensure 100% compliance. The whey protein dosage of 40 grams was chosen as this quantity increases the rates of muscle protein synthesis following resistance training in older adults compared to lower protein dosages (15). Participants consumed 25% of their beverage (i.e. 10 grams of protein or placebo) following each exercise (4 exercises in total per training day). We chose this ‘pulse’ supplementation strategy for three reasons: (1) protein ingestion (~ 10 grams) every 15 minutes during resistance training increases the rates of muscle protein synthesis (16), (2) protein ingestion (10 grams) immediately following resistance training improves muscle hypertrophy over time in aging adults (17) and (3) ingesting 40 grams (bolus) of whey protein following resistance training sessions may not be feasible for older adults (4).

Resistance Training Program and Muscle Strength

Prior to the start of supplementation and training, each participant had their unilateral 1RM strength assessed (right side muscle group followed by left side muscle group) on the leg curl, biceps curl, leg extension and triceps extension resistance training equipment (Pulse Fitness Systems Inc, Winnipeg, Manitoba, Canada). Following 5-minutes of cycling on a stationary cycle ergometer at a self-selected intensity, participants performed two warm-up sets in order: 1 set of 10 repetitions using a weight determined by each participant to be comfortable and 1 set of 5 repetitions using increased weight. Two-minutes following the warm-up sets, weight was progressively increased for each subsequent 1RM attempt with a 2-minute rest interval. The 1RM was achieved in 6 sets or less. Five minutes of rest separated each 1-RM assessment between different muscle groups. All measurements were performed by the same experienced researcher. Following determination of baseline 1RM strength, but prior to the start of supplementation and training, participants familiarized themselves with the machine-based resistance training equipment, under direct supervision of a certified personal trainer. We chose to use machine-based resistance training equipment because they are considered safer and easier to learn than free weights (18) and the use of machine-based equipment lead to greater improvements in machine-based strength tests (19). During the 3 familiarization resistance training sessions, participants were properly shown how to breathe, use the equipment, and perform repetitions to volitional fatigue (defined as the inability to perform the concentric or eccentric phase of a muscle contraction) using 30% baseline 1RM for each exercise.