This is the published version of a paper published in *Complementary Therapies in Medicine*.

**Citation for the original published paper (version of record):**

Effects of yoga and aerobic exercise on wellbeing in physically inactive older adults:
Randomized controlled trial (FitForAge)
*Complementary Therapies in Medicine*, 66: 102815-102815
https://doi.org/10.1016/j.ctim.2022.102815

Access to the published version may require subscription.

N.B. When citing this work, cite the original published paper.

This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

**Permanent link to this version:**
http://urn.kb.se/resolve?urn=urn:nbn:se:gih:diva-6979
Effects of yoga and aerobic exercise on wellbeing in physically inactive older adults: Randomized controlled trial (FitForAge)

Paul Welford a, Josefine Östh a, Sara Hoy b, Vinod Diwan a, Mats Hallgren a, * a Department of Global Public Health, Karolinska Institutet, Solna, Sweden b Swedish School of Sport and Health Sciences (GIH), Stockholm, Sweden

ARTICLE INFO

Keywords:
Yoga
Aerobic exercise
Older adults
Wellbeing
Mental health
Stress

ABSTRACT

Objective: To compare the effects of yoga and aerobic exercise (AE) on wellbeing in physically inactive, but otherwise healthy older adults. A secondary objective was to assess and compare the frequency of adverse events associated with yoga and AE.

Design: Twelve-week, three-group, parallel randomized controlled trial with blinded follow-up assessment.

Interventions: Participants were supported to complete ≥3 Hatha yoga classes/week or ≥3 AE sessions/week. A wait-list control (WLC) group continued usual daily activities.

Main outcome measure: Change in wellbeing, assessed using the Satisfaction with Life Scale (SWLS) and Life Satisfaction Index-Z (LSI), at baseline and at 12-week follow up.

Results: In total, 82 adults (mean age 72.5 years, range 65–85, 77% female) were recruited. Of these, 27 were randomized to yoga, 29 to aerobic exercise and 26 to wait-list control. Medium-magnitude treatment effects (Hedges’ g) were seen for yoga versus WLC and AE versus WLC (SWLS, g = 0.65 and 0.56; LSI, g = 0.54 and 0.54, respectively). In per-protocol analyses, larger effect sizes were found (SWLS, g = 0.72 and 0.66; LSI, g = 0.76 and 0.76, respectively). Adverse events were less frequent in the yoga group (6/27; 22%) compared to AE (10/27; 37%).

Conclusions: Among physically inactive older adults, participation in yoga or AE was associated with beneficial effects on subjective wellbeing when compared to a non-active control group. Yoga was associated with fewer injuries and may be especially suitable for older adults (DRKS 00015093).

1. Introduction

As populations age globally, there is an increasing emphasis on healthy ageing, preventive medicine, and achieving wellbeing through lifestyle changes. Many of the health problems experienced by older adults can be prevented or delayed through a physically active lifestyle. Research in elderly populations shows that regular physical activity can benefit mobility, pain, mental health, and increase autonomy and life satisfaction. Despite these known benefits, an estimated 50–60% of adults aged ≥60 do not meet recommended physical activity levels (i.e., ≥150 min of moderate-intensity or 75 min of vigorous-intensity aerobic physical activity per week).

Yoga is a popular form of physical activity with several health benefits relevant to older adults, including improved balance and mobility, cardio-metabolic health, cognition, sleep quality and quality of life. Yoga practice has also been associated with improvements in mood and mental health. These benefits are relevant as healthy ageing does not merely correspond to longevity but is also indicated by life satisfaction and overall ‘wellbeing’.

Subjective wellbeing is a measure of how individuals evaluate their own lives, and may be described in terms of life satisfaction. Quality of life, by contrast, is a heterogenous, multidimensional concept that may refer to physical, psychological, social or functional aspects. According to a recent survey of more than 2400 yoga participants, general wellbeing is a key motivation both initiating and continuing yoga practice. Moreover, the importance of subjective wellbeing is increasingly recognised in ageing-research, and is closely linked to health and quality of life in elderly populations. While previous yoga studies have tended to focus on the physical domains of health-related quality of life, its effects on the broader construct of life satisfaction remain unclear.

With a holistic focus that includes both physical and mental...
wellbeing, yoga could be a suitable activity for older adults who find aerobic exercise (AE) difficult due to musculoskeletal injuries or other health problems. With few exceptions, previous yoga trials involving older adults have focused on those with pre-existing health conditions (e.g., chronic pain, hypertension, heart disease) and residential care needs. Among these studies, most have compared yoga to a wait-list control group only. Additionally, studies reporting yoga’s effect on positive mental health are lacking. To our knowledge, no trials have compared the effects of yoga and AE on subjective wellbeing in physically inactive but otherwise healthy older adults. Such comparisons are needed, however, as older adults constitute a large and growing segment of the population that requires updated information about the relative benefits and possible risks associated with different forms of physical activity.

To address these gaps, we conducted a randomized controlled trial (RCT) to examine the effects on wellbeing of a 12-week yoga program in physically inactive adults aged 65–85 years. This intervention was compared to structured AE and a non-active control group. We hypothesized that: compared to AE, participation in yoga would be associated with small magnitude improvements in wellbeing; and compared to wait-list control, both yoga and aerobic exercise would be associated with improvements in wellbeing.

2. Method

2.1. Design and setting

Twelve-week three-group parallel RCT with blinded follow-up assessments. We adhered to the CONSORT guidelines for RCTs involving humans. All assessments were conducted at the Karolinska Institute (KI) in central Stockholm. The study was approved by the Regional Ethics Committee in Stockholm (2017/1862-1/2, amendment number 2018/2156–32). The study protocol is publicly available and the trial was prospectively registered with German Clinical Trials (DRKS 00015093).

2.2. Participants

In total, 82 participants were recruited through a newspaper advertisement distributed throughout central Stockholm (‘Mitt-I’). To avoid delays after screening (Section 2.3), three advertisements were placed between April 2019 and January 2020. Eligibility: Participants were aged 65–85 years, resident in Stockholm County and fluent in Swedish. All participants provided informed written consent prior to enrolment in the study. We excluded those: (a) currently or recently (past three months) engaged in regular structured exercise (> two days per week, moderate-to-vigorous activities >.75 min/week, or light-to-moderate activities >150 min/week); (b) with physical disabilities or injuries that could interfere with physical activity (e.g., paralysis, inability to sit, stand and/or walk, severe pain or vision impairment) or a severe cognitive deficit (e.g., dementia); (c) who had surgery during the past year (or planned the coming year); (d) with insulin-dependent diabetes, an irregular pulse, uncontrolled blood glucose or blood pressure; (e) advised against moderate exercise by their doctor; (f) recently diagnosed with serious mental illness or indicating acute signs of suicidality. Those unable to reach either the yoga studio or a fitness centre were therefore included in the study (Section 2.6) were also excluded.

2.3. Procedure

Those interested in the trial were invited to contact (phone or email) a research assistant who conducted a 20-minute telephone screening interview to determine eligibility (Section 2.2). Those eligible were invited to attend a baseline assessment (~1.5 h) with a research assistant 1–3 weeks later when demographic, questionnaire and anthropometric data were collected (Section 2.5). Participants were referred to have blood samples taken at the Karolinska University Hospital laboratory (in collaboration with Karolinska Trial Alliance) and scheduled for follow-up appointments at 6 weeks (mid-point) and 12 weeks (end-point). The purpose of the mid-point assessment was to briefly (~15 min) assess adverse events and help participants resolve adherence issues (e.g., difficulty accessing exercise classes). The follow-up assessment replicated the baseline assessment but was performed by a different research assistant. Assessments were conducted in a dedicated project room at KI.

2.4. Randomisation and blinding

An independent statistician generated a sex-stratified randomization list using a random number computer program (SAS 9.4, block length = 9). The allocation sequence was transferred into sealed, opaque envelopes by a research assistant not otherwise involved in the study. Envelopes were opened by participants immediately after their baseline assessment. Group allocation was recorded on separate forms that were stored in a locked cupboard at KI and were not available to follow-up assessors. Participants were requested not to discuss their allocation at follow-up meetings.

2.5. Measures

Wellbeing (primary outcome) was measured at baseline and at 12-week follow-up using the five-item Satisfaction with Life Scale (SWLS) and the 13-item Life Satisfaction Index-Z (LSI), which assess the cognitive and affective components of wellbeing, to provide a global judgment of life satisfaction. For the SWLS, respondents indicated the extent to which they agreed with each of five statements on a 1–7 Likert scale. Examples of items included, “In most ways my life is close to ideal” and “I am satisfied with life.” Item scores were added together and reported as a total (maximum = 35). For the LSI, participants responded to positively and negatively-formulated statements by indicating whether they agreed, disagreed or were unsure. Total scores were reported (maximum = 26). The SWLS and LSI have demonstrated validity and reliability in older adults.

Demographic data (age, gender, education), along with indicators of somatic health, including self-reported information about comorbidities, medications, smoking status, alcohol consumption and physical activity levels (International Physical Activity Questionnaire) were collected at baseline. Blood pressure and resting heart rate were measured using the Omron M3 Comfort monitor. Body mass index and waist circumference were measured, and balance assessed using the Berg Balance Scale. Grip strength was assessed for the dominant hand using an electronic hand-held dynamometer. Blood samples were analysed for total cholesterol, high-density lipoprotein (HDL) and low-density lipoprotein (LDL). Exercise adherence was monitored using a training calendar, where participants indicated when a scheduled yoga or AE session had been completed. In addition, all participants were asked to record any informal sessions of moderate-vigorous physical activity that were completed. Exercise intensity was estimated at six-week follow-up using Borg’s Rating of Perceived Exertion scale (RPE) which is scored from six (no exertion) to 20 (maximal exertion). The mean of three exercise sessions during the past week was calculated. Adverse events were assessed at six and 12-weeks by asking participants if they had experienced any injuries caused by exercise during the trial.

2.6. Interventions

2.6.1. Yoga

Those randomized to yoga received a free 12-week membership to a centrally located yoga studio and were asked to complete three sessions of yoga per week. The 60-minute classes (also available to adults not taking part in the study) were designed for older adults by an experienced (>15 years) yoga instructor. Classes were offered at least three
pants were given access to ‘Yogobe’—an online platform with yoga classes adapted for seniors. These could be used for home yoga practice. The intervention was based on Hatha yoga, which consists of gentle physical postures (asanas) plus breathing exercises and is considered suitable for older adults. Opening postures included: Cat/Cow pose, Mountain pose and Partial Sun Salute. Thereafter, classic Hatha yoga postures were instructed, including Chair pose, Plank, Tree pose, Warrior I and II, Downward facing dog, Side stretch, Spine twist, Cobra pose and Bridge pose. The finishing series includes relaxation exercises (Dead man’s pose). A detailed description of these movements can be found elsewhere. Approximately 50 min was devoted to physical postures and 10 min to breathing exercises and relaxation (final pose).

2.6.2. Aerobic exercise

Those randomized to AE received a free 12-week membership with ‘Friskis & Svettis’, permitting access to fitness centres across Stockholm. Participants were asked to complete three 60-minute supervised group AE classes/week. All classes were suitable for older adults. To optimize adherence, participants could choose from three different types of AE: cycling/spinning, dance-based exercise, and light-to-moderate intensity aerobics (continuous whole-body movements performed to music). Participants met a personal trainer (~30 min) to become familiar with the centre’s online booking system and to help them select classes. Additionally, a DVD produced by the fitness centre containing several seated AE workouts, suitable for older adults was provided to participants, and online classes were included in their fitness centre membership. Participants were encouraged to build gradually to a subjectively ‘moderate’ exercise intensity. All classes were delivered by qualified fitness instructors and were available to adults not taking part in the study.

2.6.3. Wait-list control

Those randomized to the wait-list control (WLC) group were instructed to continue their usual daily activities without increasing their physical activity levels or commencing a new exercise regime. To optimize adherence, participants were offered a free cinema ticket and a 12-week membership (to begin after the study ended) to either the yoga studio or the AE facility if they adhered to the wait-list condition and completed a follow-up assessment.

2.7. Effects of COVID-19 on recruitment, exercise adherence and assessment

Recruitment began in April 2019 and was terminated in March 2020 due to COVID-19 restrictions, which included mandatory closure of the yoga and AE facilities. Prior to the restrictions commencing, 82 participants were enrolled in the trial; 41 had completed a 12-week intervention and 41 were in various stages of completion. To allow participants to continue their allocated interventions, we implemented the following strategy: During the two weeks preceding the restrictions, we contacted participants with verbal and written instructions on how to continue their exercise regimes. Those randomized to yoga were sent a booklet written by the trial’s yoga teacher with instructions and diagrams illustrating the yoga postures and sequences used at the studio. Participants were asked to continue the yoga sessions at home three times/week using the booklet or online materials as a guide. Similarly, those randomized to AE were instructed to continue their preferred form (s) of AE from home and, where possible, to replicate the exercises offered during the trial. Unfortunately, it was also necessary to conduct follow-up assessments via telephone after restrictions commenced. It was, therefore, not possible to re-examine several of the planned secondary outcomes (e.g., physical assessments, such as blood pressure), at the study endpoint.

2.8. Data analysis plan

2.8.1. Sample size

A description of the power calculation is available in the published protocol. Based on a previous related study and a predicted small effect size (0.2) favouring yoga compared to aerobic exercise on the SWLS, a total sample of 160 participants was estimated. Due to COVID-19 restrictions this target could not be met; consequently, the trial is underpowered to detect statistically significant differences. Instead, our analyses focus on the magnitude of group differences (effect sizes).

2.8.2. Statistical methods

Descriptive data were calculated, stratified by intervention group. Primary analyses were conducted using intention-to-treat (ITT) principals, i.e., group allocation rather than adherence to the allocated intervention. Post-intervention group differences in wellbeing (SWLS and LSI) were assessed using Analysis of Covariance (ANCOVA) with baseline wellbeing included as the covariate. Within-group changes in mean wellbeing (baseline to 12-weeks) are reported with 95% confidence intervals (CIs), ANCOVA was used to determine between-group differences at follow-up (yoga versus AE; yoga versus WLC; AE versus WLC), with baseline wellbeing included as the covariate and a Bonferroni-corrected p value of 0.017 used for interpretation. Effect sizes (Hedges’ g) are reported for the three group comparisons and interpreted using the following criteria; 0.2, small, 0.5, medium and 0.8 or higher, a large effect size. Test assumptions were examined using the Shapiro-Wilk (normality) and Levene (homogeneity of variance) tests and patterns in missing follow-up data assessed using Little’s missing completely at random (MCAR) test. Pre-planned analyses included per-protocol analyses restricted to participants who reported completing 12-or-more sessions of their allocated intervention. Additionally, the effect of missing follow-up data was estimated using multiple imputation methods (50 iterations). As no interim analyses were performed, results were not known at the point of ceasing recruitment into the trial. Analyses were conducted using SPSS v27.

3. Results

3.1. Participants

As a result of recruitment stopping early due to COVID-19, final follow-up for 82 participants took place in May 2020. The flow of participants’ progress through the trial is reported in Fig. 1. Participant characteristics are reported in Table 1. The mean age was 72.5 years (65–85, standard deviation (SD) 5.3). Despite more females (77%), the distribution of sexes was similar between groups. Approximately 78% of participants were retired and 65% were educated to university level. On average (median = mean), participants reported having one (0–4) comorbidity and taking one (0–4) medication. Most participants were ex-smokers (55%), followed by non-smokers (40%) and current smokers (5%). Alcohol consumption, in general, did not reach hazardous levels. Around 7% reported consuming nine units or more per week (one unit = 12 g of pure ethanol). Physical activity levels were below WHO recommendations. For example, mean moderate-to-vigorous physical activity each week was about 44 min. Mean body mass index, waist circumference, blood pressure and cholesterol were similar between groups.

Reported data are means (standard deviations) unless otherwise stated.

Data were missing for aerobic exercise group (employment status, n = 1; education, n = 1) and wait-list control group (weekly alcohol consumption, n = 2).
3.2. Completeness of follow-up and adherence

Baseline measurements of wellbeing (SWLS) were available for all 82 participants. Of these, 3-month follow-up was completed for 75/82 participants (24/27 randomized to yoga, 27/29 to AE and 24/26 to WLC). Participants in the yoga group reported completing a median 28 (0–54) sessions (including supported home practice), compared to 16 (0–51) in the AE group. Overall, the mean number of reported sessions/week (yoga or AE) did not differ significantly between participants who completed follow-up prior to the onset of COVID-19 (mean = 19.1, SD = 15.6, n = 41) and those who were affected by COVID-19 restrictions (mean = 13.2, SD = 15.3, n = 41, t = 1.620, p = 0.110). Yoga participants also reported median of 8 (0–36) informal sessions of moderate-to-vigorous physical activity, compared to 17 (0–66) in the AE group and 17 (0–90) in the WLC group. The mean RPE was 14.5 (SD 1.4) per AE session and 12.9 (SD 1.8) per yoga session (t = 3.17, p = 0.003).

3.3. Intervention effects on wellbeing

Table 2 shows the change in mean wellbeing (SWLS) scores at 3-month follow-up, with group differences for the main (ITT) and per-protocol analyses. Fig. 2 illustrates these changes over time. Mean wellbeing scores remained stable in the yoga and AE groups (0.6-point increase) and reduced in the WLC group (2.0 points). There were medium-magnitude, positive estimated treatment effects for yoga versus WLC and AE versus WLC (Hedges’ g = 0.65 and 0.56 respectively). However, there were no significant between-group differences on the primary outcome at the study endpoint, per-protocol analyses (n = 63) revealed significant group differences favouring yoga compared to WLC, with a medium effect size (Hedges’ g = 0.76).

3.4. Adverse events reported at 6-week or 3-month follow-up

In total, 17/82 (21%) participants reported intervention-related adverse events, of which 15/17 (88%) were musculoskeletal injuries. In the yoga group, 6/27 (22%) participants reported adverse events, including two cases of intermittent dizziness, three of shoulder pain and one case of back pain. By comparison, 10/27 (37%) participants in the AE group reported adverse events. These included two cases of hip pain, four of knee pain, one episode of rib pain, two cases of lower back pain and one of shoulder pain. In the WLC group, 1/25 (4%) participant reported foot pain. All those who reported adverse events were advised to see their doctor. The Pearson chi-square value for between-group differences in reported adverse events was 8.4 (p = 0.015).

3.5. Sensitivity analyses

The results of analyses following multiple imputation methods are presented in supplementary Table S2. In general, these were similar to those of ITT analyses.

4. Discussion

Physically inactive but otherwise healthy older adults represent a growing segment of the population that requires updated information about the benefits and risks of different forms of physical activity. With limited advertising, 82 participants were recruited prior to COVID-19 restrictions, demonstrating that older adults are interested in supported physical activity programs, including yoga. Compared to WLC, both the yoga and AE interventions were associated with positive, medium magnitude estimated effects on wellbeing. These effects were consistent for both SWLS and LSI, however there was no evidence of superiority for either intervention. Per-protocol analyses revealed estimated group differences favouring yoga compared to WLC, although
Table 1
Baseline demographic, clinical and physical characteristics of participants (N = 82).

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Yoga intervention (n = 27)</th>
<th>Aerobic exercise intervention (n = 29)</th>
<th>Wait-list control (n = 26)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>72.1 (5.5)</td>
<td>73.3 (5.5)</td>
<td>72.1 (5.1)</td>
</tr>
<tr>
<td>Female sex, n (%)</td>
<td>20 (74.1)</td>
<td>22 (75.9)</td>
<td>21 (80.8)</td>
</tr>
<tr>
<td>Employment status, n (%):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>4 (15.4)</td>
<td>2 (6.9)</td>
<td>1 (3.8)</td>
</tr>
<tr>
<td>Self-Employed</td>
<td>1 (3.8)</td>
<td>1 (3.4)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Unemployed</td>
<td>1 (3.8)</td>
<td>1 (3.4)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Retired</td>
<td>19 (73.2)</td>
<td>23 (79.3)</td>
<td>22 (84.6)</td>
</tr>
<tr>
<td>Other</td>
<td>1 (3.8)</td>
<td>1 (3.4)</td>
<td>3 (11.5)</td>
</tr>
<tr>
<td>Education, n (%):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary or lower</td>
<td>3 (11.1)</td>
<td>5 (17.9)</td>
<td>1 (3.8)</td>
</tr>
<tr>
<td>High school</td>
<td>1 (3.7)</td>
<td>1 (3.6)</td>
<td>2 (7.7)</td>
</tr>
<tr>
<td>Post-secondary</td>
<td>5 (18.6)</td>
<td>4 (14.3)</td>
<td>6 (23.1)</td>
</tr>
<tr>
<td>University degree or higher</td>
<td>18 (66.6)</td>
<td>18 (62.1)</td>
<td>17 (65.4)</td>
</tr>
<tr>
<td>Number of comorbidities, n (%):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>7 (25.9)</td>
<td>9 (31.0)</td>
<td>8 (30.8)</td>
</tr>
<tr>
<td>1-2</td>
<td>15 (55.6)</td>
<td>18 (62.1)</td>
<td>13 (50)</td>
</tr>
<tr>
<td>3-4</td>
<td>5 (18.5)</td>
<td>2 (6.9)</td>
<td>5 (19.2)</td>
</tr>
<tr>
<td>Number of medications, n (%):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>10 (37.0)</td>
<td>9 (31.0)</td>
<td>8 (30.8)</td>
</tr>
<tr>
<td>1-2</td>
<td>14 (51.9)</td>
<td>17 (58.7)</td>
<td>14 (53.8)</td>
</tr>
<tr>
<td>3-4</td>
<td>3 (11.1)</td>
<td>3 (10.3)</td>
<td>4 (15.4)</td>
</tr>
<tr>
<td>Smoking status, n (%):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>0 (0)</td>
<td>4 (13.8)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Never</td>
<td>11 (40.7)</td>
<td>11 (37.9)</td>
<td>11 (42.3)</td>
</tr>
<tr>
<td>Ex</td>
<td>16 (59.3)</td>
<td>14 (48.3)</td>
<td>15 (57.7)</td>
</tr>
<tr>
<td>Weekly alcohol consumption, n (%):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 units</td>
<td>5 (18.5)</td>
<td>7 (24.1)</td>
<td>8 (30.8)</td>
</tr>
<tr>
<td>1-4 units</td>
<td>13 (48.2)</td>
<td>11 (37.9)</td>
<td>10 (38.5)</td>
</tr>
<tr>
<td>5-8 units</td>
<td>7 (25.9)</td>
<td>9 (31.1)</td>
<td>4 (15.4)</td>
</tr>
<tr>
<td>9 units or more</td>
<td>2 (7.4)</td>
<td>2 (6.9)</td>
<td>2 (7.7)</td>
</tr>
<tr>
<td>Moderate-vigorous physical activity per week (mins)</td>
<td>48.5 (88.7)</td>
<td>39.6 (126.2)</td>
<td>42.5 (88.9)</td>
</tr>
<tr>
<td>Sedentary time per day (mins)</td>
<td>470.0 (199.7)</td>
<td>406.5 (176.5)</td>
<td>469.6 (147.4)</td>
</tr>
<tr>
<td>Body mass index</td>
<td>26.6 (4.1)</td>
<td>27.2 (4.9)</td>
<td>27.4 (4.5)</td>
</tr>
<tr>
<td>Waist circumference</td>
<td>93.5 (11.4)</td>
<td>96.3 (15.2)</td>
<td>95.4 (12.6)</td>
</tr>
<tr>
<td>Resting heart rate, beats/min</td>
<td>73.9 (2.2)</td>
<td>69 (14.7)</td>
<td>70 (10.8)</td>
</tr>
<tr>
<td>Systolic blood pressure (mmHg)</td>
<td>132 (19.5)</td>
<td>138 (32.1)</td>
<td>143 (20.4)</td>
</tr>
<tr>
<td>Cholesterol (mmol/l):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>5.7 (0.9)</td>
<td>5.4 (1.2)</td>
<td>5.7 (0.9)</td>
</tr>
<tr>
<td>HDL</td>
<td>1.8 (0.6)</td>
<td>1.6 (0.6)</td>
<td>1.8 (0.3)</td>
</tr>
<tr>
<td>LDL</td>
<td>3.3 (0.8)</td>
<td>3.3 (1.1)</td>
<td>3.4 (0.8)</td>
</tr>
</tbody>
</table>

these must be interpreted with caution given our limited sample size.

Previous trials have reported beneficial effects of yoga on wellbeing in older adults. Tew et al. randomized 52 physically inactive older adults (mean age = 74.8 years; SD 7.2) to either 12-weeks of yoga or WLC. The adapted yoga program (BWY Gentle Years Yoga) was found to be feasible and potentially beneficial for mental and social wellbeing. Our findings mirror these and, in addition, suggest that the beneficial effects of yoga on wellbeing may be similar to those of aerobic exercise, but with fewer adverse events. Effect sizes for our 12-week yoga intervention were similar to those reported in a meta-analysis by Tulloch et al. In their systematic review of the effects of yoga-based exercise on mental wellbeing in older adults, the authors identified 12 RCTs for inclusion (N = 752, mean ages 60–75) and concluded that yoga was associated with small, positive effects (Hedges g = 0.38) on mental wellbeing. Both Tulloch et al. and an earlier systematic review by Patel et al. noted that few adverse events have been described in studies of yoga in older adults, although we note that this may be partly due to inadequate reporting of safety data in yoga trials. A notable exception is a RCT by Cramer et al. that investigated patients with colorectal cancer, in which 7 patients (26%) experienced minor adverse events. We observed a similar frequency of adverse events, but still the majority (78%) of yoga participants remained injury-free throughout the trial. By contrast, 37% of AE participants reported injuries related to exercise participation. Injury risk is an important consideration when recommending exercise interventions for older adults, where pre-existing conditions and frailty may complicate recovery and ongoing pain may further restrict physical activity. Compared to AE, yoga may be a less risky physical activity for older adults that has equivalent benefits for wellbeing.

The non-significant between group differences seen in our main (ITT) analyses could be explained by several factors. Healthy populations tend to report better subjective wellbeing than those with poor health. In our study, baseline SWLS scores were consistent with previously-reported normative values of 25.8 to 26.3. It is conceivable that wellbeing among trial participants was already at satisfactory levels at enrollment, leaving limited scope for improvement (ceiling effect). Given the paucity of longitudinal studies of wellbeing, the sensitivity of assessment tools changes in wellbeing among healthy older adults and the meaningfulness of small changes also remain somewhat unclear.

Various aspects of wellbeing, including social support, have been detrimentally affected by COVID-19. Given that older adults are especially vulnerable to social isolation, we speculate that a reduction of social interaction during the pandemic may have contributed to the decline in wellbeing among the WLC group in this study. Yoga and AE appeared to be somewhat protective against this decline in wellbeing. This may have occurred via social interactions involved when attending classes, or could be attributable to the beneficial health effects of physical activity. In the same way, the necessary move towards home-based yoga and AE interventions may have attenuated potential treatment effects during the course of the study.

4.1. Strengths and limitations

Strengths of this study include the RCT design with blinded follow-up assessments, the comparison of two forms of physical activity, and the inclusion of a non-active WLC group. Another strength is the inclusion of physically inactive but otherwise healthy older adults: a growing but understudied segment of the adult population. We also assessed wellbeing using two different outcome measures (SWLS and LSI), noting consistent intervention effects in both. Some potential limitations are acknowledged. Study generalizability may be affected by a healthy entrant effect, where only those with positive attitudes or expectations towards physical activity participated. As noted previously, the trial was under-powered due to COVID-19 restrictions. It is possible that outcomes were affected by the social and other restrictions that occurred during the trial, despite strategies to enable participants to continue exercising. Our rationale for reporting pre- and post-COVID-19 participants together was as follows. Firstly, all three groups were affected equally by restrictions, except for the termination of supervised exercise classes. We consider that, while this may have attenuated treatment effects, it is unlikely that significant bias was introduced. Secondly, as COVID-19 policy in Sweden did not include a formal lockdown, or curfews, participants were able to continue non-supervised physical activity and a degree of social contact, consistent with the original study protocol. Thirdly, we felt that reporting separate analyses would have introduced an unnecessary loss of statistical power, given that measures such as online materials were put in place to allow participants to continue planned interventions as closely as possible. We also recognise that conducting some follow-up assessments via telephone may have disadvantaged certain participants, such those with hearing-impairments. Although RPE and adherence were measured, the possibility of performance bias (via random allocation to a preferred
Complementary Therapies in Medicine 66 (2022) 102815

6

We also recognise that subjective wellbeing may fluctuate and that differences at 12-week follow-up may not be representative of longer-term changes.

4.2. Conclusions

Compared to a WLC group, participation in yoga or AE was associated with a medium-magnitude treatment effect. Adverse events were less frequent among yoga participants. Overall, these findings support the recommendation of both yoga and AE to improve wellbeing among
older adults, with indications that yoga may have stronger effects on wellbeing.

**Funding**

This study is supported by Swedish Research Council for Health, Working Life and Welfare (FORTE), grant number 2017-00024. The funding body had no involvement in the collection, analysis or interpretation of data, the writing of the manuscript or the decision to submit the manuscript for publication.

**Authors’ contributions**

MH and PW drafted the first manuscript. PW entered study data and conducted statistical analyses under supervision (MH). MH, JÖ and SH interviewed study participants. MH and VD conceived the study and JÖ was involved in planning the trial. All co-authors edited and agreed upon the final manuscript.

**CRediT authorship contribution statement**

Paul Welford: Data curation, Formal analysis, Writing – original draft, Writing – review & editing. Josephine Ost: Data curation, Methodology, Project administration, Writing – review & editing. Sara Hoy: Methodology, Project administration, Writing – review & editing. Vinod Diwan: Conceptualization, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Writing – review & editing. Mats Hallgren: Conceptualization, Funding acquisition, Data curation, Formal analysis, Methodology, Project administration, Resources, Supervision, Writing – original draft.

**Declarations of interest**

None.

**Acknowledgements**

The authors would like to acknowledge Hugo Sjøqvist for assistance with randomization and blinding and Patricia Eustachio Colombo for conducting assessments.

**Appendix A. Supporting information**

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.ctim.2022.102815.

**References**


