RESEARCH PAPER

Effectiveness of Dance-Based Aerobic Exercise in Improving VO_2max and Emotional Well-Being in Middle-Aged Women Undergoing Menopausal Transition

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ABSTRACT

Background

Menopause transition is accompanied by decreases in cardiovascular fitness and enhanced psychological distress. Whereas aerobic exercise is shown to counteract these effects, the influence of dance-based aerobic training on VO_2max as well as emotional health in this population remains uninvestigated.

Objective

To assess the efficacy of a formal dance-based aerobic workout program in enhancing cardiorespiratory function and psychological health in middle-aged sedentary women experiencing menopause.

Materials and Methods

A.quasi-experimental pretest-posttest design was used in 49 sedentary women aged 45–60. Participants finished a 12-week dance aerobic program (3 sessions/week, 60 minutes/session) that was equal to a group-based distribution. VO_2max was estimated by the Modified Bruce Protocol, while emotional well-being was measured by the Menopause-Specific Quality of Life Questionnaire (MENQOL) and the Depression Anxiety Stress Scale (DASS-21). Data were analyzed using paired t-tests and effect size estimation.

Results

VO_2max increased substantially from 24.1 to 27.9 mL/kg/min ($p < 0.001$, Cohen's $d = 0.87$). MENQOL scores dropped in all domains with overall scores reducing by 21.1 points ($p < 0.001$). There were significant falls in depression (–4.6), anxiety (–3.7), and stress (–3.8) scores (all $p < 0.01$) with moderate-to-large effect sizes. Adherence was excellent (89.2%) with high participant satisfaction and reported secondary benefits like better sleep and mood.

Conclusion

Aerobic exercise based on dance represents a new, enjoyable, and effective modality for improving cardiovascular and emotional well-being in menopausal women, with potential for beneficial applications to community-based health interventions.

Keywords: Menopause, Dance Aerobics, VO_2max, Emotional Well-being, Quality of Life, Women's Health

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INTRODUCTION:

Menopause transition, which usually happens between 45 and 55 years, is a time of major physiological and psychological change in women. Women at this point go through a reduction in their aerobic fitness level, as shown by decreased maximal oxygen consumption (VO_2max), an important sign of cardiovascular well-being [1]. This decrease is usually compounded by hormonal alterations, like low levels of estrogen, and physical activity declines, leading to higher risks of cardiovascular illness and metabolic syndrome [2]. At the same time, the menopausal transition is also coupled with emotional challenges, e.g., increased risk of anxiety, depression, and sleep disturbances, which can greatly affect quality of life [3]. Engaging in regular physical activity, particularly aerobic exercise, has been established as an effective strategy to mitigate these declines and enhance both physical and mental well-being [4].

Existing literature reports strong evidence supporting the positive impact of aerobic exercise on VO_2max and emotional well-being in women of different ages. For example, an 8-week high-intensity aerobic training intervention in older post-menopausal women (mean age 64 years) was studied by Carcelén-Fraile et al. (2021) and demonstrated an 18% improvement in VO_2max from 1.57 L/min to 1.85 L/min ($P < 0.001$) [5]. This research also observed enhancements in peak power output and, by implication, indicated wider cardiovascular effects. Furthermore, in perimenopausal women, it has been evidenced in research that aerobics training is effective in reducing psychological symptoms. Zhao et al. (2022) identified that an 8-week aerobics training program had high remission rates for anxiety (83.22%), depression (84.08%), and sleep disorder (89.94%) in perimenopausal women [6]. These results support the value of aerobic exercise in reversing both physical and emotional health problems during menopausal transition, with particular evidence for its effectiveness.

Even though these encouraging results exist, few studies have actually looked into the effect of dance-based aerobic exercise on VO_2max and emotional well-being among middle-aged women during menopausal transition. Dance-based aerobic exercise like Zumba or city dance presents a special blend of physical strain and social interaction that could provide extra emotional health benefits in its pleasurable and social aspects [7]. The social component of dance, with group exercise and rhythmic movement, may improve compliance and affective outcomes, possibly diminishing stress and enhancing mood. Although research has examined the impact of dance upon older adults or other health targets, for example, balance or cognitive function, evidence on its effectiveness in this group for enhancing cardiovascular fitness and affective well-being is slight [8]. This is important, since dance can be an enjoyable and easy intervention, especially for women going through menopause.

The intended study seeks to examine the efficacy of a dance aerobic exercise intervention on enhancing VO_2max and emotional well-being among middle-aged women in menopausal transition, hence filling a significant gap in the existing literature. By targeting this

particular population and intervention, the study aims to offer evidence on whether dance-based aerobic exercise is an enjoyable and effective approach to improve cardiovascular fitness and reduce psychological symptoms. The intervention will take advantage of the physical value of aerobic exercise, including enhanced VO_2max, and the emotional and social benefits of dance, possibly providing a more holistic solution to enhancing health outcomes during this important stage of life. The results can guide the development of individualized exercise programs to improve physical and emotional health, leading to enhanced quality of life among women experiencing menopause.

METHODOLOGY:

Study Design

A quasi-experimental, single-group pretest-posttest design was employed to assess the impact of a structured aerobic dance-based exercise intervention on cardiorespiratory fitness and emotional well-being in middle-aged women undergoing menopausal transition. Random assignment was not conducted since it was purposively excluded due to the practical and ethical issues related to lifestyle interventions in this age group. This design facilitated within-subject comparison before and after treatment, hence offering data on the effectiveness of the program without necessitating a control group. The study took a total of fifteen weeks, inclusive of a two-week assumption period to recruit, screen, and orient, twelve weeks of intervention, and one week of post-treatment assessment.

Study Participants

Postmenopausal women aged between 45 and 60 years who had current symptoms compatible with the menopausal transition based on the STRAW+10 (Stages of Reproductive Aging Workshop) criteria were eligible to enroll.[9] Participants should have been sedentary, i.e., less than 60 minutes per week of planned physical activity, and free from cardiovascular, neurological, or musculoskeletal diseases that would exclude them from moderate-intensity exercise. Individuals already on hormone replacement therapy (HRT) or psychiatric medications were excluded to rule out confounding effects. Screening for initial eligibility was conducted using the Physical Activity Readiness Questionnaire Plus (PAR-Q+). 55 participants were recruited, on the assumption of 20% attrition, to leave a final analyzable sample of ≥44 as calculated on G*Power 3.1 for a paired-sample design (effect size $d = 0.5$, $\alpha = 0.05$, power = 0.90).

Recruitment and Enrollment

Participants were recruited via advertisements placed on community health centers, menopause clinics, local health clubs, and women's health-focused social media sites. Potential participants attended a study orientation session where the purpose, procedures, potential risks, and advantages of the study were explicitly stated. Following informed consent, baseline assessments were scheduled and conducted within a controlled laboratory and community health club setting.

Intervention Protocol

Intervention consisted of 12-week dance aerobic exercise program, in group three times a week, 60 minutes per session. It was carried out by certified dance fitness instructor and monitored by a physiotherapist. The session structure consisted of a 10-minute warm-up incorporating light cardio and dynamic stretching, a 40-minute main session consisting of choreographed dance routines based on Zumba, Latin, freestyle aerobics, and contemporary dance styles, and a 10-minute cool-down incorporating breathing and static stretching. Intensity of every session was regulated by Polar H10 heart rate monitors, and participants were urged to perform within a target zone of 60–75% HRR, calculated from the Karvonen Formula.[10] Session perceived exertion was similarly measured using the Borg Rating of Perceived Exertion (RPE) Scale (6–20) to ensure that it is comparable with physiological load.[11]

Outcome Measures

The principal physiological outcome of interest was VO_2max, the gold-standard assessment of aerobic fitness. It was assessed on the basis of the Modified Bruce Treadmill Protocol that was both performed at baseline and post-intervention by an exercise physiologist with field training.[12] Predictive equations were used in a standard format to estimate VO_2max from exercise performance, heart rate, and attained workload.

The secondary measure of emotional well-being was ascertained using two valid self-report scales. The Menopause-Specific Quality of Life Questionnaire (MENQOL) measured menopause quality of life across four domains: vasomotor, psychosocial, physical, and sexual functioning.[13] It comprises 29 items rated on a 7-point Likert scale, with lower scores reflecting less symptom burden. At the same time, the Depression Anxiety Stress Scale (DASS-21) was administered to measure participants' psychological well-being on three subscales scored on a 0–3 scale and summed to indicate depression, anxiety, and stress.[14] For consistency adjustment, raw scores were doubled using standard scoring rules. To provide reliability, both questionnaires were completed in a quiet distraction-free room and clear instructions were provided to participants to reduce response bias. Test-retest reliability of the tools was established in a pilot sample (n = 10) before the main study.

Data Collection Timeline

We assessed two time points: before intervention (Week 0) and following the 12-week intervention (Week 14).

Baseline assessments included demographic data, medical history, VO_2max testing, and menopause-specific quality of life (MENQOL) and distress (DASS-21) questionnaires. Post-intervention assessments replicated the same procedure and also included a participant satisfaction survey evaluating satisfaction, perceived benefits, and desire to be enrolled in similar programs in the future.

Data Analysis

All the data were entered and managed with IBM SPSS Statistics v29.0. Baseline data and participant demographics were described with descriptive statistics. Shapiro-Wilk test was used to evaluate the normality of data distribution. Paired t-tests were used in contrasting outcomes among pre- and post-intervention values for normally distributed variables and Wilcoxon signed-rank tests for non-parametric variables. Effect sizes between significant outcomes were estimated with Cohen's d. Statistical significance was at $p < 0.05$. Missing data were handled using multiple imputation under the missing at random (MAR) assumption.

RESULTS:

Participant Characteristics and Study Completion

Of the 68 women who initially expressed interest in the study, 55 met the inclusion criteria and were enrolled. A total of 49 participants completed the 12-week dance-based aerobic intervention along with both the pre- and post-intervention assessments, yielding a high completion rate of 89.1%. Of the six non-completers, reasons for non-completion were personal scheduling (n = 3), acute, non-intervention related minor musculoskeletal pain (n = 2), and loss to follow-up (n = 1). There were no major adverse events reported. The median age of the 49 completers was 52.4 years (SD = 2.9) with an age range from 46 to 59 years. Most participants (63%) were in the late menopausal transition stage according to the STRAW+10 criteria. Baseline assessments showed that the sample were primarily sedentary, with a median body mass index (BMI) of 27.1 kg/m² (SD = 3.5), and more than half (57%) were overweight. None of the recruits were engaging in typical physical activity prior to recruitment, and none were receiving hormone therapy.

Changes in Cardiorespiratory Fitness (VO_2max)

The primary physiological outcome of the trial was maximum oxygen consumption (VO_2max), a robust indicator of cardiovascular health. The subjects' mean VO_2max levels at entry were low (M = 24.1 mL/kg/min, SD = 2.4) and are below age- and sex-specific normative norms for cardiorespiratory function. After 12 weeks of dance-based aerobic exercise intervention, there was a statistically significant rise in VO_2max to 27.9 mL/kg/min (SD = 2.6), an increase by a mean of 3.8 mL/kg/min ($p < 0.001$). This increase equates to a relative increase of 15.8%, a clinically meaningful gain with attendant lowered risk of cardiovascular morbidity and all-cause mortality.

Subgroup analyses showed that the degree of improvement varied by baseline fitness. The lowest tertile of VO_2max volunteers (<22 mL/kg/min) experienced the largest relative increases, with a mean increase of 4.6 mL/kg/min, whereas the highest tertile (>26 mL/kg/min) experienced a mean increase of 2.9 mL/kg/min. These findings suggest that the lower-fit volunteers responded particularly positively to the intervention. The calculated effect size (Cohen's d = 0.87) illustrates a large practical effect, attesting to the efficacy of dance-based aerobic exercise as a robust source of cardiovascular conditioning in midlife women.

Enhanced Menopause Quality of Life

Assessment of menopause quality of life by the MENQOL questionnaire revealed improvements in all four domains: psychosocial, physical, vasomotor, and sexual functioning. The total MENQOL score fell significantly from 110.2 (SD = 9.6) at baseline to 89.1 (SD = 8.2) post-intervention ($p < 0.001$), equivalent to a mean reduction of 21.1 points, which is both statistically and clinically relevant. The psychosocial domain was most improved with the development from 32.4 to 24.1 ($p < 0.001$), reflecting the ability of the program to decrease symptoms related to mood instability, irritability, and mental exhaustion. The physical domain, which comprises items such as fatigue, joint pain, and sleep disturbance, improved from 42.1 to 34.8 ($p = 0.002$). Similarly, the vasomotor domain, which is most related to hot flashes and night sweats, improved from 18.0 to 14.2 ($p = 0.006$).

Even the sexual domain, which has otherwise shown limited fluctuation in non-hormonal trials, improved moderately from 17.7 to 15.9 ($p = 0.048$). These improvements were met with self-reporting of better sleep quality, improved energy, reduced discomfort, and mood stability. These improvements were moderate to large in size, with Cohen's d scores ranging from 0.55 to 0.82. Women who had entered the study with more severe symptoms (scores ≥1 SD above the mean) experienced the most dramatic improvements, particularly in psychosocial and physical categories.

Table 1: Pre-Post Intervention Outcomes

Measure	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean ± SD)	Mean Change	p-value	Effect Size (Cohen's d)
VO_2max (mL/kg/min)	24.1 ± 2.4	27.9 ± 2.6	+3.8	< 0.001	0.87
MENQOL – Total Score	110.2 ± 9.6	89.1 ± 8.2	–21.1	< 0.001	0.84
MENQOL – Psychosocial	32.4 ± 6.0	24.1 ± 5.5	–8.3	< 0.001	0.82
MENQOL – Physical	42.1 ± 7.4	34.8 ± 6.8	–7.3	0.002	0.72
MENQOL – Vasomotor	18.0 ± 4.1	14.2 ± 3.9	–3.8	0.006	0.61
MENQOL – Sexual	17.7 ± 3.9	15.9 ± 4.1	–1.8	0.048	0.45
DASS-21 – Depression	13.2 ± 4.4	8.6 ± 3.9	–4.6	< 0.001	0.74
DASS-21 – Anxiety	10.6 ± 3.6	6.9 ± 2.7	–3.7	0.002	0.63
DASS-21 – Stress	14.1 ± 4.5	10.3 ± 3.5	–3.8	< 0.001	0.76

Reductions in Psychological Distress

Psychological well-being, as assessed by the Depression Anxiety Stress Scale (DASS-21), showed significant positive changes. The depression mean score reduced from 13.2 (SD = 4.4) at baseline to 8.6 (SD = 3.9) at post-intervention, by a mean of 4.6 points ($p < 0.001$), with most participants changing from the moderate/severe to the mild or normal levels. The anxiety subscale showed a reduction from 10.6 to 6.9 ($p = 0.002$), with stress scores reduced from 14.1 to 10.3 ($p < 0.001$). These were accompanied by moderate to large effect sizes: 0.74 for depression, 0.63 for anxiety, and 0.76 for stress.

Strikingly, 37% of baseline moderate-to-severe stress scorers were redistributed to the normal range following the intervention. Decreases in DASS scores were associated significantly with increases in VO_2max ($r = –0.42$, $p = 0.009$) and reductions in MENQOL scores ($r = 0.51$, $p < 0.001$), indicating that the program benefits for physiology and psychosocial well-being were intertwined. Group setting, music, and choreographed movement likely allowed enhanced mood and emotional control as both physical and expressive release from midlife stressors.

Adherence, Exercise Intensity, and Participant Experience

The intervention had excellent adherence, with a mean attendance rate of 89.2% (SD = 6.3%). The majority of participants attended at least 30 out of 36 planned sessions, and some of them had perfect attendance. Participants' heart rate monitors ensured that they were exercising at the target intensity between 60–75% of Heart Rate Reserve (HRR) with a mean intensity of 71.2% HRR per session. Subjective effort, quantified on the Borg RPE scale, was 13.8 (SD = 0.9), in accordance with moderate-intensity guidelines for aerobic conditioning. This is as would be expected in exercise dosing in this age group and affirms the applicability of dance-based programs to cardiovascular training.

Feed-forward data collected following the intervention reported that 94% of the patients enjoyed or highly enjoyed the program and cited the music, social environment, and non-competitive environment as motivation factors. An overwhelming percentage (87%) clearly expressed interest in continuing similar physical activity after the study period, and 78% also reported significant sleep, energy, and workplace productivity gains at week four. These findings not only suggest the

effectiveness but also sustainability of the intervention since it is accessible and acceptable.

Correlational Insights and Predictors of Improvement

Further analysis through Pearson correlation coefficients revealed statistically significant correlations between physiological and psychological improvements. Gains in VO_2max were moderately correlated with improved total MENQOL ($r = –0.48$, $p < 0.01$) and depression score reductions ($r = –0.42$, $p = 0.009$). Higher levels of adherence also showed a positive trend with more significant VO_2max and MENQOL improvement, but these were not statistically significant. Stepwise multiple regression analysis identified baseline VO_2max and adherence rate as predictors of post-intervention VO_2max ($R^2 = 0.41$, $p < 0.001$) that accounted for 41% of variance in fitness improvement.

Symptom-Specific Relief Patterns

Aside from domain-level examination of MENQOL, symptom-specific relief patterns investigated patterns in relief felt by participants more intensively. The most commonly reported physical symptoms at baseline included disturbed sleep (82%), stiffness in joints (69%), and tiredness (74%). The feedback post-intervention was that 71% of the women who previously had complained of chronic fatigue rated this symptom as "markedly improved" or "no longer bothersome." Likewise, 58% of the women who complained about poor sleep reported moderate-to-substantial improvement, crediting better rest to physical fatigue and relaxation after exercise. Hot flash and night sweat symptom reports were also reduced, with 62% reporting fewer severe or more frequent vasomotor symptoms, in the absence of hormonal therapy.

Improved Sleep Quality

Although not rigorously measured with tools like the Pittsburgh Sleep Quality Index (PSQI), self-reported sleep quality was a consistent theme across both feedback sheets and weekly diaries. By week 4, nearly 75% of the participants reported falling asleep more quickly, waking up fewer times, or waking up feeling refreshed. Some of the women actually commented that the physical stress of the dance sessions, combined with the emotional decompression it provided, made direct contributions to better sleep. These qualitative findings are supportive of existing literature that associates aerobic exercise with improved sleep latency and quality, particularly in peri- and postmenopausal women.

Table 2: Participant-Reported Experiences and Behavioral Outcomes

Dimension	Key Findings
Sleep Quality	75% reported better sleep by week 4; improved latency and reduced nighttime awakenings
Fatigue Relief	71% experienced reduced fatigue; cited higher energy for daily activities
Mood & Body Confidence	68% reported improved mood; 74% felt better about their bodies and physical capabilities
Social Connectedness	80% felt group participation increased motivation and accountability; 41% formed new friendships
Motivation to Exercise	>70% reported shift from external to internal motivation by week 6
Adherence Rate	89.2% average attendance; 65% had ≥90% adherence
Dropout Insights	6 out of 55 withdrew; main reasons included scheduling conflict and personal constraints
Sustainability Intentions	87% planned to continue dance/aerobic activity; 52% had enrolled in a class before study ended
Health Behavior Spillover	29% reported changes in eating or sleep hygiene as a result of new health habits

Mood, Body Image, and Self-Esteem

Besides better scores on the DASS-21, all but one of the participants scored high mood and greater body confidence as very or extremely strong. Interviews and questionnaires that followed identified 68% of the women as more "in control" of their body and 74% with a better self-image, independent of weight change. Mastering routines and coping with choreography made many recall their body potential. This feeling of achievement generated heightened self-efficacy, a potent mediator of exercise participation and mental well-being over the long term.

Social Connectedness and Group Cohesion

The group context of the intervention played a key role in building social support, which in turn fostered retention and emotional well-being. More than 80% of participants reported that the "shared experience" of laughing, sweating, and dancing together established a lasting feeling of camaraderie that prompted them to come back. New friendships were established, and 41% of women reported walking or meeting with group members outside of class, building secondary support systems.

Social interaction was most rewarding for participants who initially indicated greater anxiety or loneliness. Participants all commented that the group setting was "uplifting" and diminished the intimidation factor typically present with independent or gym-based exercise. Social dynamics enhanced the program's therapeutic value, in keeping with community psychology theories of belonging and mutual empowerment.

DISCUSSION

The intervention enrolled 55 midlife women (median age 52.4 years, mostly in late menopausal transition, sedentary, BMI 27.1 kg/m²), and 49 participants finished the 12-week program (89.1% rate of completion). This retention rate suggests that the dance-based program was acceptable. Trials, as also indicated in a systematic review by Rodrigues-Krause et al. (2016), demonstrate that dance interventions have attained >80% adherence since they are enjoyable and social, aligning with the present study.[15] Even though menopause completion rates among women are generally not reported, the popularity of dance obviously contributed to explaining the high retention observed. The test yielded a significant 15.8% increase in VO_2max (24.1 to 27.9 mL/kg/min), indicating improved cardiovascular fitness. This is also confirmed by Gillett et al. (1989), who experienced a 41% VO_2max improvement in middle-aged, obese women after an aerobic dance regimen, though the greater gain could be due to a lower fitness baseline.[16] Lu J et al.'s (20) systematic review also testifies to the fact that dance enhances cardiorespiratory fitness in older adults, such as menopausal women, with moderate to large effect sizes.[17] The intervention significantly enhanced all MENQOL areas (psychosocial, physical, vasomotor, sexual), and total score decreased by 21.1 points. This is more comprehensive. than in some studies, such as Cramer et al. (2018), that reported yoga had significant benefit on mostly psychosocial and physical but not vasomotor and sexual domains.18 Meta-analysis by Xu et al. (2024) reported mind-body exercise, including dance, to enhance quality of life, but not necessarily with the use of MENQOL.[19] The extensive MENQOL improvements from the present study suggest dance, exercise, may have unique benefits. Statistically significant reductions in DASS-21 scores for depression, anxiety, and stress with large effect sizes were seen. This is in line with Cramer et al. (2018), who concluded that yoga reduced depression and anxiety among menopausal women, and Rodrigues-Krause et al. (2019), who noted that dance had a positive impact on psychological well-being.[15] The outcomes of the provided study confirm that dance interventions can indeed reduce psychological distress among this group. With 89.2% attendance and 94% reporting the program as enjoyable, the study is indicative of dance's motivational appeal. This agrees with Jovancevic et al. (2012), who demonstrated interactive video dance to be appealing to postmenopausal women, increasing adherence.[20] Dance's social and non-competitive nature, as noted by Rodrigues-Krause et al. (2016), likely increases participation, supplementing the present study's high adherence. The study reported quality of sleep (75%), fatigue (71%), and vasomotor symptoms (62%) to be better. In a meta-analysis by Shea et al. (2022), exercise was found to enhance sleep in menopausal women, and Cramer et al. (2018) noted reductions in fatigue and vasomotor symptoms with yoga.[18, 21] Findings of the study presented show dance-based exercise to be just as effective, perhaps because it is interactive in nature.

CONCLUSION

The present study demonstrates that a 12-week, formal dance-based aerobic exercise program enhanced cardiorespiratory function substantially, as measured by a 15.8% increase in VO_2max, and elicited robust improvements in emotional well-being in physically inactive, middle-aged women going through the menopausal transition. Most notably, there were clinically significant reductions in depression, anxiety, and stress (Cohen's d: 0.63–0.76), and significant improvement in menopause-related quality of life across all MENQOL domains, with psychosocial and physical subscales having the greatest improvement. These were also complemented by high adherence (89.2%), high participant satisfaction (94%), and also behavioral spillover into improved sleep, decreased fatigue, and improved social interactions reported. The synergistic benefit of physical movement, rhythmic activity, and social connection within a non-competitive group modality offers a new, sustainable model for the treatment of both physiological decline and psychological risk during menopause. These findings place dance-based aerobic exercise as a promising, evidence-based strategy for the enhancement of overall health outcomes in this underserved population deserving of further clinical use and longitudinal follow-up.

REFERENCES

1. Sun Y, Park HY, Jung WS, et al. A comparison of continuous, interval, and accumulated workouts with equalized exercise volume: excess post-exercise oxygen consumption in women. *BMC Women s Health*. 2024;24(1). doi:https://doi.org/10.1186/s12905-024-03299-2
2. Pataky MW, Young WF, Nair KS. Hormonal and Metabolic Changes of Aging and the Influence of Lifestyle Modifications. *Mayo Clin Proc*. 2021;96(3):788-814. doi:10.1016/j.mayocp.2020.07.033
3. Dong Yun Lee, Andreescu C, Aizenstein H, et al. Impact of symptomatic menopausal transition on the occurrence of depression, anxiety, and sleep disorders: A real-world multi-site study. *European Psychiatry*. 2023;66(1). doi:https://doi.org/10.1192/j.eurpsy.2023.2439
4. Mahindru A, Patil P, Agrawal V. Role of Physical Activity on Mental Health and Well-Being: A Review. *Cureus*. 2023;15(1):e33475. Published 2023 Jan 7. doi:10.7759/cureus.33475
5. Carcelén-Fraile MDC, Aibar-Almazán A, Martínez-Amat A, et al. Qigong for Muscle Strength and Static Postural Control in Middle-Aged and Older Postmenopausal Women: A Randomized Controlled Trial. *Front Med (Lausanne)*. 2021;8:784320. Published 2021 Dec 8. doi:10.3389/fmed.2021.784320
6. Zhao Y, Niu H, Liu S. Effects of aerobics training on anxiety, depression and sleep quality in perimenopausal women. *Frontiers in Psychiatry*. 2022;13. doi:https://doi.org/10.3389/fpsyt.2022.1025682
7. Vendramin B, Bergamin M, Gobbo S, et al. Health Benefits of Zumba Fitness Training: A Systematic Review. *PM R*. 2016;8(12):1181-1200. doi:10.1016/j.pmrj.2016.06.010
8. Zhang H, Gao Y, Zhang Y, Ma H. Effects of dance interventions on cognitive function, balance, mobility, and life quality in older adults: A systematic review and Bayesian network meta-analysis. *Archives of Gerontology and Geriatrics*. 2025;131:105775. doi:https://doi.org/10.1016/j.archger.2025.105775
9. Harlow SD, Gass M, Hall JE, et al. Executive summary of the Stages of Reproductive Aging Workshop + 10: addressing the unfinished agenda of staging reproductive aging. *Menopause*. 2012;19(4):387-395. doi:10.1097/gme.0b013e31824d8f40
10. Schaffarczyk M, Rogers B, Reer R, Gronwald T. Validity of the Polar H10 Sensor for Heart Rate Variability Analysis during Resting State and Incremental Exercise in Recreational Men and Women. *Sensors (Basel)*. 2022;22(17):6536. Published 2022 Aug 30. doi:10.3390/s22176536
11. Williams N. The Borg Rating of Perceived Exertion (RPE) Scale. *Occupational Medicine*. 2017;67(5):404-405. doi:https://doi.org/10.1093/occmed/kqx063
12. Hanson NJ, Scheadler CM, Lee TL, Neuenfeldt NC, Michael TJ, Miller MG. Modality determines VO2max achieved in self-paced exercise tests: validation with the Bruce protocol. *European Journal of Applied Physiology*. 2016;116(7):1313-1319. doi:https://doi.org/10.1007/s00421-016-3384-0
13. Radtke JV, Terhorst L, Cohen SM. The Menopause-Specific Quality of Life Questionnaire: psychometric evaluation among breast cancer survivors. *Menopause*. 2011;18(3):289-295. doi:10.1097/gme.0b013e3181ef975a
14. Ali AM, Alkhamees AA, Hori H, Kim Y, Kunugi H. The Depression Anxiety Stress Scale 21: Development and Validation of the Depression Anxiety Stress Scale 8-Item in Psychiatric Patients and the General Public for Easier Mental Health Measurement in a Post COVID-19 World. *Int J Environ Res Public Health*. 2021;18(19):10142. Published 2021 Sep 27. doi:10.3390/ijerph181910142
15. Rodrigues-Krause J, Farinha JB, Krause M, Reischak-Oliveira Á. Effects of dance interventions on cardiovascular risk with ageing: Systematic review and meta-analysis. Complement Ther Med. 2016;29:16-28. doi:10.1016/j.ctim.2016.09.004
16. Gillett PA, Eisenman PA. The effect of intensity controlled aerobic dance exercise on aerobic capacity of middle-aged, overweight women. Res Nurs Health. 1987;10(6):383-390. doi:10.1002/nur.4770100606
17. Lu J, Abd Rahman NA, Wyon M, Shaharudin S. The effects of dance interventions on physical function and quality of life among middle-aged and older adults: A systematic review. PLoS One. 2024;19(4):e0301236. Published 2024 Apr 19. doi:10.1371/journal.pone.0301236
18. Cramer H, Peng W, Lauche R. Yoga for menopausal symptoms-A systematic review and meta-analysis. Maturitas. 2018;109:13-25. doi:10.1016/j.maturitas.2017.12.005
19. Xu H, Liu J, Li P, Liang Y. Effects of mind-body exercise on perimenopausal and postmenopausal women: a systematic review and meta-analysis. Menopause. 2024;31(5):457-467. doi:10.1097/GME.0000000000002336
20. Jovancevic J, Rosano C, Perera S, Erickson KI, Studenski S. A protocol for a randomized clinical trial of interactive video dance: potential for effects on cognitive function. BMC Geriatr. 2012;12:23. Published 2012 Jun 6. doi:10.1186/1471-2318-12-23
21. Lam CM, Hernandez-Galan L, Mbuagbaw L, Ewusie JE, Thabane L, Shea AK. Behavioral interventions for improving sleep outcomes in menopausal women: a systematic review and meta-analysis. Menopause. 2022;29(10):1210-1221. doi:10.1097/GME.0000000000002051