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ORIGINAL ARTICLE

Effects of resistance training on quality of life in postmenopausal women with vasomotor symptoms

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ABSTRACT

Objective: Most women experience vasomotor symptoms (VMS) around menopause that may affect quality of life negatively. Effective pharmacological treatment exists but is not recommended for all women, and there is a demand for alternatives to reduce symptoms and improve quality of life. The objective of this study was to investigate the effect of a resistance training intervention on health-related quality of life (HRQoL) in postmenopausal women with VMS.
Methods: This open randomized controlled trial included 65 postmenopausal women >45 years old with daily VMS. The participants were randomized to 15 weeks of resistance training three times per week or an untreated control group. The Women's Health Questionnaire (WHQ) and Short Form Health Survey (SF-36) were used to assess HRQoL at baseline and after 15 weeks.
Results: The resistance training group improved compared to the control group in the WHQ domains of VMS ($p = 0.002$), sleep problems ($p = 0.003$) and menstrual symptoms ($p = 0.01$) from baseline to post intervention. No significant between-group differences were found in SF-36 summary scores, or in any of the domains.
Conclusion: In postmenopausal women with moderate to severe VMS, resistance training three times per week for 15 weeks improved menopause-specific HRQoL.

Introduction

The menopausal transition is often accompanied by symptoms that affect quality of life substantially. Hot flushes and night sweats are the cardinal symptoms and approximately 75% of women experience these vasomotor symptoms (VMS) around menopause [1]. The main reason to treat VMS is the detrimental effect they may have on women's daily life. Moderate and severe VMS decrease mood, productivity and concentration [2,3]. Night sweats cause sleep disturbances and moderate–severe VMS correlate with reported poor sleep during the menopausal transition [4,5].

VMS have been associated with poorer quality of life scores in longitudinal studies of the menopausal transition [4]. Women with VMS report reduced quality of life compared to asymptomatic women [6] and medical treatment that reduces VMS improves quality of life [7,8].

In a Swedish study with data from 2010 [9], about 25% of perimenopausal and postmenopausal women reported severe VMS with a need for treatment. Menopausal hormone therapy (MHT) containing estrogen (combined with a progestogen for non-hysterectomized women) is the most effective treatment and reduces the frequency of VMS by at least 75% [10]. MHT also improves quality of life in women with bothersome VMS [8]. However, MHT is not suitable for all women because it may increase the risk for breast cancer, deep vein thrombosis and, at least for older women, cardiovascular events [11]. Moreover, VMS may last for several years and often reappear after discontinuation of MHT. Undoubtedly, non-hormonal treatment alternatives are necessary. In addition, many women want to avoid MHT and already use natural remedies or non-pharmacological alternatives to alleviate VMS [9].

Exercise is a safe intervention that has been suggested as a lifestyle intervention to alleviate VMS [4,5]. Recently, we reported that women who participated in resistance training two or three times per week reduced their VMS frequency and severity from baseline to week 15 compared with a control group of untreated women [12]. Although the effect of resistance training on VMS frequency is important, it is also crucial to evaluate the impact on quality of life measures since that remains the most important indication for treatment. Previous reports show that how much women are bothered by their VMS, rather than VMS frequency, is associated with decreased quality of life [6], which in turn is affected by negative mood, depressive symptoms and

psychosocial factors that can improve with regular exercise [13,14].

Regular exercise has been positively associated with quality of life in mid-life women in general. Physically active women report better quality of life in domains related to anxiety, depressed mood, well-being, somatic symptoms and VMS [15,16]. However, results from intervention trials in mid-life women with VMS are mixed regarding health-related quality of life (HRQoL) and do not consistently show improvements [17]. Traditionally, focus has been on aerobic exercise and low-intensity interventions like yoga to improve quality of life and menopausal symptoms [17], and we have found no reports on resistance training and HRQoL in women with VMS.

The aim of this study was to investigate the effect of a 15-week resistance training intervention on HRQoL in postmenopausal women with VMS [12] and examine whether changes in quality of life correlated with changes in VMS frequency and severity.

Materials and methods

This study is a sub-analysis of an open parallel-group randomized controlled trial with the primary objective to assess the effect of resistance training on frequency of VMS among postmenopausal women. Participants were allocated in a 1:1 ratio to a 15-week resistance training intervention or a control group. Details concerning study design, eligibility criteria and intervention have been reported previously [12]. The trial was conducted in accordance with the Declaration of Helsinki. Approval from the Regional Ethical Review Board in Linköping was received (2013/285-31). All participants received oral and written information prior to inclusion and gave written informed consent to participate.

Participants

Participants were postmenopausal women ≥45 years old who experienced at least four moderate to severe VMS per day during a 2-week screening period before inclusion. Additional inclusion criteria were a maximum of 225 min of physical activity per week, of which a maximum 75 min at vigorous intensity (adapted from the World Health Organization's recommendations on physical activity for adults), blood pressure <160/100 mmHg, hemoglobin >110 g/l and physical ability to participate in resistance training. The use of medical therapy, including natural remedies, to treat VMS was not allowed at least 2 months before screening.

Women were recruited by advertisements in the local press and through information screens in the outpatient clinic of Obstetrics and Gynecology at Linköping University Hospital where the study was based. After telephone screening, women were assessed for eligibility during a screening visit and informed consent was obtained. Baseline anthropometrics and clinical data were collected, and a 2-week VMS screening diary was distributed. In the diary, the women daily registered mild, moderate and severe VMS.

Randomization was performed at a second visit after checking for eligibility, including frequency of VMS (≥4 moderate to severe VMS per day or 28 VMS per week). During the second visit, baseline questionnaires on HRQoL were completed. Measurements and questionnaires were repeated at 15 weeks. Participants registered VMS continuously during the trial, as well as physical activity. Recruitment took place between November 2013 and October 2016.

The randomization sequence was constructed by an independent statistician at Linköping University using a computer-based random number generator (Stata 13.1; StataCorp LP, College Station, TX, USA) and group allocation was concealed in opaque, sealed envelopes. The envelopes were handled by a research nurse and stored in a locked location. When a new participant was included, the investigator took the envelope next in turn and opened it in presence of the new participant.

Intervention

The 15-week resistance training program consisted of eight exercises in the following order: chest press, leg press, seated row, leg curl, latissimus dorsi pull-down, leg extension, crunches and back raises. The exercises aimed at activating major muscle groups. Six exercises were performed in seated resistance machines and two were body-weight exercises. Exercise sessions were preceded by 7–10 min of warm-up and finished with dynamic and static stretching. The seated exercises were performed with 15–20 repetitions (weeks 1–3) to minimize risk of injury and 8–12 repetitions (weeks 4–15) in two sets with 2 min of rest between sets. Participants were instructed to train three times per week, with one session per week in the presence of a physiotherapist who gradually increased loads. To individualize the exercise prescription and assess muscle strength, eight-repetition maximum (8RM) tests were performed at baseline, after 3 weeks and at the end of the intervention. The 15-week intervention was chosen to let participants exercise with lighter weights for 3 weeks followed by 12 weeks of vigorous resistance training. Twelve weeks of training would be enough to elicit effects on muscle strength and volume, and is also a commonly used and recommended length of intervention in previous trials investigating pharmacological treatments for VMS [10,18].

Compliance was checked via the electronic card system at the gym and a personal logbook where participants in the intervention group noted exercises, loads and repetitions. Those who completed two or more sessions per week, excluding missed sessions due to illness, were pre-defined as compliant in the study protocol.

Women in the control group were asked not to change their physical activity during the 15-week study period, after which they were offered a free 4-month membership at the gym and an individual resistance training introduction.

Outcomes

HRQoL was assessed with two questionnaires (Women's Health Questionnaire [WHQ] and Short-Form Health Survey

[SF-36]) that were collected at baseline and after 15 weeks. The WHQ is a 36-item questionnaire developed to assess mid-aged women's emotional and physical health [19]. Each item is answered on a 4-point scale, and scores are generated in nine domains: depressed mood, somatic symptoms, anxiety, VMS, sleep problems, sexual behavior, menstrual symptoms, memory/concentration and attractiveness [19,20]. The score for each domain ranges from 0 to 1, where a higher score indicates more symptoms/worse HRQoL. The Swedish version has shown good reliability and has been validated for assessment of HRQoL in postmenopausal women [21]. The WHQ is sensitive to change in HRQoL after interventions for VMS and has previously been used to assess change in quality of life after an exercise intervention [20,22]. A difference of 0.1–0.2 is considered clinically significant [20].

The Swedish version of the SF-36 was used to assess general HRQoL. It consists of 36 items that evaluate eight dimensions related to health: physical functioning, role limitations due to physical problems, bodily pain, general health perception, vitality, social functioning, role limitations due to emotional problems and mental health. A score from 0 to 100 is calculated for each dimension, with 0 representing maximum disability and 100 no disability. The scores in the dimensions also generate two summary scales; one each for the physical and mental components of HRQoL.

All participants registered VMS in a diary continuously during the study period. A VMS score was calculated to reflect severity and was calculated as the sum of mild VMS × 1, moderate VMS × 2 and severe VMS × 3. Participants also registered any physical activity performed for at least 10 min, apart from the prescribed resistance training, in a physical activity diary. Results regarding VMS and physical activity have been reported previously [12].

Statistical methods

All randomized participants who had more than baseline data registered were included in the analyses. Baseline characteristics are presented using means and standard deviations, or absolute numbers and percent where applicable. The scores for each dimension in the WHQ and SF-36 were calculated according to guidelines for each questionnaire and results are given as means and standard deviations. Changes from baseline were analyzed for each domain and compared between the intervention and control groups using analysis of covariance, with the treatment group as factor and the baseline value as covariate. Differences in change scores pre to post intervention between groups were also analyzed with the Mann–Whitney U-test since all data were not normally distributed. Within-group differences pre to post intervention were examined using the Wilcoxon signed-rank test for related samples for each group separately.

Missing data were handled according to instructions for each questionnaire. In the WHQ, a domain score was calculated if enough items were answered for each domain score as recommended (5/7 for depressed mood, 5/7 for somatic symptoms, 2/3 for memory/concentration, 2/3 for Sexual

behavior, 2/3 for sleep problems, 3/4 for menstrual symptoms, 3/4 for anxiety, 2/2 for VMS and 2/2 for attractiveness); otherwise, that item was reported as missing. Missing data were not imputed.

Correlations between change in WHQ and SF-36 scores and change in VMS frequency and VMS score were examined using Pearson correlation for both groups separately.

The sample size calculation was based on the primary outcome VMS frequency; 40 participants in total (20 per group) were needed to detect a clinically significant difference of 50% decrease with 80% power allowing for 20% drop out. For ethical reasons, we included all eligible women who responded to the final recruitment advert, resulting in 65 included participants. A post-hoc power analysis based on the sample size of 57 participants included in the analysis, a two-sided α level of 0.05 and observed standard deviations between 0.2 and 0.3 showed 45–80% power to detect a difference of 0.15 between groups in WHQ domains.

Results

In total, 65 women were randomized and 58 women completed the 15-week study period (Figure 1). One participant was wrongly included and therefore excluded from the analysis. One participant in the intervention group did not fill out the questionnaires at the week 15 visit.

Baseline data

Women in the study had a mean age of 55 years (range 45–70 years), mean body mass index of 27 kg/m² and mean time since menopause of 5.0 years. There were no differences between groups in any of the baseline variables (Table 1). Mean realized resistance training sessions during the intervention were 2.2 per week. There was no change from baseline in weight, body mass index or waist circumference in either group at the week 15 visit.

Health-related quality of life – WHQ

At 15 weeks, the intervention group had greater mean improvements from baseline compared with the control group in the vasomotor domain ($p = 0.002$), sleep domain ($p = 0.003$) and menstrual symptoms domain ($p = 0.01$) in the WHQ. The mean adjusted difference between groups at week 15 was 0.28 (95% confidence interval 0.11, 0.45) for the vasomotor domain, 0.17 (95% confidence interval 0.06, 0.29) for the sleep domain and 0.09 (95% confidence interval 0.02, 0.15) for the menstrual symptoms domain (Table 2). The non-parametric analysis found significant differences in the same domains. Within groups, the intervention group improved in the vasomotor ($p = 0.007$), sleep ($p = 0.003$), menstrual symptoms ($p = 0.007$) and anxiety ($p = 0.046$) domains whereas there were no changes within the control group. The rest of the WHQ domains did not differ between groups. There were no significant differences in improvements between participants defined as compliant and non-compliant to the intervention.
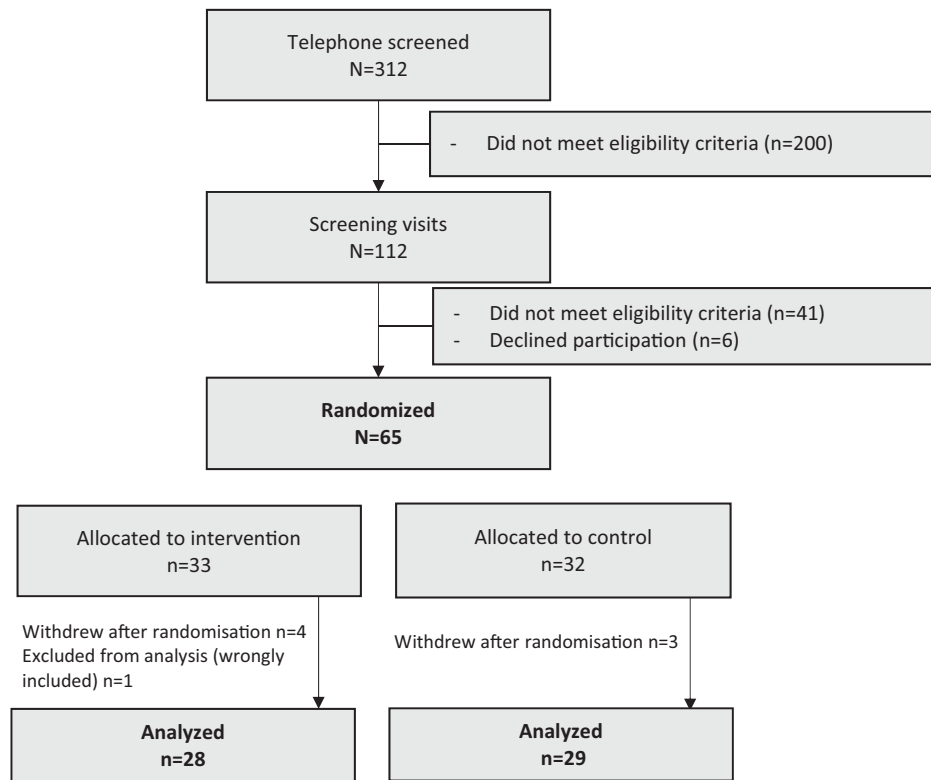
Figure 1. CONSORT flow chart. Number of persons screened, randomized and analyzed in the trial. CONSORT, Consolidated Standards of Reporting Trials.

Table 1. Baseline data of included participants.

Participant characteristic	Intervention group (n = 28)	Control group (n = 29)
Age at inclusion (years)	55.2 ± 5.5	55.4 ± 5.0
Time since menopause (years)	4.5 (range 1.0–18.1)	5.3 (range 1.0–18.0)
Weight (kg)	76.3 ± 12.0	72.3 ± 11.5
Body mass index (kg/m^2)	28.2 ± 4.1	26.7 ± 3.6
Waist circumference (cm)	92.2 ± 12.5	88.8 ± 12.9
Moderate and severe VMS per 24 h	7.5 ± 4.0	6.6 ± 2.2
VMS score[a]	19.2 ± 9.4	17.9 ± 6.4
Exercise (min per week), median (IQR)	15 (35)	0 (49)
Smoker, n (%)	1 (3.6)	1 (3.4)

Data are presented as mean ± standard deviation or median (IQR) (except for time since menopause, where range is given) for continuous data, and absolute number (percent) for categorical data. Exercise data from the screening diary. IQR, interquartile range; VMS, vasomotor symptoms.
[a]VMS score = sum of mean daily mild VMS × 1, moderate VMS × 2 and severe VMS × 3, registered in a 2-week screening diary.

Table 2. WHQ scores at baseline and week 15 (post intervention).

	Intervention (n = 28)				Control (n = 29)				
	Baseline		Week 15		Baseline		Week 15		
Domain in WHQ	n	Score	n	Score	n	Score	n	Score	Mean difference (95% CI)
Depressed mood	28	0.11 ± 0.17	27	0.08 ± 0.16	29	0.08 ± 0.16	29	0.11 ± 0.17	0.04 (−0.05, 0.12), $p = 0.40$
Somatic symptoms	28	0.20 ± 0.19	27	0.13 ± 0.21	29	0.19 ± 0.22	29	0.21 ± 0.24	0.09 (−0.02, 0.21), $p = 0.10$
Memory/concentration	28	0.15 ± 0.25	27	0.14 ± 0.31	29	0.11 ± 0.26	29	0.20 ± 0.26	0.09 (−0.04, 0.22), $p = 0.16$
Vasomotor symptoms	28	0.95 ± 0.16	27	0.69 ± 0.42	29	0.95 ± 0.15	28	0.96 ± 0.13	0.28 (0.11, 0.45), $p = 0.002$[a]
Anxiety/fears	28	0.05 ± 0.12	27	0.02 ± 0.10	29	0.05 ± 0.14	29	0.07 ± 0.18	0.05 (−0.01, 0.12), $p = 0.11$
Sexual behavior	25	0.28 ± 0.28	24	0.22 ± 0.25	25	0.41 ± 0.38	25	0.33 ± 0.41	0.06 (−0.08, 0.20), $p = 0.40$
Sleep problems	28	0.38 ± 0.35	27	0.21 ± 0.25	29	0.26 ± 0.26	29	0.32 ± 0.27	0.17 (0.06, 0.29), $p = 0.003$[a]
Menstrual problems	28	0.16 ± 0.16	27	0.05 ± 0.12	29	0.09 ± 0.14	29	0.11 ± 0.13	0.09 (0.02, 0.15), $p = 0.01$[a]
Attractiveness	28	0.50 ± 0.36	27	0.37 ± 0.41	29	0.54 ± 0.34	29	0.36 ± 0.38	0.01 (−0.19, 0.21), $p = 0.91$

Scores of the WHQ domains at baseline and at week 15 (end of study period), and the mean difference between groups at week 15 adjusted for the baseline score (analysis of covariance). Data are presented as mean ± standard deviation. CI, confidence interval; WHQ, Women's Health Questionnaire.
[a]Statistically significant difference between groups.

Table 3. SF-36 scores at baseline and post intervention.

Domain in SF-36	Intervention (n = 28)				Control (n = 29)				Mean difference (95% CI)
	Baseline		Week 15		Baseline		Week 15		
	n	Score	n	Score	n	Score	n	Score	
PCS	28	49.2 ± 6.6	27	50.7 ± 7.1	29	51.3 ± 6.5	29	50.2 ± 7.6	−2.01 (−5.18, 1.17), $p = 0.21$
MCS	28	50.2 ± 8.8	27	51.8 ± 8.8	29	48.3 ± 10.2	29	48.9 ± 11.3	−1.67 (−5.63, 2.29), $p = 0.40$
Physical function	28	92.1 ± 6.9	27	92.9 ± 7.6	29	89.5 ± 12.6	29	89.7 ± 11.6	−1.36 (−5.20, 2.49), $p = 0.48$
Role physical	28	79.5 ± 34.7	27	85.2 ± 34.2	29	88.8 ± 18.4	29	84.5 ± 31.6	−4.84 (−21.82, 12.14), $p = 0.57$
Bodily pain	28	72.0 ± 21.0	27	74.8 ± 24.7	29	80.1 ± 19.3	29	74.8 ± 24.8	−6.35 (−16.83, 4.12), $p = 0.23$
General health	28	75.4 ± 17.4	27	80.0 ± 17.5	29	78.5 ± 20.3	29	77.5 ± 20.0	−5.37 (−10.84, 0.11), $p = 0.05$[a]
Vitality	28	65.5 ± 19.7	27	72.8 ± 21.3	29	59.5 ± 25.6	29	61.6 ± 24.6	−7.12 (−15.36, 1.12), $p = 0.09$
Social function	28	86.7 ± 17.6	27	91.7 ± 21.1	29	85.4 ± 18.0	29	86.6 ± 21.4	−4.48 (−13.84, 4.87), $p = 0.34$
Role emotional	28	91.7 ± 26.6	27	92.6 ± 23.3	29	87.3 ± 27.4	29	90.8 ± 25.1	0.15 (−10.89, 11.19), $p = 0.98$
Mental health	28	82.0 ± 13.7	27	83.7 ± 15.6	29	81.7 ± 16.1	29	79.1 ± 18.8	−4.63 (−12.34, 3.08), $p = 0.23$

Scores of the SF-36 domains at baseline and at week 15 (end of study period), and the mean difference between groups at week 15 adjusted for the baseline score (analysis of covariance). Data are presented as mean ± standard deviation. CI, confidence interval; MCS, mental component summary; PCS, physical component summary; SF-36, Short Form Health Survey.
[a]Statistically significant difference between groups.

Health-related quality of life – SF-36

In the non-parametric analysis there was an improvement in the general health domain in the intervention group compared to the control group ($p = 0.045$), but in the parametric analysis it was borderline significant ($p = 0.052$). Within groups, the intervention group improved in the vitality domain ($p = 0.005$), whereas there were no differences in any other domains. Change in the composite physical and mental scores (PCS and MCS, respectively) did not differ between groups (Table 3).

There was a correlation between change in VMS frequency and change in the WHQ domain VMS in the intervention group ($r = 0.64$, $p < 0.01$), but not in the control group. There were no significant correlations between change in VMS frequency or VMS score and the other WHQ domains in either group. No significant correlations were found between change in SF-36 scores and change in VMS frequency in either group.

Discussion

This trial showed that quality-of-life scores improved in three domains in postmenopausal women who performed structured resistance training for 15 weeks. Improvements were detected in the vasomotor, sleep and menstrual domains in the WHQ. For generic HRQoL, we found only borderline improvements in the domains of general health and vitality. Also, change in VMS frequency correlated with change in the VMS score in the WHQ. The results support the hypothesis that successful treatment for VMS improves quality of life in postmenopausal women, which is the single most important reason to treat VMS. This is in line with previous trials showing that a reduction in VMS frequency correlates with improvements in quality of life [8].

MHT given to women with bothersome VMS has been shown to improve HRQoL [8]. The change in the vasomotor domain was expected since previous analyses from this trial showed that VMS decreased significantly in the intervention group at 15 weeks [12]. The improvement in the vasomotor domain may be interpreted as less bother from VMS in

addition to a reduction in VMS frequency, which is an important outcome measure when evaluating the effect of interventions for VMS. A positive effect was also found in the menstrual symptoms domain. This domain is generated from questions about somatic symptoms (abdominal cramps, feeling bloated and breast tenderness) that can still be experienced by postmenopausal women. It could be interpreted that resistance training had a positive effect on these somatic symptoms.

The improvement in the domain concerning sleep could indicate less disturbance from nightly VMS since VMS and sleep difficulties often are associated and affect each other. Sleep problems are common among postmenopausal women and there is a consistent link between sleep problems and the experience of VMS [23]. Moderate aerobic exercise in mid-aged women can improve self-reported sleep quality, but to our knowledge there are sparse data on the effect of resistance training on sleep in postmenopausal women [24]. However, some studies on older men and women, and people in nursing homes, have reported effects on sleep quality after 6–24 weeks of resistance training two or three times per week [25]. Thus, resistance training may have a positive impact on sleep in itself, and not only through a secondary effect via reduced VMS. To better evaluate the effect on sleep in this trial, a validated questionnaire for sleep quality could have been used. The WHQ was designed to assess health in mid-aged women and is responsive to change after treatment. Notably, improvements in both the vasomotor and sleep domains reached a clinically important difference in this trial. However, the WHQ does not allow for a calculation of an overall score, which may otherwise have indicated an overall change in HRQoL.

This is, to our knowledge, the first trial to evaluate effects of resistance training on HRQoL in postmenopausal women in relation to menopausal symptoms. Previous trials in menopausal women that investigated moderate and low-intensity aerobic exercise show mixed results. A 6-month aerobic exercise intervention in women with VMS found improved WHQ scores in depressed mood and attraction, as well as the SF-36 domains of physical functioning and physical role limitation [22]. Another trial of 6 months of aerobic exercise in

perimenopausal and postmenopausal women with VMS showed improvements in the somatic symptoms and sleep problems domains in WHQ but no change in generic HRQoL [26]. Importantly, none of the previous studies on aerobic exercise found effects on vasomotor symptom domains or VMS scores.

It has been suggested that exercise has to be performed at a sufficiently high intensity to have an effect on VMS, which could explain why light and moderate-intensity exercise/physical activity has improved HRQoL but not menopausal symptoms in previous studies. This hypothesis is based on the findings that the activity of central opioids believed to be involved in VMS, such as dynorphin and β-endorphin, are reduced after menopause, but could possibly be upregulated by exercise and activation of large muscle groups [27,28].

Regarding generic HRQoL, a trial of aerobic exercise in overweight postmenopausal women found dose-dependent improvements in almost all domains of the SF-36, and aerobic exercise combined with resistance training for 1 year improved both physical and mental domains in the SF-36 in overweight postmenopausal women with VMS [29,30]. As for the SF-36 in this trial, an improvement was only found in the general health domain in the intervention group compared to the control group. In comparison, Socha et al. [31] found improvements in several of the physical subscales and the vitality subscale in the SF-36 in postmenopausal women after 8 weeks of resistance training twice weekly. Those changes were associated with changes in body fat and body composition. In our study, the body mass index or waist circumference did not change in any group after 15 weeks (data not shown). The differences in results may be explained by the fact that women in the trial by Socha et al. were older (mean age 62.5 years) and had lower baseline scores in all physical subscales of the SF-36 than the women in this study [31].

Based on results from previous trials that have demonstrated positive effects on QoL by exercise interventions, we had expected to see larger differences in QoL domains, especially in the physical domains. One explanation is that the baseline scores for both the WHQ and the SF-36 indicated less symptoms/less disability than European and Swedish norms [32] except from the vasomotor domain in the WHQ [33]. The fact that SF-36 scores were in line with norms at baseline may have resulted in a 'ceiling effect' where possible improvements in quality of life did not appear since the scores were already relatively high compared to norms and previous studies. Since the SF-36 is an instrument to measure generic HRQoL, it may not be as sensitive to change in areas related to menopause-specific symptoms. However, the SF-36 has been used in many studies to evaluate HRQoL in menopausal women, facilitating the comparison of data between trials. On the other hand, it can also be considered a strength that SF-36 scores at baseline were similar to Swedish and European norms, since this supports the generalizability of the trial. A larger sample size in this study may have increased the power to detect differences in the SF-36, but the sample size calculation was based on the primary outcome of VMS frequency. Moreover, previous studies with sample sizes similar to or smaller than ours have found effects on SF-36 domains in postmenopausal women with VMS, but those women had lower baseline scores [31].

A strength of this study was the randomized controlled design with good control of the exercise dose and similar relative intensity. The compliance to the exercise intervention was good, which is crucial to be able to evaluate the effect of the intervention. Validated questionnaires were used to evaluate outcome, which should increase internal validity of the trial. Both groups underwent the same procedures at baseline and after 15 weeks and met the staff of the study in the same way – except for the contacts with the physiotherapist for the intervention group. To minimize the possible effect of this regular contact, participants in the control group could also have had contact such as telephone calls from the study staff.

Finally, since quality of life is a multi-dimensional concept that is individual, based on personal judgment and affected by physical, material, social and emotional well-being, there are aspects that the quantitative instruments do not capture. For this reason, future studies could also consider qualitative methods to further explore and construct a deeper understanding of the impact of exercise – and resistance training specifically – on aspects of quality of life in women with menopausal symptoms.

Conclusions and implications

Structured resistance training performed two to three times per week improved aspects of quality of life in postmenopausal women with VMS, mainly related to improvements in VMS. Since the intervention was performed in a public gym and participants exercised individually with weekly support, the intervention could be transferable to a real-life setting.

Registration

The trial is registered at ClinicalTrials.gov (www.clinicaltrials.gov NCT01987778).

Protocol

The protocol for this study has been published previously [34].

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