cogent psychology

HEALTH PSYCHOLOGY | RESEARCH ARTICLE

The longitudinal mental health benefits of a yoga intervention in women experiencing chronic stress: A clinical trial

Kaitlin N. Harkess, Paul Delfabbro and Sarah Cohen-Woods

Cogent Psychology (2016), 3: 1256037

Harkess et al., *Cogent Psychology* (2016), 3: 1256037
http://dx.doi.org/10.1080/23311908.2016.1256037

cogent psychology

HEALTH PSYCHOLOGY | RESEARCH ARTICLE

The longitudinal mental health benefits of a yoga intervention in women experiencing chronic stress: A clinical trial

Kaitlin N. Harkess[1]*, Paul Delfabbro[2] and Sarah Cohen-Woods[3]

Received: 12 August 2016
Accepted: 28 October 2016
Published: 23 November 2016

*Corresponding author: Kaitlin N. Harkess, Department of Psychology, The University of Adelaide, Level 4, Hughes Building, Adelaide SA 5000, Australia
E-mail: kaitlin.harkess@adelaide.edu.au

Reviewing editor:
Cornelia Duregger, Neuroconsult, Austria

Additional information is available at the end of the article

Abstract: *Background and Objectives*: Chronic stress contributes to psychopathology and the practise of yoga is suggested to decrease stress and improve well-being. However, the literature often reports methodological problems (cross-sectional designs, sample sizes ≤ 20, and limited exploration of community populations). The aim of this study was to address these limitations and evaluate the potential psychological benefits of yoga to a non-clinical population. *Methods*: Women (N = 116) reporting chronic stress participated in this longitudinal study. Participants were allocated to a twice-weekly, hour-long yoga class for a period of two months, or a waitlist-control. Indicators of psychological well-being were measured at baseline, post-test and one-month follow-up. *Results*: Psychological distress decreased over time in both groups, however the control group experienced decreases in positive effect compared with the yoga group. Curvilinear trends were observed, indicating that trajectories of improvement seen at post-test were not robustly seen at follow-up. *Conclusion*: The study indicates that short-term yoga practise may yield some benefits to stressed individuals, but that evaluation over a longer term of practise may be required to determine the optimal dose for improvements and maintenance. Differential treatment effects may be difficult to detect in studies with populations that may already be motivated to improve their health.

ABOUT THE AUTHORS

Kaitlin Harkess, Paul Delfabbro and Sarah Cohen-Woods are conducting a multifaceted clinical trial exploring the psychological and biophysiological effects of a yoga intervention in a group of women reporting chronic stress (ACTRN12616000612415). Ms Harkess is a PhD Candidate at The University of Adelaide, a psychologist, and a yoga instructor. She has a strong interest in the application of mind–body interventions for clinical benefit, which falls under the field of psychoneuroimmunology. Professor Delfabbro lectures on methodology and statistics at The University of Adelaide. He has published broadly in the field of psychology, his principal research interests being in the areas of behavioural addictions, as well as child protection and out-of-home care. Dr Cohen-Woods lectures on behavioural genetics, and heads the Behavioural Genetic and Environmental Mechanisms Lab at Flinders University. Her research focuses on incorporating environmental factors, such as life stress, with genetic analysis in the context of mental and physical health.

PUBLIC INTEREST STATEMENT

High levels of stress and distress are being reported globally. This has a negative effect on both physical health and psychological well-being. Given that activities such as yoga are becoming popular for stress management, the aim of this research was to evaluate the effect of an 8-week yoga intervention in a sample of women experiencing elevated levels of stress. The study examined both the immediate effects of yoga as well as whether any benefits would be sustained following cessation of the activity. Small benefits were found within the short duration of the intervention, but these did not appear to be sustained beyond the intervention. This may indicate that yoga is only beneficial when practised regularly, or that 8-weeks is not long enough to cultivate ongoing benefits. Further exploration into what aspects of yoga practise are beneficial is needed to help elucidate its potential role in alleviating chronic stress.

Subjects: Behavioral Medicine; Mood Disorders in Adults-Depression, Mania, Bi-polar; Stress in Adults; Anxiety in Adults; Positive Psychology

Keywords: yoga; well-being; stress; affect; psychotherapy; chronic stress

1. Introduction

In recent years, an increased prevalence in mental disorders has been reported globally. The World Health Organization (WHO) has estimated the projected lifetime risk of experiencing a mental disorder to be between 17 and 49% (Kessler et al., 2007). Mental disorders are found to commonly occur in the general population and have significant societal costs (Kessler et al., 2009) and, by 2020, it is predicted that mental illnesses, including stress-related disorders, will constitute the leading burden of disease worldwide (Kalia, 2002; Kessler et al., 2009; Mathers, Fat, & Boerma, 2008). These observations follow reports that the level of stress and distress experienced by the general population is increasing, whilst levels of well-being are decreasing (Cassey, 2013). Although stress may be a motivating and useful experience in the short-term and can lead to adaptive responses and resilience, stress that lasts over extended periods is concerning as it is physiologically detrimental and can contribute to maladaptive psychological states, including clinical anxiety and depression.

In addition to effecting mental health, chronic stress can lead to widespread dysfunctions in the body, affecting the digestive system (Mathers et al., 2008), endocrine system (Cohen, Janicki-Deverts, & Miller, 2007) and immune system (Glaser & Kiecolt-Glaser, 2005; Segerstrom & Miller, 2004). Encouragingly, it has been demonstrated that regular exercise engagement buffers the negative impact of stress on mental and physical health (Zschucke, Renneberg, Dimeo, Wüstenberg, & Ströhle, 2015). Exercise enhances psychological well-being (Hassmén, Koivula, & Uutela, 2000), and has demonstrated positive effects on symptoms of depression and other mood states, such as improving self-perceptions, self-efficacy and general well-being (Fox, 2000; Penedo & Dahn, 2005).

There is also evidence that stress reduction can be effected through psychological methods, including meditation (Goyal et al., 2014). Meditation is not currently a formal therapy, although its practise has been linked to enhanced psychological well-being (Brown & Ryan, 2003). Recent meta-analysis has demonstrated that in diverse populations, it provides small to moderate reductions in the negative affect dimensions of psychological stress, such as 10–20% reductions in depression and 5–10% decreases in anxiety (Goyal et al., 2014). These findings suggest that meditation-based activities may have a role in addressing psychological distress. While a number of individual activities may reduce stress and promote mental and physical health, yoga has been proposed as a potentially useful approach to reducing psychological distress due to its integration of physical exercise and meditation. Physical, spiritual, psychological and social elements are introduced through the utilisation of postures (asanas) that focus on strength, flexibility and balance, co-ordinated with breathing (pranayama) and meditation (Amin & Goodman, 2014).

Over the past decade, there has been a proliferation of interest in the efficacy of yoga interventions to address both the physical and psychological consequences of stress (Cohen, Penman, Pirotta, & Costa, 2005; Penman, Cohen, Stevens, & Jackson, 2012). Recently, a self-regulation framework has been proposed to help model a myriad of psychological and physical health benefits that have been linked to the practise of yoga (Gard, Noggle, Park, Vago, & Wilson, 2014). The use of yoga is suggested to couple the top-down processing (Beauregard, 2007) used in psychotherapies like cognitive behaviour therapy (CBT; Beck, Freeman, & Davis, 1990) with the bottom-up transformation of advanced meditation (van den Hurk, Janssen, Giommi, Barendregt, & Gielen, 2010). Specifically, yoga is thought to target cognitive process (e.g. thoughts, feelings, beliefs) by enhancing meta-awareness, and developing self-regulation tools such as reframing and reappraising negative cognitions. These tools are coupled with mindfulness-related skills in “third-wave” CBT. Mindfulness-related skills involve more formal concentrative practises including meditation (Cahn & Polich, 2006), which is thought to

target physiological pathways such as the autonomic nervous system and cardiorespiratory system, as well as emotion-generative processes (Gard et al., 2014; Vestergaard-Poulsen et al., 2009).

Practising yoga has indeed been associated with overall increases in well-being, quality of life and positive affect, alongside decreases in negative affect, levels of stress, and, psychological distress (i.e. symptoms of anxiety and depression; Pilkington, Kirkwood, Rampes, & Richardson, 2005; Woodyard, 2011). Further studies have provided support for yoga as a potential treatment, or adjunct treatment, for psychiatric disorders, such as depression, anxiety, post-traumatic stress and schizophrenia (Balasubramaniam, Telles, & Doraiswamy, 2012; Cabral, Meyer, & Ames, 2011; Cramer, Lauche, Langhorst, & Dobos, 2013; Kirkwood, Rampes, Tuffrey, Richardson, & Pilkington, 2005; Li & Goldsmith, 2012). For example, a small, randomised study examining yoga and CBT for stress management found that both treatments proved equally efficacious (Granath, Ingvarsson, von Thiele, & Lundberg, 2006). Another study used a CBT intervention enriched with yoga (Y-CBT) in a population of treatment resistant sufferers of generalised anxiety, yielding improvements in anxiety, depression and quality of life (Khalsa, Greiner-Ferris, Hofmann, & Khalsa, 2014). A limitation of these psychotherapeutically focused studies is small sample sizes ($N = 33$ and $N = 22$, respectively), and the latter's lack of a control group. This is broadly reflective of the literature, with most possessing small sample sizes, no randomised or control groups, and using a non-standardised intervention of varying durations, meaning it is difficult to compare one study to another (Sharma, 2014).

Most studies of the efficacy of yoga have been conducted using clinical populations, such as those who have been diagnosed with breast cancer or psychiatric disorders (e.g. Balasubramaniam et al., 2012; Cabral et al., 2011; Harder, Parlour, & Jenkins, 2012; Pilkington et al., 2005; Sadja & Mills, 2013), which is not reflective of the community populations reporting increased levels of stress and psychological distress. A further limitation of yoga literature thus far is that, while established interventions such as CBT and mindfulness-based stress reduction (MBSR) have demonstrated effectiveness in the treatment of psychological distress for periods beyond the intervention itself (DiMauro, Domingues, Fernandez, & Tolin, 2013; Miller, Fletcher, & Kabat-Zinn, 1995), the psychological impact of yoga intervention beyond cessation of yoga practise has not been evaluated (Li & Goldsmith, 2012). Accordingly, there is a need for investigations involving larger studies involving randomised controlled designs that enable assessment of the sustained psychological benefits of yoga in the general population (Gard et al., 2014; Li & Goldsmith, 2012).

A further consideration in evaluating yoga as an intervention is frequency and duration of the intervention provided. Several studies have provided support for a minimum of once-weekly yoga practise being sufficient for psychological benefits, such as a reduction in stress or distress (Banerjee et al., 2007; Cowen & Adams, 2005; Michalsen et al., 2005, 2012; Moadel et al., 2007; Satyapriya, Nagendra, Nagarathna, & Padmalatha, 2009; Sujatha & Judie, 2014; West, Otte, Geher, Johnson, & Mohr, 2004). Additionally, established group interventions, such as MBSR, have traditionally used an 8-week intervention period, which is reflective of the median duration of Western yoga interventions (Sherman, 2012).

1.1. The present study

This paper presents the longitudinal psychotherapeutic outcome of yoga practise in a sample of middle-aged women, who work in largely professional occupations. This population is reported to commonly experience high levels of chronic stress and to be characteristic of community yoga users (Birdee et al., 2008; Diener, Suh, Lucas, & Smith, 1999; Nolen-Hoeksema, Larson, & Grayson, 1999; Penman et al., 2012) and using a single-sex population was deemed prudent to avoid the potential confound of gender. The intervention was an 8-week, moderate intensity yoga class (practising twice-a-week) with baseline (pre-intervention) and post-intervention and follow-up (1 month after) measures. In line with post-test outcomes in the population (Harkess, Delfabbro, Mortimer, Hannaford, & Cohen-Woods, 2016), it was hypothesised that after accounting for the duration of the intervention (time) and other potentially influential variables, yoga would influence both cognitive and emotional facets of mental health. These effects would be reflected in decreased levels of perceived stress and psychological distress, increase mindfulness and improve well-being (measured by

an increase in subjective well-being and positive affect and a decrease in negative affect). Further, we planned to explore the trajectory of any effects observed in the yoga group across the multiple assessment periods (pre-, post-intervention and follow-up).

2. Method

2.1. Study design

This study used a longitudinal, stratified, randomised, waitlist-control trial design. Participants were encouraged to attend two yoga classes a week; however, completion of the yoga intervention per protocol (PP) was defined as attendance at an average of 1 class each week (8 classes), which was met by 46 women (14 did not receive the intervention PP, only 3 completed all classes). To account for not all participants receiving the allocated intervention both PP and intention-to-treat analysis (ITT), were conducted and are described below. Practising 1 class a week is more reflective of what the population can fit into their training schedule (Amin & Goodman, 2014) and has been demonstrated to be sufficient to have a positive influence on stress and psychological distress (e.g. Cowen & Adams, 2005; Moadel et al., 2007; Sujatha & Judie, 2014). The control group did receive any treament and were requested to withold yoga practise until after completion of the study (they were encoraged to continue with their normal activities). Measures were collected at baseline (April 2013), post-treatment (July 2013) and a 1-month follow-up (August 2013) in a testing lab at The University of Adelaide.

This trial was approved by the Human Research Ethics Committee of The University of Adelaide, and all participants gave informed consent. In addition, this trial has been registered at the Australian and New Zealand Clinical Trials Registry (ANZCTR), under the registration number ACTRN12616000612415. The study was initiated as a portion of a PhD Dissertation and registration as a Clinical Trial was not compulsory. However, with increased recognition of the importance of transparency and dissemination in a timely manner we decided to make the study accessible to the public and register the trial at ANZCTR. The authors confirm that all ongoing and related trials for this intervention are registered.

2.2. Randomisation and stratification

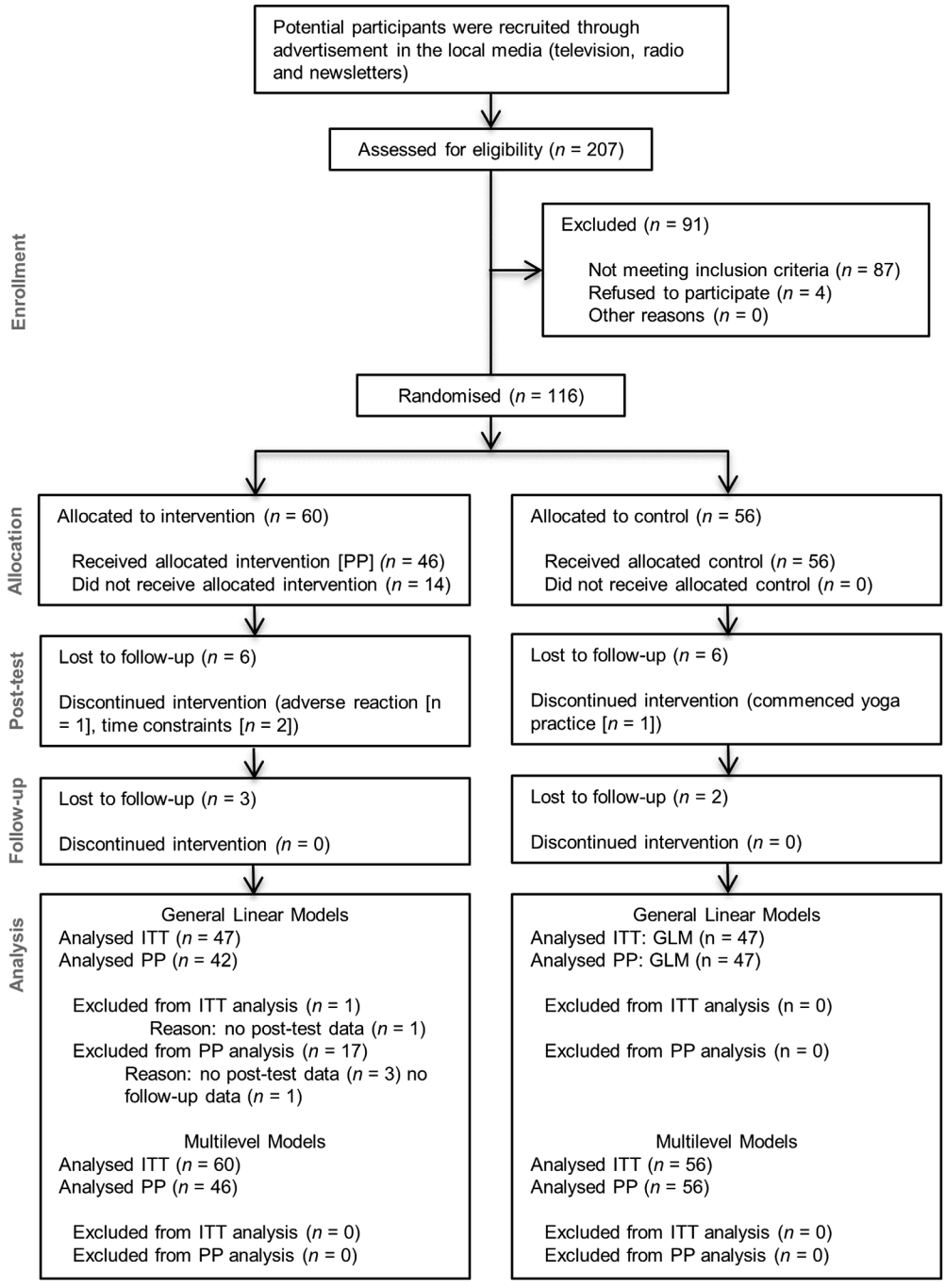
Participants were randomly allocated to the intervention group or to the control group using Research Randomizer (Urbaniak & Plous, 2013). Stratification was based on the level of psychological distress reportedly experienced using Psychological Distress Categories (Moderate, High and Very High), as measured by the K10 (Andrews & Slade, 2001). Scores in the "Low" category indicate that the individual was not experiencing significant feelings of distress and was therefore not included in this study.

2.3. Participants

The CONSORT flow diagram (Figure 1) illustrates recruitment and retention for this study. Eligible participants were females between the ages of 35 and 65 years old, non-obese (as measured by BMI), and experiencing symptoms of depression and/or anxiety, or some form of depression and/or anxiety for at least one month (as indicated by moderate to very high levels of psychological distress Andrews & Slade, 2001; Australian Bureau of Statistics, 2003; Kessler & Mroczek, 1994). Potential participants who had undertaken regular yoga practise over the previous year were excluded. The first author was in charge of screening potential participants.

Power analysis (0.80) indicated a total of 84 participants was needed to detect a minimum effect ($F = 0.35$), which is considered to be a meaningful, so a minimum of 96 participants was sought due to the common drop-outs in exercise interventions. See Table 1 below for the characteristics of the study participants, including detailing of participants included in per-protocol (PP) analysis and ITT analysis, which is described in detail below.

Figure 1. CONSORT flow diagram.



2.4. Measures

Psychological measures were collected via an online survey, and physiological measures were collected in person at The University of Adelaide. The measures used were (a) Kessler Psychological Distress Scale (K10; Kessler & Mroczek, 1994), which gives a global measure of psychological distress based on questions about anxiety and depression symptoms over the previous four weeks; (b) Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983), which measures the degree to which situations in one's life are appraised as stressful; (c) the Mindfulness Attention Awareness Scale (MAAS; Brown & Ryan, 2003), which measures people's tendency to be mindful of moment to moment experience; (d) the Psychological Wellbeing Index-Adult (PWI-A; International Wellbeing

Table 1. Baseline characteristics of study participants

	Total sample (*N* = 116) *n* (%)	Control (*N* = 56) *n* (%)	Yoga (PP) (*N* = 46) *n* (%)	Yoga (ITT) (*N* = 60) *n* (%)
Level of education				
High school (no degree)	13 (11.2)	7 (12.5)	6 (13.0)	6 (10.0)
High school degree	8 (6.9)	4 (7.1)	3 (6.5)	4 (6.7)
Vocational school	21 (18.1)	7 (12.5)	11 (23.9)	14 (23.3)
Bachelor's degree	56 (48.3)	27 (48.2)	21 (45.7)	29 (48.3)
Master's degree	14 (12.1)	8 (14.2)	4 (8.7)	6 (10.0)
Doctorate degree	4 (3.4)	3 (5.4)	1 (2.2)	1 (1.7)
	M (SD)	*M* (SD)	*M* (SD)	*M* (SD)
Age (years)	47.86 (8.22)	47.30 (7.98)	49.20 (7.93)	48.38 (8.47)
WHtR	0.526 (0.077)	0.525 (0.078)	0.521 (0.070)	0.526 (0.076)
MET	1,442 (1,253)	1,500 (1,245)	1,654 (1,973)	1,387 (1,269)

Notes: PP = Per-protocol analysis (received allocated intervention); ITT = Intention-to-treat analysis; WHtR = waist-to-height ratio; MET = Metabolic equivalence of task.

Group, 2006); which is a measure of subjective well-being focusing on cognitive evaluations in different areas of life (standard of living, health, achieving in life, relationships, safety, community-connectedness, future security and spirituality/religion); (e) Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), which consists of two high activation mood scales, which measure people's positive and negative affect; (f) the International Physical Activity Questionnaire (IPAQ; Craig et al., 2003; IPAQ Web site, 2005), which is a measure of the physical activity taken over the past week in a number of domains. From the IPAQ the energy cost of participants' weekly physical activities is calculated as the Metabolic Equivalence of Task (MET) from the IPAQ (IPAQ Web site, 2005); and (h) the waist-to-height ratio (WHtR; Cox & Whichelow, 1996; Janssen, Katzmarzyk, & Ross, 2002; Savva, Lamnisos, & Kafatos, 2013), which is a measure to detect central obesity, in particular visceral fat, and the health risks associated with it.

2.5. Procedure

The yoga condition was comprised of 16 one-hour yoga classes that took place twice a week over a period of 8 weeks. Yoga classes were conducted at a local community centre by the first author, a certified yoga instructor with 7 years' teaching experience (Yoga Australia – Level 2 Member). The classes followed a standardised structure and were Ashtanga-based, commencing with a guided meditation; followed by Sun-Salutations (a series of postures that flow together), standing postures, and floor postures, and concluding with a relaxation posture. Ashtanga yoga has demonstrated cardiovascular benefit, and is considered a dynamic style, relative to other gentle and relaxation-based yoga styles (Carroll, Blansit, Otto, & Wygand, 2003; Cowen & Adams, 2005). Further, it has been demonstrated that the dynamic practise of Ashtanga yoga is associated with benefits beyond a gentler Hatha yoga practise (Cowen & Adams, 2005). Two adverse events were reported by one participant. During attendance at the first and second class, this participant reported developing a headache and aches throughout her body, which she described as a "shock reaction". In both cases, she recovered within that day and chose not to participate in further classes. No other adverse events were reported.

Baseline measures were taken in the two-weeks prior to the yoga intervention's first class. After the conclusion of the yoga classes, post-test measures were taken (8-weeks post-baseline), see Harkess et al. (2016). A follow-up was conducted 4 weeks after the post-test (12-weeks post-baseline).

2.6. Statistical analysis

SPSS-v.22 statistical software package was used to conduct all statistical analyses, with an alpha level of 0.05. A number of analytic strategies can be used to examine this type of longitudinal data; each addresses a specific research problem and is situationally preferable. In psychological literature, there are two preferred methods for examining change and both were utilised to thoroughly examine longitudinal differences in outcome variables between the yoga-intervention and control groups. Mean change in the outcome variable from baseline to follow-up was examined to see if it differs between the two groups. To do this a 2×3 mixed factorial design with a between-subjects factor of group (yoga or control) and a within subjects-factor of Time (baseline, post intervention, or follow-up) was conducted. A benefit of mixed-model ANOVA is that it provides a reliable measure of effect size as well as contrasts of significant effects that indicate the trajectory of time (i.e. linear or quadratic trajectories). However, generalised linear models have been criticised for violating the assumption of independence of observations. To address this concern, mixed-level models (mixed effect models and marginal models) with maximum likelihood (ML) estimation were also used to analyse the intervention data (Bryk & Raudenbush, 1992). Mixed-level models are appropriate for analysis of this data as cases are nested within the individual, so there is a lack of independence between observations obtained at each time point (two-level hierarchy). In addition, these models are more robust to missing data and unbalanced designs (Krueger & Tian, 2004).

To account for the attrition bias in estimating treatment effect, an ITT analysis was run on all outcome variables, in addition to PP analysis, which was conducted to estimate maximum treatment efficacy (Armijo-Olivo, Warren, & Magee, 2009; Gupta, 2011; Lesaffre & Verbeke, 2005). Separate models were conducted for each outcome variable. While a number of participants did discontinue attendance at the yoga class they still attended the post-test and follow-up (see Figure 1), so it was possible to ascertain the practical value of being able to offer yoga in this population (Lesaffre & Verbeke, 2005).

We did not adjust for multiple testing. Exact *p*-values are presented along with the effect size for mixed-model ANOVA and confidence intervals for mixed models.

3. Results

Results of the mixed-model ANOVA will be presented first, followed by results of multi-level models (mixed effect and marginal).

3.1. Mixed-model ANOVA

Mixed between–within subjects analysis of variances (ANOVA) were conducted to assess the impact of the yoga intervention on various outcome measures, across three time points (pre-intervention, post-intervention and one-month follow-up). The outcome variables used were changes in psychological distress, stress, well-being, and positive and negative affect measures.

3.1.1. Intent-to-treat analysis

All participants were included in the construction of ITT models based on the original randomisation, regardless of protocol adherence. There was a significant interaction of group (yoga vs. control) and time in relative to positive affect ($\eta_\rho^2 = 0.07$). No other significant interactions were observed, but subjective well-being changes indicated a medium effect size ($\eta_\rho^2 = 0.06$). There was a substantial main effect of Time for psychological distress ($\eta_\rho^2 = 0.23$), perceived stress ($\eta_\rho^2 = 0.27$) and subjective well-being ($\eta_\rho^2 = 0.12$). The main effect of group was not found significant, which suggested no difference in effectiveness between participation in the yoga intervention and the control group. No effect was seen for mindfulness or negative effect. Descriptive statistics and ANOVA outcomes are detailed in Table 2.

Table 2. Raw Mean, SD and ANCOVA of psychological outcome variables of total sample and groups

	K10			PSS			MAAS		
	Pre	**Post**	**Foll-up**	**Pre**	**Post**	**Foll-up**	**Pre**	**Post**	**Foll-up**
	***M* (SD)**	***M* (SD)**	***M* (SD)**	***M* (SD)**	***M* (SD)**	***M* (SD)**	***M* (SD)**	***M* (SD)**	***M* (SD)**
Control[a]	24.27 (5.43)	22.53 (5.9)	21.11 (5.15)	26.0 (5.4)	24.23 (5.63)	22.87 (7.15)	3.55 (0.76)	3.65 (0.82)	3.60 (0.82)
Yoga (PP)[b]	23.31 (4.91)	19.40 (6.24)	19.52 (6.27)	26.40 (5.05)	21.93 (6.87)	22.87 (7.37)	3.46 (0.83)	3.72 (0.79)	3.73 (0.78)
Group*time (PP)	F (2, 86) = 2.42, p = 0.095			F (2, 86) = 2.37, p = 0.099			F (2, 86) = 0.41, p = 0.665		
	η_p^2 = 0.05 (small)			η_p^2 = 0.05 (small)			η_p^2 < 0.01 (small)		
Time (PP)	F (2, 86) = 15.53, p < 0.001			F (2, 86) = 20.99, p < 0.001			F (2, 865) = 1.94, p = 0.150		
	η_p^2 = 0.27 (large)			η_p^2 = 0.33 (large)			η_p^2 < 0.04 (small)		
Group (PP)	F (1, 87) = 229.41, p = 0.071			F (1, 87) = 0.81, p = 0.371			F (1, 87) = 0.19, p = 0.665		
	η_p^2 = 0.04 (small)			η_p^2 = 0.01 (small)			η_p^2 < 0.00 (small)		
Yoga (ITT)[c]	23.55 (5.22)	20.23 (6.88)	20.40 (7.08)	26.42 (4.86)	22.21 (6.85)	22.40 (7.71)	3.53 (0.80)	3.72 (0.82)	3.71 (0.79)
Group*time (ITT)	F (2, 91) = 2.16, p = 0.121			F (2, 91) = 2.17, p = 0.121			F (2, 91) = 0.492, p = 0.613		
	η_p^2 = 0.05 (small)			η_p^2 = 0.05 (small)			η_p^2 = 0.01 (small)		
Time (ITT)	F (2, 91) = 13.29, p < 0.000			F (2, 91) = 16.88, p < 0.000			F (2, 91) = 2.46, p < 0.091		
	η_p^2 = 0.23 (large)			η_p^2 = 0.27 (large)			η_p^2 = 0.05 (small)		
Group (ITT)	F (1, 92) = 1.28, p = 0.260			F (1, 92) = 0.93, p = 0.534			F (1, 92) = 12, p = 0.736		
	η_p^2 = 0.01 (small)			η_p^2 < 0.00 (small)			η_p^2 < 0.00 (small)		
Control[a]	50.89 (11.48)	53.76 (9.93)	55.00 (0.40)	32.49 (7.19)	29.78 (8.20)	29.64 (8.20)	13.91 (4.54)	13.33 (4.3)	12.76 (3.77)
Yoga (PP)[b]	48.68 (11.94)	54.65 (12.45)	52.65 (9.86)	32.45 (7.00)	32.5 (7.4)	33.01 (7.73)	13.39 (4.64)	11.79 (2.92)	12.24 (3.30)
Group*time (PP)	F (2, 65) = 1.50, p = 0.230			F (2, 80) = 2.61, p = 0.080			F (2, 80) = 1.0, p = 0.374		
	η_p^2 = 0.04 (small)			η_p^2 = 0.06 (medium)			η_p^2 = 0.02 (small)		
Time (PP)	F (2, 65) = 4.67, p = 0.013			F (2, 80) = 1.53, p = 0.223			F (2, 80) = 2.33, p = 0.104		
	η_p^2 = 0.13 (medium)			η_p^2 = 0.04 (small)			η_p^2 = 0.06 (medium)		
Group (PP)	F (1, 66) = 0.32, p = 0.573			F (1, 81) = 2.05, p = 0.156			F (1, 81) = 1.17, p = 0.194		
	η_p^2 = 0.01 (small)			η_p^2 = 0.03 (small)			η_p^2 = 0.02 (small)		
Yoga (ITT)[c]	47.86 (11.56)	53.72 (12.6)	51.36 (10.99)	32.48 (6.73)	32.30 (6.84)	33.36 (7.30)	13.30 (4.34)	12.5 (4.93)	12.53 (3.57)
Group*time (ITT)	F (2, 70) = 2.08, p = 0.133			F (2, 86) = 3.12, p = 0.049			F (2, 86) = 0.29, p = 0.751		
	η_p^2 = 0.06 (medium)			η_p^2 = 0.07 (medium)			η_p^2 = 0.01 (small)		
Time (ITT)	F (2, 70) = 4.84, p = 0.011			F (2, 86) = 1.68, p = 0.193			F (2, 86) = 1.82, p = 0.169		
	η_p^2 = 0.12 (medium)			η_p^2 = 0.04 (small)			η_p^2 = 0.04 (small)		
Group (ITT)	F (1, 71) = 1.07, p = 0.304			F (1, 87) = 2.44, p = 0.122			F (2, 87) = 0.71, p = 0.401		
	η_p^2 = 0.02 (small)			η_p^2 = 0.03 (small)			η_p^2 = 0.01 (small)		

Notes: PWI-A = the psychological well-being index-Adult, POS affect = positive, NEG affect = negative affect, PP = per-protocol analysis, ITT = intent-to-treat analysis, Foll-up = follow-up, η_p^2 = partial eta squared.

Field (2013) suggests that small, medium and large effect sizes correspond to: small = 0.01; medium = 0.06; and, large = 0.14.

[a]n = between 37 and 47.

[b]n = between 31 and 42.

[c]n = between 36 and 47.

3.1.2. PP analysis

Only participants who adhered to protocol were included in the construction of PP models; specifically, those in the yoga group were required to have attended a minimum of one yoga class per week. There were no significant group × time interactions, although positive affect indicated a trend and demonstrated a medium effect size ($\eta_\rho^2 = 0.06$). The Time main effect was significant for psychological distress ($\eta_\rho^2 = 0.27$), perceived stress ($\eta_\rho^2 = 0.33$), and subjective well-being ($\eta_\rho^2 = 0.13$), but no such effect for mindfulness, positive affect or negative effect. The Group main effect was not significant. Descriptive statistics and mixed ANOVA outcomes are detailed in Table 2.

3.2. Multi-level models (mixed and marginal)

Following the proposed method suggested by Singer and Willett (2003) models were constructed sequentially to determine if the increasing polynomial complexity enhanced model fit, as assessed by the Akaike information criterion (AIC), Bayesian information criterion (BIC) and Log-linear likelihood ratio (−2LLR), where non-significant values indicate that the number of variables contained in the model does not improve the fit from the previous model with fewer variables. In the first stage of analysis, we constructed mixed effects that modelled time as a random effect. These models were tested first to determine if they provided enough control to deal with the non-independence of subject's residuals (*between* subject). The models we constructed were: (1) a base intercept only model (Model 1) to examine mean differences in the outcome across individuals (i.e. the starting value of the outcome variable), (2) an unconditional growth model (Model 2) that serves as a baseline linear model for growth curves (i.e. the slope of the growth curve over time), in the case where the mixed ANOVA result indicated a significant quadratic function of time, (3) a quadratic growth factor was used to construct a second-order polynomial model (Model 3) to estimate the rate of change, and (4) a conditional model (Model 4) to examine if the predictor (group was examined as a time-invariant covariate) was related to the growth parameters (i.e. initial status, linear growth and quadratic growth). The second stage involved examining *within* subject variance by altering the covariance structure of the residuals in 3 different marginal models (AKA, the population averaged models) with time as an independent variable (Models 6, 7 and 8) which examined the following residual covariance structures: Unstructured (UN), Compound Symmetry (CS) and First-Order Autoregressive (AR1). In this second stage time was modelled as a repeated variable, which yields enhanced model fit if there is extra non-independence or non-consistent variance among the residuals that is not accounted for in growth curve models. Successful model convergence was achieved for all models reported.

The covariates of age, energy expenditure, blood pressure and heart-rate were examined, but these factors are not included in the final models because they were not found to approach significance, nor were they statistically relevant when included. This supports the previous observation of these factors not being found to differ between groups in this population (Harkess et al., 2016). The measurement of time was adjusted to account for the unequal measurement intervals. Resultant model parameters (fixed effects) indicated the unit differences in scores on the outcome measure associated with a unit increase in the value of a predictor variable.

3.2.1. Analysis of multi-level models

Please see Table 3 for an overview of relevant ITT and PP analysis for each measure. Please see Supplementary Data Tables 4 through 9 for a detailed depiction of relevant ITT and PP analysis for each measure.

3.2.1.1. Time and Time^2. Intent-to-treat (ITT) and PP analysis both indicated equivalent outcomes for the dependant variables, with the exception of PWI-A, so for simplicity ITT and PP models will not be defined unless the significance of the results differ. The addition of linear time improved the "change from baseline" model fit for all psychological variables tested. Following results of mixed-model ANOVAs, quadratic time (Time^2) was included for all K10, PSS, PQI-A, though none of the models improved significantly with its addition. However, we retained quadratic time as it was theoretically predicted that there would be an interaction for the yoga Group and Time^2 (due to the

Table 3. Overview of multi-level models representing change in psychological outcome variables

	K10[a]		PSS[a]		PWI-A[a]	
	ITT	PP	ITT	PP	ITT	PP
	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)
Fixed effects						
Intercept	24.39 (1.59)***	23.64 (1.76)***	27.95 (1.46)***	27.95 (1.66)***	42.90 (3.80)***	43.85 (4.22)***
Time (Lin)	−5.74 (1.94)**	−6.34 (2.08)**	−6.88 (2.22)**	−6.59 (2.44)**	11.26 (4.42)*	9.88 (4.91)*
Time (Quad)	1.48 (0.59)*	1.57 (0.64)*	1.71 (.75)*	−0.82 (0.51)	−3.10 (1.30)*	−2.60 (1.42)*
Group	−0.12 (1.01)	.25 (1.08)	−.95 (.94)	−0.95 (1.02)	3.26 (2.43)	2.79 (2.60)
Group*time (Lin)	2.61 (1.23)*	2.91 (1.29)*	3.18 (1.41)*	3.04 (1.51)*	−4.74 (2.81)*	−4.05 (3.04)
Group*time (Quad)	−0.83 (0.38)*	−0.87 (0.39)*	−.94 (.48)*	−0.82 (0.51)	1.47 (0.82)*	1.22 (0.88)
Log likelihood	−14.55	−16.63	−5.91	−6.32	−48.11	−20.76
LLR-2 Log likelihood[c]	1,856.73	1,684.48	1,905.63	1,738.31	2,080.81	1,900.34
Δ-2 Log likelihood[d]	$p < 0.05$	$p < 0.05$			$p < 0.05$	$p < 0.05$
	POS affect[b]		NEG affect[b]		MAAS[b]	
	ITT	PP	ITT	PP	ITT	PP
	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)
Fixed effects						
Intercept	31.85 (1.98)***	32.31 (2.23)***	13.00 (1.23)***	12.65 (1.39)***	3.34 (.22)***	3.48 (0.25)***
Time (Lin)	1.69 (0.74)*	1.46 (.79)*	−0.27 (0.49)	−0.41 (0.54)	0.14 (.07)*	0.11 (0.07)
Group	−0.09 (1.27)	−0.32 (1.37)	0.49 (0.79)	0.68 (0.86)	0.12 (.14)	0.05 (0.15)
Group*time (Lin)	−1.34 (.47)**	−1.23 (0.49)*	−0.04 (0.31)	0.02 (0.33)	−0.06 (.04)	−0.05 (0.04)
Log likelihood	−9	−7.52	−21.77	−18.22	−2.23	11.65
LLR-2 Log likelihood[c]	1,983.52	1,804.85	1,694.21	1,509.41	563.81	506.35
Δ-2 Log likelihood[d]	$p < 0.05$	$p < 0.05$	$p < 0.05$	$p < 0.05$	–	–

Notes: Coef = coefficient; PWI-A = the psychological well-being Index-Adult, POS affect = positive, NEG affect = negative affect, PP = per-protocol analysis, ITT = intent-to-treat analysis.

[a]Model 5 (unstructured (UN) covariance structure marginal model), evaluated against Model 3 (quadratic growth curve model).

[b]Model 5 (unstructured (UN) covariance structure marginal model), evaluated against Model 2 (unconditional growth curve model).

[c]i.e. deviance.

[d]*p*-value.

*Level of significance at $p < 0.05$.

**Level of significance at $p < 0.01$.

***Level of significance at $p < 0.001$.

post-follow-up period vs. the pre-to-post). The statistically significant variance components for K10, and PWI-A suggest that participants differ substantially from the average linear change over time.

3.2.1.2. Addition of group and group-by-time interactions. The addition of group and interaction between group and time variables significantly improved K10, PWI-A, PA and NA, but did not improve PSS or MAAS.

3.2.1.3. Mixed or marginal models. It was found that only PA had a significantly better fit when controlling for between subject variability, rather than within. This suggests less variability in participants' PA over time than the other psychological variables tested. In the marginal model, Group was a significant predictor of linear changes in PA score but was not associated with the initial status. The control group showed a faster rate of change as compared with the yoga group. K10, PQI-A and NA models were best fit by the UN covariance structure marginal model, where within subject variability was controlled.

3.2.1.4. Main effects demonstrated by significant models. K10 and the ITT PQI-A model demonstrated main effects of Time and Time^2, as well as interactions for Group × Time, and Group × Time^2, specifically, the yoga group had a faster rate of linear change (decrease) and a slower rate of quadratic change (upturn), relative to the control group, while the PWI-A ITT indicated the yoga group had a slower rate of linear change (increase) but a quicker quadratic rate (downturn). PP PQI-A demonstrated main effects for Time and Time^2, and NA did not demonstrate any main effects.

4. Discussion

The aim of this study was to investigate the longitudinal impact of an 8-week, moderate-intensity yoga intervention on chronically stressed women's psychological well-being (at baseline, post-test and a one-month follow-up). A mixed-ANOVA approach revealed a main effect of time, with women reporting decreased psychological distress and perceived stress, alongside increased subjective well-being, regardless of group. As expected, both quadratic and linear trajectories of change were indicated for distress, stress and well-being, though only linear was indicated for PA. No main effects of group were found. The only significant Group × Time interaction was observed for PA. The clearly observed effect for time observed across both groups may reflect the fact that women who chose to participate were actively seeking stress reduction and had a "readiness" to change attitude that would support engagement in health-promoting behaviours (Mann, de Ridder, & Fujita, 2013), such as physical activity. This is supported by the observation that including energy expenditure as a covariate in multilevel models did not significantly improve any models, and by previous analysis in this cohort that showed that the two groups were generally matched in terms of the estimated energy expenditure reported over the period of the study (Harkess et al., 2016).

It is possible that a longer intervention duration was necessary to maintain effects seen on distress, stress and PA at post-test (Harkess et al., 2016) through the follow-up period. To the authors' knowledge, this was the first study to examine the effects of a brief yoga intervention on psychotherapeutic measures in a follow-up assessment, as called for in a review of yoga on anxiety and stress (Li & Goldsmith, 2012). One previous RCT has conducted a follow-up assessment in a community population at 6-weeks after a 10-week yoga intervention in a community population (Smith, Hancock, Blake-Mortimer, & Eckert, 2007). However, they did not report on how the effect of yoga was maintained as their purpose was to compare yoga and relaxation participants (Smith et al., 2007). It was reported that relaxation participants had a more significant follow-up effect, plausibly due to the challenge of incorporating yoga into daily life beyond formal classes (Smith et al., 2007). Further, while CBT and MBSR demonstrate that the psychotherapeutic benefit is maintained beyond intervention cessation, it likely that the case self-regulation tools instructed in CBT are implemented beyond therapy and this continues to affect top-down processing. By contrast, MBSR requires continued home practise and this gives rise to bottom-up transformation. This highlights the importance of future research exploring the association between home yoga practise, or continued yoga practise, and outcomes, as well as the longevity of effects reported from varying intervention durations.

A further consideration in evaluating intervention durations is that not all dispositions demonstrated the same trajectory. For example, it has been reported that levels of mindfulness did not change over the 8-weeks in a clinical population (early stage breast and prostate cancer patients; Brown & Ryan, 2003). This was attributed to longer durations of time being necessary to detect change in this disposition, which is supported by their finding that mindfulness levels of Zen meditation students were not related to current practise, but to the years they had practised (Brown &

Ryan, 2003). It is likely that intervention effects on different domains have varied minimum intervention necessary to produce change (MINC) and to maintain effects beyond the conclusion of formal intervention. At current, the optimal durational frequency and duration of yoga has yet to be determined.

The MINC frequency of practise is suggested to be weekly, offering twice-weekly yoga classes is not reported to be more beneficial than once-weekly, due to limited compliance (Michalsen et al., 2012). Previous analysis of this cohort (Harkess et al., 2016) supported a minimum of once-weekly yoga practise for maximal benefit. However, robust difference between PP and ITT analysis is not indicated in the current study, which may be attributed to the inclusion of the follow-up period (1 month following cessation of the formal yoga classes) in analysis and the large variability in the follow-up group (relative to the previous time points). This larger variability in the follow-up group may also be attributable to some continuing with yoga practise independently, and others not. Previously, the group was homogenous in yoga practise (none at the start, and either experimental or wait-list group during the active part of the study). While previous studies have not conducted follow-ups (Li & Goldsmith, 2012), which would allow us to compare how differing intervention lengths effect outcomes over time, it seems probable that this study did not administer the MINC to impact on various systems of self-regulation beyond weekly participation in the intervention itself.

The moderate Group × Time effect for positive affect did not reach significance in the mixed-model ANOVA (PP $p = .080$), but was supported by multilevel models. Previous studies have demonstrated that PA increases with yoga (Danhauer et al., 2009; Narasimhan, Nagarathna, & Nagendra, 2011; Tolbaños Roche & Mas Hesse, 2014; Vadiraja et al., 2009); contrarily the trajectory here suggests PA decreased in the control group. Considering the decreased distress and stress and increased well-being seen in both groups, it is interesting to postulate why this may be the case. One possibility is that it may be a seasonal effect; namely, the study commenced in autumn, and the follow-up took place in winter. Cold weather is known to assist in the survival of bacteria (Handley & Webster, 1995), as well as having adverse effects on the immune system. Winter is a time when the normal population experiences increased levels of anxiety and depression, a subset being vulnerable to seasonal affective disorder (SAD; Lansdowne & Provost, 1998; Partonen & Lönnqvist, 1998). As PA is protective of illness (Cohen, Doyle, Turner, Alper, & Skoner, 2003) and is found to be diminished in depressed individuals (Folkman & Moskowitz, 2000), it is plausible that yoga buffered the seasonal effect on positive affect, supporting a bottom-up effect. Alternatively, it could be due to anticipation of yoga being sufficient in the wait-list group to have some effect.

Multi-level models demonstrated group was a significant predictor of linear and quadratic changes in distress and well-being (ITT). The interactions indicate that the yoga group had a faster decrease in distress to post-test, but their rate of change slowed, while the control group's continued until follow-up. Similar trends have been characterised by previous research findings that when people are engaged in physical activity, they report less symptoms of depression; but when they cease exercising, they report more symptoms of depression than those who maintain an exercise program (Babyak et al., 2000). However, the current study design does not allow for formal testing of the effects of ceasing yoga vs. continuation. Another contribution to this effect may be the control group would be anticipating the start of their round of yoga classes.

Contrastingly, the yoga group and control groups showed similar growth in subjective well-being (ITT analysis) from baseline to post-test, but unexpectedly there was a decrease in the yoga practitioners' well-being upon the completion of the yoga intervention, whilst the control group's well-being continued to increase. It may be that the yoga classes are perceived to increase in value to the person's well-being once they are unavailable (Brock, 1968), and may be reflective of reported barriers to continuing a yoga practise, namely cost and availability (Penman et al., 2012).

5. Limitations

There are some limitations to this study which merit consideration when interpreting the results. First, due to the nature of the intervention, it was not possible for participants to be blind to their group allocation; due to timeframe constraints the follow-up period was of a brief duration (1 month), further, in our efforts to follow trends in the psychotherapy (e.g. MBSR**),** our intervention was only 8 weeks, which may not have provided the MINC. A second limitation was that the research focused on self-selected middle-aged women in an educated population. Although this may be reflective of those who generally practise yoga (Birdee et al., 2008), further resarch examining other populations will highlight if these results are generalisable to a broader community. Additionally, the women self-selected so they were likely ready to make life changes to reduce stress experienced, which may explain clear time effect. Furthermore, the wait-list control design may have impacted on outcomes measured as at the conclusion of the first round of yoga classes which was the time that the intervention group ceased to be offered further yoga classes, a resource known to be limited by availability and cost, while the control group was approaching the ofference of yoga classes. This may be avoided in future by allowing the intervention group to continue practising with the control group, which would also be interesting as it would allow the evaluation of outcomes at multiple time points. A further option is to commence the second round of classes after a longer duration, so their effect and cognition is less affected at post-test and follow-up assessments. A final consideration is the use of a no-treatment control, which does not allow for controlling for variables such as attention to reported levels of stress, or contact with a caring yoga teacher. While this study indicates benefit for participating in the yoga intervention, future research may utilise an active-control, which would allow for more refined exploration of the effects of a yoga intervention compared with participation in another intervention aimed at stress-reduction.

6. Conclusions

In conclusion, the findings of this study indicate that at a 1-month follow-up assessment, participation in a weekly 60-min yoga class taking place over two months only yielded small and largely non-significant changes in psychological measures for women with chronic stress. There was some evidence of psychotherapeutic outcome improvements in the intervention group compared to the control at post-test, however these effects were not robustly captured when the follow-up assessment was modelled. In light of the cost-effectiveness and physical benefit of engaging in aerobic and resistance training exercise (Wanderley et al., 2013), further validation of this finding over a longer duration and with other samples may have important implications. Given that yoga very likely provides physical benefits, or is comparable with other stress reduction interventions (i.e. psychotherapy), it could provide a multifaceted intervention (targeting both cognitive, emotional and behavioural output as well as autonomic output (Gard et al., 2014). Further research into yoga's MINC, mechanisms and potential to enrich psychotherapy (e.g. Khalsa et al., 2014 with CBT) may be beneficial in global efforts to address the negative effects of chronic stress.

Supplementary material
The supplementary material for this paper is available online at http://dx.doi.10.1080/23311908.2016.1256037.

Funding
The authors received no direct funding for this research.

Competing Interests
The authors declare no competing interest.

Author details
Kaitlin N. Harkess[1]
E-mail: kaitlin.harkess@adelaide.edu.au
ORCID ID: http://orcid.org/0000-0002-7717-0951
Paul Delfabbro[2]
E-mail: paul.delfabbro@adelaide.edu.au
Sarah Cohen-Woods[3]
E-mail: sarah.cohenwoods@flinders.edu.au
[1] Department of Psychology, The University of Adelaide, Level 4, Hughes Building, Adelaide SA 5000, Australia.
[2] School of Psychology, University of Adelaide, Adelaide, Australia.
[3] Faculty of Social and Behavioural Sciences, School of Psychology, Flinders University, Adelaide, Australia.

Citation information
Cite this article as: The longitudinal mental health benefits of a yoga intervention in women experiencing chronic stress: A clinical trial, Kaitlin N. Harkess, Paul Delfabbro & Sarah Cohen-Woods, *Cogent Psychology* (2016), 3: 1256037.

Cover image
Source: Author.

References

Amin, D. J., & Goodman, M. (2014). The effects of selected asanas in Iyengar yoga on flexibility: Pilot study. *Journal of Bodywork and Movement Therapies, 18*, 399–404. doi:10.1016/j.jbmt.2013.11.008

Andrews, G., & Slade, T. (2001). Interpreting scores on the Kessler psychological distress scale (K10). *Australian and New Zealand Journal of Public Health, 25*, 494–497. doi:10.1111/j.1467-842X.2001.tb00310.x

Armijo-Olivo, S., Warren, S., & Magee, D. (2009). Intention to treat analysis, compliance, drop-outs and how to deal with missing data in clinical research: A review. *Physical Therapy Reviews, 14*, 36–49. doi:10.1179/174328809X405928

Australian Bureau of Statistics. (2003). *Information paper: Use of the Kessler psychological distress scale in ABS health surveys*. Canberra: Author.

Babyak, M., Blumenthal, J. A., Herman, S., Khatri, P., Doraiswamy, M., Moore, K., … Krishnan, K. R. (2000). Exercise treatment for major depression: Maintenance of therapeutic benefit at 10 months. *Psychosomatic Medicine, 62*, 633–638. http://dx.doi.org/10.1097/00006842-200009000-00006

Balasubramaniam, M., Telles, S., & Doraiswamy, P. M. (2012). Yoga on our minds: A systematic review of yoga for neuropsychiatric disorders. *Front Psychiatry, 3*, 117. doi:10.3389/fpsyt.2012.00117

Banerjee, B., Vadiraj, H. S., Ram, A., Rao, R., Jayapal, M., Gopinath, K. S., … Prakash Hande, M. (2007). Effects of an integrated yoga program in modulating psychological stress and radiation-induced genotoxic stress in breast cancer patients undergoing radiotherapy. *Integrative Cancer Therapies, 6*, 242–250. doi:10.1177/1534735407306214

Beauregard, M. (2007). Mind does really matter: Evidence from neuroimaging studies of emotional self-regulation, psychotherapy, and placebo effect. *Progress in Neurobiology, 81*, 218–236. http://dx.doi.org/10.1016/j.pneurobio.2007.01.005

Beck, A. T., Freeman, A., & Davis, D. D. (1990). *Cognitive therapy of personality disorders*. New York, NY: Guilford.

Birdee, G. S., Legedza, A. T., Saper, R. B., Bertisch, S. M., Eisenberg, D. M., & Phillips, R. S. (2008). Characteristics of yoga users: Results of a national survey. *Journal of General Internal Medicine, 23*, 1653–1658. http://dx.doi.org/10.1007/s11606-008-0735-5

Brock, T. C. (1968). Implications of commodity theory for value change. *Psychological Foundations of Attitudes, 1*, 243–275.

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84*, 822. http://dx.doi.org/10.1037/0022-3514.84.4.822

Bryk, A. S., & Raudenbush, S. W. (1992). *Hierarchical linear models: Applications and data analysis methods*. Newbury Park, CA: Sage.

Cabral, P., Meyer, H. B., & Ames, D. (2011). Effectiveness of yoga therapy as a complementary treatment for major psychiatric disorders: A meta-analysis. *The Primary Care Companion to CNS Disorders, 13*, 7. doi:10.4088/PCC.10r01068

Cahn, B. R., & Polich, J. (2006). Meditation states and traits: EEG, ERP, and neuroimaging studies. *Psychological Bulletin, 132*, 180. http://dx.doi.org/10.1037/0033-2909.132.2.180

Carroll, J., Blansit, A., Otto, R. M., & Wygand, J. W. (2003). The metabolic requirements of vinyasa yoga. *Medicine & Science in Sports & Exercise, 35*, S155. http://dx.doi.org/10.1097/00005768-200305001-00856

Cassey, L. (2013). *Stress and wellbeing in Australia survey 2013*. Australian Psychological Society. Retrieved from http://www.psychology.org.au/Assets/Files/StressandwellbeinginAustraliasurvey2013.pdf

Cohen, M. M., Penman, S., Pirotta, M., & Costa, C. (2005). The integration of complementary therapies in Australian general practice: Results of a national survey. *The Journal of Alternative and Complementary Medicine, 11*, 995–1004. doi:10.1089/acm.2005.11.995

Cohen, S., Doyle, W. J., Turner, R. B., Alper, C. M., & Skoner, D. P. (2003). Emotional style and susceptibility to the common cold. *Psychosomatic Medicine, 65*, 652–657. doi:10.1097/1001.PSY.0000077508.0000057784.DA http://dx.doi.org/10.1097/01.PSY.0000077508.57784.DA

Cohen, S., Janicki-Deverts, D., & Miller, G. E. (2007). Psychological stress and disease. *JAMA, 298*, 1685–1687. doi:10.1001/jama.298.14.1685

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress [Research Support, U.S. Gov't, P.H.S.]. *Journal of Health and Social Behavior, 24*, 385–396.

Cowen, V. S., & Adams, T. B. (2005). Physical and perceptual benefits of yoga asana practice: Results of a pilot study. *Journal of Bodywork and Movement Therapies, 9*, 211–219. doi:10.1016/j.jbmt.2004.08.001

Cox, B. D., & Whichelow, M. (1996). Ratio of waist circumference to height is better predictor of death than body mass index. *BMJ, 313*, 1487. http://dx.doi.org/10.1136/bmj.313.7070.1487

Craig, C. L., Marshall, A. L., Sjostrom, M., Bauman, A. E., Booth, M. L., Ainsworth, B. E., … Oja, P. (2003). International physical activity questionnaire: 12-country reliability and validity. *Medicine & Science in Sports & Exercise, 35*, 1381–1395. doi:10.1249/01.mss.0000078924.61453.fb

Cramer, H., Lauche, R., Langhorst, J., & Dobos, G. (2013). Yoga for depression: A systematic review and meta-analysis. *Depression and Anxiety, 30*, 1068–1083. http://dx.doi.org/10.1002/da.2013.30.issue-11

Danhauer, S. C., Mihalko, S. L., Russell, G. B., Campbell, C. R., Felder, L., Daley, K., & Levine, E. A. (2009). Restorative yoga for women with breast cancer: Findings from a randomized pilot study. *Psycho-Oncology, 18*, 360–368. doi:10.1002/pon.1503

Diener, E., Suh, E. M., Lucas, R. E., & Smith, H. L. (1999). Subjective well-being: Three decades of progress. *Psychological Bulletin, 125*, 276. http://dx.doi.org/10.1037/0033-2909.125.2.276

DiMauro, J., Domingues, J., Fernandez, G., & Tolin, D. F. (2013). Long-term effectiveness of CBT for anxiety disorders in an adult outpatient clinic sample: A follow-up study. *Behaviour Research and Therapy, 51*, 82–86. doi:10.1016/j.brat.2012.10.003

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. London: Sage.

Folkman, S., & Moskowitz, J. T. (2000). Positive affect and the other side of coping. *American Psychologist, 55*, 647–654. doi:10.1037/0003-066x.55.6.647

Fox, K. R. (2000). Self-esteem, self-perceptions and exercise. *International Journal of Sport Psychology, 31*, 228–240.

Gard, T., Noggle, J. J., Park, C. L., Vago, D. R., & Wilson, A. (2014). Potential self-regulatory mechanisms of yoga for psychological health. *Frontiers in Human Neuroscience, 8*, 1–20. doi:10.3389/fnhum.2014.00770

Glaser, R., & Kiecolt-Glaser, J. K. (2005). Science and society: Stress-induced immune dysfunction: Implications for health. *Nature Reviews Immunology, 5*, 243–251. http://dx.doi.org/10.1038/nri1571

Goyal, M., Singh, S., Sibinga, E. M., Gould, N. F., Rowland-Seymour, A., Sharma, R., … Shihab, H. M. (2014). Meditation programs for psychological stress and well-being: A systematic review and meta-analysis. *JAMA Internal Medicine, 174*, 357–368. http://dx.doi.org/10.1001/jamainternmed.2013.13018

Granath, J., Ingvarsson, S., von Thiele, U., & Lundberg, U. (2006). Stress management: A randomized study of cognitive behavioural therapy and yoga. *Cognitive Behaviour Therapy, 35*, 3–10. doi:10.1080/16506070500401292

Gupta, S. K. (2011). Intention-to-treat concept: A review. *Perspectives in Clinical Research, 2*, 109–112. doi:10.4103/2229-3485.83221

Handley, B., & Webster, A. (1995). Some factors affecting the airborne survival of bacteria outdoors. *Journal of Applied Bacteriology, 79*, 368–378. http://dx.doi.org/10.1111/jam.1995.79.issue-4

Harder, H., Parlour, L., & Jenkins, V. (2012). Randomised controlled trials of yoga interventions for women with breast cancer: A systematic literature review. *Supportive Care in Cancer, 20*, 3055–3064.

Harkess, K. N., Delfabbro, P., Mortimer, J., Hannaford, Z., & Cohen-Woods, S. (2016). Brief report on the psychophysiological effects of a yoga intervention for chronic stress. *Journal of Psychophysiology,*. doi:10.1027/0269-8803/a000169

Hassmén, P., Koivula, N., & Uutela, A. (2000). Physical exercise and psychological well-being: A population study in Finland. *Preventive Medicine, 30*, 17–25. doi:10.1006/pmed.1999.0597

International Wellbeing Group. (2006). *Personal wellbeing index*. Melbourne: Deakin University Retrieved from http://www.deakin.edu.au/research/acqol/instruments/wellbeing-index/pwi-a-english.pdf

IPAQ Web site. (2005). Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ)—Short and Long Forms. Retrieved March 2012 from www.ipaq.ki.se

Janssen, I., Katzmarzyk, P. T., & Ross, R. (2002). Body mass index, waist circumference, and health risk: Evidence in support of current national institutes of health guidelines. *Archives of Internal Medicine, 162*, 2074–2079. doi:10.1001/archinte.162.18.2074

Kalia, M. (2002). Assessing the economic impact of stress—The modern day hidden epidemic. *Metabolism, 51*, 49–53. http://dx.doi.org/10.1053/meta.2002.33193

Kessler, R., & Mroczek, D. (1994). Final versions of our non-specific psychological distress scale. *Memo dated March, 10*, 1994.

Kessler, R. C., Aguilar-Gaxiola, S., Alonso, J., Chatterji, S., Lee, S., Ormel, J., ... Wang, P. S. (2009). The global burden of mental disorders: An update from the WHO World Mental Health (WMH) Surveys. *Epidemiologia e Psichiatria Sociale, 18*, 23–33. http://dx.doi.org/10.1017/S1121189X00001421

Kessler, R. C., Angermeyer, M., Anthony, J. C., De Graaf, R., Demyttenaere, K., Gasquet, I., ... Haro, J. M. (2007). Lifetime prevalence and age-of-onset distributions of mental disorders in the World Health Organization's World Mental Health Survey Initiative. *World Psychiatry, 6*, 168.

Khalsa, M. K., Greiner-Ferris, J. M., Hofmann, S. G., & Khalsa, S. B. (2014). Yoga-enhanced cognitive behavioural therapy (Y-CBT) for anxiety management: A pilot study. *Clinical Psychology & Psychotherapy, 22*, 364–371. doi:10.1002/cpp.1902

Kirkwood, G., Rampes, H., Tuffrey, V., Richardson, J., & Pilkington, K. (2005). Yoga for anxiety: A systematic review of the research evidence. *British Journal of Sports Medicine, 39*, 884–891. doi:10.1136/bjsm.2005.018069

Krueger, C., & Tian, L. (2004). A comparison of the general linear mixed model and repeated measures ANOVA using a dataset with multiple missing data points. *Biological Research For Nursing, 6*, 151–157. doi:10.1177/1099800404267682

Lansdowne, A. T., & Provost, S. C. (1998). Vitamin D3 enhances mood in healthy subjects during winter. *Psychopharmacology, 135*, 319–323. http://dx.doi.org/10.1007/s002130050517

Lesaffre, E., & Verbeke, G. (2005). Clinical trials and intervention studies. *Encyclopedia of statistics in behavioral science*. Hoboken, NJ: John Wiley & Sons.

Li, A. W., & Goldsmith, C. A. (2012). The effects of yoga on anxiety and stress. *Altern Med Rev, 17*, 21–35.

Mann, T., de Ridder, D., & Fujita, K. (2013). Self-regulation of health behavior: Social psychological approaches to goal setting and goal striving. *Health Psychology, 32*, 487. http://dx.doi.org/10.1037/a0028533

Mathers, C., Fat, D. M., & Boerma, J. T. (2008). *The global burden of disease: 2004 update*. Geneva: World Health Organization. http://dx.doi.org/10.1016/B978-012373960-5.00335-X

Michalsen, A., Grossman, P., Acil, A., Langhorst, J., Ludtke, R., Esch, T., ... Dobos, G. J. (2005). Rapid stress reduction and anxiolysis among distressed women as a consequence of a three-month intensive yoga program. *Medical Science Monitor, 11*, CR555–561.

Michalsen, A., Jeitler, M., Brunnhuber, S., Lüdtke, R., Büssing, A., Musial, F., ... Kessler, C. (2012). Iyengar yoga for distressed women: A 3-armed randomized controlled trial. *Evidence-based Complementary and Alternative Medicine, 2012*.

Miller, J. J., Fletcher, K., & Kabat-Zinn, J. (1995). Three-year follow-up and clinical implications of a mindfulness meditation-based stress reduction intervention in the treatment of anxiety disorders. *General Hospital Psychiatry, 17*, 192–200. http://dx.doi.org/10.1016/0163-8343(95)00025-M

Moadel, A. B., Shah, C., Wylie-Rosett, J., Harris, M. S., Patel, S. R., Hall, C. B., & Sparano, J. A. (2007). Randomized controlled trial of yoga among a multiethnic sample of breast cancer patients: Effects on quality of life. *Journal of Clinical Oncology, 25*, 4387–4395. doi:10.1200/jco.2006.06.6027

Narasimhan, L., Nagarathna, R., & Nagendra, H. (2011). Effect of integrated yogic practices on positive and negative emotions in healthy adults. *International Journal of Yoga, 4*, 13–19. doi:10.4103/0973-6131.78174

Nolen-Hoeksema, S., Larson, J., & Grayson, C. (1999). Explaining the gender difference in depressive symptoms. *Journal of Personality and Social Psychology, 77*, 1061–1072. http://dx.doi.org/10.1037/0022-3514.77.5.1061

Partonen, T., & Lönnqvist, J. (1998). Seasonal affective disorder. *The Lancet, 352*, 1369–1374. http://dx.doi.org/10.1016/S0140-6736(98)01015-0

Penedo, F. J., & Dahn, J. R. (2005). Exercise and well-being: A review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry, 18*, 189–193. http://dx.doi.org/10.1097/00001504-200503000-00013

Penman, S., Cohen, M., Stevens, P., & Jackson, S. (2012). Yoga in Australia: Results of a national survey. *International Journal of Yoga, 5*, 92–101. doi:10.4103/0973-6131.98217

Pilkington, K., Kirkwood, G., Rampes, H., & Richardson, J. (2005). Yoga for depression: The research evidence. *Journal of Affective Disorders, 89*, 13–24. doi:10.1016/j.jad.2005.08.013

Sadja, J., & Mills, P. J. (2013). Effects of yoga interventions on fatigue in cancer patients and survivors: A systematic review of randomized controlled trials. *Explore: The Journal of Science and Healing, 9*, 232–243. doi:10.1016/j.explore.2013.04.005

Satyapriya, M., Nagendra, H. R., Nagarathna, R., & Padmalatha, V. (2009). Effect of integrated yoga on stress and heart rate variability in pregnant women. *International Journal of Gynecology & Obstetrics, 104*, 218–222. doi:10.1016/j.ijgo.2008.11.013

Savva, S. C., Lamnisos, D., & Kafatos, A. G. (2013). Predicting cardiometabolic risk: waist-to-height ratio or BMI. A meta-analysis. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy, 6*, 403–419. doi:10.2147/dmso.s34220

Segerstrom, S. C., & Miller, G. E. (2004). Psychological stress and the human immune system: A meta-analytic study of 30 years of inquiry. *Psychological Bulletin, 130*, 601. http://dx.doi.org/10.1037/0033-2909.130.4.601

Sharma, M. (2014). Yoga as an alternative and complementary approach for stress management. *Journal of Evidence-Based Complementary & Alternative Medicine, 19*, 59–67. doi:10.1177/2156587213503344

Sherman, K. J. (2012). Guidelines for developing yoga interventions for randomized trials. *Evidence-based Complementary and Alternative Medicine, 2012*.

Singer, J. D., & Willett, J. B. (2003). *Applied longitudinal data analysis: Modeling change and event occurrence*. New York, NY: Oxford University Press.

Smith, C., Hancock, H., Blake-Mortimer, J., & Eckert, K. (2007). A randomised comparative trial of yoga and relaxation to reduce stress and anxiety. *Complementary Therapies in Medicine, 15*, 77–83. doi:10.1016/j.ctim.2006.05.001

Sujatha, T., & Judie, A. (2014). Effectiveness of a 12-week yoga program on physiopsychological parameters in patients with hypertension. *International Journal of Pharmaceutical and Clinical Research, 6*, 329–335.

Tolbaños Roche, L., & Mas Hesse, B. (2014). Application of an integrative yoga therapy programme in cases of essential arterial hypertension in public healthcare. *Complementary Therapies in Clinical Practice, 20*, 285–290. doi:10.1016/j.ctcp.2014.10.004

Urbaniak, G. C., & Plous, S. . (2013). Research randomizer (Version 4.0) [Computer software]. Retrieved April 10, 2013, from http://www.randomizer.org/

Vadiraja, H. S., Rao, M. R., Nagarathna, R., Nagendra, H. R., Rekha, M., Vanitha, N., ... Rao, N. (2009). Effects of yoga program on quality of life and affect in early breast cancer patients undergoing adjuvant radiotherapy: A randomized controlled trial. *Complementary Therapies in Medicine, 17*, 274–280. doi:10.1016/j.ctim.2009.06.004

van den Hurk, P. A., Janssen, B. H., Giommi, F., Barendregt, H. P., & Gielen, S. C. (2010). Mindfulness meditation associated with alterations in bottom-up processing: Psychophysiological evidence for reduced reactivity. *International Journal of Psychophysiology, 78*, 151–157. http://dx.doi.org/10.1016/j.ijpsycho.2010.07.002

Vestergaard-Poulsen, P., van Beek, M., Skewes, J., Bjarkam, C. R., Stubberup, M., Bertelsen, J., & Roepstorff, A. (2009). Long-term meditation is associated with increased gray matter density in the brain stem. *NeuroReport, 20*, 170–174. http://dx.doi.org/10.1097/WNR.0b013e328320012a

Wanderley, F. A., Moreira, A., Sokhatska, O., Palmares, C., Moreira, P., Sandercock, G., ... Carvalho, J. (2013). Differential responses of adiposity, inflammation and autonomic function to aerobic versus resistance training in older adults. *Experimental Gerontology, 48*, 326–333. doi:10.1016/j.exger.2013.01.002

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*, 1063. http://dx.doi.org/10.1037/0022-3514.54.6.1063

West, J., Otte, C., Geher, K., Johnson, J., & Mohr, D. C. (2004). Effects of hatha yoga and african dance on perceived stress, affect, and salivary cortisol. *Annals of Behavioral Medicine, 28*, 114–118. doi:10.1207/s15324796abm2802_6

Woodyard, C. (2011). Exploring the therapeutic effects of yoga and its ability to increase quality of life. *International Journal of Yoga, 4*, 49–54. doi:10.4103/0973-6131.85485

Zschucke, E., Renneberg, B., Dimeo, F., Wüstenberg, T., & Ströhle, A. (2015). The stress-buffering effect of acute exercise: Evidence for HPA axis negative feedback. *Psychoneuroendocrinology, 51*, 414–425. doi:10.1016/j.psyneuen.2014.10.019