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EDITORIAL

Resistance training improves cardiovascular health in postmenopausal women

Evidence has been emerging on the importance of adding a muscle-strengthening component to regular physical activity to improve quality of life; delay the loss of muscle mass and function; and prevent osteoporosis, sarcopenia, and the falls, fractures, and disability that may follow.[1] Menopause and aging may lead to a loss in fitness, decrease in muscle strength and bone mineral density, and a gain in weight, all of which concomitantly increase the risk for many chronic diseases, such as cardiovascular disease.[2] If muscle-strengthening exercise can delay or prevent these diseases in postmenopausal women, this would have important public health implications.

Recently, studies have been looking at the effectiveness of resistance training to improve strength and risk factors for cardiovascular disease, such as blood pressure and anthropometric outcomes.[3-9] Knowing that the reduction in muscle mass and strength may be exacerbated after the loss of estrogen, a few studies have looked at resistance training and cardiovascular health, specifically in postmenopausal women. The study presented by Shaw et al[10] in the current issue of *Menopause* aimed to investigate if a hypertrophy-specific training program could alleviate some of the detrimental anthropometric and cardiovascular changes often seen in postmenopausal women aged 50 to 79 years. Using a randomized 6-week intervention (resistance training vs control), the authors observed substantial improvements with participants performing resistance training only two times per week for 40 minutes at 67% to 85% of their 1-repetition maximum (1-RM). On completion of the 6-week training program, the individuals in the resistance training group, on average, saw reductions in heart rate (−5 bpm), systolic blood pressure (−2 mm Hg), diastolic blood pressure (−3 mm Hg), waist circumference (−7 cm), and body fat percentage (−5%). There were no significant changes noted in the control group. This article provides further evidence that resistance training is beneficial for postmenopausal women to aid in reducing the negative effects of aging and/or menopause on cardiovascular health and anthropometric outcomes. It, however, is evident that there are limitations that should be considered when interpreting the results.

First, a more conservative analysis, such as repeated measures analysis of variance with adjustment for the baseline value of each outcome measure, would probably have better captivated the true treatment and time effects. An adjustment for age could have also been considered because it is an important determinant of cardiovascular health outcomes (eg, blood pressure, glucose, total cholesterol) and a wide range existed between participants (50-79 y) in this study. In addition, several of the outcome variables (eg, resting systolic/diastolic blood pressure, body mass index) are reported with very large standard deviations that would make it difficult to determine if the training intervention was effective. Casey et al recently performed an 18-week resistance training intervention with a slightly smaller sample size (n = 13), but even with a greater reduction, although not significant, in systolic blood pressure of ~5 mm Hg and smaller standard deviations (3.0) than the current study (systolic blood pressure reduction of 1.8 mm Hg and mean standard deviation of 4.2).[4] It is plausible that the current study had responders and nonresponders, which could compensate for the large variation. Therefore, it would be informative and important to provide individual responsiveness to resistance exercise on health outcomes in future studies, specifically when there is a large variation between individuals. Furthermore, it is not clear how the effect of resistance training was statistically compared with the control group. This could have been done by comparing the change values, only the posttest values when there is no difference at baseline, or the change values after adjusting for the baseline values between the two groups. Because randomization cannot completely remove the heterogeneity on all outcome variables between the two groups at baseline (eg, VO_2max, 16.1 vs 13.6; glucose, 6.1 vs 5.6; body mass index, 24.5 vs 26.1; upper-body 1-RM, 20.1 vs 16.3), it is suggested that considering both baseline and change values in the analyses (eg, using repeated measures analysis of variance) would be more appropriate to reduce the risk of potential confounding errors.

Second, Shaw et al[10] point to the reasoning for the loss of muscle mass and changes in postmenopausal women being due to the reduction and loss of estrogen production. In the present study, women on hormone therapy (HT) were not excluded from participation, nor are the readers provided the information of how many women were using HT. This has the potential to influence the measured outcomes and negate the ability to relate the improvements from resistance training to strictly make up for the loss of estrogen production, because HT can offset the typical loss of muscle mass and function seen during menopause.[11] For example, Phillips et al showed that women on HT were able to delay the loss of maximal voluntary force and muscle cross-sectional area compared with postmenopausal women not on HT of the same age, height, and weight.[12]

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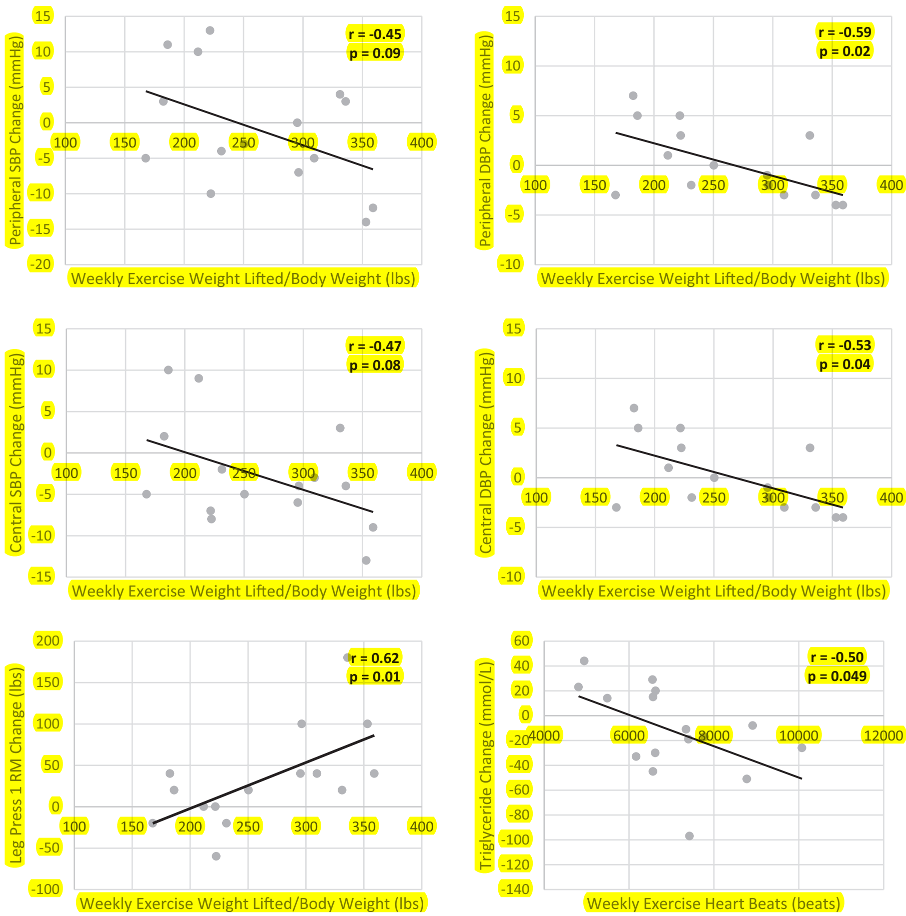

FIG. 1. Relationship of objectively measured resistance and aerobic exercise training with favorable changes in cardiovascular disease risk factors. Weekly exercise weight lifted/body weight (lb) was calculated as an average total weekly weight lifted ([sum of exercise weight] × [repetitions] × [sets of each resistance exercise]) per week, and then divided by body weight to control for individual differences in body weight. Weekly exercise heart beats were calculated as an average total weekly aerobic exercise heart beats ([sum of average heart beats during each aerobic exercise] × [min of each exercise]) per week minus (resting heart rate) × (average minutes of total weekly aerobic exercise) to adjust for individual differences in resting heart rate. All Pearson correlation analyses were adjusted for baseline age, sex, and average daily steps during an 8-week exercise intervention. 1-RM, 1-repetition maximum; DBP, diastolic blood pressure; SBP, systolic blood pressure.

Third, and possibly most important, several recent studies have looked at similar outcomes in this population, in which there is little discussion initiated. Although few studies exist specifically on cardiovascular outcomes, it is important for comparisons to be made. Two recent studies implementing 12-week resistance training interventions in postmenopausal women observed significant reductions in systolic blood pressure, with no change in diastolic blood pressure.[13,14] In addition, two other studies in postmenopausal women have reported reductions in systolic (−5 mm Hg and −15 mm Hg) and diastolic (−4 mm Hg and −6 mm Hg) blood pressure after 8 and 18 weeks, respectively, of resistance exercise that trend toward significance, but, regardless, are clinically significant reductions.[3,4]

Another suggestion to consider in future exercise training studies is that exercise study participants are generally more motivated to be active, which may possibly increase their lifestyle physical activity levels outside the exercise center or laboratory during the intervention period. Therefore, measuring lifestyle physical activity using activity monitors, such as pedometers or accelerometers, is necessary in exercise intervention studies. Also, in studies with the outcomes of cardiometabolic and anthropometric measures, such as the current study, energy intake and its components should be measured because diet can affect the outcomes (eg, sodium intake on blood pressure or possible increase in total energy intake in the exercise group as a compensation for exercise training).

The benefits of resistance training on cardiovascular health can further be supported with studies using combination training in postmenopausal women. A 16-week combined aerobic and resistance training regimen in postmenopausal women found that 1 day/wk of combination training led to similar changes in vascular hemodynamics compared with 2 or 3 days/wk.[15] Another 12-week intervention showed significant reductions in heart rate, systolic and diastolic blood pressure, and brachial–ankle pulse wave velocity.[16]

Most exercise training studies have reported their planned exercise program (prescription), but did not report the actual completed amount and intensity of exercise that their

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participants performed, which could be different from the originally planned exercise program due to individual differences in compliance to the exercise program. Our recent original data (unpublished), however, have shown that objectively measured resistance and aerobic exercise training provided cardiovascular health benefit. This study included 31 men and women (55%), aged 45 to 74 (mean age 56 y) who were sedentary, overweight or obese, and had prehypertension or stage I hypertension (Fig. 1). We randomized the participants into either resistance training only (n = 15) or aerobic training only (n = 16) group, and all participants exercised 3 days/wk for 60 minutes/session (time-matched exercise intervention). During an 8-week intervention, the amount of weight lifted and exercise heart beats per week were objectively measured using an innovative computer-controlled exercise intervention system (Technogym Wellness System, Gambettola, Italy). The weekly amount of weight lifted during the intervention period was correlated with favorable changes with reductions in peripheral systolic ($r = -0.45$, $P = 0.09$) and diastolic ($r = -0.59$, $P = 0.02$) blood pressure, central systolic ($r = -0.47$, $P = 0.08$) and diastolic ($r = -0.53$, $P = 0.04$) blood pressure using the SphygmoCor device (AtCor Medical, Itasca, IL), and increase in leg press 1-RM ($r = 0.62$, $P = 0.01$) after adjusting for baseline age, sex, and average daily steps during the intervention. In addition, we also found that the automatically recorded total weekly exercise heart beats (beyond their expected resting heart beats) were significantly correlated with a reduction in triglyceride levels ($r = -0.50$, $P = 0.049$) after adjusting for baseline age, sex, and average daily steps, which is another cardiovascular disease risk factor.

Overall, the study by Shaw et al[10] adds to the current evidence that resistance training can be beneficial for cardiovascular health and the prevention of the detrimental body composition changes often seen with menopause. A study design eliminating HT, however, would strengthen the results presented and provide more reliable data. The authors demonstrated that 8 weeks of resistance training only twice per week for approximately 40 minutes at 67% to 85% of a 1-RM could lead to cardiovascular health benefits in postmenopausal women. Furthermore, this study suggested a favorable body composition change and fat distribution (eg, increased lean mass, decreased fat mass, and reduced waist circumference, although not significant) without significant change in body weight (67.8 at pre vs 67.4 at post) in the resistance exercise group. This favorable result could explain the improved hemodynamics and glucose metabolism (eg, decreased blood pressure and fasting glucose) that were presented in the study. These findings again suggest that people should not be disappointed and stop resistance exercise because they do not see weight reduction on the scale. From a public health perspective, these data, in conjunction with previous studies, reiterate the importance of adding a muscle-strengthening component to physical activity regimens, especially in postmenopausal women to reduce the detrimental changes due to the loss of estrogen production.

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REFERENCES

1. Braith RW, Stewart KJ. Resistance exercise training: its role in the prevention of cardiovascular disease. *Circulation* 2006;113:2642-2650.
2. Sowers MR, La Pietra MT. Menopause: its epidemiology and potential association with chronic diseases. *Epidemiol Rev* 1995;17:287-302.
3. Elliott KJ, Sale C, Cable NT. Effects of resistance training and detraining on muscle strength and blood lipid profiles in postmenopausal women. *Br J Sports Med* 2002;36:340-344.
4. Casey DP, Pierce GL, Howe KS, Mering MC, Braith RW. Effect of resistance training on arterial wave reflection and brachial artery reactivity in normotensive postmenopausal women. *Eur J Appl Physiol* 2007;100:403-408.
5. Collier SR, Kanaley JA, Carhart R, et al. Effect of 4 weeks of aerobic or resistance exercise training on arterial stiffness, blood flow and blood pressure in pre- and stage-1 hypertensives. *J Hum Hypertens* 2008; 22:678-686.
6. Bateman LA, Slentz CA, Willis LH, et al. Comparison of aerobic versus resistance exercise training effects on metabolic syndrome (from the Studies of a Targeted Risk Reduction Intervention Through Defined Exercise—STRRIDE-AT/RT). *Am J Cardiol* 2011;108:838-844.
7. Taaffe DR, Galvão DA, Sharman JE, Coombes JS. Reduced central blood pressure in older adults following progressive resistance training. *J Hum Hypertens* 2007;21:96-98.
8. Cortez-Cooper MY, DeVan AE, Anton MM, et al. Effects of high intensity resistance training on arterial stiffness and wave reflection in women. *Am J Hypertens* 2005;18:930-934.
9. Cornelissen VA, Fagard RH, Coeckelberghs E, Vanhees L. Impact of resistance training on blood pressure and other cardiovascular risk factors: a meta-analysis of randomized, controlled trials. *Hypertension* 2011;58: 950-958.
10. Shaw BS, Gouveia M, McIntyre S, Shaw I. Anthropometric and cardiovascular responses to hypertrophic resistance training in postmenopausal women. *Menopause* 2016;23:1176-1181.
11. Tiidus PM. Benefits of estrogen replacement for skeletal muscle mass and function in post-menopausal females: evidence from human and animal studies. *Eurasian J Med* 2011;43:109-114.
12. Phillips SK, Rook KM, Siddle NC, Bruce SA, Woledge RC. Muscle weakness in women occurs at an earlier age than in men, but strength is preserved by hormone replacement therapy. *Clin Sci (Lond)* 1993;84: 95-98.
13. Gelecek N, Ilçin N, Subaşi SS, Acar S, Demir N, Ormen M. The effects of resistance training on cardiovascular disease risk factors in postmenopausal women: a randomized-controlled trial. *Health Care Women Int* 2012;33:1072-1085.
14. Gerage AM, Forjaz CLM, Nascimento MA, Januário RSB, Polito MD, Cyrino ES. Cardiovascular adaptations to resistance training in elderly postmenopausal women. *Int J Sports Med* 2013;34:806-813.
15. Corrick KL, Hunter GR, Fisher G, Glasser SP. Changes in vascular hemodynamics in older women following 16 weeks of combined aerobic and resistance training. *J Clin Hypertens* 2013;15:241-246.
16. Figueroa A, Park SY, Seo DY, Sanchez-Gonzalez MA, Baek YH. Combined resistance and endurance exercise training improves arterial stiffness, blood pressure, and muscle strength in postmenopausal women. *Menopause* 2011;18:980-984.

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