



Yoga Intervention in the *Aftermath* of an Earthquake in Iceland

The Effect of Six-Week Hatha Yoga Program on
Psychological Complications following an Earthquake

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**Thesis submitted for the degree of Master of Public Health
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HÁSKÓLI ÍSLANDS

Jóga í kjölfar jarðskjálfta á Suðurlandi
Áhrif sex vikna hatha jógaíðkunar á sálræn einkenni í kjölfar jarðskjálfta

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Yoga Intervention in the Aftermath of an Earthquake in Iceland
The effect of a six week hatha yoga practice on stress, anxiety and depression

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Ágrip

Rannsókn þessi var unnin sem meistaraverkefni í lýðheilsuvísindum við Háskóla Íslands. Tilgangur hennar var að kanna áhrif reglubundinnar hatha jógaíðkunar á streitu, kvíða, þunglyndi og svefn í kjölfar jarðskjálfta. Kannanir sýna að fólk leitar í auknum mæli eftir óhefðbundnum leiðum sér til heilsubótar. Ýmsar rannsóknir benda til að jóga geti dregið úr streitu, kvíða og þunglyndi. Fáar rannsóknir hafa verið gerðar á áhrifum jóga á streitu í kjölfar náttúruhamfara. Þessi rannsókn var gerð eftir jarðskjálftann á Suðurlandi 29. maí 2008. Þátttakendur voru í tveimur hópum og komu aðalega frá Selfossi og Hveragerði. Annar hópurinn fékk sex vikna jógaíhlutun meðan hinn hópurinn var á biðlista til samanburðar. Jógaþjálfunin fólst í mildum jógaæfingum, öndun og hugleiðslu tvisvar í viku. Til að kanna áhrif jógaíðkunar voru viðurkenndir spurningalistar lagðir fyrir þátttakendur fyrir og eftir jógaíhlutun. Einnig var mældur blóðþrýstingur í upphafi og lok íhlutunar. Niðurstöður sýndu að hóparnir voru sambærilegir í upphafi rannsóknarinnar. Tölfræðiþrófið MANOVA var notað til að meta mun á hópunum fyrir og eftir íhlutun. Munur var á hópum í lok jógaíhlutunar á svefni sem batnaði marktækt ($P < .029$) í jógahópnum og einnig varð marktækur munur á samskiptum ($P < .035$) samkvæmt undirskölum HL spurningalista. Báðir hóparnir sýndu marktækt betri lífsgæði, minni streitu, kvíða og þunglyndi í lok jógaíhlutunar. Niðurstöðurnar sýna að reglubundin jógaíðkun getur bætt svefn og samskipti fólks. Jóga er kostnaðarlítill og auðveld leið til sjálfshjálpar og ætti að vera ákjósanleg viðbótarmeðferð í almennu heilbrigðiskerfi til að bæta líðan fólks. Þörf er á stærri langtíma samanburðarrannsóknum á áhrifum hatha jóga á áfallastreitu, kvíða og þunglyndi í kjölfar náttúruhamfara.

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Abbreviations

PTSD	post traumatic stress disorder
RR	relaxation response
BP	blood pressure
PSS-10	perceived stress scale
PDS	posttraumatic stress diagnostic scale
BDI-II	Beck depression inventory
BAI	Beck anxiety inventory
HRQL	health related quality of life
IQL	Icelandic quality of life scale
SBP	systolic blood pressure
DSB	diastolic blood pressure
HR	heart rate
PASW	predictive analytics software

1 Background

Stress is a normal reaction to normal stressors of life events. It is the alarm system of the body for the protection of the individual. Life can be filled with stressful situations that arise from day to day. Stress can be a reaction to a short-lived situation, such as being stuck in traffic or it can last a long time if dealing for example with relationship problems, too many responsibilities, conflict at work, grief, chronic pain or living with unemployment or poverty. Daily situations can become hassles that cause strain on the individual which may lead to perceived physical or emotional stress and interfere with the ability to live a normal life over an extended period of time ("Mind/body health", 2010). Sudden events can cause major changes in life as happens by natural disasters, accidents or injuries, death or man-made catastrophes as a crime abuse and violence. These events are considered as universally stressful and can cause extreme stress response that can have traumatic effect on health (Mikhail, 1985).

If perceived stress happens too often or lasts too long, it may develop and lead to different physical and/or psychological health disorders, such as cardiovascular disease, hypertension, fatigue, insomnia, anxiety, depression and chronic pain. Psychological stress has been suggested to play a big role in the patho physiology of depression and anxiety (De Rooij, Schene, Phillips, & Roseboom, 2009).

Coping with stressful situations are of great importance for well being. Positive coping strategies such as yoga are one kind of self-helping mind-body relaxation technique that has been used worldwide for ages to manage stress. A regular yoga practice may offer a way to reprogram automatic physical responses for example if activated by traumatic experience (Van der Kolk, 2006). Yoga can have both physical and psychological effect to elicit the relaxation response that acts against the physiological effects caused by the stress response (Galvin, Benson, Deckro, Fricchione, & Dusek, 2006).

1.1 The Stress Response

Stress has been the focus of science and practical medicine for decades. Humans, like other animals, react in a predictable way to acute or chronic stressful situations that trigger an inborn physiological stress response (Benson & Klipper, 1976). Selye defined stress in 1956 as a set of bodily defenses or reactions against any form of stimulus or stressors in life including physiological or psychological demands or threats from the environment (Selye, 1985). The stimulus evokes the stress response in the body, which is a physiological arousal of the sympathetic nervous system and a perfectly normal reaction to stressors of life events and an inevitable part of being alive (Selye, 1985). Psychological theories marked a progress in the stress concept, with the cognitive-phenomenological approach to stress, implying that great importance should be attached to the meaning individuals read into the events taking place around them (Lazarus & Folkman, 1984). Three important aspects of stress have been identified: individuals differ in their reactivity to stressors, stress is determined by the perception of the stressful situation rather than the situation itself and the extent of stress partly depend on the capability of the individual to cope (Mikhail, 1985). This reveals the individual's

appraisal of his/her situation as a crucial part of the psycho-physiological process of the stress response.

It is considered fundamental for the overall health and well being of the individual how he /she manages the stress or copes with stressful situations experienced (Lazarus & Folkman, 1984). Importantly, stress has the potency to exert either ameliorating or detrimental effects on health. While short time stress can be considered as a healthy stimulation of growth and development, long time stress or distress can become chronic and have damaging influence on psychological and physical health (Selye, 1985).

An exposure to an extreme stressor can lead to overwhelming experience that can be traumatic and lead to post-traumatic stress disorder (PTSD). The symptoms of PTSD are commonly grouped into: intrusive memories of the traumatic event, avoidance and numbing, and increased anxiety or emotional arousal (American Psychiatric Association, 2000). One critical factor in traumatic experiences is considered to be the experience of physical helplessness, the realization that no action can be taken to stave off the inevitable (Van der Kolk, 2006). Research have demonstrated how extreme stress affects the brain function and how the physical immobilization can become a conditioned behavioral response (Ledoux & Gorman 2001). Trauma can be conceptualized as stemming from the failure of the natural physiological activation and hormonal secretions to organize an effective response to threat. Rather than producing a successful fight or flight response the individual becomes immobilized (Van der Kolk, 2006). When the fight or flight response is not used appropriately or repeatedly elicited, it may ultimately lead to psychological or physiological diseases (Benson & Klipper, 1976). It is suggested that stress has a major impact on neurodegenerative diseases and mental disorders and plays a significant role in the susceptibility, progress and outcome of diseases (Esch, Stefano, Fricchione, & Benson, 2002).

Chronic activation of the sympathetic nervous system, as in prolonged stress, has specifically been linked to the onset of anxiety and depression (De Rooij et al, 2009; Esch et al, 2002). People suffering from depression may experience fatigue and sleep disturbance, lowering energy, poor concentration and an excessive sadness and unhappiness. In its worst, depression may result in withdrawal from daily activities that negatively affect family, social and occupational roles. Depression is expected to become the second leading contributor to the global burden of disease by 2020 ("Burden of mental health," 2001). It is well documented how stressful life events can negatively affect sleep quality and depression (Hall et al, 2000). In chronic stress there is an increased risk of developing chronic medical illnesses, such as hypertension or coronary heart diseases and diabetes. The effects of extreme or prolonged stress need to be considered as a major environmental challenge that places individual's physical and psychological health equally at risk (Matthieu & Ivanoff, 2006; Mc Farlane, 2010).

1.2 The Relaxation Response

An opposition to the stress response is the relaxation response, the one counteracting the other. The relaxation response was first described by Herbert Benson in 1974 as a coordinated physiological response, a physical state of deep rest that changes a person's physical and emotional response to stress (Benson & Klipper, 1976). It is characterized by an altered state of consciousness and a

decreased arousal in the body, for example by lowering the heart rate, blood pressure and oxygen consumption. The relaxation response alleviates symptoms associated with a vast array of conditions, including hypertension, arthritis, insomnia, anxiety and depression and thereby increasing the individual's state of well-being (Galvin et al, 2006). Anything that breaks an intrusion thought will decrease the activity of the sympathetic nervous system and evoke the physiological and psychological state of relaxation and counteract the harmful effects of inappropriate stress response on the body (Benson & Klipper, 1976). The simple act of becoming relaxed can have surprising health benefits. Scientific research has shown that regular relaxation practices can have both physical and psychological effect (Goleman, 1995).

1.3 Self-help Strategies for Stress

There are several relaxation techniques that can be used to elicit the physiological changes called the relaxation response. These techniques can be of various forms such as relaxation, meditation and breathing exercises, hypnosis, biofeedback, tai chi, qi gong or yoga. Researchers have demonstrated the benefit of such non-pharmacological techniques to reduce stress. The relaxation response has been shown to be an effective therapeutic measure as a counterbalancing mechanism to the stress response (Dusek et al, 2008). Mind-body awareness that modulates the stress response, can tone down maladaptive nervous system arousal ("Yoga for anxiety and depression", 2009). A purposeful mind-body practice can elicit the relaxation response to act against the physiological effects caused by stress (Galvin et al, 2006).

Studies have demonstrated that in a mild or moderate psychological distress people very commonly use self-help strategies to cope with stress (Jorm, Griffiths, Christensen, Parslow, & Rogers, 2004). A recent survey in the UK demonstrates that an informal help such as from friends and family is preferred rather than from health professionals, and in milder distress, strategies such as exercise, yoga or relaxation are very popular (Walters, Buszewicz, Weich, & King, 2008). Some population surveys have shown that most people do not seek help for depression or anxiety (Roness, Mykletun, & Dahl, 2005). Others suggest that majority of people with self-defined anxiety or severe depression uses some form of complementary and alternative therapies for help (Kessler et al, 2001). In the US, 16,6% of adults use mind-body therapies, most commonly for anxiety, depression and pain symptoms (Bertisch, Wee, Phillips, & McCarthy, 2009). A study from 2006 has shown that residents of Iceland are using complementary and alternative methods for health to a considerable degree. The use has increased in recent years with yoga and meditation as the second most commonly style used (Helgadottir, Vilhjalmsón, & Gunnarsdottir, 2010). Currently millions of individuals around the world practice yoga for health benefit with the popularity continually growing (Barnes, Bloom, & Nahin, 2008; Birdee et al, 2008; Saper, Eisenberg, Davis, Culpepper, & Phillips, 2004).

1.4 Yoga

Traditionally, this system of philosophy, that originated thousands years ago in the ancient India, is believed to have beneficial effects on mental and physical health. It is a system of self-discipline which balances, harmonizes, purifies and strengthens the body and the mind of the practitioner (Wishnu-Devananda, 1960). Evidence suggests that yoga works to enhance stress-coping mechanisms. Yoga has been defined as a prescription for self-help stress management for optimal health with no side effect and little cost for the community (Cameron, 2006). Anyone, regardless of health or beliefs, can benefit from regular practice of yoga (Kabat-Zinn, 1994).

1.5 Research on Yoga

Yoga encompasses a variety of styles and therefore can include somewhat different components depending on the practitioner. This has made it difficult to compare results on the benefit of yoga on health in research. Systematic reviews indicate that results need to be interpreted carefully since many of the studies have been poor in quality with inadequacies in methodology. Pilkington, Kirkwood, Rampes, & Richardson (2005) carried out a systematic review evaluating the evidence on the effectiveness of yoga intervention for the treatment of depression. Five randomized controlled trials were located, but each utilized different form of yoga intervention, incorporating a variety of postures and breathing exercises. Another limitation was that the severity of depression being treated was from mild to moderate with different measures being used. Thirdly the basic details of trial methodology were not reported. The initial indication is though that yoga intervention may potentially be an interesting option as a treatment for depression disorders. Kirkwood, Rampes, Tuffrey, Richardson, & Pilkington,(2005) carried out a systematic review in 2004 evaluating the evidence on the effectiveness of yoga intervention for the treatment of anxiety and anxiety disorders. Eight studies were reviewed and positive results were reported but there were many inadequacies in methodology such as , inadequate method of randomization and allocation concealment or a large loss to follow up, lack of sufficient data and use of own scales. The results were encouraging particularly with obsessive compulsive disorder but it was not possible to tell if yoga might be effective in treating anxiety or anxiety disorders. A critical review from 2010 suggests that yoga may be an attractive alternative to augment depression treatment strategies (Uebelacker et al, 2010).

Hatha yoga including mindfulness and exercise has shown to have plausible biological, psychological and behavioral mechanisms that impact anxiety and depression. An intensive yoga training was found to improve perceived stress, anxiety, depression and physical wellbeing (Michalsen et al, 2005) and yoga was found beneficial to reduce performance anxiety in musicians (Khalsa, Shorter, Cope, Wyshak, & Sklar, 2009). Symptoms of depression and trait anxiety decreased in younger adults after five weeks of hatha yoga classes compared to a control group (Woolery, Myers, Sternlieb, & Zeltzer, 2004). A comparison of yoga and cognitive behavioral program indicated both as promising stress management techniques (Granath, Ingvarsson, Von Thiele & Lundberg, 2006). Modified hatha yoga may benefit individuals with low back pain (Galantino et al, 2004; Saper et al, 2009). A research on elderly people has shown that mental health improved significantly after six months of an adapted yoga program called silver yoga (Chen et al, 2008). Quality of life improved

significantly in a group of hatha yoga practicing seniors compared to an exercise group and a waitlist control group (Oken et al, 2006). Hatha yoga might have a role in managing distress in early breast cancer patients undergoing radiotherapy (Vadiraja et al, 2009). Yoga practice has been associated with significant psycho- and biological differences including better sleep quality (Khalsa, 2004; Vera et al, 2009). An evaluation of the effects of yogic breathing on chronic insomnia has been reported as significantly improving sleep efficiency (Manjunath & Telles, 2005). Yoga postures and their connections with mindfulness-based interventions have been linked to improved sleep in cancer patients (Carlson & Garland, 2005).

There are few studies in the literature examining the effect of yoga on traumatic stress or traumatic stress disorder following a natural disaster like an earthquake. Researchers have started exploring whether yoga can be helpful for individuals with PTSD. A review on yoga intervention for the treatment of PTSD finds that data supporting the efficacy of yoga for PTSD is scarce (Cukor, Spitalnick, Difede, Rizzo, & Rothbaum, 2009). A pioneer study conducted in the US, in 2004 showed that yoga may change core physiology related to PTSD (Van der Kolk, 2006). Recent controlled studies in India suggest that yoga practice may be useful in the management of stress following a natural disaster (Telles, Singh, Joshi, & Balkrishna, 2010) and a yoga based breath interventions may relieve psychological distress following mass disasters (Descilo et al, 2010).

1.6 The Hatha Yoga Components

Hatha yoga is the best known yoga in the West and the most commonly practiced in the US and Europe ("Yoga for Health," 2009). Hatha yoga practice traditionally emphasizes balance of three main components, that is physical activity, breathing exercises and mindfulness meditation (Wishnu-Devananda, 1960) all of which may induce the relaxation response (Benson & Klipper, 1976) (see Figure 1).

The effects of physical activity are associated with a range of health benefits which are well documented in the literature. Most styles of yoga involve physical activities and in mainstream media and culture, yoga has been identified as a conventional form of exercise. These physical activities involve moving through systematic, rhythmic body positions that are designed to strengthen different parts of the body and increase blood circulation and flexibility. Each position is held in place for a period of time before moving to the next one. Many forms of yoga may be categorized as low aerobic intensity and in that regard yoga might have a potential role for individuals with limitations that restrict use of conventional exercise (Birdee et al, 2008). Many studies support positive effects of physical activity on mood, depression, anxiety and general well-being. Studies have shown that there is a clear dose-response relationship between increasing physical activity and decreasing depressive symptoms (Brown, Ford, Burton, Marshall, & Dobson, 2005). Research is needed to explore how to decrease depression and anxiety related symptoms when physical situation hinder individuals from participating in ordinary physical activity (Ströhle, 2009).

Another central aspect of hatha yoga practice is the use of controlled breathing while doing the exercises. It is considered fundamental for the development of physical well-being, meditation and awareness (Wishnu-Devananda, 1960). Yoga breathing can be considered as one form of meditation

and certain breathing practices can be a preparation for deeper meditation. Both yoga breathing and meditation can activate the parasympathetic nervous system and induce altered states of consciousness (Brown & Gerbarg, 2009). A sequence of breathing exercises may be beneficial for stress, anxiety, post-traumatic stress disorder (PTSD), depression and stress-related medical illnesses (Brown & Gerbarg, 2005). Voluntary control breathing is likely to bring about alterations in the autonomic responses and lower hypertension (Moruya, Mahajan, Singh, & Jain, 2009). Adult participants of normal health can improve their wellness using breathing exercises (Kjellgren, Bood, Axelsson, Norlander, & Saatcioglu, 2007) and rapidly bring the mind to the present moment and reduce stress (Brown & Gerbarg, 2009). Yoga based mind-body interventions may improve the pulmonary function which can reduce acute medication use in bronchial asthma and increase the quality of life (Vempati, Bijlani, & Deepak, 2009).

The third central aspect of hatha yoga practice is mindfulness meditation which means paying attention to the present moment (Wishnu-Devananda, 1960). Meditation has been described as the systematic cultivation of wakefulness, of present-moment awareness and simply about of being (Kabat-Zinn, 1994). Rapidly accumulating evidence supports mindfulness in reducing stress and stress related symptoms and thereby enhancing positive emotions and improving the quality of life (Greeson, 2009). Mindfulness meditation programs may change effects on brain and immune function in positive ways (Davidson et al, 2003) and lower mood disturbance and decrease symptoms of stress, depression and anxiety in cancer outpatients (Specia, Carlson, Goodey, & Angen, 2000). It is suggested that meditation may reduce metabolic change where specific breathing techniques may increase it compared to a state of rest (Danucalov, Simoes, Kozasa, & Leite, 2008). Yoga intervention may increase levels of mindfulness in a healthy population and be a preventive method for later development of negative emotional mood states i.e. anxiety and depression (Shelov, Suchday, & Friedberg, 2009). Systematic review on the effect of mindfully physical exercises on individuals with depression points strongly to positive effects on treating depression (Tsang, Chan, & Cheung, 2008).

Taken together, the literature to date suggests that the components of hatha yoga that is physical activity, breathing exercises and mindfulness meditation may be beneficial for stress and stress related symptoms, such as anxiety, depression, insomnia and post-traumatic stress disorder (PTSD).

1.7 Current Study

The purpose of the current study was to examine the effectiveness of hatha yoga on stress related symptoms. The research was a community based yoga intervention evaluating the effectiveness of six week hatha yoga practice on individuals living in an earthquake area. Individuals still experiencing symptoms of stress eight months after a large earthquake participated in the study ("Strong earthquake", 2008). It was hypothesized that the intervention would decrease stress and stress related symptoms among the inhabitants living at the earthquake area. Few studies have explored the effect of hatha yoga on stress and stress related symptoms in the aftermath of a natural disaster like an earthquake. To the best of our knowledge, no study has to date been conducted in Iceland on the effect of yoga on psychological or physical health.

1.8 Specific Aims

The aim of this research was to investigate whether a participation in a hatha yoga program including exercises, breathing and mindfulness meditation would lead to change in stress and stress related symptoms. It was hypothesized that PTSD, perceived stress, depression and anxiety, quality of life, energy, well being, pain, concentration, relationship and sleep quality among individuals exposed to traumatic experience would change more in a yoga practicing group than in a control group on a wait-list.

The Effect of Six-Week Yoga Program on Psychological Complications following an Earthquake

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Key words: yoga, stress, depression, anxiety, concentration, sleep, natural disaster.

Abstract

Background: The strain of responding to stressful situations can be cumulatively detrimental over time and lead to physical and mental disorders. Many research indicate that positive coping strategies as yoga are one kind of self-helping mind-body relaxation technique that works to enhance stress-coping mechanisms. Few studies have explored the effect of hatha yoga practice on stress and stress related symptoms in the aftermath of a natural disaster. **Design:** This was a non-randomized, community intervention with pre- and post-intervention valid measurements. **Objective:** To evaluate the effectiveness of hatha yoga on perceived stress and stress related symptoms. **Participants:** Fifty eight individuals, from highly exposed earthquake areas were self selected into the research and divided into an experimental group and a control group on a waitlist. **Intervention:** A hatha yoga program emphasizing balance of physical activity, breathing exercises and mindfulness meditation was instructed twice a week for six weeks. Several questionnaires were administered and blood pressure measured pre- and post intervention. **Results:** Multivariate analysis of variance (MANOVA) showed statistically significant improvement of quality of relations ($P<.035$) and quality of sleep ($P<.029$) measured by subscales of IQL. Participants in both groups showed a significant improvement in concentration, well being and quality of life. There was a significant improvement in stress, post-trauma symptoms, depression and anxiety from pre to post intervention in both groups. **Conclusion:** Current findings suggest that hatha yoga may be considered as a valuable self-helping strategy to improve sleep and relations. Studies of a long-term hatha yoga practice on PTSD and moderate to high levels of anxiety and depression are suggested. Research on the use of hatha yoga as an intervention in early stage of traumatic situation and crisis is recommended.

Introduction

Iceland is a land of volcanoes where earthquakes are common. On May 29, 2008, exceptionally strong earthquake (6,1 on Richter) ("Strong earthquake", 2008) struck the south part of Iceland with high frequency of aftershocks. Although considerable damage was done to buildings and household articles, residents only suffered minor injuries. According to a recent study (Gudmundsdottir et al, 2008), many inhabitants (70%) experienced fear, helplessness and/or horror during the earthquake and thus meeting diagnostic criteria for a traumatic event (American Psychiatric Association, 2000). Smaller earthquakes were still experienced eight months after the initial earthquake and concurrently expected the country was also experiencing economical crisis, influencing most inhabitants either by immense financial loss or unemployment in the community.

Stress is a normal reaction to normal stressors of life and humans react in a predictable way to acute or chronic stressful situations that trigger an inborn physiologic stress response (Benson & Klipper, 1976). While short time stress can be considered as a healthy stimulation of growth and development, long time stress can become chronic and have damaging influence on psychological and physical health (Selye, 1985). If perceived stress happens too often or lasts too long, it may develop and lead to different physical and/or psychological health disorders, such as cardiovascular disease, hypertension, fatigue, insomnia, anxiety, depression and chronic pain (Esch et al, 2002; De Rooij et al, 2009). It is well documented how stressful life events can negatively affect sleep quality (Hall et al, 2000). People suffering from depression may experience fatigue and sleep disturbance, lowering energy, poor concentration and an excessive sadness and unhappiness. In its worst, depression may result in withdrawal from daily activities that negatively affect family, social and occupational roles. Depression is expected to become the second leading contributor to the global burden of disease by 2020 ("Burden of mental health," 2001). An exposure to an extreme stressor as in natural disaster can lead to overwhelming traumatic experience and lead to post-traumatic stress disorder (PTSD) (American Psychiatric Association, 2000). The effects of extreme or prolonged stress need to be considered as a major environmental challenge that places individual's physical and psychological health equally at risk (Matthieu & Ivanoff, 2006; Mc Farlane, 2010).

An opposition to the stress response is the relaxation response, first described by Herbert Benson in 1974 as a coordinated physiological response, a physical state of deep rest that changes a person's physical and emotional response to stress (Benson & Klipper, 1976). It is characterized by an altered state of consciousness and a decreased arousal in the body, for example by lowering the heart rate, blood pressure and oxygen consumption. The relaxation response alleviates symptoms associated with a vast array of conditions, including hypertension, arthritis, insomnia, anxiety and depression, and thereby increasing the individual's state of well-being (Galvin et al, 2006). The relaxation response has been shown to be an effective therapeutic measure as a counterbalancing mechanism to the stress response (Dusek et al, 2008). The simple act of becoming relaxed can have surprising health benefits. Scientific research has shown that regular relaxation practices can have both physical and psychological effect (Goleman, 1995).

There are several relaxation techniques that can be used to elicit the physiological changes called the relaxation response. These techniques can be of various forms such as relaxation, meditation, breathing exercises and yoga. Positive coping strategies as yoga, are one kind of self-helping mind-body relaxation techniques that has been used worldwide for ages to manage stress. Yoga can have both physical and psychological effect to elicit the relaxation response and act against the physiological effects caused by the stress response (Galvin et al, 2006). It has been defined as a prescription for self-help stress management for optimal health with no side effect and little cost for the community (Cameron, 2006). Researchers have demonstrated the benefit of such non-pharmacological techniques to reduce stress and have shown that in a mild or moderate psychological distress people very commonly use alternative self-help strategies to cope with stress (Jorm et al, 2004; Walters et al, 2008). Currently millions of individuals around the world practice yoga for health benefit with the popularity continually growing (Barnes et al, 2008; Birdee et al, 2008).

Previously published research indicates that yoga can have both physical and psychological effect to elicit the relaxation response that acts against the physiological effects caused by the stress response (Galvin et al, 2006). A research on elderly people has shown that mental health improved significantly after six months of an adapted yoga program called silver yoga (Chen et al, 2008). An intensive yoga training was found to improve perceived stress, anxiety, depression and physical well being (Michalsen et al, 2005) and yoga was found to be beneficial to reduce performance anxiety in musicians (Khalsa et al, 2009). Modified hatha yoga may benefit individuals with low back pain (Galantino et al, 2004; Saper et al, 2009). Quality of life improved significantly in a group of hatha yoga practicing seniors compared to an exercise group and a control group (Oken et al, 2006). Yoga practice has been associated with significant psycho- and biological differences including better sleep quality (Khalsa, 2004; Vera et al, 2009). An evaluation of the effects of yogic breathing on chronic insomnia have been reported as significantly improving sleep efficiency (Manjunath & Telles, 2005). Yoga postures and their connections with mindfulness based interventions have been linked to improved sleep in cancer patients (Carlson & Garland, 2005).

There are few studies in the literature examining the effect of yoga on traumatic stress or posttraumatic stress disorder following a natural disaster. Researchers have started exploring whether yoga can be helpful for individuals with posttraumatic stress disorder (PTSD). A regular yoga practice may offer a way to reprogram automatic physical responses activated by traumatic experience (Van der Kolk, 2006). A review on yoga intervention for the treatment of PTSD finds that data supporting the efficacy of yoga for PTSD is still scarce (Cukor et al, 2009). Two recent controlled studies in India suggest that yoga practice may be useful in the management of stress following a natural disaster (Telles et al, 2010) and a yoga based breath interventions may relieve psychological distress following mass disasters (Descilo et al, 2010).

The purpose of this current study was to examine the effectiveness of yoga on stress related symptoms in the aftermath of an earthquake. The research was a community based yoga intervention evaluating the effectiveness of six week hatha yoga practice on individuals living in an earthquake area. It was hypothesized that the intervention would decrease stress and stress related symptoms among the inhabitants living at the earthquake area. Few studies have explored the effect of hatha

yoga practice on stress and stress related symptoms in the aftermath of a natural disaster. To the best of our knowledge, no study has to date been conducted in Iceland on the effect of yoga on psychological or physical health.

2 Method

2.1 Study Design

The study was a non-randomized community intervention with pre and post intervention measurements. An intervention group was provided with a six week hatha yoga program. The group met twice a week for sixty minutes. The control group was on a waitlist and was assigned to start yoga sessions immediately after the yoga group had finished their program. Several questionnaires were administered and blood pressure (BP) and heart rate (HR) were measured in both groups pre and post intervention.

2.2 Population and Procedure

Participants, aged 23-66, who lived in the earthquake prone area, came mostly from two small towns in south Iceland. Sixty five volunteers initially enrolled in the study but three individuals from the control group and four from the intervention group dropped out during the study period. Reasons for leaving the study included being ill or in pain, hospitalization, or being too busy to participate. Altogether 54 women and 4 men completed the study. The intervention group and control group consisted of 26 and 32 participants respectively. All provided data at pre and post intervention, however not all participants provided full data on each measure at each time-point.

Recruitment began in January 2009 and the yoga intervention started in February 2009, eight months after the large earthquake. After approval from the Icelandic National Bioethics Committee, the research was advertised in the local papers and public places, on a website, and online ads were sent to local institutions. In cooperation with two Primary Health Care Centers in the area patients were invited to enroll in the study. Those interested in volunteering, contacted the first author of this research (a qualified nurse and certified teacher), who verified if criteria were met. Participants were formally invited to a meeting where the objectives of the study were described further. After giving a written informed consent at the meeting, participants answered the questionnaires and blood pressure was measured. The yoga group was divided into two groups of 10 to 15 participants and the yoga program started a few days after the initial meeting. The yoga program was instructed by the first author of this research.

2.3 Eligibility Criteria

Participants were eligible to participate if they had been living in the earthquake area during the large earthquake, and if they evaluated themselves as experiencing distress or having stress symptoms at the time of recruitment. Otherwise participants had to be relatively healthy and in the age range 20 to 65.

2.4 Exclusion Criteria

Participants with any current physical injuries at neck, head, back or joints that made them unable to participate in hatha yoga exercises (assessed by first author of this research or their primary physician) were excluded. Pregnant participants were also excluded. In addition, participants were excluded if they had planned to participate in another yoga class during the study. Two interested participants were excluded, one because of pregnancy and another for practice in another yoga class.

2.5 Yoga intervention

The yoga sessions were scheduled two times per week, 60 minutes in duration. The frequency of sessions was based on common yoga class availability in Iceland and for optimal maintenance and compliance for this six weeks trial. The hatha yoga program consisted of physical activities of mild to moderate intensity in the context of mindfulness and meditation, yogic breathing and relaxation (see Figure 1). Seated, standing and lying (supine) yoga postures were instructed with emphasizes on mindfully movements from one posture to another. Breathing awareness and relaxation into postures was encouraged. Each session included approximately 35 minutes of gentle yoga postures. Each posture was held 30-40 seconds, with relaxation between poses. Basic voluntary breathing techniques for beginners were taught including abdominal breathing, which uses the diaphragm primarily, and is congruent with the shape of the lungs and the capacities of the breathing muscles. Alternate nostril breathing was also used. This is done by directing the air stream mildly and alternately through each nostril at a time by gently occluding the opposite nostril. The need for gentle practice in challenging the poses was highlighted and participants' attention was directed to be aware of the movement. Relaxation music was played on low volume during the session. Each session ended in a 15-minute instructed deep relaxation in a lying position, the body's muscles relaxing one by one from feet to face. Participants were given handouts of some of the poses taught for practicing at home if they wanted and notes of positive statements. For attendance and completion of the yoga intervention program, participants were awarded with documents.

2.6 Data Collection

Demographic characteristics were assessed at pre-intervention for baseline information of gender, age, occupation, education, marital and parental status, any history of smoking or substance abuse, financial status, and past participation of counselling or alternative therapies, including yoga. Use of medication, other physical activity and traumatic experience were assessed at pre- and post-intervention. Five questionnaires covering different aspects of psychological and physiological well-being were administered at pre and post intervention.

2.6.1 Perceived Stress scale: PSS-10

Perceived Stress scale: PSS-10 (Cohen, Kamarck, & Mermelstein, 1983) is a widely used and well validated 10 item self-report questionnaire designed to measure to what degree the respondent appraises his life situation over the past month as unpredictable, uncontrollable and overwhelming for use within the general community. The scale measures each question from 0 to 4. Higher score is associated with greater vulnerability to stressful life-event-elicited symptoms and the likelihood of

perceiving that environmental demands exceed the individual's ability to cope with the situation (Kuiper, Olinger, & Lyons, 1986). This scale has been found to provide better predictions for psychological and physical symptoms and utilization of health services than other instruments of similar kind (Cohen & Williamson, 1988). In the current sample, Cronbach's alphas for the PSS-10 was $\alpha = .89$ at pre-intervention and $.86$ at post-intervention, indicating high internal consistency.

2.6.2 Posttraumatic Stress Diagnostic Scale: PDS

The Posttraumatic Stress Diagnostic Scale (PDS) is a 49-item self-report questionnaire designed to measure the severity of posttraumatic stress disorder (PTSD) symptoms (Foa, Cashman, Jaycox, & Perry, 1997). The PDS has five sections. The first section is a trauma checklist with specific questions of twelve traumatic events. The individual is inquired if he has ever witnessed or experienced one or more of them as a very traumatic situation. In the second part the respondent is asked to describe his most upsetting traumatic event. In third section there are specific questions about when the event happened, if anyone was injured, if life threat was perceived, and whether the event resulted in helplessness or terror. In the fourth section the severity of the 17 PTSD symptoms is assessed from 0 ("not at all or only one time") to 3 ("5 or more times a week/almost always"). The fifth section assesses interference of the symptoms on daily functioning over the last month. In typical practice, which was used in the current study, symptom severity scores are obtained by summing the 17 PTSD symptom items, with higher scores indicating greater symptomatology. The range of the scale score is from 0 – 51. Total score of 1-10 is considered to be mild, 11-20 moderate, 21–35 moderate to severe and more than 36 is considered to be severe. This scale provides a means of quantifying the severity of PTSD symptoms and has been validated in a clinical population aged 18 to 65 years (Foa, Riggs, Dancu, & Rothbaum, 1993). The Icelandic translation of the PDS scale has been examined in a student population and demonstrated good reliability (Cronbach's $\alpha = .83$) (Ragnarsdottir & Gudmundsdottir, 2008). In the current sample, Cronbach's alphas for the PDS was $\alpha = .84$ at pre intervention and $.92$ at post intervention, indicating high internal consistency.

2.6.3 Beck Depression Inventory-II: BDI

The Beck Depression Inventory Second Edition: BDI-II (Beck, Steer, Ball, & Ranieri, 1996) is a 21-item self-report instrument measuring the existence and severity of symptoms of depression consistent with the criteria of the DSM-IV (American Psychiatric Association, 2000). For each item there is a four-point scale, ranging from 0 to 3. Each of the 21 items corresponding to a symptom of depression is summed and one total score is given. Total score of 0-13 is considered to reflect depression in a minimal range, 14-19 is mild depression, 20-28 is moderate, and 29-63 severe depression. Solid evidence for convergent and discriminate validity has been demonstrated by correlations between the BDI-II and other measures (Beck et al, 1996). The psychometric properties of the Icelandic version of the BDI-II have been supported in patient and student population in Iceland (Arnarson, Olason, Smari, & Sigurdsson, 2008). In the current sample, Cronbach's alphas for the BDI-II was $\alpha = .92$ at pre-intervention and $.95$ at post-intervention, indicating high internal consistency.

2.6.4 Beck Anxiety Inventory: BAI

The Beck Anxiety Inventory (Beck & Steer, 1993), BAI is designed to discriminate anxiety from depression. It is a 21-item instrument that measures the severity of self-reported anxiety. The items are rated from 0 to 3 with a possible total score of 63 points. Total scores from 0 to 7 is considered to be of minimal level of anxiety, 8-15 a mild anxiety, 16-25 moderate anxiety and scores of 26-63 is considered to be severe anxiety. The items are on experiences related to anxiety such as “fear of the worst happening” or “heart pounding/racing”. BAI has been recommended for clinical and research settings in order to obtain the highest accuracy (Beck & Steer). In the current sample, Cronbach's alphas for the BAI was $\alpha = .91$ at pre-intervention and .92 at post-intervention, indicating high internal consistency.

2.6.5 Icelandic Quality of Life: IQL

The Icelandic Quality of Life scale (Helgason, Björnsson, Tomasson, & Ingimarsson, 1997) IQL, is a generic Icelandic instrument with 32 questions. The IQL evaluates how the individual consider his/her health and how diseases interfere with his/her well being. The scale measures the health related quality of life (HRQL) and has 12 subscales consisting of general health, mental well being, concentration, sleep, pain, anxiety, finance, mood, energy, relations, perceived self control and social connection. In the current study the questionnaire was used to examine the effect of yoga practice on health related quality of life, energy, well being, pain, concentration, relations and sleep. The higher score the higher the health related quality of life. Score below 40 is considered low; scores at 50 moderate and 60 is high. The scale takes into consideration the difference of HRQL between men and women and the changes occurring with age. IQL has been shown to have good reliability (Cronbach's alfa $\alpha = .91$) and validity in Icelandic researches (Helgason, Björnsson, Tomasson, & Gretarsdottir, 2000). In the current sample, Cronbach's alphas for the IQL was $\alpha = .94$ at pre-intervention and .96 at post-intervention, indicating high internal consistency.

2.6.6 Physiological Measures

Systolic (SBP) and diastolic blood pressure (DBP) and heart rate (HR) were measured by an automatic digital blood pressure device (TOPCOM BPM ARM 3301) at pre and post intervention. Participants were asked to rest at least 10 minutes before each measurement. Measurement of blood pressure was categorized.

2.7 Statistical Analysis

Chi-square tests were performed to test differences in characteristics of both groups at baseline. Independent sample t-tests were performed to determine whether statistically significant differences at baseline existed in yoga group and control group on several dependent variables, such as stress, anxiety, depression, quality of life and blood pressure.

In order to examine the proposed hypotheses, a series of repeated measures Group by Time (2; pre intervention, post intervention) MANOVAs for each measure of PSS-10, PDS, BDI-II, BAI and IQL (*quality of life, energy, well being, pain, concentration, relationship and sleep*) were used. As discussed by Vasey & Thayer (1988), the MANOVA is preferable to an analysis of variance approach

(ANOVA) when examining data from a repeated measures design, as it is robust to possible violations of the sphericity assumption. A significant omnibus interaction effect showing multivariate differences between the two groups over time was examined further with planned comparisons. Effect sizes were computed for each dependent variable and evaluated using criteria provided by Cohen (1988), where small effects range from 2-12% of variance, medium effects from 13-44% and large effects are those that account for 45% or more of variance.

Data was analyzed using PASW (formerly SPSS) statistics, version 18.0. An alpha level of .05 was used for all statistical tests.

2.8 Ethical Issues

The trial had the approval of the Icelandic National Bioethics Committee and all participants provided written informed consent. Everyone was informed of their right to discontinue the program at any time if they chose to do so. Both groups were given the opportunity to participate in yoga classes. The yoga training has very little physical risk and the yoga instructor observed each participant closely. No injuries were reported.

3 Results

3.1 Subjects

In the yoga group, 30 participants were initially involved. Altogether 26 participants completed the yoga program and attended at an average of 9.54 yoga lessons (SD 1.73) of the 12 sessions program or almost 77% attendance to classes. Those who attended 10 sessions or more were 62%. No one attended fewer lessons than five.

In the control group, initially 35 participants were involved, 32 completed the research. Reasons for dropping out were personal affairs.

3.2 Demographics

Demographic characteristics of participants in the two groups at the beginning of the study are presented in Table 1. Pearson Chi-square indicated no statistically significant differences between the intervention group and the control group at baseline. Participants were mostly women (84%) at the age 40–60 years. They were generally well educated and most of them working full or part time jobs. One participant reported unemployment. Around 35% of each group enjoyed some other physical activity like walking or swimming regularly (2-3 times a week or more). In the yoga group 30% were smokers and 13% in the control group. In the yoga group 46% had never smoked, whereas 53% of the control group members had never smoked. At some point in their lives 68% of participants had used counselling for help and 74% had used alternative therapies, including yoga. Around 45% of participants in the yoga group and 55% in the control group had experienced traumatic event meeting the DSM-IV criteria of a traumatic event (American Psychiatric Association, 2000) when the intervention started. Most of them reported the earthquake as the trauma that bothered them the most.

3.3 Baseline Measures

An independent sample t-test was used to compare post-trauma symptoms, depression, anxiety, stress, quality of life and blood pressure between the yoga group and the control group at baseline. No significant mean difference was found between the two groups in any of the measurement. Both groups reported moderate to high perceived stress as measured by the PSS-10 at pre-intervention $t(90)$, $p = .929$. Symptoms of PTSD were moderate in both groups as measured by PDS scale $t(-.07)$, $p = .944$.

On average both groups showed mild depression symptoms measured by the BDI-II $t(-.41)$, $p = .681$ and mild anxiety symptoms as measured by the BAI scale $t(-.24)$, $p = .812$. The IQL scale presented rather low score in overall quality of life $t(.61)$, $p = .546$, energy $t(.60)$, $p = .553$, well being $t(.27)$, $p = .789$, pain $t(1.46)$, $p = .150$, concentration $t(-.44)$, $p = .324$, relations $t(.18)$, $p = .856$ and sleep quality $t(1.75)$, $p = .087$. No significant difference was seen in mean blood pressure measurement at baseline in either group $t(-.72)$, $p = .473$, and the heart rate measure was also identical $t(-1.57)$, $p = .121$. At baseline the use of medication for health benefit was identical in the groups (see Table 1).

3.4 Yoga Impact on Stress Related Symptoms

In order to examine the effect of yoga intervention on stress, post-trauma symptoms, depression, anxiety, health related quality of life, blood pressure and heart rate, a series of repeated measures Group (2; yoga group, control group) by Time (2; pre intervention, post intervention) MANOVAs was carried out. Examination of the group by time interaction for stress, posttraumatic symptoms, depression and anxiety did not indicate any significant effects (see Table 3). These results were not consistent with what was expected. A significant time main effect was noted for these responses. In particular, participants showed a significant decrease in these symptoms between pre and post intervention. No group differences were noted for these responses (see Table 3).

Examination of the group by time interaction for measures of health related quality of life and energy, well being and pain (subscales of IQL) did not indicate any significant effects (see Table 3). These results were not consistent with what was expected. A significant time main effect was noted for energy and well being. In particular, participants showed a significant increase in the quality of these areas between pre and post intervention. No significant time main effect was noted for pain. No group differences were noted for these quality of life areas (see Table 3). However, examination of the group by time interaction for measures of concentration, relations and sleep (subscales of IQL) showed significant effects (see Table 3). Planned comparison for each measure was conducted to examine further the significant interaction. As expected the results showed that participants in the yoga group showed significant improvement in concentration (as measured by the IQL) from pre to post intervention. However, different from what was expected, the control group also showed significant improvement in concentration from pre to post intervention (see Figure 2). For the relations subscale of the IQL the yoga group showed significant improvement in relations from pre to post intervention but the improvement were not noted for the control group (see Figure 3). Similarly, the yoga group showed

significant improvement in sleep as measured by the IQL but the control group did not show this improvement (see Figure 4). This is consistent with what was expected.

Examination of the group by time interaction for blood pressure and heart rate did not indicate any significant effects (see Table 3). These results were not consistent with what was expected. Also, no significant time main effect and no significant group differences were noted for these variables (see Table 3).

4 Discussion

The current study is a carefully conducted intervention with valid measurements and, to our knowledge, the first of its kind that specifically is aimed at a population exposed to an earthquake. It is a controlled trial done in normal situations among the inhabitants in the community and represents the impact of a short-term yoga practice on stress-related symptoms.

The main findings of the present study are that six weeks hatha yoga practice is significantly associated with better relations and sleep quality (Figure 3-4). No other groups by time interactions were observed as significant. The benefit of yoga on sleep quality is in accordance with previous reports (Chen et al, 2008; Vera et al, 2009). It is well recognized how function of sleep in everyday life is crucial to individual's well being and there seems to be a strong relationship between the quality of sleep and psychological symptoms (Manjunath & Telles, 2005).

The research demonstrates also time main effects between responses at pre and post intervention. Regardless of group, the participants reported a significant reduction of stress, PTSD, depression, anxiety, health and quality of life including energy, and well being after six weeks of participation. Studies have shown that yoga may be a useful stress management technique (Kjellgren et al, 2007; Michalsen et al, 2005; Smith, Hanock, Blake-Mortimer, & Eckert, 2007) but the difference in this study was insignificant between groups. Quality of life and energy has been found to improve after silver yoga practicing (Oken et al, 2006). Modified hatha yoga has been shown to be of benefit for individuals with pain (Galantino et al, 2004; Saper et al, 2009). Improvements of pain were not found at post-intervention in this current study. This might be explained by this short time of yoga practice.

Of note, of unknown reason, many participants did not give answers in the PDS questionnaire at post intervention. Only 15 (58%) participants in the yoga group answered the questionnaire (PDS) at post intervention and 14 (44%) in the control group. This might interfere with the outcome and comparison of PTSD pre and post intervention. Recent studies of the effectiveness of yoga on PTSD, suggest that yoga might be a useful stress management following a disaster (Descilo et al, 2010, Telles et al, 2010; Van der Kolk, 2006).

The data did not demonstrate lowering measures of heart rate or blood pressure (BP) after the intervention. The mean blood pressure in the groups at pre intervention falls into category of normal blood pressure of adult individuals at the rate of 120/80 (Kozier & Erb, 1989) with quite an exception of few hypertensive individuals. Of note, BP and heart rate measures in the yoga group post intervention was done right after the last yoga session when participants were in a relaxed state, compared to the control group where the BP measure was done after a 10 minutes rest. Psychological stress is a risk

factor for hypertension, which is a major public health issue (Cohen et al, 2009). Benefits of yoga have been supported in a systematic review evaluating the effects in relation to hypertension (Hyman, Feldman, Harris, Levin, & Malloy, 1989). As hypertension was not seen in the sample of the current study, lowering of BP was hardly to be expected.

Various aspects of the hatha yoga intervention, that is physical activity, meditation or yogic breathing (see Figure 1), may all together account for the observed benefits. Each of these components has been argued for as eliciting the relaxation response (Brown & Gerbarg, 2005; Brown, et al, 2005; Kabat-Zinn, 1994). According to Van der Kolk (2006) it is essential to engage in effective action after experience of extreme physical helplessness to learn to tolerate feelings and sensations and modulate the arousal. Mindful yoga practice can change the brainstem arousal system, and the sympathetic and parasympathetic nervous system and has been described to quiet the brain.

Research suggest that individuals experiencing mental health problems may not seek out sufficient professional support which may indicate a need for appropriate and most importantly evidence-based self-help strategies (Henderson, 2002). In the current study, participants were self selected into the research and it is anticipated that those who attended were interested in yoga for dealing with their distress.

The shortcoming of this research is that this was not a randomized trial. Participants interested in yoga were self-selected into the study and came from two towns highly exposed to the earthquake. After registering for the study, they were divided into an intervention group or a wait-list group by demographic convenience. This could be alleviated with a proper randomization in a full scale trial.

A further shortcoming of this study is the small sample size and the short time yoga practice. This study allowed only one yoga teacher and a room for 15 persons at each session. This could be alleviated with a design of long-term practice, more yoga instructors and convenient facilities for the intervention program.

A further complication in the current study is the fact that the instructor of the yoga program and the first author of this article was acquainted with many of the participants in the control group, some of which had participated in her yoga class a few years earlier. This could be alleviated by getting other yoga instructors to come into the yoga program.

Placebo effect cannot be ruled out in the control group who waited for six weeks for the yoga program to start. It has been scientifically demonstrated that the placebo effect and a relaxation response are real phenomena which represent the manifestation of a proactive mind-body link that evokes a protective response in the body (Stefano, Fricchione, Slingsby, & Benson, 2001). They might have expected benefit for their health which could have elicited a relaxation response while waiting. This could be alleviated by changing the design of the control group. Instead of a waitlist there could be a control group participating in, for example cognitive behavioral therapy or exercise like swimming or walking.

The design of the study only allowed for one measure of blood pressure (BP) and heart rate (HR) at pre and post intervention. Three measurements of BP and HR are recommended for acquiring the mean BP/HR of each individual (Omboni, Frattola, Parati, Ravogli, & Mancia, 1992). Comparison of one measurement from one time to another should therefore be interpreted with caution.

5 Conclusion

The present work represents the impact of a short-term community based yoga practice on stress-related symptoms. The current findings suggest that adult participants living in an earthquake prone area are interested to improve their wellness by participating in a yoga program. The score of relations and quality of sleep (IQL) after six week of hatha yoga program based on yogic exercises, breathing and mindfulness meditation was significantly higher in the yoga group than in the control group. This may be of clinical implication. For modern people in a world bursting with stressful life events, understanding the ways in which stress affects health is important. Knowledge of reliable self-help strategies is crucial for public health in the community at large. Yoga is easily learned and applied cost effective yogic practices can thus be offered as an alternative intervention to adult population at large to relieve psychosocial stress and its associated disorders.

This study has allowed recommendations to be made to facilitate the design of large-scale and improved trial. Further research is needed. Studies of long-term hatha yoga practice on moderate to high levels of anxiety and depression are suggested. Research on the use of modified hatha yoga practice in early stage of traumatic situation and in crisis should be considered as a psychosocial intervention for the prevention of stress related symptoms. Hatha yoga practice, including physical activity, breathing exercises and mindfulness meditation may be considered as a valuable self-help strategy to improve sleep in inhabitants living in an area prone to natural disasters.

Figures

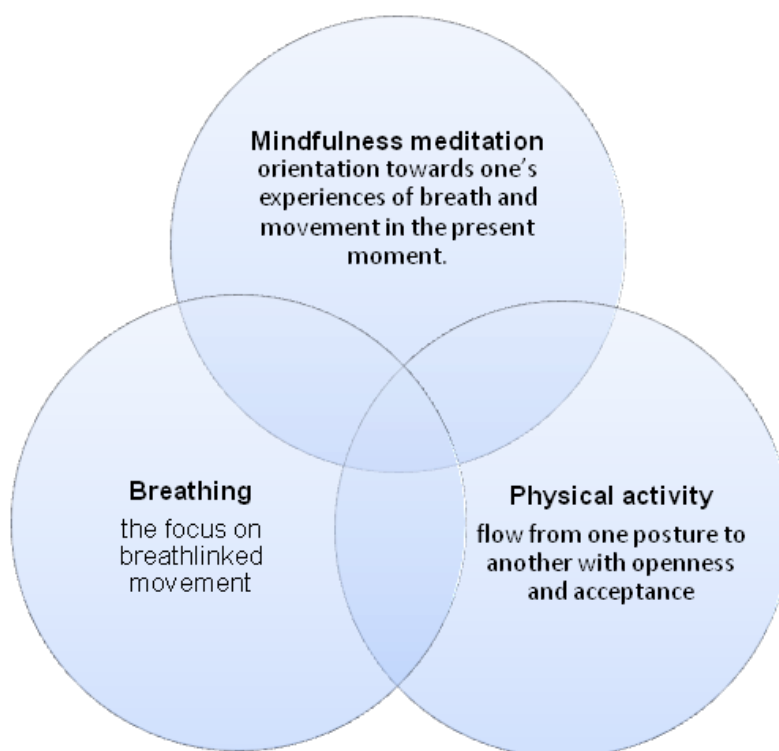


Figure 1: Three components of hatha yoga practice

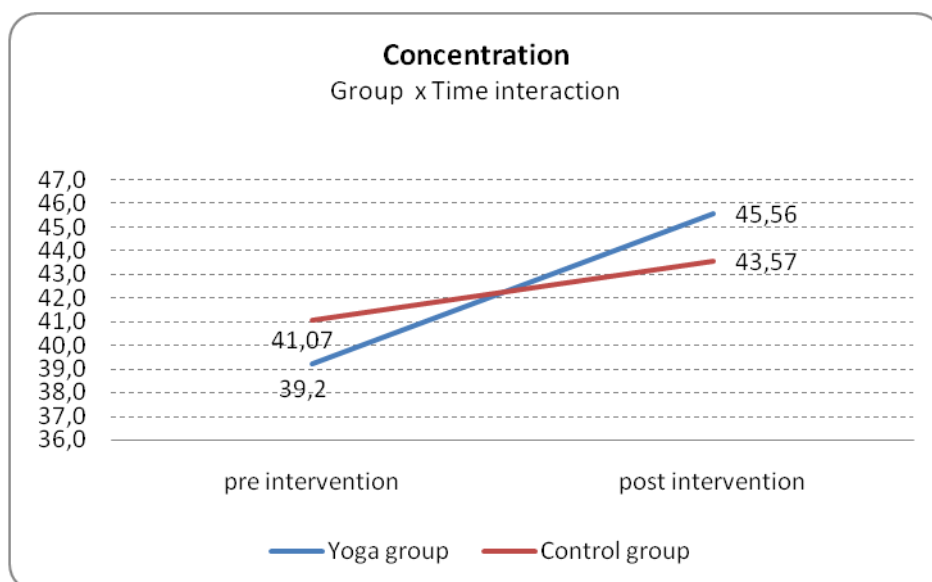


Figure 2: Group by time interaction for the concentration subscale of the IQL scale

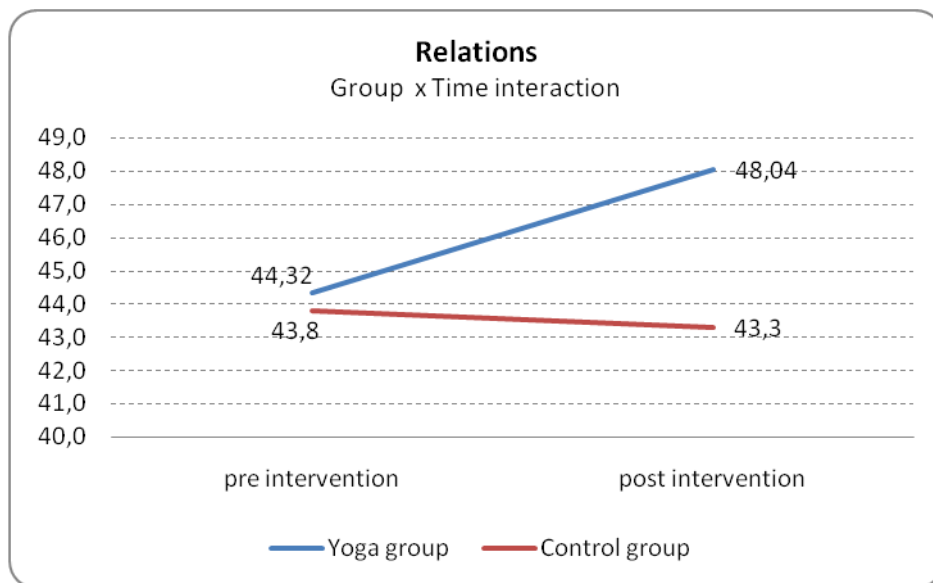


Figure 3: Group by time interaction for the relations subscale of the IQL scale

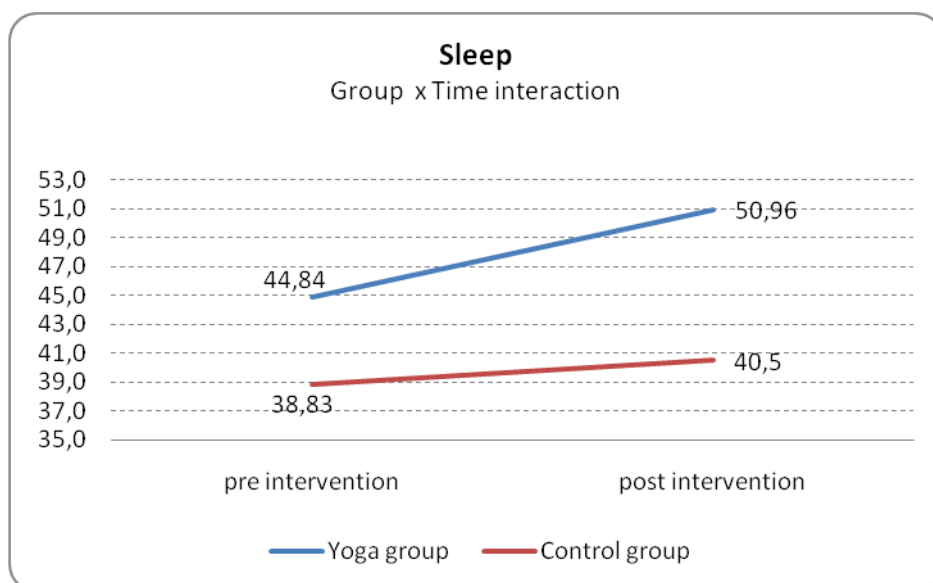


Figure 4: Group by time interaction for the sleep subscale of the IQL scale

Tables

Table 1: Characteristic of baseline

Characteristics of the study population by group: Gender, age, education, employment, health behavior, traumatic experience

	Yoga group n = 26	Control group n = 32	χ^2	<i>p</i>
<u>Gender</u>			1.58	0.209
Male	3 (11.5%)	1 (3.1%)		
Female	23 (88.5%)	31 (96.9 %)		
<u>Age</u>			4.50	0.288
23-30 years	3 (11.5%)	2 (6.3%)		
31-40 years	3 (11.5%)	11 (33.4%)		
41-50 years	9 (34.6%)	8 (25.0%)		
51-60 years	5 (19.2%)	7 (21.9%)		
61-66 years	6 (23.1%)	4 (12.5%)		
<u>Employment</u>			1.74	0.627
Full time	13 (50.0%)	13 (40.6%)		
Part time	9 (34.6%)	13 (40.6%)		
Unemployment / disabled	2 (7.7%)	5 (15.6%)		
Other	2 (7.7%)	1 (3.1%)		
<u>Education</u>			1.70	0.427
Primary school	5 (19.2%)	8 (25.0%)		
Secondary school	15 (57.7%)	11 (34.4%)		
College / University	6 (23.1%)	11 (34.4%)		
<u>Other physical activity</u>			0.22	0.894
Once in a month or less	7 (26.9%)	8 (25.0%)		
2-4 times in a month	9 (34.6%)	13 (40.6%)		
2-3 a week or more	10 (38.5%)	11 (34.4%)		

Table 1 continued

<u>Smoking</u>			3.08	0.215
Yes	8 (30.8%)	4 (12.5%)		
No, never smoked	12 (46.2%)	17 (53.1%)		
No, stopped smoking	6 (23.1%)	11 (34.4%)		
<u>Using medication</u>				
Sleeping pills	7 (36.8%)	4 (20.0%)	1.37	0.243
Sedatives	5 (29.4%)	3 (16.7%)	0.81	0.369
Anti-depressants	3 (18.8%)	2 (11.8%)	0.31	0.576
Pain medication	8 (44.4%)	12 (63.2%)	1.30	0.254
Hypertension drugs	4 (23.5%)	4 (20.0%)	0.68	0.795
<u>Used alternat. therapies</u>	20 (83.3%)	21 (65.6%)	2.50	0.286
<u>Used counseling</u>	19 (73.1%)	20(62.5%)	0.73	0.393
<u>Traumatic experience</u>	12 (44.8%)	15 (55.2%)	0.03	0.956

* Chi-square test

Table 2: Yoga group and control group: pre- and post tests

Comparison of means and standard deviations pre- and post- yoga intervention on psychological and physiological measures for *PSS-10*, *PDS*, *BDI-II*, *BAI*, *IQL* *, blood pressure and heart rate (SD shown in parenthesis). Descriptive statistics.

	Yoga group		Control group	
	Pretest n= 26 (45%) Mean (std.dev)	Posttest n= 26 (45%) Mean (std.dev)	Pretest n= 32 (55%) Mean (std.dev)	Posttest n= 32 (55%) Mean (std.dev)
<u>PSS-10</u>	19.73 (6.32)	15.31(6.85)	19.76 (8.78)	16.69 (7.52)
<u>PDS</u>	19.00 (13.58)	12.86 (9.81)	17.54 (13.47)	12.23 (11.03)
<u>BDI-II</u>	15.60 (9.20)	10.60 (10.36)	17.20 (11.42)	14.37 (12.99)
<u>BAI</u>	11.73 (9.95)	8.50 (6.44)	13.04 (9.68)	12.18 (10.38)
<u>IQL</u>				
Quality of life	42.04 (9.69)	47.12 (9.25)	40.20 (11.27)	42.40 (12.07)
Energy	43.12 (8.67)	48.40 (8.33)	41.70 (9.88)	45.10 (10.74)
Well being	43.72 (9.90)	47.84 (9.72)	42.97(10.33)	45.00(10.32)
Pain	44.96 (12.68)	45.24 (7.97)	40.10 (12.90)	39.97 (12.03)
Concentration	39.20 (11.39)	45.56 (8.75)	41.07 (12.11)	43.57 (10.46)
Relations	44.32 (10.44)	48.04 (9.34)	43.80 (10.46)	43.30 (11.98)
Sleep	44.84 (8,94)	50.96 (6.50)	38.83 (11.11)	40.50 (11.64)
<u>Blood pressure</u>				
BP systolic	123.16 (18.13)	118.40 (15,06)	126.52 (18.19)	125.48 (15.21)
BP diastolic	80.92 (10.72)	80.44 (7,88)	82.71 (10.53)	83.84 (9.82)
<u>Heart rate</u>	71.28 (9.52)	67.84 (10,14)	76.39 (14.41)	75.65 (13.11)

*Note. **PSS-10**= Perceived Stress scale; **PDS**= Posttraumatic Stress Diagnostic Scale; **BDI-II**= Beck Depression Inventory-II; **BAI**= Beck Anxiety Inventory; **IQL**= Icelandic Quality of Life.

Table 3: Manova: variance of time, group and main effects

Multivariate Analyses of variance of time main effects, group main effects, and group by time interaction for *PSS-10*, *PDS*, *BDI-II*, *BAI*, *IQL* *, blood pressure and heart rate

<i>Measure</i>	<i>df</i>	<i>Error df</i>	<i>F</i>	<i>p</i>
<u><i>PSS-10 - Stress</i></u>				
Group	1	53	0.147	.703
<i>Time (pre /post)</i>	1	53	20.472	.000
Group x Time	1	53	0.669	.417
<u><i>PDS - PTSD symptoms</i></u>				
Group	1	25	0.056	.815
<i>Time (pre /post)</i>	1	25	14.456	.001
Group x Time	1	25	0.077	.784
<u><i>BDI-II - Depression</i></u>				
Group	1	53	0.895	.348
<i>Time (pre /post)</i>	1	53	13.438	.001
Group x Time	1	53	1.028	.315
<u><i>BAI - Anxiety</i></u>				
Group	1	48	0.966	.331
<i>Time (pre /post)</i>	1	48	6.343	.015
Group x Time	1	48	2.136	.150

Table 3 continued

<i>Measure</i>	df	Error df	F	p
<u>IQL: Quality of life</u>				
Group	1	53	1.374	.246
<i>Time (pre /post)</i>	1	53	21.415	.000
Group x Time	1	53	3.351	.073
<u>IQL: Energy</u>				
Group	1	53	0.945	.335
<i>Time (pre /post)</i>	1	53	24.070	.000
Group x Time	1	53	1.129	.293
<u>IQL: Well being</u>				
Group	1	53	0.510	.478
<i>Time (pre /post)</i>	1	53	8.303	.006
Group x Time	1	53	0.955	.333
<u>IQL: Pain</u>				
Group	1	53	3.091	.085
<i>Time (pre /post)</i>	1	53	0.003	.955
Group x Time	1	53	0.026	.873

Table 3 continued

Measure	df	Error df	F	p
<u>IQL: Concentration</u>				
Group	1	53	0.001	.982
Time (pre /post)	1	53	25.201	.000
Group x Time	1	53	4.783	.033
<u>IQL: Relations</u>				
Group	1	53	0.936	.338
Time (pre /post)	1	53	2.738	.104
Group x Time	1	53	4.703	.035
<u>IQL: Sleep</u>				
Group	1	53	10.880	.002
Time (pre /post)	1	53	15.315	.000
Group x Time	1	53	5.009	.029
<u>Blood pressure</u>				
<u>BP Systolic</u>				
Group	1	54	2.209	.143
Time (pre /post)	1	54	1.065	.307
Group x Time	1	54	0.441	.509
<u>BP Diastolic</u>				
Group	1	54	1.269	.265
Time (pre /post)	1	54	0.062	.804
Group x Time	1	54	0.381	.540
<u>Heart rate</u>				
Group	1	54	46.30	.036
Time (pre /post)	1	54	2.547	.116
Group x Time	1	54	1.060	.308

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