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Effects of Long-Term Square Dance Exercise on Physical Fitness Indicators and Anxiety Level in Postmenopausal Women

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Abstract

Objective: This study examined the effects of long-term square dance exercise on selected physical fitness indicators and anxiety level in postmenopausal women, with the aim of providing empirical evidence for community-based exercise guidance for this population. Methods: Forty postmenopausal women from Haigang District, Qinhuangdao City, were included and divided into a long-term square dance group (n=20) and a comparison group (n=20). Long-term square dance participation was defined as dancing at least three times per week, at least 30 minutes per session, for one year or longer. Body mass index (BMI), vital capacity, grip strength, reaction time, single-leg standing with eyes closed, and anxiety level were assessed. Data were analyzed with independent-samples t tests, and Cohen's d and 95% confidence intervals were reported to improve interpretation. Results: There were no significant between-group differences in BMI, vital capacity, or grip strength (P>0.05). The long-term square dance group showed a shorter reaction time, a longer duration of single-leg standing with eyes closed, and a lower anxiety score than the comparison group (P<0.05). Conclusion: Long-term square dance exercise may be associated with better reaction ability, balance ability, and anxiety status in postmenopausal women, whereas its effects on BMI, vital capacity, and grip strength were not significant. Square dance is a low-threshold, socially interactive, and sustainable form of community exercise and may be suitable for health promotion among postmenopausal women.

Keywords

Square dance; Postmenopausal women; Physical fitness; Balance ability; Anxiety level; Community exercise.

1. Introduction

Population aging has become an important public health issue in China and many other countries. Within the aging population, postmenopausal women deserve particular attention because menopause is accompanied by a series of physiological and psychological changes. Declining estrogen levels, slower metabolism, reduced muscle function, changes in body composition, sleep disturbance, mood fluctuation, and increased anxiety may jointly affect health and quality of life. These changes do not occur in isolation. They are also influenced by lifestyle, exercise habits, family responsibilities, social participation, and access to community health resources. Therefore, identifying exercise forms that are safe, economical, acceptable, and easy to maintain is important for promoting healthy aging among postmenopausal women [3,4,9,10].

Physical exercise is widely recognized as an important means of improving physical and mental health. Aerobic exercise, resistance training, balance training, and mind-body exercise have all been shown to contribute to health maintenance in middle-aged and older adults. For postmenopausal women, regular exercise may help improve cardiovascular function, neuromuscular coordination, balance ability, mood state, sleep quality, and social adaptation.

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However, the effectiveness of any exercise program depends not only on physiological mechanisms but also on adherence. Exercise forms that are too intense, expensive, technically demanding, or inconvenient may be difficult for middle-aged and older women to maintain over time. This makes community-based and socially supported forms of exercise especially valuable [2,3].

Square dance is a highly popular community-based physical activity in China. It combines music, rhythmic movement, group participation, and moderate aerobic activity. Compared with many organized sports, square dance has a low participation threshold, requires limited equipment, can be performed in open public spaces, and is relatively easy to learn. Its movement intensity can also be adjusted according to participants' physical condition and experience. In addition to its physical training effect, square dance has a strong social attribute. Participants dance together, communicate before and after activity, encourage each other, and gradually form stable social networks. These characteristics may be particularly beneficial for postmenopausal women, who may face both physical decline and psychological stress [1,7,10].

Previous studies have reported that square dance may be associated with better physical fitness, emotional state, cognitive function, sleep quality, and subjective well-being in middle-aged and older women. Some studies suggest that square dance can improve balance and coordination because it involves continuous weight shifting, step changes, rhythm control, and body orientation adjustment. Other studies emphasize its psychological benefits, arguing that music, collective participation, and social support may help relieve anxiety and depressive symptoms. Nevertheless, the health effects of square dance may not be uniform across all indicators. For example, body mass index (BMI), vital capacity, and grip strength may be affected by multiple factors such as diet, baseline fitness, chronic disease status, and other exercise behaviors. Therefore, it is necessary to examine which indicators are more sensitive to long-term square dance participation [1,3].

Existing research has often focused on middle-aged and older women as a broad group. Relatively fewer studies have examined postmenopausal women specifically and compared both physical fitness indicators and anxiety level in the same research design. Moreover, some previous conclusions have been expressed too broadly, such as claiming that square dance improves overall physical and mental health without distinguishing significant and non-significant indicators. To provide a more accurate understanding, this study compares postmenopausal women who have engaged in long-term square dance exercise with those who have not met the long-term square dance criteria. The purpose is to examine whether long-term square dance exercise is associated with differences in BMI, vital capacity, grip strength, reaction time, single-leg standing with eyes closed, and anxiety level [3,4,9].

2. Materials and Methods

2.1. Study Design and Participants

This study adopted a cross-sectional comparative design. Forty postmenopausal women from Haigang District, Qinhuangdao City, were included as participants. According to square dance participation status, they were divided into a long-term square dance group and a comparison group, with 20 participants in each group. The general characteristics of the two groups are shown in Table 1. The long-term square dance group had a mean age of 59.74+/-5.84 years, and the comparison group had a mean age of 56.78+/-7.17 years. The two groups were similar in height and body weight, which provided a basic basis for comparison.

The inclusion criteria were as follows: women who had entered menopause, were able to complete the physical fitness tests, volunteered to participate in the study, and provided informed consent. The long-term square dance group was required to have participated in square dance at least three times per week, at least 30 minutes per session, for at least one year.

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The comparison group included postmenopausal women who did not meet the above long-term square dance criteria. Participants with acute disease, severe cardiopulmonary disease, serious musculoskeletal injury, or inability to safely complete the tests were not suitable for inclusion. Because the original study was based on a small community sample, the results should be interpreted as exploratory evidence rather than population-level inference[3,4,9].. This study was approved by the local community health working group, and all participants signed written informed consent before testing. All testing procedures complied with the ethical standards of the Declaration of Helsinki.

Table 1. General characteristics of the participants

Variable	Long-term square dance group (n=20)	Comparison group (n=20)
Age (years)	59.74+/-5.84	56.78+/-7.17
Height (m)	1.59+/-0.08	1.60+/-0.07
Body weight (kg)	59.15+/-9.39	57.98+/-9.08

2.2. Physical Fitness Indicators

The physical fitness indicators included BMI, vital capacity, grip strength, reaction time, and single-leg standing with eyes closed. BMI was calculated based on measured height and body weight. Although BMI is a convenient indicator for describing weight status, it cannot distinguish between fat mass and muscle mass. Therefore, the interpretation of BMI in this study was limited to general body mass status rather than detailed body composition [6,10].

Vital capacity was measured using a vital capacity tester. During the test, the participant inhaled deeply and then exhaled as fully as possible into the mouthpiece. The test was repeated, and the best value was recorded. Grip strength was measured using a grip dynamometer. Participants stood naturally and squeezed the instrument with maximum effort; the best result was recorded. Reaction time was used to assess neuromotor response speed. Single-leg standing with eyes closed was used to evaluate static balance ability. During the balance test, participants stood naturally, lifted one foot after the start command, and the timing was stopped when the supporting foot moved or the lifted foot touched the ground.

2.3. Anxiety Assessment

Anxiety level was assessed using the Self-Rating Anxiety Scale (SAS). The SAS is widely used to evaluate subjective anxiety symptoms. A higher score indicates a higher anxiety level. In this study, the anxiety score was used as a psychological indicator to compare group differences. Because the study used a cross-sectional design, the anxiety comparison reflects differences between the two groups at the time of investigation. It should not be interpreted as direct proof that square dance caused a reduction in anxiety. Nevertheless, the comparison may provide useful evidence for understanding the potential psychological value of long-term square dance participation [11].

2.4. Statistical Analysis

Excel was used for data entry and organization, and SPSS statistical software was used for statistical analysis. Measurement data were expressed as mean +/- standard deviation. Independent-samples t tests were used to compare differences between the long-term square dance group and the comparison group. A two-sided P value of less than 0.05 was considered statistically significant. To improve interpretation beyond P values, mean differences with 95% confidence intervals and Cohen's d effect sizes were also reported. Cohen's d values of approximately 0.20, 0.50, and 0.80 were interpreted as small, medium, and large effects, respectively. Given the small sample size, both statistical significance and effect size were considered when interpreting the results.

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3. Results

3.1. Comparison of Physical Fitness Indicators

The comparison of physical fitness indicators is shown in Table 2. There was no significant difference in BMI between the long-term square dance group and the comparison group (22.41+/-1.93 vs. 22.57+/-2.32, P=0.818). The effect size was very small, indicating that long-term square dance participation was not associated with a meaningful difference in BMI in this sample.

The vital capacity of the long-term square dance group was higher than that of the comparison group (1850.79+/-261.18 mL vs. 1681.62+/-396.02 mL), but the difference did not reach statistical significance (P=0.123). The effect size was moderate (d=0.50), suggesting a possible trend that requires verification with a larger sample. Grip strength was also not significantly different between the two groups (10.99+/-6.31 kg vs. 12.51+/-5.65 kg, P=0.425).

In contrast, the long-term square dance group showed better performance in reaction time and single-leg standing with eyes closed. Reaction time was significantly shorter in the long-term square dance group than in the comparison group (385.00+/-75.99 ms vs. 487.01+/-106.16 ms, P=0.001), with a large effect size. The duration of single-leg standing with eyes closed was significantly longer in the long-term square dance group than in the comparison group (10.28+/-2.37 s vs. 8.15+/-1.88 s, P=0.003), also showing a large effect size. These findings indicate that long-term square dance participation may be more strongly associated with neuromotor response and balance ability than with body mass or upper-limb strength.

Table 2. Comparison of physical fitness indicators between the two groups

Indicator	L-T group	Comp. group	Diff. (95% CI)	t	P	d
BMI (kg/m^2)	22.41+/-1.93	22.57+/-2.32	-0.16 (-1.53 to 1.21)	-0.232	0.818	-0.07
Vital capacity (mL)	1850.79+/-261.18	1681.62+/-396.02	169.17 (-45.53 to 383.87)	1.580	0.123	0.50
Grip strength (kg)	10.99+/-6.31	12.51+/-5.65	-1.52 (-5.35 to 2.31)	-0.806	0.425	-0.25
Reaction time (ms)	385.00+/-75.99	487.01+/-106.16	-102.01 (-161.10 to -42.92)	-3.460	0.001	-1.11
Single-leg stand (s)	10.28+/-2.37	8.15+/-1.88	2.13 (0.76 to 3.50)	3.150	0.003	1.00

Note: L-T group = long-term square dance group; Comp. group = comparison group. Diff. = mean of the long-term square dance group minus mean of the comparison group. P<0.05 indicates statistical significance.

3.2. Comparison of Anxiety Level

The anxiety comparison is presented in Table 3. The anxiety score of the long-term square dance group was significantly lower than that of the comparison group (28.74+/-2.49 vs. 36.71+/-13.37, P=0.014). The mean difference was -7.97, and the effect size was large (d=-0.83). This result suggests that postmenopausal women who participated in long-term square dance exercise had a lower anxiety level than those in the comparison group. However, because the study was cross-sectional, the finding should be interpreted as an association rather than causal evidence.

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Table 3. Comparison of anxiety level between the two groups

Indicator	L-T group	Comp. group	Diff. (95% CI)	t	P	d
SAS score	28.74+/-2.49	36.71+/-13.37	-7.97 (-14.13 to -1.81)	-2.680	0.014	-0.83

4. Discussion

4.1. Interpretation of Non-Significant Indicators

The present study found no statistically significant difference in BMI between the two groups. This result suggests that long-term square dance exercise may not be sufficient to change BMI among postmenopausal women. BMI is influenced by many factors, including diet, total daily energy expenditure, basal metabolism, heredity, sleep, chronic disease, and hormone-related changes after menopause. Square dance is usually a moderate-intensity rhythmic activity, and its energy expenditure may not be high enough to produce substantial weight change without dietary adjustment or additional exercise. Moreover, BMI is a crude indicator; it does not reflect fat distribution, muscle mass, or changes in body composition. Therefore, future studies should include waist circumference, body fat percentage, muscle mass, and dietary information to more accurately evaluate the effect of square dance on body composition [3,6].

The difference in vital capacity was not statistically significant, although the mean value was higher in the long-term square dance group. This may be related to the small sample size and large individual variation. Square dance includes continuous rhythmic movement and may stimulate cardiorespiratory function, but the intensity and breathing demand may vary substantially depending on dance style, music tempo, movement range, and participant effort. Some participants in the comparison group may also have engaged in other physical activities, which could reduce between-group differences. Thus, the non-significant result does not necessarily mean that square dance has no possible respiratory benefit; rather, it indicates that this study did not provide sufficient statistical evidence for a significant effect on vital capacity [2,6].

Grip strength also showed no significant difference between the two groups. This result is reasonable because square dance mainly emphasizes lower-limb movement, rhythm, coordination, and whole-body aerobic activity. It does not usually include systematic resistance exercise for the upper limbs. Grip strength is more sensitive to resistance training, manual labor, nutritional status, and muscle mass than to moderate rhythmic dance. Therefore, if the aim is to improve upper-limb strength in postmenopausal women, square dance may need to be combined with resistance training, elastic band exercises, or light dumbbell training [2,10].

4.2. Potential Mechanisms for Improved Reaction Ability and Balance

The long-term square dance group had a significantly shorter reaction time than the comparison group. Reaction time reflects the speed of sensory perception, central processing, and motor response. Square dance requires participants to follow music, remember movement sequences, respond to rhythm changes, and coordinate limb movements. Repeated practice may stimulate attention, processing speed, motor planning, and coordination. In addition, square dance is often performed in a group environment, where participants need to maintain spacing and synchronize movements with others. These demands may further enhance visual attention and rapid response ability [1,8].

The long-term square dance group also performed better in the single-leg standing with eyes closed test, indicating better static balance ability. Balance control depends on visual, vestibular, and proprioceptive systems, as well as lower-limb muscle control. Square dance commonly includes changes in direction, turns, weight shifting, stepping patterns, and posture adjustments. These movements may repeatedly challenge balance control and improve proprioceptive sensitivity. For postmenopausal women, improvement in balance ability is

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particularly important because aging and hormonal changes may increase the risk of decreased muscle function and falls. The finding therefore has practical significance for fall prevention and daily functional independence [10].

The large effect sizes for reaction time and balance suggest that square dance may be especially useful for neuromotor and coordination-related functions. This is consistent with the movement characteristics of square dance. Unlike simple walking, square dance requires participants to combine rhythm, memory, coordination, and balance. These combined demands may make square dance more beneficial for functional ability than some monotonous forms of low-intensity activity [1,8,10].

4.3. Potential Role of Square Dance in Anxiety Relief

The long-term square dance group had a significantly lower anxiety score than the comparison group. This suggests that square dance may have psychological benefits for postmenopausal women. The mechanisms may be multidimensional. First, square dance involves rhythmic aerobic activity, which can help relieve tension and promote relaxation. Second, music and dance provide emotional expression and may improve mood. Third, square dance is typically practiced in groups, which creates opportunities for communication, companionship, and social support. Social interaction may be especially important for postmenopausal women, who may face changes in family roles, retirement-related adaptation, and reduced social networks [9,10].

The psychological value of square dance should therefore not be understood as a purely physiological exercise effect. It is also a social and emotional activity. During square dance participation, women may gain a sense of belonging, receive encouragement from peers, and experience positive emotions through collective movement. These factors may help reduce anxiety and improve psychological well-being. From a community health perspective, square dance may function as both exercise and social intervention [7,9].

However, this study cannot prove causality. It is possible that women with lower anxiety are more willing to participate in long-term square dance, or that women with better social adaptability are more likely to maintain group exercise. Future longitudinal or intervention studies are needed to determine whether square dance can directly reduce anxiety and to identify mediating factors such as social support, exercise enjoyment, sleep quality, and self-efficacy.

4.4. Practical Implications

The findings have practical implications for community exercise promotion. First, square dance can be recommended as a feasible exercise option for postmenopausal women because it is easy to organize, inexpensive, and socially attractive. Second, community instructors should guide participants to perform adequate warm-up and cool-down activities and adjust movement intensity according to individual health status. Third, because square dance may not sufficiently improve upper-limb strength or body composition, it can be combined with resistance exercise, flexibility training, and nutrition guidance. Fourth, local communities should provide safe, flat, and accessible activity spaces to reduce injury risk and encourage continuous participation. Finally, the social function of square dance should be valued. Organizers can use square dance groups to enhance social participation, emotional support, and healthy lifestyle communication among middle-aged and older women [3,7,10].

4.5. Limitations

Several limitations should be acknowledged. First, the sample size was small, with only 20 participants in each group. This reduces statistical power and limits generalizability. Second, the study adopted a cross-sectional design, so causal relationships cannot be established. Third, potential confounding factors such as diet, other physical activities, medication use, chronic disease history, sleep quality, and hormone levels were not fully controlled. Fourth, BMI was

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used as the only body mass indicator, and more detailed body composition indicators were not included. Fifth, the anxiety assessment relied on self-report, which may be affected by response bias. Future studies should use larger samples, longitudinal designs, and more comprehensive measurement systems [3,4,9].

Despite these limitations, this study provides exploratory evidence that long-term square dance exercise may be associated with better reaction ability, balance ability, and anxiety status among postmenopausal women. The results also suggest that square dance should not be described as a universal method for improving all aspects of physical fitness. A more accurate conclusion is that its benefits may be more evident in coordination, balance, and psychological well-being than in BMI, vital capacity, or grip strength.

5. Conclusion

This study compared physical fitness indicators and anxiety level between postmenopausal women who participated in long-term square dance exercise and those who did not meet the long-term square dance criteria. The results showed no significant differences in BMI, vital capacity, or grip strength. However, the long-term square dance group showed significantly better reaction time, longer single-leg standing with eyes closed, and lower anxiety score.

These findings suggest that long-term square dance exercise may be associated with improved neuromotor response, balance ability, and psychological status in postmenopausal women. Square dance is a low-threshold, sustainable, and socially interactive form of community exercise. It may be promoted as part of a comprehensive health program for postmenopausal women, especially when combined with strength training, scientific exercise guidance, and community support. Future research should expand sample size, adopt intervention or follow-up designs, and include more indicators to clarify the mechanisms of square dance in promoting physical and mental health.

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