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Pilot Study

A randomized controlled pilot study of the effects of 6-week high intensity hatha yoga protocol on health-related outcomes among students

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ABSTRACT

Objective: Modern hatha yoga exercises (YE) provide an alternative form of physical activity which may reduce stress, facilitate recovery and improve health. This study investigated the short-term effects of high intensity hatha yoga exercises (HIY) on health-related outcomes.
Methods: A 6-week randomized controlled study was performed to compare HIY with a control group not changing their exercise behavior. Healthy students (N = 44; median age: 25 years, range 20–39 years; HIY: n = 21, including 3 men; control group: n = 23, including 3 men) novice to yoga participated in the intervention which included one weekly class and recommended home training. Participants provided self-reports in questionnaires before and after the intervention. Self-reports included anxiety and depression (Hospital Anxiety and Depression Scale), stress (Perceived Stress Scale), sleep quality (Pittsburgh Sleep Quality Index), insomnia (Insomnia Severity Index), subjective health complaints (Common Symptoms in General Practice Index) and self-rated health (single-item).
Results: After the 6-week intervention, there were no between-group differences in anxiety, depression, stress, sleep or self-rated health. However, when investigating associations within the HIY-group, a higher HIY-dose was related to less depression ($r = 0.47$; $p = 0.03$), improved sleep quality ($r = 0.55$; $p = 0.01$), and less insomnia ($r = 0.49$; $p = 0.02$).
Conclusions: There were no short-term between-group effects of HIY on mental distress, sleep or self-rated health. However, within the HIY-group, a higher dose was associated with improved mental health in terms of depression and with improved sleep. Although future studies with larger samples are needed, these preliminary findings suggest short-term positive effects of HIY on health-related outcomes among students.
Trial registration number: NCT01305096.

1. Introduction

Yoga exercises (YE) involve body, breath, and mind exercises (Garber et al., 2011; Schmalzl et al., 2015) that include body awareness and self-regulation techniques (Schmalzl et al., 2015; Shelov et al., 2009), and use mindful exercises as a form of biofeedback and thus constitute a form of moving meditation (Shelov et al., 2009; Lorenc et al., 2014). Yoga can be used for a variety of mental and physical health problems, and are often used as a complementary treatment (Mustian et al., 2013) for instance in rehabilitation programs (Desveaux et al., 2015). However, yoga exercises can also be used as a non-pharmacological tool for managing stress (Pascoe and Bauer, 2015; Garber et al., 2011) and form part of a general health regime in order to prevent inactivity

Abbreviations: HIY, High intensity hatha yoga.

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and achieve physical fitness (Ross and Thomas, 2010; Larson-Meyer, 2016). Depending on the purpose and yoga style, the physical exertion can vary but is often of intermittent and moderate character.

Research comparing YE with physical activity, such as cardiovascular and strength training, suggests that YE and physical activity have similar effects on mood (Berger and Owen, 1992; Ross and Thomas, 2010). Findings from meta-analyses have shown small to moderate effects of YE on different health-related outcomes including anxiety (Hofmann et al., 2016; Cramer et al., 2018), depression (Cramer et al., 2013), stress (Pascoe and Bauer, 2015), sleep (Wu et al., 2015), and health-related quality of life (Cramer et al., 2017). Recent meta-analytic findings (Vollbehr et al., 2018) suggest that YE may reduce symptoms in individuals suffering from anxiety and depression.

However, less is known about the specific effects of YE involving high intensity yoga exercises (HIY), which consist of vigorous sun salutation (SS) physical exercises (*asanas*). Findings from a meta-analysis (Pascoe and Bauer, 2015) have shown that comparing yoga to active control groups, asanas seem to regulate stress physiology. With SS being among the most common physical exercise sequence within YE programs (Broad, 2012; Larson-Meyer, 2016), it is important to study their effects. Also, the fact that the number of YE participants is increasing (Statista, 2016) makes it important to evaluate any beneficial and/or preventative effects of SS on different health-related outcomes including self-reports of symptoms of anxiety and depression, sleep, stress, subjective health complaints, and self-rated health. This also includes investigating the feasibility of a HIY-program and the safety of participating in such a high intensity intervention.

The present randomized controlled pilot study aimed at investigating the effects of a 6-week HIY program with SS on different health-related secondary outcomes including self-reports of symptoms of anxiety and depression, sleep, stress, subjective health complaints, and self-rated health. This includes investigating associations between HIY dose (i.e., time spent on HIY-training) and changes in health-related outcomes. Another aim involved investigating the feasibility of the HIY-program in terms of safety and injuries along with negative effects on outcome measures. Considering previous findings, the HIY-program was expected to have positive effects on health-related outcomes and to be feasible, safe, and to produce no injuries.

2. Material and methods

2.1. Participants

Participants (Fig. 1) included in this study were recruited for a randomized controlled trial (RCT) of HIY compared to a control condition including an attentional control intervention, with the primary aim of examining the effects of HIY on cardiorespiratory fitness (Papp et al., 2016). The attentional control intervention involved weekly contacts with the research coordinator to make sure that there were no changes in exercise behavior. All participants provided self-reports in questionnaires at baseline and follow-up which allowed researchers to investigate the effects on secondary outcomes including different health-related measures.

Details regarding recruitment, statistical power, the HIY-program, and findings of primary outcomes have been reported elsewhere (Papp et al., 2016). In brief, participants were recruited through advertising on websites and bulletin boards for students (e.g., student network websites, public health websites, and university bulletin boards). The study was introduced with a question inviting participants to a 6-week HIY-program. Of the 260 participants who volunteered, 54 were included and randomized into HIY or to a control group. Potential participants received detailed written and oral information, which made clear that participation was voluntary and that they had the right to withdraw from further participation at any time without explaining why. They were then screened for inclusion/exclusion criteria on the basis of physical and mental health, injuries and chronic diseases. Analyses were made per-protocol, meaning that only those participants who completed the intervention were analyzed. Inclusion criteria involved being a healthy student residing in Sweden, aged 20–40 years, performing physical exercise no more than 2 h per week at a moderate intensity or 1 h a week at a high intensity. The rationale for the criteria regarding exercise related to the detection of cardiorespiratory changes and to the avoiding of ceiling effects. Exclusion criteria included the presence of chronic diseases, injuries, recent surgery, or taking medication affecting performance. No medication was allowed except for asthma/allergies (used by one participant in each group) to avoid negative effects of non-medication on performance. Participants suffering from morning headaches were excluded due to the HIY-program including exercises (inversions) which may cause headaches.

The volunteers who fulfilled the inclusion criteria provided written informed consent before being randomized to HIY (with home training) or to a control group (attentional control; no treatment, no yoga or home exercises or change in exercise behavior) instructed to maintain their exercise regime according to the inclusion criteria. The randomization was performed by an individual not involved in the in the research project. Papers with the participants' identity codes were placed up-side down on a table. To avoid unequal group sizes, a paper with a code was first placed in the HIY-group while the next paper was added to the control group. The majority of the participants were HIY novices. This research was approved by the Regional Ethical Review Board in Stockholm (Ref. No. 2011/248–31/1).

2.2. Secondary outcome measures

Participants completed questionnaires at baseline and follow-up at a sports arena. All research assistants (physical therapy students) were blind to participants' group allocation.

2.2.1. Anxiety and depression

The Hospital Anxiety and Depression Scale (HADS; Lisspers et al., 1997; Zigmond and Snaith, 1983), a measure with adequate psychometric properties (Bjelland et al., 2002), was used to measure anxiety and depression. HADS includes two subscales covering anxiety and depression, with seven items each. Scores above 11 indicate clinical anxiety or depression, scores between 8 and 10 are borderline, while scores below 7 are of no clinical significance (Snaith, 2002).

2.2.2. Stress

The 10-item Perceived Stress Scale (PSS; Cohen et al., 1983; Nordin and Nordin, 2013) was used to measure stress. PSS reflects whether individuals experience their lives as stressful, unpredictable and uncontrollable. A sum score was computed with high scores indicating higher levels of perceived stress.

2.2.3. Sleep quality

The Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989) includes seven domains (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction) and was used to measure sleep quality over the last two weeks. Sum scores including all domains were computed. High scores indicate poorer sleep quality, with scores above five indicating poor sleep and the

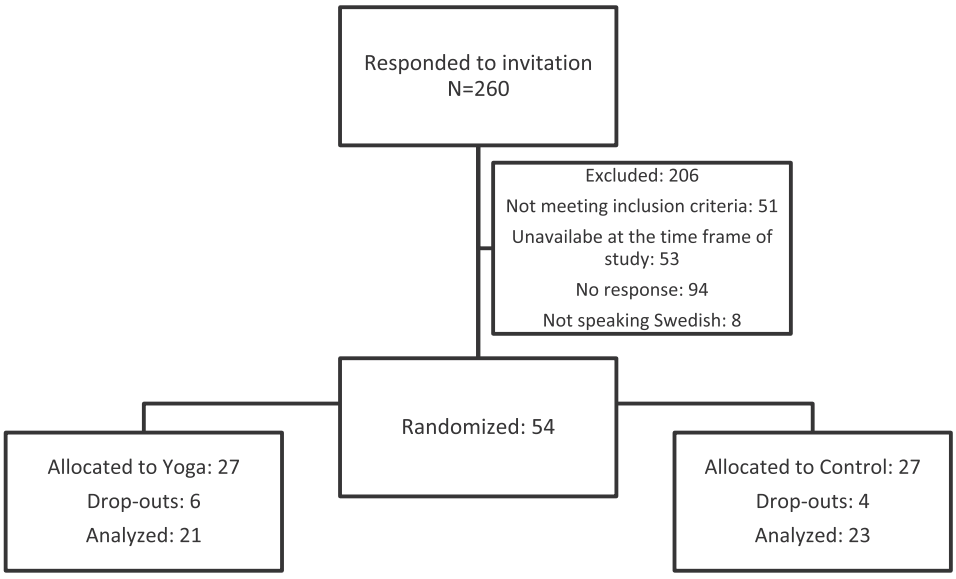

Fig. 1. Flow chart of participant enrollment, randomization and attrition.

clinically accepted criterion corresponding to a score of 8.

2.2.4. Insomnia

The Insomnia Severity Index (ISI; Bastien et al., 2001), which consists of seven items evaluating sleeping problems (severity of initial sleep-onset, sleep maintenance, early morning awakenings, sleep satisfaction, interference with daily functioning, impairments and distress) was used to measure insomnia. Scores between 8 and 14 indicate some sleeping problems, while scores between 15 and 21 indicate a moderate sleeping disorder, and scores above 22 reflect severe insomnia.

2.2.5. Self-rated health

Self-rated health was measured using a well-established single-item question (Idler and Benyamini, 1997) asking individuals to report their perceptions of their current health status. Ratings were made on a 5-point scale (1 = excellent health).

2.2.6. Subjective health complaint

A check-list including common mental and physical health complaints (Tibblin et al., 1990) was used to measure subjective health complaints (SHC; Eriksen and Ihlebaek, 2002; Tibblin et al., 1990). For every complaint, participants were asked to indicate how often during the past two weeks they had had a complaint. Response alternatives ranged from *Never* (0) to *Almost every day* (4). Sum scores were computed with higher scores reflecting more SHC.

2.3. High intensity yoga (HIY) program

Participants performed a standardized 1-h HIY program once a week for six weeks with an instructor; additional home practice was encouraged during the 6-week intervention (weekly reports were collected). The HIY program included yoga postures with synchronized breathing (to the best of ability) of vigorous intensity according to the American College of Sports Medicine (Garber et al., 2011) with 30–40 min of sun salutations (SS; *Surya Namaskar*, Fig. 3); and 15 min of peacock (*pincha mayurasana*); half hand-stands towards a wall; (*ardha adhomukha vrksasana*); twisted side-angle poses (*parivrtta parsvakonasana*); cow pose (*gomukasana*, arms only) and shoulder-stand (*sarvangasana*). The 5-min meditative relaxation was performed in the waterfall pose (*viparita karani*) or lying on the back (*savasana*). Participants were instructed to synchronize the breathing with each movement. No specific breathing exercises were included (Fig. 3 shows the SS postures). The HIY classes were run by experienced certified yoga instructors on the same weekdays, at the same time in the afternoon. To support home training, all in the HIY group received a 55-min DVD that was identical to the program used in the instructor-led HIY classes. The control group received the DVD after the end of the six-week intervention. The intervention was offered to students as part of another randomized controlled trial (Papp et al., 2016) and the study was carried out during the spring and late summer/fall 2013 in Stockholm. The attentional control group was asked about their regular exercise every week to ascertain that they made no changes to their exercise behavior.

3. Statistical analysis

Power calculations regarding sample size included the primary outcomes (i.e., VO_2 max), and have been reported elsewhere (Papp et al., 2016). This required a minimum of 20 participants in each group. A 2-way repeated measures analysis of variance (ANOVA) was performed to test interactions (group x time) for each self-report outcomes. Additional analyses included Huynh-Feldt post-hoc tests, Student's t-tests (two-tailed) or Wilcoxon Rank-Sum tests (within and between groups). To analyze participants completing the intervention, we performed per protocol analyses (only including individuals participating in the intervention and in all measurements). Depending on skewness, either Wilcoxon signed rank tests or t-tests were computed to analyze differences between time points within and between groups. Statistically significant skewness emerged for depression, sleep quality, insomnia, and self-rated health. Depending on skewness, either Spearman (rs) coefficients or Pearson (rp) coefficients were computed. Cronbach's alpha coefficients were computed to indicate reliability. The significance level was set to $p < 0.05$. Differences before and after the intervention were calculated (value after the intervention minus baseline value). This means that a positive difference refers to an increased value after the intervention. All analyses, including sample size calculations, were performed using STATA 14 (College station, TX, USA).

Table 1
Results of group comparisons including means (M), standard deviations (SD), and confidence intervals (CI) for anxiety, depression, sleep quality, insomnia, perceived stress, subjective health complaints, and self-rated health at baseline and after 6 weeks for high intensity yoga (HIY) and for controls.

Outcome	HIY group (n = 21)					Control group (n = 23)			p-value PI[b] HIY vs. controls	Reliabilities[a]
	Anova time p**	Anova group x time p**	Baseline M±SD (CI)	6 weeks M±SD (CI)	p-value	Baseline M±SD (CI)	6 weeks M±SD (CI)	p-value		Baseline/6 weeks
Anxiety	0.93	0.25	6.9 ± 2.9 (5.54 8.17)	7.4 ± 4.2 (5.49 9.27)	0.50	7.6 ± 4.2 (5.74 9.39)	7.0 ± 4.3 (5.12 8.80)	0.36	0.26	0.76/0.83
Depression	0.19	0.43	4.0 ± 3.0 (2.58 5.33)	3.7 ± 3.0 (2.33 5.10)	0.89	4.4 ± 3.6 (2.82–5.97)	3.4 ± 3.3 (1.99–4.88)	0.16	0.20	0.76/0.80
Sleep quality	0.57	0.28	5.5 ± 3.2 (4.09 6.96)	5.7 ± 3.7 (4.02 7.41)	0.87	5.4 ± 2.3 (4.43 6.44)	4.8 ± 1.8 (4.06 5.59)	0.27	0.59	n/a
Insomnia	0.27	0.63	8.3 ± 6.1 (5.56 11.11)	8.0 ± 6.2 (5.19 10.81)	0.96	7.3 ± 3.6 (5.76 8.84)	6.5 ± 3.7 (4.88 8.08)	0.16	0.31	0.82/0.87
Stress	0.80	0.72	16.0 ± 7.1 (12.74 19.16)	16.0 ± 6.4 (13.12 18.97)	0.96	17.1 ± 6.0 (14.52 19.74)	16.6 ± 6.7 (13.69 19.45)	0.73	0.72	0.82/0.85
SHC	0.73	0.40	11.3 ± 6.5 (8.36 14.31)	10.9 ± 6.8 (7.79 14.02)	0.90	11.0 ± 6.7 (8.04 13.87)	12.0 ± 6.0 (9.41 14.59)	0.27	0.47	n/a
SRH	0.80	0.50	2.1 ± 0.7 (1.81 2.47)	2.0 ± 0.7 (1.74 2.35)	0.53	2.0 ± 0.8 (1.66 2.34)	2.0 ± 0.6 (1.80 2.29)	0.74	0.49	n/a

Anxiety = Hospital Anxiety and Depression Scale with higher scores indicating more symptoms of anxiety; Depression = Hospital Anxiety and Depression Scale, with higher scores indicating more symptoms of depression; Sleep quality = Pittsburgh Sleep Quality Index with high scores reflecting poor sleep and with scores above 5 indicating poor sleep while 8 is the accepted clinical criterion; Insomnia = Insomnia Severity Index, high scores reflect poor sleep with scores between 8 and 14 indicating some sleeping problems, 15–21 indicating moderate sleep disorder, and scores above 22 reflect severe insomnia; Stress = Perceived Stress Scale, high scores reflect more stress; SHC = Subjective Health Complaints; high scores reflect more complaints. SRH = Self-rated health; low scores indicate better health.
p = p-value, p **: ANOVA findings.
[a] Reliabilities are Cronbach's alpha coefficients.
[b] PI = post intervention.

4. Results

Results showed no significant between-group effects in any of the health-related outcome measures at baseline or at follow-up, after the 6-week HIY program (Table 1). As for age, sex, and height and weight distributions, the HIY group included 21 participants (median age: 25 years; age range: 20–37 years; 3 men; height 1.66 m, range 1.59–1.93; weight (kg) 65.4 ± 12.8) and the control group included 23 participants (median age: 25 years; age range: 20–39 years; 3 men; height 1.68 m, range 1.53–1.91; weight 62.8 ± 8.5).

4.1. High intensity yoga (HIY) dose and its associations with self-reported outcomes

Analyzing difference scores between time points within the HIY group (Table 2) showed that increased home training was associated with lower depression scores (rp = 0.51, p = 0.02), lower PSQI-scores (rp = 0.55, p = 0.01), and lower ISI-scores (rp = 0.49, p = 0.02). Unfortunately, a more detailed analysis of home training was restricted due to the small sample size. Yet, analyzing participants (n = 15) reporting 300–600 min of home practice showed a strong significant association between time and sleep quality (rp = 0.74, p = 0.002; Fig. 2, Table 2). Also, a higher total HIY dose, including both instructor-led yoga classes and home training, was associated with lower depression scores (rp = 0.47, p = 0.03). However, there were no other statistically significant associations with HIY dose.

The mean HIY dose for the instructor-led classes in the HIY group amounted to 240 min (max.: 360 min, range 60–360 min). This corresponds to an average of four classes during the six-week intervention. The total HIY dose, including both instructor-led classes and home training, amounted to 390 min (range:210–800 min), with home training amounting to 135 min (range: 0–560 min). The control group did not change their exercise behavior during the six-week intervention but maintained their ordinary physical activity regimen (maximum 2 h/week).

As for feasibility, all participants managed to perform the HIY program. Regarding safety, neither instructors nor test leaders observed any injuries and none of the participants reported any injury.

5. Discussion

Studying the immediate and short-term effects of 6-week high intensity yoga (HIY) program among healthy students, the present study showed, contrary to our expectations, no significant effects on any of the investigated health-related outcomes. However, secondary findings of the HIY group including the analysis of HIY training dose, showed that more HIY home training was associated with less symptoms of depression, better sleep quality, and less insomnia symptoms. The total HIY dose and home training was also

Table 2
Associations (Pearsons r) between yoga dose and depression, sleep quality, and insomnia respectively after 6 weeks of high intensity yoga.

Outcome	Home training (HT) N = 21		Total yoga dose (TYD) N = 21		TYD and HT 300–600 min n = 15		
	rp	p	rp	p	rp	(p-value)	
Depression	0.51	**0.02***	0.47	**0.03***	0.07	(0.81)	TYD
					0.21	(0.45)	HT
Sleep quality	0.55	**0.01***	0.34	0.13	0.45	(0.09)	TYD
					0.74	(**0.002***)	HT
Insomnia	0.49	**0.02***	0.40	0.08	0.43	(0.11)	TYD
					0.58	(**0.02***)	HT

Yoga (HIY). Home training (HT) and total yoga dose (TYD).
Total yoga dose = TYD, home training and attended yoga classes; rp = correlation (Pearson); p = p-value; min = minutes.
Depression = Hospital Anxiety and Depression Scale.
Sleep quality = Pittsburgh Sleep Quality Index; Insomnia = Insomnia Severity Index.
*p < 0.05, significant associations in bold.

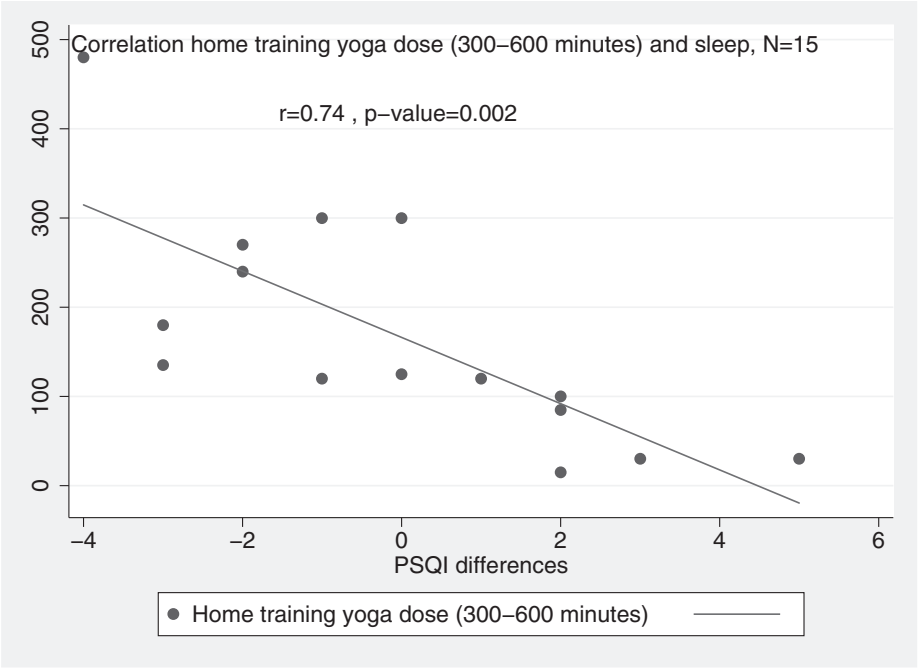

Fig. 2. Association between home-training yoga dose and sleep quality (Pittsburgh Sleep Quality Index).

Fig. 3. Vigorous sun-salutations. Note that the third exercise in the top row was performed with bent knees; the seventh exercise in the top row was performed with knees on the ground, straight arms and hips high, as a synthesis between the cobra pose and upward facing dog pose.

associated with reduced symptoms of depression. This suggests that the HIY dose, and in particular the home training dose, is important for health-related outcomes including depressive symptoms and sleep.

5.1. Anxiety and depression

As for anxiety and depression, the present study showed no consistent effects of HIY as compared to the control group. This is in contrast with previous studies which have reported small to moderate effects of YE on symptoms of anxiety and depression (Vollbehr et al., 2018; Domingues, 2018; Cramer et al., 2018). However, these studies have typically included patient groups with a diagnosis or groups with more severe symptoms of anxiety and depression than those reported by the students included in the present study. Yet, a closer look at findings from different patient groups show that results are mixed, with some studies reporting no effects (Sudarshan et al., 2013; Kiecolt-Glaser et al., 2014).

When it comes to HIY dose (home training and classes), our results showed statistically significant associations with reduced symptoms of depression. No such association emerged for symptoms of anxiety. This may relate to symptoms of anxiety not only being higher among study participants but also among students in general. With anxiety being part of their daily life, and typically relating to worrying about academic performance or financial matters, anxiety is perhaps more difficult to change. However, it has to be emphasized that symptoms of both anxiety and depression, and symptoms of depression in particular, were below cut-offs considered clinically relevant. This probably relates to the strict inclusion criteria which, in turn, allow little room for change over a shorter time period of about six weeks.

5.2. Stress

As for perceived stress, the body positions (e.g., supine and inverted postures) that were included in the HIY program may,

through stimulation of the baroreceptor reflex (Tai and Colaco, 1981; Selvamurthy et al., 1998) and relaxation, yield parasympathetic activity. Also, previous research has found significantly lower perceived stress levels (Michalsen et al., 2012; Bussing et al., 2012; Pascoe and Bauer, 2015) after YE. Despite reports of weekly hatha yoga having effects on stress similar to those resulting of exercising twice a week (Michalsen et al., 2012), we found no effects on perceived stress. This may relate to the yoga dose of the present study being insufficient for a healthy sample of individuals with low baseline levels of perceived stress.

5.3. Sleep

Regarding sleep quality and insomnia, healthy yoga practitioners have been found to report better sleep quality as compared to controls (Vera et al., 2009; Bankar et al., 2013). However, these studies have included experienced yoga practitioners. Despite the present study participants being healthy, they were novice to yoga and and good sleepers (approx. PSQI-score of 5), with no insomnia. Obviously, this gives little room for additional improvement and probably explains why there were no effects on sleep quality or insomnia. Still, the analysis of HIY dose showed that more HIY home training was associated with less depression, better sleep quality, and less insomnia. This suggests that participants who reported spending more time on home training were more compliant, which potentially has positive effects. Yet, it should be acknowledged that some previous findings of healthy (but mostly older) individuals (Elavsky and Mcauley, 2007; Taibi and Vitiello, 2011) show no effects, while moderate effects are shown in individuals with sleep problems (Wu et al., 2015) Importantly, significant effects on sleep quality and insomnia are very likely to require groups reporting such problems, but also longer interventions for inexperienced yoga practitioners, including a stricter focus on and monitoring of compliance, and with long-term follow-ups.

Similar to the sleep measures, levels of subjective health complaints and self-rated health showed that the present study included a healthy sample. For subjective health complaints, the average score was 11 (out of maximum 45) in both groups, thus reflecting few subjective health complaints. Also, participants' self-rated health was very good, again leaving little room for improvement, which along with the sample size, probably explains why there were no significant effects.

5.4. Feasibility

In terms of feasibility, safety and injury reports, our findings aligned with expectations of the HIY being feasible to perform, safe and without any injuries. This probably relates to the careful screening of participants and the instructors taking care to show participants how to perform HIY. Thus, clinicians can recommend HIY as a form of physical exercise for healthy students who prefer yoga exercises.

5.5. Methodological considerations

An obvious limitation relates to the HIY training dose being low; on average around 6.5 h distributed over six weeks. Thus, further encouragement of home training and perhaps possibilities to attend additional classes along with careful monitoring of compliance is needed. Overall, the HIY dose was probably insufficient to influence the health-related outcomes that were investigated. Also, the large variation in time spent on home training is an issue. In view of the program involving a very intensive physical yoga, home training may have been too challenging for this inexperienced but healthy student group. Also, the short intervention time may be a challenge for individuals being novice to yoga to be motivated to learn to master adequately the poses and the program to yield clear effects on health-related outcomes. Also, in the middle of the intervention period, many suffered from common colds meaning that they missed at least one weekly yoga class.

When it comes to the control group, the participants were asked to keep up their ordinary physical activity regimen. Ideally, the control condition should perhaps have included a comparison including a lower intensity YE. However, the students in the control group did receive weekly attention and were monitored and reminded of being part of a study. This may of course have had an effect. Yet their physical activity levels remained stable throughout the study period.

With this study reporting on secondary outcomes, the statistical power calculations were based on the primary outcomes. To get significant effects, larger samples are needed. Also, the students included in the study reported surprisingly few health-related problems, thus giving little room for any change over a short time period. However, the health-related outcomes studied here include self-reports typically investigated in yoga research. Importantly, previously validated self-report measures were used with their reliabilities (where applicable) being satisfactory.

Taken together, the present study can be considered a feasibility study showing that it is possible to recruit students who are novice to yoga to high intensity training without them suffering from any negative effects in the investigated outcomes.

6. Conclusions

This study showed no significant between-group effects of HIY on secondary health-related outcomes, including symptoms of anxiety and depression, sleep quality, insomnia, perceived stress, subjective health complaints, and self-rated health. This may relate to the relatively low HIY dose that was delivered during a shorter period of 6 weeks to a healthy student group but also to challenges relating to compliance regarding home training. However, within the HIY-group significant associations emerged and showed that a higher HIY dose had positive effects of depressions and sleep.

7. Clinical relevance

- A higher yoga dose decreased symptoms of depression
- A higher yoga dose improved sleep
- High intensity yoga is a feasible form of physical activity for healthy students
- Healthy students reported no injuries from high intensity yoga
- High intensity yoga can be recommended to healthy students

Conflicts of interest

We conformed to the Helsinki Declaration concerning human rights and informed consent, and followed standard procedures concerning treatment of humans. The first author is an experienced registered yoga teacher and yoga therapist (E-RYT, C-IAYT). None of the authors have any conflict of interest.

Authors' contributions

All authors were involved in designing the study. The first author educated the yoga teachers. The first and last authors analyzed the data. The first author drafted the manuscript mainly assisted by the last author, while other authors provided input on

the manuscript. All authors read and approved of the final version of the manuscript.

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