

# **The effects of yoga on stress and psychological health among employees: an 8- and 16-week intervention study**

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**Objectives:** This study investigated the effects of 8- and 16-week gym yoga on stress and psychological health.

**Design and Method:** Ninety individuals reporting moderate-to-high stress were randomly assigned to 16 consecutive weeks of yoga, or to a waitlist crossover group who did not practice yoga for 8 weeks then practiced yoga for 8 weeks. Stress and psychological health variables were assessed at baseline, 8 weeks, and 16 weeks.

**Results:** Significant reductions in stress and all psychological health measures were found within the Yoga group over 16 weeks. When compared to the control group, yoga practitioners showed significant decreases in stress, depression, insomnia, and general psychological health complaints, and significant increases in well-being. The group who did not practice yoga showed significant decreases in stress, anxiety, depression, insomnia, and general psychological health complaints after they crossed over and practiced yoga for 8 weeks.

**Conclusions:** Gym yoga appears to be effective for stress amelioration and promotion of psychological health among workers experiencing stress.



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### KEYWORDS

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### Introduction

Stress is on the rise among adults (American Psychological Association, 2012), with work stress in particular leading to problems with job performance (Glise, Hadzibajramovic, Jonsdottir, & Ahlberg, 2010), absenteeism (Cox, Griffiths, & Rial-Gonzalez, 2000), burnout (Plieger, Melchers, Montag, Meermann, & Reuter, 2015), and compromised psychological and physiological health (Nilsen et al., 2014). This host of consequences indicates that people need effective coping strategies to manage modern work life.

Not coincidentally, there has been a surge of interest in accessible, stress-reducing practices such as yoga (Barnes, Bloom, & Nahin, 2008; Cramer et al., 2016). A U.S. National Health Interview survey found that the number of people practicing yoga has doubled over a 10-year period (2002–2012; National Center for Health Statistics, 2012), and yoga classes are now routinely offered at local gyms and fitness centers. However, there is little research available from these types of settings. Most investigations of yoga modify standard practices to adjust to clinical samples (Beltran et al., 2016; Bijlani et al., 2005; Janelsins et al., 2016; Mitchell et al., 2014; Van der Kolk et al., 2014). Other types of yoga research require excessive time and place commitments

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(Gard et al., 2012), or they are carried out in specialized yoga studios (Bryan, Pinto, & Raju, 2012; Gaskins, Jennings, Thind, Becker, & Bock, 2014). These studies inform us little about everyday people and the community resources they likely have access to. Thus, the present study is designed to examine common gym yoga on stress reduction and psychological health among non-clinical individuals.

In previous research, yoga has been found to be effective for reducing stress (Brisbon & Lowery, 2011; Gard et al., 2012; Rocha et al., 2012) and ameliorating psychological health factors associated with high stress, such as excessive worry (anxiety; Li & Goldsmith, 2012), rumination (depression; Kinser, Bourguignon, Whaley, Hauenstein, & Taylor, 2013), and mood (Streeter et al., 2010). There are also well-documented consequences of stress on physiological health. These include risk of cardiovascular disease (Kivimaki & Kawachi, 2015; Li, Zhang, Loerbroks, Angerer, & Siegrist, 2015), metabolic syndrome (Chandola, Brunner, & Marmot, 2006), and musculoskeletal disorders (Schneider & Irastorza, 2010).

Ross and Thomas (2010) reviewed studies examining yoga and dynamic, aerobic exercise (e.g., running and cycling) for general health conditions, and concluded that yoga is as effective or better at improving health-related outcomes (e.g., relieving physical symptoms, reducing pain and lowering blood pressure). When added to usual cardiac care in randomized controlled trials, yoga has also been shown to be significantly better than usual care at improving blood lipid levels (Manchanda et al., 2000), decreasing markers of inflammation (Pullen et al., 2008), and reducing the number of coronary revascular procedures (Manchanda et al., 2000).

Yoga's putative effect on stress appears to rely on a bodily shift to parasympathetic nervous system (PNS) dominance. The slow breathing and movement patterns in yoga stimulate the vagus nerve and lower blood pressure and heart rate (Salmon, Lush, Jablonski, & Sephton, 2009). This is compared to aerobic exercise which activates the sympathetic nervous system, elevating blood pressure and heart rate. Yoga has also been found to increase the inhibitory neurotransmitter Gamma-aminobutyric acid (Streeter et al., 2007; Streeter, Gerbarg, Saper, Ciraulo, & Brown, 2012), producing anxiolytic effects.

Some have also suggested that the mindfulness component of yoga may be a key factor in explaining its health effects, as mindfulness has garnered robust scientific support for stress reduction (Carmody & Baer, 2008). Mindfulness is defined as attention – in an open monitoring state – which allows practitioners to recognize their thoughts and experiences as merely occurring (i.e., meta-awareness) without need for judgment or change (Kabat-Zinn, 1994). In yoga, strength, balance, coordination, and proprioception all require attention (Lutz, Slagter, Dunne, & Davidson, 2008; Raffone & Srinivasan, 2010).

What is more, yoga postures are sometimes difficult or disorientating (e.g., poses with the head under the heart) but the practitioner uses a breathing technique (Ujjayi breathing) to stay calm and focused. Slow, purposeful, controlled breathing helps the individual “turn towards unpleasant or stressful sensations that arise in the context of the physical practice, and breathe into them rather than avoid or fight them” (Hayes, Strosahl, & Wilson, 1999; Schmalzl, Powers, & Henje Blom, 2015).

In summary, it appears that focused attention and controlled breathing still the mind from external distractions while activating the “rest and digest” PNS system, producing stress relief (Brown & Gerbarg, 2009; Cahn & Polich, 2006).

The purpose of the present study is to examine the effects of gym yoga for stress and psychological health. To our knowledge, this is the first study to investigate easily accessible yoga in a non-clinical sample using a randomized, controlled, short-term, and crossover follow-up design. We hypothesized that yoga classes twice a week for 8 and/or 16 weeks would reduce stress and increase psychological health and well-being among employees reporting moderate-to-high levels of stress.

## **Method**

### ***Ethical considerations***

This study was reviewed and approved by the Regional Ethics Board at Lund University, Sweden. In accordance with ethical regulations for research involving human subjects, informed consent was obtained from all participants. Participants were informed the study was voluntary and of their right to drop out for any reason without penalty. Each participant was assigned a personal research number to preserve confidentiality on study-related documentation.

### ***Participants***

Employees at a large University (>40,000 students) were recruited for participation in this study. They were informed about the research through email announcements sent via Human Resources. Those with interest in participation were invited to a secure website to provide their contact information to research staff. Subsequently, they were contacted for a comprehensive telephone interview.

Telephone interviews were conducted by research staff who were not associated with the data collection or yoga intervention. Information about the study was given and eligibility was assessed. Individuals were required to be working at least 50% of full time and report at least a moderate level of stress (i.e., a score of 8 or greater) using four items from the Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983). Eligible participants were also required to be available during the intervention period (1 hour, 2 times per week, for 16 weeks).

Exclusion from participation was made for anyone practicing yoga or meditation in the past year, or if there were known physical limitations preventing light physical activity (yoga postures). Individuals were also assessed for major mental distress, wherein indications of suicidal ideation, self-harm, or psychosis were exclusionary.

Two hundred were screened for participation with 90 individuals meeting eligibility requirements. They were subsequently randomly assigned using Research Randomizer which generated a two-group randomization list. Participants were assigned to one of two study conditions:

- (1) Yoga group (Yoga): Yoga practice, 1 hour, twice a week for 16 consecutive weeks.
- (2) Waitlist – Crossover group (WaitCross): No yoga for 8 weeks (i.e., control group), then yoga practice, 1 hour, twice a week for 8 consecutive weeks.

Following randomization, each participant received a welcome letter by mail indicating their yoga schedule and a “yoga diary” to verify completed yoga sessions each week. Additionally, a battery of self-report measures was sent for completion and return (baseline, Time 1 (T1)). Demographics for the sample who completed the T1 measures can be found in Table 1.

### ***Design***

This study was a mixed, between-within subjects design with repeated measures involving three data collection time points. It consisted of an 8-week between-subjects phase (Phase I) and an 8-week continuation phase with active crossover (Phase II). The two phases were contiguous, with a total study period of 16 consecutive weeks.

Phase I began at pre-intervention (baseline; Time 1, T1) and lasted 8 weeks (Time 2, T2). Participants assigned to the Yoga group practiced yoga for 1 hour, twice a week. The WaitCross group did not practice yoga or any other exercise during this period, allowing for comparisons between intervention and control groups from T1 to T2. Phase II began at T2 and lasted 8 weeks (Time 3, T3). Here, the Yoga group continued with yoga, 1 hour, twice a week, and the WaitCross group switched over and began the active intervention, practicing yoga for 1 hour, twice a week. Phase

**Table 1.** Descriptive statistics of the participants at baseline (T1).

Variable	Total (N = 80)	Yoga group (n = 43)	WaitCross group (n = 37)
Age (SD)	46.0 (10.0)	45.5 (10.0)	47.1 (10.4)
Gender			
Woman	66 (82.5%)	40 (93%)*	26 (70.3%) <sup>a</sup>
Man	14 (17.5%)	3 (7%)	11 (29.7%)
Marital status			
Single	10 (12.5%)	4 (9.3%)	6 (16.2%)
Married	57 (71.3%)	33 (76.7%)	24 (64.9%)
In a relationship	5 (6.3%)	4 (9.3%)	1 (2.7%)
Divorced	6 (7.5%)	1 (2.3%)	5 (13.5%)
Widowed/other	2 (2.6%)	1 (2.3%)	1 (2.7%)
Child status			
Yes	45 (56.3%)	25 (58.1%)	20 (54.1%)
No	35 (43.8%)	18 (41.9%)	17 (45.9%)
Employment status			
PhD student	14 (17.5%)	10 (23.3%)	4 (10.8%)
Post-doctoral/researcher	7 (8.8%)	5 (11.6%)	2 (5.4%)
Teaching staff	18 (22.6%)	8 (18.6%)	10 (27.0%)
Technical staff	9 (11.3%)	5 (11.6%)	4 (10.8%)
Administrative staff	25 (31.3%)	12 (27.9%)	13 (35.1%)
Other/unknown	7(8.8%)	2 (4.7%)	4 (10.8%)
Number of years working at the university			
Less than 1 year	5 (6.3%)	3 (7.0%)	2 (5.4%)
1–3 years	12 (15.0%)	4 (9.3%)	8 (21.6%)
4–5 years	13 (16.3%)	10 (23.3%)	3 (8.1%)
More than 5 years	47 (58.8%)	25 (58.1%)	22 (59.5%)
Unknown	3 (3.8%)	1 (2.3%)	2 (5.4%)

<sup>a</sup> $\chi^2 = 7.13, p = .008$ .

It allowed for assessment of the Yoga group for a total of 16 active intervention weeks and a within-subjects comparison of the WaitCross group from no intervention (T1–T2) to active intervention (T2–T3), thereby serving as their own controls.

A full battery of measures was taken at all three time points (T1, T2, and T3) for both study groups. At T1, measures were completed via paper with a mail-back envelope. At T2 and T3, participants were invited to a confidential, secure web-survey link. Using their unique research code, participants accessed and completed the study's measures online.

### Intervention

The intervention for this study is known as Power yoga. Power yoga was selected as it is commonly found at gyms and fitness centers, thus representing a "real-world" scenario that everyday individuals could easily access. In general, the practice of Power yoga uses the physical body to build strength and flexibility while relying on regulated breathing to stay in a calm psychological space during the physical challenge of yoga postures.

Power yoga classes allow instructors some freedom to select from the many yoga poses available (Iyengar, 1995). Therefore, classes do not necessarily follow a strict pre-determined series of postures. However, certain key elements are present in every class: a beginning set of poses to slowly warm up the body and spine in particular (approx. 5 minutes), a selection of yoga poses with cues to direct attention to breathing in synchrony with the poses (approx. 50 minutes), and a final period of relaxation in supine position to rest and recover (approx. 5 minutes).

To ensure participants received the same intervention as best as possible, classes were held at one location only – a local University affiliated fitness center. Fifteen yoga instructors were involved in the study, and they did not know which students were research subjects. All instructors were female except one, and they each completed the same 9-month training for instructing Power yoga. Classes were 60 minutes and conducted in a group format.

## Measures

Baseline (T1) and post-intervention (T2 and T3) assessments measured the following variables: Perceived stress, anxiety, depression, sleep quality, general psychological health, life satisfaction, harmony in life, mindfulness, and experiential avoidance.

*The PSS* (Cohen et al., 1983) is a 10-item scale measuring the degree to which situations in one's life are appraised as stressful. Items are rated on a 5-point scale from 0 (never) to 4 (very often). The PSS has shown good internal consistency with alpha coefficients ranging from .80 to .86 (Nordin & Nordin, 2013). In the present study, the alpha values were .78 (T1), .84 (T2), and .81 (T3).

*General Health Questionnaire* (GHQ; Goldberg & Williams, 1988) consists of 12 items, each one assessing the severity of a psychological problem over the past few weeks using a 4-point scale (0–3). Previous research has shown high internal consistency with alpha values ranging from .82 to .86 (Goldberg & Williams, 1988). For this study, the alpha values were .85 (T1), .89 (T2), and .89 (T3).

*The Hospital Anxiety and Depression Scale* (HADS; Zigmond & Snaith, 1983) is a 14-item scale used to assess levels of anxiety (7 items) and depression (7 items), with items scored from 0 to 3. The psychometric properties of the HADS are well-established with average alpha coefficients for the anxiety and depression subscales .83 and .82, respectively (Bjelland, Dahl, Haug, & Neckelmann, 2002). In the present study, alpha values were .78 (T1), .84 (T2), .81 (T3) for anxiety and .79 (T1), .84 (T2), .82 (T3) for depression.

*The Insomnia Severity Index* (ISI; Morin, 1993) is a 7-item screening measure of insomnia. Items assess severity of sleep onset and maintenance difficulties, satisfaction with current sleep pattern, interference with daily functioning, appearance of impairment attributed to a sleep problem, and the degree of concern caused by insomnia. Items are rated on a 5-point scale from 0 (not at all) to 4 (extremely). The ISI has shown good internal consistency (Cronbach's alpha of .76; Bastien, Vallières, & Morin, 2001). The alpha values for the current study were .92 (T1), .89 (T2), and .86 (T3).

*Life satisfaction* was measured by three questions (1) How satisfied are you with your current life? (2) To what extent are you pleased with your present life? (3) How do you value your life? – using a 7-point scale from 1 (I am not satisfied with it/Not at all/Very bad) to 7 (I am totally satisfied with it /To a very high extent/Very good). In the present study, alpha values were .90 (T1), .96 (T2), and .94 (T3).

*The Harmony in Life Scale* (HILS; Kjell, Daukantaitė, Hefferon, & Sikström, 2016) assesses a global sense of harmony in one's life and consists of five statements (e.g., "Most aspects of my life are in balance"). Participants are asked to indicate degree of agreement on a 7-point scale from 1 (strongly disagree) to 7 (strongly agree). A total harmony score is established by summarizing the five statements. The HILS has shown high internal consistency (Cronbach's alpha of .91; Vainio & Daukantaitė, 2016) and in this study, the alpha values were .82 (T1), .91 (T2), and .86 (T3).

*The Kentucky Inventory of Mindfulness Skills – Short Version* (KIMS; Höfling, Ströhle, Michalak, & Heidenreich, 2011) is a 20-item multi-dimensional scale of interrelated skills related to what one does while practicing mindfulness, and how one does it. In this study, three subscales were selected that could be influenced by yoga, including "observing" (i.e., focusing full attention on current activity), "acting with awareness" (i.e., using undivided attention), and "accepting without judgment" (i.e., accepting, refraining from evaluation). These subscales show good internal consistency with alpha coefficients ranging from .80 to .85 (Baer, Smith, & Allen, 2004). In this study, the alpha values were .86 (T1), .92 (T2), .90 (T3) for observing, .71 (T1), .75 (T2), .79 (T3) for acting with awareness, .85 (T1), .92 (T2), .91 (T3) for accepting without judgment, and .80 (T1), .89 (T2), and .89 (T3) for the KIMS total.

*The Brief Experiential Avoidance Questionnaire* (BEAQ; Gamez et al., 2014) consists of 15 items used to assess behavioral avoidance (situational avoidance of physical discomfort and distress), distress aversion (non-acceptance of or negative attitudes toward distress), procrastination (delaying activities that may cause distress), distraction/suppression (attempts to ignore or suppress distress), repression/denial (distancing and dissociating from distress), and distress endurance (willingness to engage in behavior that is consistent with one's values even when in distress). Items are rated on a 6-point scale ranging from 1 (strongly disagree) to 6 (strongly agree). The scale shows good internal

consistency with alpha coefficients ranging from .80 to .89 (Gamez et al., 2014). In this study, the alpha values were .87 (T1), .89 (T2), and .87 (T3).

### **Statistical analyses**

Preliminary analyses were performed to examine comparability of the intervention and control groups on demographics and initial status of key variables. Independent-samples *t*-tests were computed to compare groups on all continuous variables at T1. For categorical variables, Fisher exact tests were used. For 2 × 2 tables, exact tests were conducted with SPSS. For all others, tests were conducted through online statistical services by simple interactive statistical analysis.

To test the effects of the intervention on outcome variables (stress, different aspects of psychological health and well-being), hierarchical linear modelling (HLM) was used, with intervention condition, time, and the interaction of intervention with time as fixed effects. Model estimates were obtained using restricted maximum likelihood estimation implemented with the mixed linear models module of SPSS (Heck, Thomas, & Tabata, 2014). Separate models were evaluated for each studied measure and tested (1) effects for intervention (coded as 0), time (coded as -1, 0, 1) and the interaction of intervention with time intervention × time and (2) simple effects of time across the three time points (baseline, 8 weeks and 16 weeks) within each group separately. Time was centered at T2 (8 weeks) to test hypotheses related to group differences at post-intervention. Models included both linear and quadratic effects for time. If the quadratic effect was not significant, the model was refitted without this term.

## **Results**

### **Descriptive statistics and randomization check**

Table 1 presents descriptive statistics for the full baseline sample, and as split by group. No significant differences between groups were found for any demographic variables apart from gender wherein the Yoga group had significantly more women as compared to the WaitCross group ( $z = 2.67$ ,  $p < .008$ ). For all outcome variables, no significant differences between groups were found on T1 scores, indicating a successful randomization.

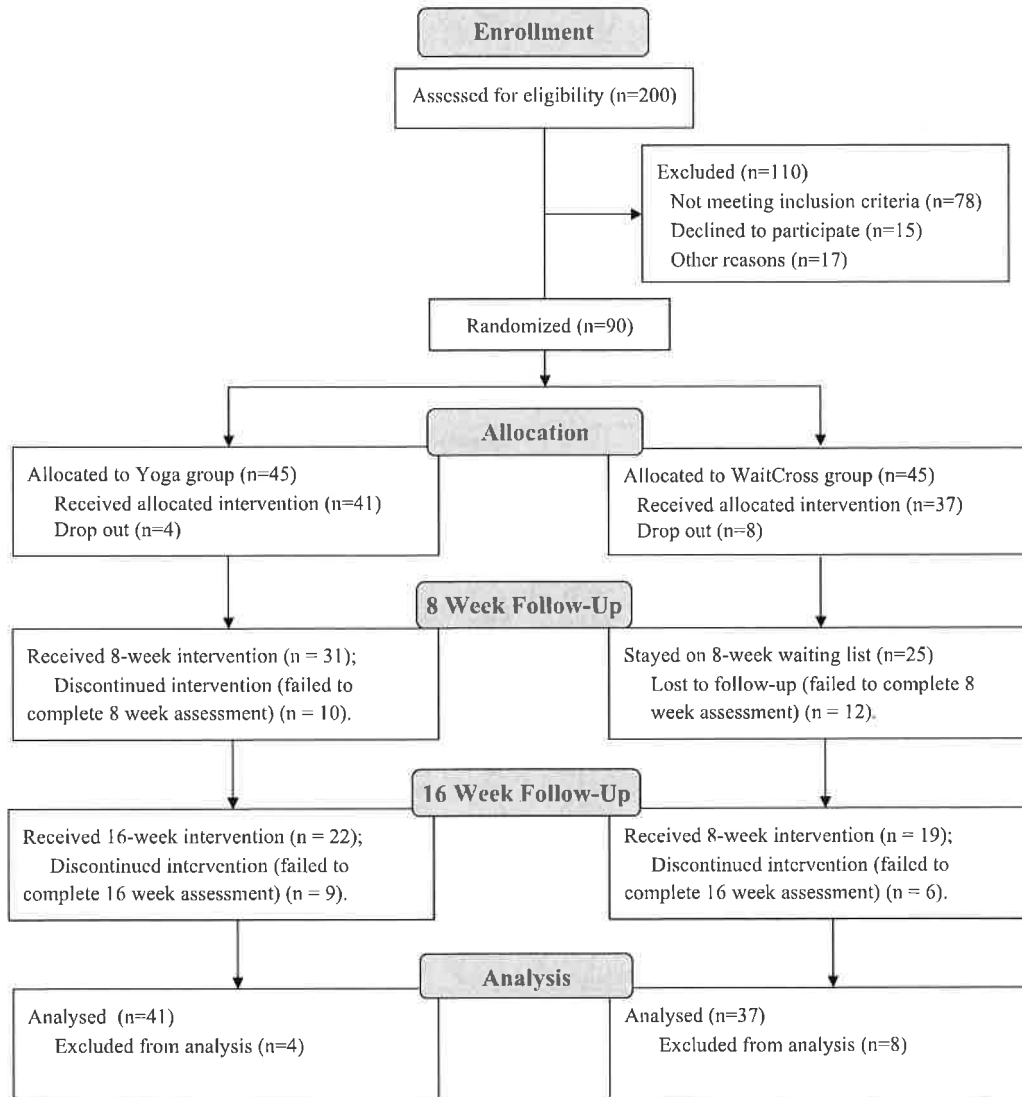
Figure 1 depicts participants as they proceeded through the study according to group assignment. Attrition analyses were conducted, and no significant differences were found between groups on T1 scores for any variable after attrition. Within the Yoga group, those who completed the study did not score significantly differently on any variables at T1 as compared to those who did not complete. Within the WaitCross group, one significant difference was found. Those who completed the study scored significantly lower at T1 on the HILS as compared to those who did not complete,  $t(35) = -2.19$ ,  $p = .035$ ,  $d = 0.72$ .

### **Phase I: T1–T2 (8 weeks) between-groups (Yoga vs. WaitCross) comparisons**

Table 2 presents the results of HLM analyses for all outcome variables. A significant main effect of intervention was interpreted as evidence for a differential intervention effect at T2. Participants in the Yoga group showed significantly lower PSS scores, GHQ scores, ISI scores, BEAQ scores, and HADS depression subscale scores as well as a significantly higher KIMS and HILS scores compared to the WaitCross group at T2. This indicates improvements in mental health over the 8-week intervention period.

### **Phase II: T1 to T2 to T3 (16 weeks) within-groups comparisons**

Table 3 presents results of the separate HLM analyses for all outcome variables across the three time points. As Table 3 and Figure 2 show, score changes were found for the Yoga



**Figure 1.** Consolidated Standards of Reporting Trials (CONSORT) diagram.

Note. Yoga group received 16-week intervention; WaitCross group did not receive yoga for 8 weeks (i.e., control group), then yoga practice, one hour, twice a week for 8 consecutive weeks.

group indicating significant differences for all outcome variables across the three time points. Notably, PSS scores dropped significantly at each time point (i.e., from T1 to T2 and again from T2 to T3).

For the WaitCross group, no significant changes on outcome scores between T1 and T2 were expected, with expected significant score changes from T2 to T3 (i.e., crossover into yoga). As can be seen in Table 3, scores between T1 and T2 were not significantly different except for Mindfulness, which increased during the control period. Between T2 and T3, significant changes were found for stress, anxiety, depression, and insomnia scores, with no significant increases in well-being. General psychological health significantly improved from T1 to T3, and statistically significant differences were found for Mindfulness from T1 to T2 to T3.



**Table 2.** Results of HLM examining between-group yoga effect on study outcomes.

Effect	Perceived stress				General health				Anxiety			
	B (SE)	t	p	95% CI	B (SE)	t	p	95% CI	B (SE)	t	p	95% CI
Intercept	16.4 (0.7)	24.4	<.001	[15.1;17.8]	23.3 (0.7)	34.3	<.001	[21.9;24.6]	15.0 (0.4)	38.4	<.001	[14.3;15.8]
Intervention	2.2 (1.0)	2.2	.030	[0.2; 4.1]	2.3 (1.0)	2.3	.021	[0.3; 4.3]	0.3 (0.6)	0.6	.548	[-0.8; 1.5]
Time	-3.4 (0.8)	-4.2	<.001	[-5.1; -1.8]	-2.9 (0.8)	-3.5	.001	[-4.5; -1.3]	-2.2 (0.5)	-4.6	<.001	[-3.1; -1.2]
Intervention × Time	1.5 (1.2)	1.3	.205	[-0.8; 3.9]	2.2 (1.2)	1.8	.073	[-0.2; 4.6]	1.2 (0.7)	1.7	.095	[-0.2; 2.6]
Effect	Depression				Sleep problems				Life satisfaction			
	B (SE)	t	p	95% CI	B (SE)	t	p	95% CI	B (SE)	t	p	95% CI
Intercept	12.3 (0.4)	31.2	<.001	[11.5;13.1]	15.3 (0.6)	24.9	<.001	[14.1;16.5]	15.3 (0.4)	40.4	<.001	[14.5;16.0]
Intervention	1.2 (0.6)	2.1	.041	[0.1; 2.3]	2.1 (0.9)	2.4	.019	[0.4; 3.9]	-0.9 (0.6)	-1.7	.094	[-2.0; 0.2]
Time	-1.2 (0.5)	-2.4	.015	[-2.1; -0.2]	-2.1 (0.8)	-2.8	.006	[-3.6; -0.6]	0.8 (0.5)	1.7	.101	[-0.1; 1.7]
Intervention × Time	0.4 (0.7)	0.6	.570	[-1.0; 1.8]	0.6 (1.1)	0.6	.566	[-1.5; 2.8]	-0.4 (0.7)	-0.7	.508	[-1.8; 0.9]
Effect	Harmony in Life				Mindfulness				Experiential Avoidance			
	B (SE)	t	p	95% CI	B (SE)	t	p	95% CI	B (SE)	t	p	95% CI
Intercept	23.3 (0.7)	35.9	<.001	[22.1;24.6]	49.9 (1.0)	53.2	<.001	[48.1;51.8]	40.9 (1.3)	31.8	<.001	[38.4;43.5]
Intervention	-2.9 (1.0)	-3.1	.003	[-4.8; -1.0]	-2.7 (1.4)	-2.0	.051	[-5.5; 0.1]	3.8 (1.9)	2.0	.046	[0.1; 7.6]
Time	3.0 (0.8)	3.7	<.001	[1.4; 4.5]	3.9 (1.1)	3.4	.001	[1.7; 6.2]	-2.8 (1.6)	-1.8	.076	[-5.9; 0.3]
Intervention × Time	-2.6 (1.2)	-2.2	.029	[-4.8; -0.3]	-1.9 (1.7)	-1.1	.253	[-5.2; 1.4]	1.8 (2.3)	0.8	.439	[-2.8; 6.3]

**Table 3.** Estimated marginal means, standard errors (in parentheses) and results of HLM examining within-group effects on study outcomes.

Variable	Yoga group			Within-group effect of time	WaitCross group			Within-group effect of time
	T1	T2	T3		T1	T2	T3	
Perceived stress	20.2 <sup>ab</sup> (1.0)	16.1 <sup>ac</sup> (1.1)	13.6 <sup>bc</sup> (1.2)	$F(2,26.6) = 14.7, p < .001$	20.2 <sup>a</sup> (1.0)	18.9 <sup>b</sup> (1.1)	14.9 <sup>ab</sup> (1.3)	$F(2,24.5) = 22.6, p < .001$
General health	25.9 <sup>ab</sup> (1.0)	23.1 <sup>a</sup> (1.0)	20.9 <sup>b</sup> (1.3)	$F(2,27.8) = 9.1, p < .001$	26.1 <sup>a</sup> (1.0)	25.7 <sup>b</sup> (1.3)	23.4 <sup>ab</sup> (1.3)	$F(2,21.3) = 5.4, p = .013$
Anxiety	17.5 <sup>ab</sup> (0.6)	14.5 <sup>a</sup> (0.7)	13.6 <sup>b</sup> (0.7)	$F(2,26.9) = 17.6, p < .001$	16.3 <sup>a</sup> (0.6)	15.4 <sup>b</sup> (0.8)	13.8 <sup>ab</sup> (0.7)	$F(2,22.6) = 8.7, p < .001$
Depression	13.4 <sup>a</sup> (0.6)	12.6 <sup>b</sup> (0.6)	11.2 <sup>ab</sup> (0.6)	$F(2,26.3) = 6.2, p < .001$	14.0 <sup>a</sup> (0.7)	14.0 <sup>b</sup> (0.8)	11.7 <sup>ab</sup> (0.7)	$F(2,22.7) = 13.7, p < .001$
Sleep problems	17.4 <sup>ab</sup> (1.0)	15.2 <sup>a</sup> (1.1)	13.1 <sup>b</sup> (1.0)	$F(2,25.4) = 11.9, p < .001$	18.9 <sup>a</sup> (1.0)	17.4 <sup>b</sup> (1.0)	15.1 <sup>ab</sup> (0.9)	$F(2,24.7) = 13.8, p < .001$
Life satisfaction	14.4 <sup>a</sup> (0.5)	15.9 <sup>a</sup> (0.6)	15.6 (0.7)	$F(2,21.0) = 5.5, p = .012$	14.2 (0.6)	13.8 (0.7)	15.0 (0.6)	$F(2,23.1) = 1.8, p = .190$
Harmony in life	20.4 <sup>ab</sup> (1.0)	23.7 <sup>a</sup> (1.1)	25.5 <sup>b</sup> (1.2)	$F(2,28.6) = 12.0, p < .001$	20.2 (0.9)	20.9 (1.2)	22.4 (1.0)	$F(2,21.2) = 3.3, p = .055$
Mindfulness	45.8 <sup>ab</sup> (1.3)	50.5 <sup>a</sup> (1.6)	52.3 <sup>b</sup> (1.8)	$F(2,24.0) = 14.6, p < .001$	45.4 <sup>a</sup> (1.3)	47.8 <sup>b</sup> (1.5)	50.5 <sup>ab</sup> (1.5)	$F(2,21.5) = 11.8, p < .001$
Experiential avoidance	43.8 <sup>a</sup> (2.1)	40.1 (2.1)	38.5 <sup>a</sup> (2.1)	$F(2,28.3) = 3.9, p = .032$	45.9 (1.8)	42.8 (2.0)	42.6 (2.3)	$F(2,21.7) = 2.4, p = .118$

Note: Estimated marginal means sharing the same superscript are significantly different from each other within each group.

## Discussion

The purpose of this study was to investigate the effects of gym yoga on stress and psychological health among non-clinical individuals. When examining changes within the same individuals over a 16-week period, results showed that taking yoga classes significantly improved psychological health. Participants reported less stress, anxiety, depression, insomnia, and distress avoidance behaviors and significant improvements in general psychological health and harmony in life. Even practicing yoga for 8 weeks had positive effects on perceived stress and health for participants, as compared to both the control (wait list) group and the participant's initial ratings.

These findings corroborate several studies on yoga as an intervention for stress reduction (Chong, Tsunaka, Tsang, Chan, & Cheung, 2011; Huang, Chien, & Chung, 2013), and improvements in anxiety and depression (Rocha et al., 2012), insomnia (Wolever et al., 2012), and well-being (Hartfiel et al., 2012). These results also expand the literature by demonstrating that an easily accessible type of yoga provided by local gyms may improve psychological health, which answers a recent public health call to increase understanding of real-world patterns and outcomes of yoga (National Center for Complementary and Alternative Medicine, 2011).

One particularly interesting finding from this study is that through yoga, people may learn to tolerate stress rather than try to avoid it. The findings show significant decreases in the measure experiential avoidance after 16 weeks (though no changes on this measure for either practicing Yoga group in 8 weeks), suggesting that people learnt a skill in yoga classes which, over time, could transfer off the yoga mat into everyday situations. For individuals who may have limited opportunities to reduce their daily stressors, a weekly yoga practice at the local gym may be an hour well invested.

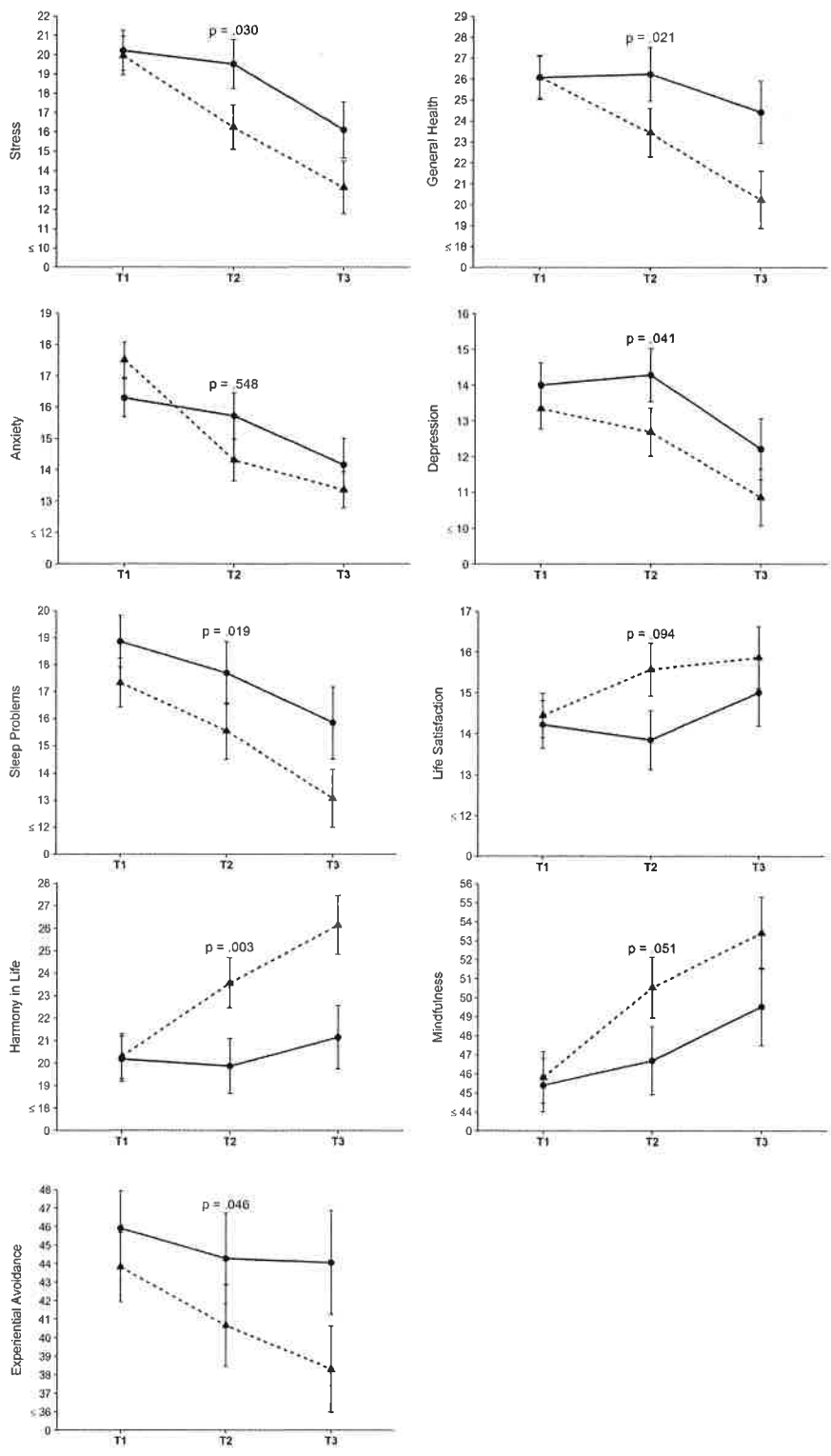
The participants in our study were University employees, and to our knowledge only two previous studies have examined the effects of yoga specifically in academic workplace organizations. Both these studies reported stress reductions via yoga practice (Brems, 2015; Hartfiel, Havenhand, Khalsa, Clarke, & Krayner, 2011). Thus, our results stand in line with previous research in this specific population.

In addition to positive health effects, our results showed that 16 weeks of gym yoga increased the participants' self-reported mindfulness. However, unexpectedly, the control group also increased their level of mindfulness while waiting to begin yoga classes. This curious result has also been seen in another 8-week yoga intervention for chronic stress (Harkess, Delfabbro, Mortimer, Hannaford, & Cohen-Woods, 2017). One speculation is that those interested in participating yoga began to self-educate on contemplative practices during the waiting period. Future studies could explicitly dissuade from self-education in yoga and mindfulness during the control period, with an interview following the study to determine compliance to these instructions.

Based on this study's findings, there are several recommendations for future research. First, additional knowledge is still needed about the effects of yoga among non-clinical populations. As has been shown here, functioning individuals (albeit stressed) garnered number of positive psychological health benefits. Thus, it appears that one does not need to be clinically ill to benefit from yoga practice.

Second, future research could supplement self-reports to include objective biological measures associated with psychologically experienced stress, such as heart rate, vagal tone, and salivary cortisol levels (Smeets, 2010). New evidence from the psychoneuroimmunological literature also shows that stress impacts circulating inflammatory markers (Steptoe, Hamer, & Chida, 2007). Thus, examining inflammatory responses could provide interesting biological data to couple with psychological data.

Given the accumulating findings on yoga for stress and health, a next important step would be to investigate the mechanism of action of these effects. Some have suggested this may occur by way of increased mindfulness (Carmody & Baer, 2008). However, in some studies including ours, mindfulness increased both in the intervention and control conditions – casting doubt on this as an explanatory variable (Harkess et al., 2017; Shelov, Suchday, & Friedberg, 2009). Recently, Gard, Noggle, Park, Vago,



**Figure 2.** Changes in marginal means from T1 to T2 to T3 for the Yoga (dotted lines) and WaitCross groups (solid lines). Error bars represent standard errors.

Note. *p* indicates between-group differences at T2.

and Wilson (2014) have put forward a comprehensive model of self-regulatory pathways that could serve as a guide for future research in this area.

Lastly, it is important to understand the ways in which yoga is similar or different in its stress reduction effect as compared to other types exercise, meditation, and/or relaxation techniques. Studies could be designed to directly compare approaches or with the goal of parsing the components of yoga to search for an "active ingredient". For example, exercise would mimic the physical challenge of yoga but does not include slow, regulated breathing. Meditation would mimic controlled breathing and mental attention but does not include physical movement. Relaxation (such as receiving massage) would mimic activation of the PNS but does not include physical challenge, controlled breathing, and mental attention.

Since it is likely that people expect to achieve benefits from yoga, it could also be interesting to design a study with a placebo arm wherein placebo participants are given an intervention that should not affect psychological health but to where they are led to believe it might. By this, it may be possible to disentangle what effects of yoga are due to expectations and what are due to the yoga itself.

### Limitations

The study presented here has limitations which must be acknowledged. First, since the main aim was to investigate effects of real-world yoga classes offered at the gym, the intervention contains some internal validity compromises. For example, the yoga classes varied slightly across sessions, which is typical for gym yoga, but it means less control over the intervention delivery. However, each session followed a general structure including grounding and centering to begin class, a selection of yoga poses cadenced to breathing cues, and a period of relaxation to close the class.

Next, the majority of participants in this study were women (82.5%), a clear gender imbalance. The study was open to both men and women, and it is possible that women are generally more interested in yoga as a modality as compared to men. Future research could benefit by recruiting equal numbers of men and women and looking for gender differences in outcome measures.

This study also has the limitation of solely relying on self-report measures, which has been criticized for problematic response bias (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). In some cases, participants may have presented themselves inaccurately knowing they were under evaluation. However, they answered questions on measures anonymously thereby minimizing the risk of favorably presenting themselves. Future research could continue to ensure participant anonymity on self-reports, but also consider adding health measurement markers that are more objective (e.g., blood pressure) and therefore less subject to response bias.

Last, there were a number of dropouts in this study. It is possible that moderate-to-high stressed individuals are a unique group of individuals conducive to problematic attrition in long-term intervention studies. Stress, by definition, occurs when a person perceives his/her environmental demands outweigh his/her personal resources to cope with those demands, thereby endangering well-being (Lazarus & Folkman, 1984). Thus for some stressed individuals it may have been daunting to add yet another environmental demand (i.e., going to twice weekly yoga), becoming too much to cope with and therefore resulting in dropout. Conversely, for other individuals, the benefits of attending yoga classes on a regular basis for stress reduction may have become an effective resource for coping. Future research could benefit by following up with participants at the time of dropout and/or study completion to understand their reasons for finishing or discontinuing early.

### Conclusions

In conclusion, the results from this study indicate that practicing yoga at the local gym twice a week may reduce stress and improve psychological health for the general working public. It provides support for the benefits of easily accessible yoga among individuals who experience daily work-stressors but are otherwise healthy and functional.

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No potential conflict of interest was reported by the authors.

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