

'A meta-analysis of the effectiveness of yoga on mental health; taking on a dual perspective reflecting the medical and positive perspective of mental health'

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## Abstract

*Introduction:* Results of systematic reviews show that yoga has a positive effect on mental health. A meta-analysis of RCTs is relevant to show reliable empirical evidence of the effectiveness of yoga on mental health. This meta-analysis differentiates itself from earlier reviews, because it takes on a dual perspective showing a more complete picture of mental health. Mental health is more than the cure of symptoms and disorders. Researchers state that taking only the medical perspective, as in reducing symptoms, is not sufficient to improve mental health. This is supported by empirical evidence. For this reason two outcomes will be analysed, illustrating the medical and positive psychology perspective, which can be complementary in the study and promotion of mental health.

*Methods:* This paper will continue on the work of ten Damme and Kruese, who made a systematic review of yoga. From their literature list, studies that measure well-being and depression were included. This meta-analysis researched the effect yoga has on mental health. The primary outcomes in this meta-analysis are depression or depressive symptoms and well-being, which consists of emotional well-being (EWB), psychological well-being (PWB) and social well-being (SWB).

*Results:* 34 studies have been included and 32 remained after the removal of outliers. The following effects (Hedges  $g$ ) of yoga on mental health were seen: A total of 32 studies with 38 outcomes showed an effect of 0.52 (Hedges  $g$ ) on mental health. On depression 29 studies showed an effect of  $g = 0.49$ , on well-being 6 studies with 11 outcomes showed an effect of  $g = 0.62$  (EWB  $g=0.56$ , PWB  $g=0.53$ , SWB  $g=0.42$ ). Subgroup analysis result shows that lower quality rated studies show lower effect sizes than higher rated studies. Also yoga is effective for all population types like healthy people, with mental illness or somatic illness. There is no indication of publication bias.

*Conclusion:* This meta-analysis shows that yoga interventions can be effective in reducing depression, depressive symptoms and the promotion of well-being. In other words it has positive effects not only on depression, but also on the positive functioning of a person. This in turn doesn't only lighten symptoms, but also adds buffering factors against psychopathology. This is the case for a broad selection of populations. Yoga could be a good addition to the list of positive interventions on (mental) health, in view of its possibilities.

## Samenvatting

*Introductie:* Resultaten van systematische reviews laten zien dat yoga een positief effect heeft op mentale gezondheid. Een meta-analyse van RCTs is relevant om sterke empirische evidentie te laten zien van de effectiviteit van yoga op mentale gezondheid. Deze meta-analyse differentieert zichzelf van eerdere reviews, omdat het een tweezijdig perspectief aanneemt wat een completer beeld laat zien van mentale gezondheid. Mentale gezondheid is meer dan de genezing van symptomen en stoornissen. Onderzoekers suggereren dat alleen het medische perspectief aannemen, als in het reduceren van symptomen, niet genoeg is om mentale gezondheid te bevorderen. Om deze reden zullen twee perspectieven worden aangenomen, namelijk die van de medische en de positieve psychologie, wat aanvullend kan zijn in de studie en promotie van mentale gezondheid.

*Methode:* Dit onderzoek zal voortborduren op het werk van ten Damme en Kruese die een systematische review heeft gemaakt van yoga en depressie. Van hun lijst zullen de studies die welbevinden en depressie meten, worden opgenomen in de analyse. Deze meta-analyse zal de effecten van yoga op mentale gezondheid onderzoeken. De primaire uitkomsten in deze meta-analyse zijn depressie of depressieve symptomen en welbevinden, wat bestaat uit emotioneel welbevinden, psychologisch welbevinden en sociaal welbevinden

*Resultaten:* 34 studies zijn geïncludeerd en 32 bleven er over na het verwijderen van uitschieters. De volgende effecten (Hedges  $g$ ) van yoga op mentale gezondheid zijn gevonden: Een totaal van 32 studies met 38 uitkomsten lieten een effect zien van 0.52 (Hedges  $g$ ) op mentale gezondheid. Op depressie lieten 29 studies effecten zien van  $g=0.49$ , op welbevinden 6 studies met 11 uitkomsten lieten een effect zien van  $g=0.62$  (EWB  $g=0.56$ , PWB  $g=0.53$ , SWB  $g=0.42$ ). Subgroep analyse resultaten laten zien dat lager kwaliteit studies, hogere effect sizes hebben en hogere kwaliteit studies, lagere effect sizes hebben. Yoga is ook effectief voor populaties zoals gezonde mensen, met psychopathologie en somatische kwalen. Er is geen indicatie voor publicatie bias.

*Conclusie:* Deze meta-analyse laat zien dat yoga interventies effectief kunnen zijn in het reduceren van depressie, depressieve symptomen en het bij het bevorderen van welbevinden. In andere woorden heeft het niet alleen effect op depressie, maar ook op het positieve functioneren van een persoon. Dit geeft aan dat het niet alleen symptomen verlaagt, maar ook beschermende factoren aanbrengt tegen psychopathologie. Dit is het geval voor een brede selectie van populaties. Gezien de mogelijkheden, zou yoga wellicht een goede additie kunnen zijn aan de lijst voor positieve interventies voor de bevordering van (geestelijke) gezondheid.

## Table of contents:

<b>Introduction .....</b>	<b>5</b>
Yoga in improving health.....	5
Perspectives on mental health .....	6
Positive approaches to mental health.....	6
The hedonic approach: Emotional well-being.....	7
The eudaimonic approach: Psychological well-being and social well-being.....	7
The mental illness depression as an indicator of the medical perspective.....	8
Effects of yoga on mental health .....	9
Present study .....	9
<b>Method.....</b>	<b>11</b>
Selection of studies, Search strategy, Quality assessment .....	11
Meta-analysis, Data extraction, Heterogeneity .....	12
Subgroup analyses, Publication bias .....	13
<b>Results .....</b>	<b>14</b>
Description of the studies .....	14
Characteristics of the studies .....	15
Quality of the studies .....	18
Post-test effects.....	20
Depression .....	20
Well-being .....	21
Follow-up effects .....	22
Subgroup analysis.....	22
Publication bias .....	24
<b>Discussion .....</b>	<b>26</b>
Main findings.....	26
Strengths and limitations implications for practice .....	27
Recommendations for research, Conclusion .....	28
<b>References .....</b>	<b>29</b>
.....	35

# 1 Introduction

## Yoga in improving mental health

Yoga arose a couple of thousand years ago BC in India. It aims by means of mindful exercise, awareness of body and mind (Bock & Wapenaar, 2010; Keengan, 2001). According to Mehta and Sharma (2010) it's a complex system of spiritual, moral and physical practice aimed at attaining 'self-awareness'. By definition, yoga is seen as improvement of the control of the five senses and a reduction of mental activity, eventually reaching a clear state of mind (Mehta & Sharma, 2010). Various schools of yoga exist, such as, Bikram, Iyengar, Siddha Samadhi, Hatha, Sudrashan Kriya Yoga (SKY), Silver Yoga and Sahaj Yoga. Although differing slightly from each other, all school utilize the base triad of meditation (dhyana), postures (asanas) and breathing (pranayama) to promote and restore health in mind and body (Mehta & Sharma, 2010). The postures involve standing, bending, twisting and balancing the body and consequently improve flexibility and strength. The controlled breathing helps to focus the mind and achieve relaxation while meditation aims to calm the mind (Riley, 2004).

Prior information makes clear that yoga is a broad concept that uses different exercises as its method. In order to understand the mechanisms at work, it's important to differentiate these methods. Explanations based on western physiology can be summarised as the modulation of autonomic nervous tone and consequent reduction in sympathetic tone, activation of antagonistic neuromuscular systems, which increases relaxation (Riley, 2004). Yoga is considered a mind-body exercise and the underlying premise of mind-body exercises is that the physiological state of the body may shape emotions, thoughts and attitudes (Monk-Turner & Turner, 2010).

A more in depth explanation of the effects of yoga can maybe be found in the working processes of mindfulness. Yoga shares in common with mindfulness, the meditative/contemplative practice and emphasis on focused attention, reduced extraneous external stimulation, controlled breathing, and relaxation. Mindfulness based therapies are scientifically proven. Two of these are mindfulness-based stress reduction therapy (Grossman, Niemann, Schmidt, & Walach, 2004) and mindfulness-based cognitive therapy (Ma & Teasdale, 2004). Shapiro, Carlson, Astin and Freedman (2006) developed a psychological model consisting of the three fundamental components of mindfulness. These are intention, attention and attitude. Intention can be used to improve self-regulation and self exploration. Attention is the ability to observe external and internal experiences. Attitude is the way someone gives attention to the experiences in his environment. The combined effect of this triad leads to the process of reperceiving of one owns emotions and thoughts. This creates space and has a transforming effect on health and behavior (Shapiro, Carlson, Astin and Freedman, 2006). Yoga may share the same mechanism like mindfulness, considering the similar aspects like meditation and attention on mind-body and breathing when performing postures.

Because of yoga's probable positive effects on (mental) health, it has been getting more attention of the medical community with more research into its effects on (mental) health. Health is not a miracle or a stroke of luck (Chandra, 2001). While genetics shape health, it's conditioned by many factors that may be influenced, such as diet, exercise and stress-reduction techniques. Yoga-based interventions may prove to be an attractive option for the promotion of mental health (Pilkington et al., 2005).

## **Perspectives on mental health**

In the promotion of mental health, more than one perspective can be assumed. This study takes on an innovative approach by taking on two perspectives. First we will explore what mental health is and then the perspectives will be described.

Mental health is defined by the World Health Organization (WHO, 2005, p. 2) as “a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community”. The three components of this definition are (1) well-being, (2) effective functioning of an individual, and (3) effective functioning for a community (WHO, 2005, p. 2).

Mental health is too often presumed to be the opposite of mental illness and seen as the absence of mental illness, such as depression or anxiety (Keyes, 2005; Westerhof & Keyes, 2010). Although it has important consequences for individual functioning and society, mental illness represents only part of a person’s functioning and mental health (Westerhof & Keyes, 2010). According to Maddux (2009) the emphasis is too much on that, which is deviant, abnormal or maladaptive. The main aim is to treat symptoms and success in therapy is measured by reduction of symptoms (Westerhof & Bohlmeijer, 2010). The assumption is too often that mental illness and mental health are the opposites of each other and the treatment of illness keeps a person healthy (Westerhof and Bohlmeijer, 2010). Seligman and Csikzentmihalyi (2002) add to this that psychotherapies solely aimed at reducing symptoms won’t lead to sufficient prevention of psychological disorders. Keyes (2005) developed from the data of the MIDUS-study (Midlife Development in the United States) a two continua model. His empirically supported model showed that a model with one dimension, whereof mental illness and mental health were the opposite poles, was unfitting. A model that was promising consisted of two independent dimensions, but also didn’t fit well with the data. What almost perfectly aligned with the data, was a model whereof mental health and mental illness, where two related factors. This empirical supported model illustrate that mental health and mental illness are not on the same dimension, but they are related (Compton, Smith, Cornish, & Qualls, 1996; Greenspoon & Saklofske, 2001; Headey, Kelly, & Wearing, 1993; Masse et al., 1998; Suldo & Shaffer, 2008; Westerhof & Keyes, 2008).

To study optimal mental health, we will define and study mental health as two dimensions with a positive part and a part that is mental illness that together make up mental health.

## **Positive approaches to mental health**

Within a positive approach of mental health, positive aspects of life have a long history within philosophy and modern literature often refers two ancient Greek schools of philosophy (Deci & Ryan, 2008; Keyes, 2005; Ryan & Deci, 2001; Ryff & Singer, 2008; Waterman, 1990; Westerhof & Bohlmeijer, 2010). Two millennia ago, ancient Greek philosophers had already begun to theorize about what constitutes a good life (Lamers, 2012). Although their theories didn’t have the direct goal of studying mental health, they do correspond with two traditions on well-being that show aspects of mental health in recent studies.

According to Aristippus of Cyrene (435-356 BC), a student of Socrates who plead that *hedonia*, the aspire for happiness or pleasure, is the highest imaginable goal for an individual. This can be related to the modern emotional well-being. In contrast Aristoteles (384-322 BC) stated that not simple pleasure, but *eudemonia* is more important, which refers to having a ‘good’ life and doing what is

worth doing (Lamers, 2012). According to Aristotle you have good life when you have a developed character, fulfill one's own potential and have virtue in social movement (Westerhof & Bohlmeijer, 2010). This corresponds with the modern psychological and social well-being. Within the hedonic and eudemonic tradition of research on well-being, three constructs of well-being can be distinguished (figure 1); emotional well-being, psychological well-being and social well-being (Lamers, 2012). These three components comprise the subjective experience of individuals. Through self-report these constructs can be empirically investigated.

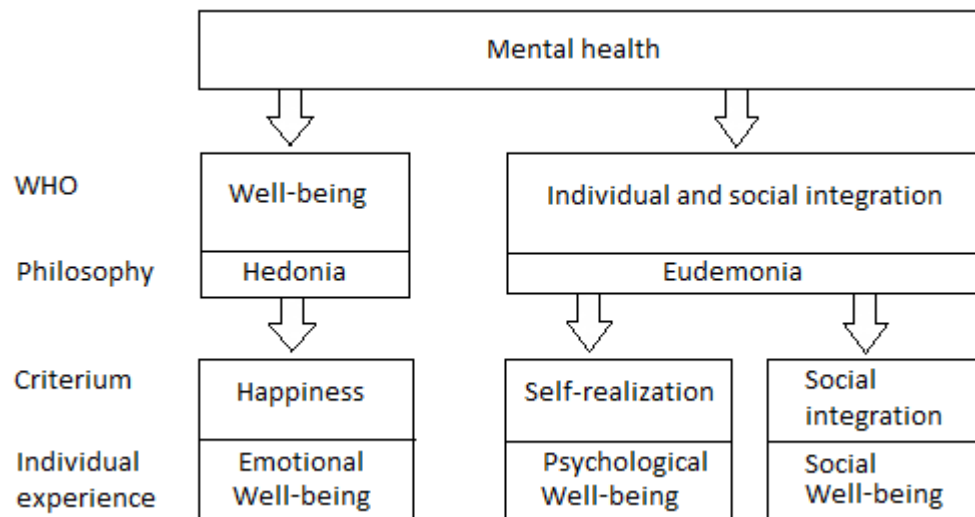


Figure 1. Components of Mental health (Westerhof & Bohlmeijer, 2010, pag. 50).

Note. this model also shows the definition of the World Health Organization.

### The hedonic approach: Emotional well-being

Due to the highly quoted article of Diener (1984) there is consensus in the scientific community on how to define emotional well-being. It is seen as the amount of positive feelings that are present, the amount in which negative feelings are absent and the amount in which people are satisfied about their lives (Diener, 1984; Diener, Suh, Lucas, & Smith, 1999). The first two are affective components, while life satisfaction is a process in which more cognitive information processing takes place. Research consistently showed that positive and negative emotions are independent of each other (Lamers, 2012; Westerhof & Bohlmeijer, 2010). The broad spectrum of positive emotions consists of liveliness, enthusiasm, alertness and vitality. Bohlmeijer and Westerhof (2010) state that it's also important to differentiate between intensity and frequency. Although most people experience high levels of emotional well-being most of the time (Biswas-Diener, Vitterso, & Diener, 2005), it is not the same between individuals.

### The eudaimonic approach: Psychological well-being and social well-being

Whereas the previous hedonic approach is about optimal experiences and the emotional components of positive mental health, the eudaimonic tradition focuses on optimal functioning and

meaning in both individual life (psychological well-being) and social life (social well-being) (Lamers, 2012). The eudaimonic perspective states that well-being is self-realization through the fulfillment of one's own personal potential (Lamers, 2012). Ryff wrote the most complete and influential elaboration of the concept eudaimonic well-being (Ryff, 1989; Ryff & Essex, 1991; Ryff & Singer, 1998, 2008). Ryff after thoroughly studying the works of different classical masters like Erikson, Jung, Neugarten, Maslow, Rogers et cetera (Ryff, 1989), came up with six criteria that emerged from their theories, that are essential in the general endeavor to realize an own potential (Westerhof & Bohlmeijer, 2010). These six are; purpose in life, personal growth, autonomy, environment control, self acceptance and positive relations.

Well-being is not merely an intra psychological phenomenon, since each individual has to deal with social structures and communities, where multiple roles and tasks are required of a person (Keyes, 1998). Keyes has the broadest conceptualization of social well-being (Bohlmeijer & Westerhof, 2010) and developed a systematic framework to research social well-being (Keyes, 1998). His definition of social well-being is; "the individual experience and review of one's own functioning in public and the community". He makes distinction between five dimensions that together make up social well-being. These are; social acceptance, social actualization, social contribution, social coherence and social integration. He states that social well-being encompasses the experience and judgement of one's own social functioning. These prior dimensions were correlated, but not overlapping with dimensions of emotional and psychological well-being indicating that social well-being is a distinct component of well-being (Keyes, 1998).

The hedonic and the eudaimonic approach with the three types of well-being will be used to assess the effect yoga has on mental health, assuming a positive perspective on mental health.

### **The mental illness depression as an indicator of the medical perspective**

From the medical perspective, the mental illness depression and depressive symptoms can give an indication of what the effect is of yoga on mental health. Depression can be seen as a psychological disorder with symptoms like loss of interested in all or nearly all activities, depressive state, loss of energy, fatigue, feelings of worthlessness and/or guilt, shortened ability to concentrate and in more severe cases thoughts about suicide. When these symptoms occur (almost) daily with a negative effect on social and/or professional functioning, one can speak of the psychological disorder depression (American Psychiatric Association, 2000). Reasons for taking depression and depressive symptoms as a mental health indicator is, because it's a common psychological disorder whereupon yoga shows potential in improving it (Pilkington et al., 2005). For example 18.7% of the Axis-I disorders is depression, in a western country like the Netherlands (De Graaf, Ten Have, & Van Dorsselaer, 2010). Around 5% had a depression in the 12 months prior of the study of de Graaf et al. (2010). 15 to 17 percent in western civilization has had a depression at some point in their lives (Simon, Goldberg, Von Korff, & Ustun, 2002).

It can be said that a large portion of the western population will have to deal with this psychological disorder, which has dire consequences. Depression is highly related with the beginning and course of somatic diseases (Moussavi et al., 2007; Prince et al., 2007). Persons have a higher risk of death, more risk of social isolation and an overall decline in quality of life (Cuijpers & Smit, 2002). They will also have more work absence due to illness or even unemployment due to their inability to function and work properly (Romijn, Ruiters, & Smit, 2008). This in turn will have financial effects on a macro level for businesses and country's which will have to deal with the strain on medical securities.



This prior information makes clear with multiple reasons that it's important to give great attention to the treatment of people with (pre) depression disorder or symptoms underlying this spectrum of psychological functioning.

This meta-analysis of RCTs on yoga can contribute to the answer if yoga is effective against depression and depressive symptoms.

### **Effects of yoga on mental health**

Up to this day the effects found of yoga on mental health are numerous and the following are some of it, found in literature. People, who exercise yoga, frequently report a sense of deep relaxation, calm and happiness at the end of a yoga session (Monk-Turner & Turner, 2010). It increases muscular strength, flexibility, range of motion, energy and sleep quality (Pilkington et al., 2005). Yoga also improves hormone levels, immune response, cardiovascular health and respiratory functions (Pilkington et al., 2005). Five systematic reviews have shown that yoga has positive effects on depression (Cramer et al., 2012; Ten Damme, 2013; Mehta et al., 2010; Pilkington et al., 2005; Uebelacker, Epstein-Lubow et al., 2010). It is also effective for relieving stress and anxiety conditions that impact physical and mental health conditions (Long, Huntley, & Ernst, 2001). Furthermore, have positive effects of yoga been seen on well-being and satisfaction with life (Impett, Daubenmier & Hirschman, 2006).

Although a lot of effects of yoga have been found, it remain lose parts. This could be more true for the effect of yoga on positive health or well-being. Not many studies were found researching the effect of yoga on well-being. This meta-analysis of yoga distinguishes itself by using a proper theoretical framework in the study on positive health and combining it with the study of a common mental illness. Reducing symptoms is just a small part in the improvement of mental health (Keyes, 2007; Seligman and Csikzentmihalyi, 2002). A dualistic view can show a more complete picture in the study and promotion of mental health. The relevance of more research in this particular area can be beneficial for prevention and better treatments for depression and is relevant to study yoga and its effects on positive health/well-being.

### **Present study**

The aim of the present study is to conduct a meta-analysis of the effect of yoga on mental health on populations varying in age, physical and mental health. Yoga seems to be a possible intervention which improves mental health in more than one way. For this reason a dual perspective will be assumed. By taking on the medical perspective that sees mental health as the absence of illness and the positive perspective which emphasizes on the healthy parts of a person.

A strength of yoga is that it can be used as a self-management technique where a yoga exerciser does not need to go to the hospital or therapist. An individual could well use yoga their entire lifetime to improve their well-being as well as preventive means against depressive symptoms or the development of severe depression.

Although yoga has been studied in the past decade, a meta-analysis of RCTs is relevant to show powerful empirical evidence of the effectiveness of yoga on mental health. This meta-analysis distinguishes itself by taking on dual perspective, taking quality of the studies into account and by only including RCTs.

Depression, depressive symptoms, and well-being which consist of emotion-, psychological, social well-being, were the outcome measures. Potential variables moderating the effectiveness of yoga, such a style of yoga, duration of intervention, quality of research design, were also examined.

## 2 Method

### Search strategy

This paper will continue on the work of ten Damme (2013) and Kruese (2013) who made a systematic review. Their literature search also consisted of the constructs depression and well-being. The reference list of these researchers was used for studies fitting the inclusion criteria.

### Selection of studies

Ten Damme (2013) and Kruese (2013) systematically searched on Cochrane library using 'yoga' in the 'record title'. The option 'trials' was active and Cochrane automatically searches for effect studies and randomized controlled trials. This resulted in 253 articles. They also searched on Scopus in the following way; *(TITLE(yoga) AND TITLE-ABS-KEY((effect\* OR rct OR (random\* controlled trial) OR efficacy OR intervention)))*, which resulted in 617 articles. This resulted in a total of 870 articles and 672 after removing doubles. They made a further selection using the following inclusion criteria: (1) It's a primary study, (2) Experimental group has an yoga intervention, with exercises which consist of asanas, pranayama or a specific form of yoga, for example Iyengar, (3) Outcome measure are on the area of psychological health; depression, anxiety, mood and stress, (4) Measurement instruments are used for psychological outcomes, for example Becks Depression Inventory for depression, (5) study must use a randomized controlled trial (RCT), (6) study must have a full text available. Using these criteria, 164 studies remained on which this meta-analysis made a further selection by using the following inclusion criteria; outcome measurements have at least one of the following; depression, depressive symptoms, well-being or comparable forms. In the end 34 studies remained, which were used in this analysis (see figure 2 for flow chart). In these studies that measured depression, instruments and subscales that explicitly measure depression were used (e.g. the Beck Depression Inventory, Hospital Anxiety and Depression Scale and the Depression Anxiety Stress Scale). For emotional-, psychological- and social well-being instruments related to the construct of well-being, such as positive affect for EWB and social relationships for SWB were used. The questionnaires measuring these similar constructs were looked at for face validity and included in the analysis, if found adequate enough, on judgment of the researcher.

### Quality assessment

For the quality assessment eleven studies were independently checked by a second reviewer (RK). The methodological quality of the included studies was assessed using a short scale of seven criteria tailored to yoga studies and based on criteria established by the Cochrane collaboration (Higgins & Green, 2005). The quality checklist consisted of the following questions: 1) Adequate subject randomization to groups; randomly done by computer or independent source, 2) Baseline comparability; were study groups comparable at the beginning of the study and was this explicitly assessed? (Or were adjustments made to correct for baseline imbalance using appropriate covariates), 3) Power analysis; is there an adequate power analysis and/or are there at least 50 participants in the analysis?, 4) Completeness of attrition follow up data; clear attrition analysis and loss to follow up <50%, 5) Handling of missing data; the use of intention-to-treat analysis (as opposed to a completers-only analysis), 6) Study integrity; Is the study followed as planned, 7) Quality of yoga trainer; does the trainer have a professional yoga certification and the required experience (at least

thousand hours). Each criterion was rated as 0 (study does not meet criterion) or 1 (study meets criterion). The quality of a study was assessed as high when six or seven criteria were met, medium when four or five criteria were met, low when two or three criteria were met, and really low when zero or one criteria were met. Table 1 shows the quality assessment for each study. Disagreements were resolved by consensus. This was the case with two of 77 ratings. Interrater reliability was 0.93 (Cohen's kappa).

### **Data extraction**

Data was collected on design, target group, amount of yoga sessions and minutes, yoga type, control group, outcome measures and effect sizes, the primary outcomes in this meta-analysis are depression or depressive symptoms and well-being, from which the latter consists of emotional well-being (EWB), psychological well-being (PWB) and social well-being (SWB).

### **Meta-analysis**

In a meta-analysis, the effects found in the primary studies are converted into a standardized effect size, which is no longer placed on the original measurement scale and can therefore be compared with measures from other scales. For each study Hedges g effect sizes were made of the constructs of interest. This was done by using the tool 'Comprehensive Meta Analyses' (CMA, Version 2.2.064) by subtracting the mean score of the experimental group from the mean score of the control group, and dividing the result by the pooled standard deviations of both groups. Where no standard deviations were available, effect sizes were calculated from difference in means, t-values, sample sizes and p-values. This was done only post-test. From a clinical perspective, effect sizes of 0.56 - 1.2 can be interpreted as large, while effect sizes of 0.33 – 0.55 are of medium size, and effects of 0 - 0.32 are small (Lipsey & Wilson 1993).

If a study had more than one construct in the same compiled effect size, N was divided by the number of constructs analyzed to ensure studies have the same weight in the pooled effect size. Follow up effects were not included in this analysis, because only a small portion of the studies included this data.

### **Heterogeneity**

The presence of heterogeneity was tested with two indicators. First, the Q-statistic was calculated. A significant Q rejects the null-hypothesis of homogeneity and indicates that the true effect size probably does vary from study to study. Second the I<sup>2</sup>-statistic was calculated. This statistic shows the percentage of the study-to-study dispersion due to true differences, over and above random sampling error. A value of zero percentage indicates no dispersion, and larger values indicate increasing levels of heterogeneity, where 25% is considered as low, 50% as moderate and 75% as a high level (Higgins, Thompson, Deeks, & Altman, 2003). Where heterogeneity is significant, a random effect model will be chosen in the analysis. Effect sizes may differ under this model, giving right to true variation in effect sizes between studies. This method reduces the likelihood of type-II errors.

Removal of outliers which are outside the confidence interval of the pooled effect size is advised when a common effect size is assumed. All studies will be taken into account and outliers will be considered and not automatically removed from this meta-analysis. Only the removal of Hedges g > 2.5 from the final sample was planned.

### **Subgroup analyses and meta-regression**

Subgroup analyses were performed by testing the pooled effect sizes between subgroups. Four potential moderators were determined: 1) Participants inclusion type (healthy, psychopathology, or somatic pathology populations). 2) Quality rating, low when (score 3) or medium (score 4 or 5) and high when (score 6 or 7). Score 1 and 2 were not seen so not taken into account. 3) Control group type (Waiting list, Care as usual, or some sort of intervention). 4) The impact of the duration of yoga and quality ratings was assessed using meta-regression. Emotional -, psychological- and social well-being will be pooled together into well-being, because analysing them separately would have given too small groups to make a proper analysis. Therefore this makes an analysis of the subgroup effects on depression and well-being (EWB, PWB and SWB).

### **Publication bias**

Results of meta-analysis may be biased due to the fact that studies with non-significant or negative results are less likely to be published in peer-reviewed journals. To address this issue, funnel plots, Egger's test and the failsafe number were investigated to get a picture of the amount of publication bias. When there is no publication bias, the studies are expected to be distributed symmetrically around the pooled effect size. If asymmetry is caused by publication bias we would expect that high standard errors (small studies) would be associated with larger effect sizes. Egger's linear regression method is intended to quantify the bias captured by the funnel plot. It uses the values of the effect sizes and their precision. The standard normal deviate is regressed on precision, defined as the inverse of the standard error. The intercept in this regression corresponds to the slope in a weighted regression of the effect size on the standard error.

## 4 Results

### Description of the studies

The selection process is illustrated in Figure 2. First, 617 titles were retrieved from the Scopus database and 253 from the Cochrane database. After reviewing titles, 198 duplicates were removed and 672 records remained. These were screened on five criteria and 164 studies were eligible for full-text assessment. 34 studies met the inclusion criteria.

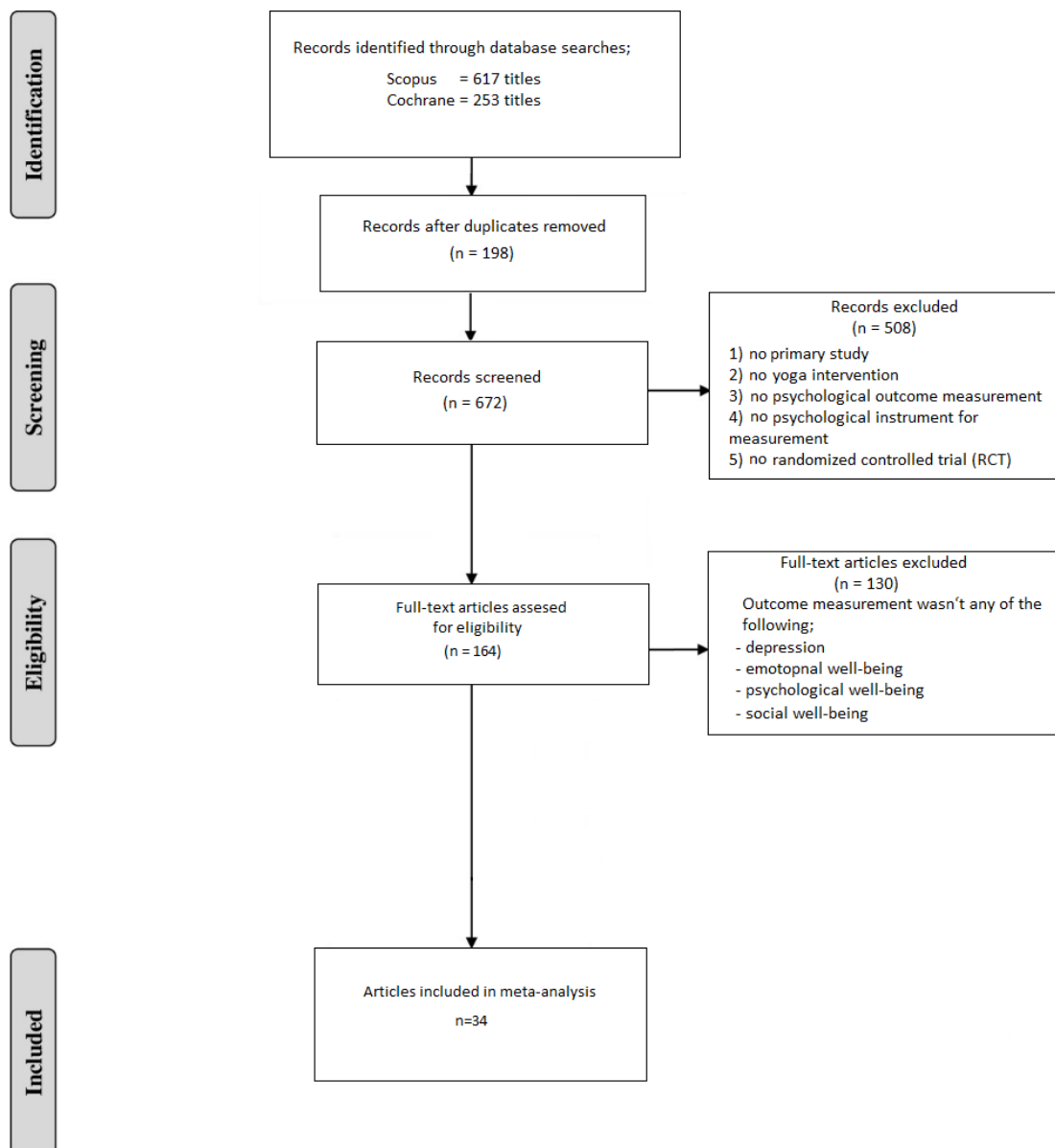


Figure 2. Flow Diagram

### Characteristics of the studies

The characteristic of the studies included are described in table 1. After the selection, 34 studies remained with 41 outcomes of the effect of yoga on mental health. Total of participants of these studies is 1623. 30 (73%) outcomes on depression and 11 (27%) on well-being were seen, from which 5 (12%) emotional wellbeing, 3 (5%) psychological well-being and 3 (5%) social well-being (take note that some studies had more than one outcome, e.g. depression and EWB). The studies that measured depression consists of 1299 (81%) participants and the studies that measured well-being of 314 (19%) participants, making a total of 1613 participants in this meta-analysis.

From the analysis emerged that the studies used different group types for comparison. 25 of 34 (74%) studies compared their experimental group with a control group (n=7 care as usual and n=18 waiting list) and 8 (24%) with a group that got some form of intervention; group/individual counseling, mindfulness, medication, physical education, social group and psycho-education. Another finding was that the studies targeted different population types. A portion of 10 of 34 (29%) studies applied criteria to target specific people with some form of psychopathology, like depression, eating disorder and schizophrenia. 12 of the 34 (35%) studies targeted healthy populations, like students, musicians and army men. 12 (35%) other studies targeted populations with (chronic) somatic illnesses or post treatment of illness, like breast cancer, cancer, COPD and chronic back pain. The studies had different outcomes measures. 30 of 34 (88%) studies measured depression or depressive symptoms, 5 (15%) studied emotional well-being, 3 (9%) psychological well-being and 3 (9%) social well-being (take note that some studies measured multiple constructs). There were also a wide variety of 38 instruments used in the 34 studies. 7 of 38 (18%) measurements were done by using the BDI, 5 (13%) times the CES-D was used, 4 (11%) times a version of the POMS, 4 (11%) times the FACT-B, 3 (8%) times the HADS, 2 (5%) times the WHOQOL-BREF, and 13 (34%) times another instrument.

What also emerged, was a lot of different types of yoga in this pool of studies. Some of these types are, Iyengar, Kriya and Kripalu. All the yoga forms share the same methods, which are breathing, physical exercise and mediation, but only the emphasizes differ. It's unclear how much the three methods are used in proportion by each form of yoga. For this reason, the type of yoga will not be further analyzed as a moderator in this paper. The average time of yoga per study is 1244 minutes. Ranging from 30 minutes to 3600 with a standard deviation of 857 (Dhruva, 2012 and Kuttner, 2006 were not taken into account with this value, due to missing data).

Table 1

#### *Characteristics of the Studies (shown in order of measured construct)*

Author	Inclusion criteria and total N	Yoga type and n yoga group	Intervention time (weeks)	Per week (minutes)	Total (minutes)	Intervention and n control group	Outcome measure	Instrument (subscale)
<b><u>Depression</u></b>								
Afonso 2012	Women after menopause age 50-65 (N=30)	Yogasana, Bashtrika, Asanas (X=15)	16	120	1920	care as usual (C=15)	Dep	BDI

Banerjee 2007	After breastcancer surgery and radio and/or chemotherapy, age 30-70 (N=58)	Asanas, Nidra, Pranayama (X=35)	6	90	540	groupcounseling (C=23)	Dep	HADS (depression)
Bowden 2012	Healthy schoolchildren (N=24)	Iyengar (X=12)	5	150	750	mindfulness (C=12)	Dep	DASS (depression)
Carei 2010	DSM-IV criteria AN, BN age 10-21 (N=50)	Viniyoga (X=24)	8	120	960	care as usual (C=26)	Dep	BDI
Carson 2010	>1 year diagnoses fibromyalgie (N=48)	Dhyana, Swadhyaya, paranyama, Satsang (X=22)	8	120	960	care as usual (C=26)	Dep	FIQR (depression)
Chen 2009	Elders, no history with yoga, cognitive healthy (N=128)	Silver yoga, Hatha yoga (X=62)	6	210	1260	waiting list (C=66)	Dep	TDQ
Cohen 2008*	Metabolic syndrom (bloodpresure, bloodsucre) or at risk, insufficient exercise age 30-65 (N=24)	Restorative yoga (X= 12)	10	135	1350	waiting list (C=12)	Dep	CES-D
Culos-Reed 2006	Posttreatment breastcancer >3 months (N=36)	asanas, Shevasana (X=18)	7	75	525	waiting list (C=18)	Dep	POMS (depression)
Danhauer 2009*	post treatment breastcancer 2-24 months (N=27)	asanas, Savasana, pranayana (X=13)	10	75	750	waiting list (C=14)	Dep	CES-D
Dhruva 2012	patients with cancer and undergoing chemotherapy (N=16)	Pranayama (X=8)	-	90	500+**	waiting list (C=8)	Dep	HADS (depression)
Donesky-Cuenco 2009	COPD patients age >40 (N=19)	Iyengar, asanas, pranayama (X=14)	12	120	1440	care as usual (C=15)	Dep	CES-D
Field 2012	prenatal depression (N=56)	yoga (X=28)	12	40	480	care as usual (C=28)	Dep	CES-D
Hartfiel 2011	employees british university (N=40)	Dru yoga (X=20)	6	60	360	waiting list (C=20)	Dep	POMS-BI (depression)
Janakiramaiah 2000	melancholic depressives (N=30)	Sudarshan, Kriya yoga (X=15)	4	270	1080	medication (C=15)	Dep	HRS D
Javnbakht 2009	women, no mental diagnoses and drugs or yoga history (C=65)	Iyengar (X=34)	8	180	1440	waiting list (C=31)	Dep	BDI
John 2007	diagnose migraine and moderate depression (N=75)	pranayama, Kriya (X=32)	12	300	3600	self help with education about migraine (C=33)	Dep	HADS (depression)
Khalsa 2012	Elementary school students (N=111)	Kripalu yoga (X=72)	11	88	968	standard school (C=39)	Dep	POMS-SF (depression)
Khalsa 2009	Musicians (N=30)	Kripalu yoga (X=15)	8	210	1680	waiting list (C=15)	Dep	POMS (depression)
Kroner-Herwig 1995	Chronic Tinnitus >6 months (N=28)	Hatha, asanas (X=9)	10 sessions	120 per session	1200	waiting list (C=19)	Dep	DS



Kuttner 2006	Adolescents with criteria for irritable bowel syndrome (N=25)	Hatha, Iyengar (X=14)	4	-	-	waiting list (C=11)	Dep	CDI-SF
Marefat 2011	men with addiction and some degree of depression (N=24)	yoga (X=12)	5	180	900	waiting list (C=12)	Dep	BDI
Mitchell 2007	female psychology students with dissatisfaction about their body's (N=63)	yoga (X=33)	6	45	270	waiting list (C=30)	Dep	CES-D
Raghavendra 2009	breastcancer diagnoses fase II-III operable breastcancer with radiotherapy age 30-70 (N=56)	asanas, pranayama (X=27)	6	270	1620	supportive therapy (C=29)	Dep	HADS-D
Rocha 2012	Men brazilian army age 20-40 (N=36)	yoga (X=17)	26	120	3120	standard exercises (C=19)	Dep	BDI
Shahidi 2011	geriatric depression score >10 women ages 60-80 (N=40)	laughter yoga (X=20)	4	210	840	waiting list (C=20)	Dep	GDS
Tekur 2012	Chronic lower backpain > 3 months (N=80)	asanas, Pranayama (X=40)	1	3360	3360	phys exercisese, supp therapy, education (C=40)	Dep	BDI
Visceglia 2011	diagnoses schizofrenia (N=18)	asanas, Nidra (X=10)	8	90	720	waiting list (C=8)	Dep	PANNS (depression)
Wang 2010	>60 who live independantly in a seniorhouse (N=18)	asanas, pranayama (X=8)	4	120	480	social group (C=10)	Dep	CES-D
Woolery 2004	score mild depression BDI (N=23)	Iyengar (X=10)	5	120	600	waiting list (C=13)	Dep	BDI
<b><u>Emotional well-being</u></b>								
Banasik 2011*	posttreatment stages II,III,IV breastcancer >2 months (N=14)	Iyengar (X=7)	8	180	1460	waiting list (C=7)	EWB	FACT-B (emotional well- being)
Danhauer 2009*	post treatment breastcancer 2-24 months (N=27)	asanas, Savasana, pranayana (X=13)	10	75	750	waiting list (C=14)	EWB	FACT-B (emotional well- being)
Noggle 2012*	11th and 12th grade students who registerd for physical education (N=51)	asanas, dhyana, pranayama (X=36)	10	80-120	1120	Physical education (C=15)	EWB	PANAS-C (positive affect)
Vancampfort 2011	Schizophrenia or schizoaffective disorder of an acute inpatient care unit in Kortenberg (N=26)	asanas, Shavisana, Hatha (X=13)	1 session	30	30	waiting list (C=13)	EWB	SEES (positive well-being)

Vogler 2011	a single retirement resort, age >55, new to Iyengar yoga (N=38)	Iyengar (X=19)	8	240	1920	waiting list (C=19)	EWB	Life's Odyssey (emotional well-being)
<b>Psychological well-being</b>								
Chung 2012*	age 18-65 care seekers at the international Sahaja yoga and research center (N=129)	Sahaja (X=67)	2	1050	2100	care as usual (C=62)	PWB	WHOQOL-BREF (psychological)
Cohen 2008	Metabolic syndrom (bloodpressure, bloodsuce) or at risk, insufficient exercise age 30-65 (N=24)	Restorative yoga (X= 12)	10	135	1350	waiting list (C=12)	PWB	SF-36 (mental health)
Noggle 2012*	11th and 12th grade students who registerd for physical education (N=51)	asanas, dhyana, pranayama (X=36)	10	80-120	1120	Physical education (C=15)	PWB	IPPA (life's purpose and satisfaction)
<b>Social well-being</b>								
Banasik 2011*	posttreatment stages II,III,IV breastcancer >2 months (N=14)	Iyengar (X=7)	8	180	1460	waiting list (C=7)	SWB	FACT-B (social/family well-being)
Chung 2012*	age 18-65 care seekers at the international Sahaja yoga and research center (N=129)	Sahaja (X=67)	2	1050	2100	care as usual (C=62)	SWB	WHOQOL-BREF (social)
Danhauer 2009*	post treatment breastcancer 2-24 months (N=27)	asanas, Savasana, pranayana (X=13)	10	75	750	waiting list (C=14)	SWB	FACT-B (social/family well-being)

Abbreviations. BDI = Beck Depression Inventory, CES-D = Center for Epidemiologic Studies Depression Scale, CDI-SF = Children's Depression Inventory-Short Form, DASS = Depression Anxiety Stress Scale, DS = Depressiviäts, FIQR = Fibromyalgia Impact Questionnaire Revised, GDS = Geriatric depression scale, HADS = Hospital Anxiety and Depression Scale, HRSD = Hamilton Rating Scale for Depression, PANAS = Positive affect and Negative Affect Schedule, POMS(BI)(SF) = Profile of Mood State(Bipolar)(short form), TDQ = Taiwanese Depression Questionnaire, WHOQOL-BREF = World Health Organization Quality of Life-BREF, PANAS-C, Positive and Negative Affect Schedule for Children, PANNS = Positive and Negative Syndrome Scale, FACT-B = Functional Assessment of Cancer Therapy – with breast cancer, IPPA = The Inventory of Positive Psychological Attitudes, SEE S = Subjective Exercise Experiences Scale, Life's Odyssey Questionnaire, SF-36 = Short Form 36 health survey.

\*Note. Banasik 2011, Chung 2012, Cohen 2008, Danhauer 2009, Noggle 2012 are shown multiple times because they have more than one outcome measures.

\*\*Note. Dhruva 2012 yoga time is an estimated minimum by author.

### Quality of the studies

The quality of the 34 studies were scored 0 or 1 on individual criteria (Table 2). The total scores ranged from 3 to 7 with an average of 4.9. 5 of 34 (15%) studies were rated as low, 17 (50%) as medium and 12 (35%) studies were rated high quality. Every study met the criterion of study integrity (study followed as planned). Three studies met all criteria. The average number of participants was

rather low, only 13 of 34 (38%) studies met requirements for power N. The Intention to treat analysis was often not adequately described and only 15 of 34 (44%) studies passed this criterion. Baseline comparability was frequently reported by 22 of 34 (65%) studies. Also adequate randomization was often applied, by 28 of 34 (82%) studies. Follow up data on attrition was often described or there was no significant attrition in 25 of 34 (74%) studies. Most of the studies had adequate yoga trainers and was described by 26 of 34 (76%) studies.

Table 2

*Quality Score per Study*

<b>Study</b>	<b>Randomization</b>	<b>Baseline</b>	<b>Power N (&gt;50)</b>	<b>follow data</b>	<b>ITT analysis</b>	<b>Implementation integrity</b>	<b>Quality trainer</b>	<b>Total score</b>
Afonso 2012	1	0	0	1	0	1	0	3
Banasik 2011	1	1	0	1	0	1	0	4
Banerjee 2007	1	0	1	1	1	1	1	6
Bowden 2012	1	1	0	1	0	1	1	5
Carei 2010	1	1	1	1	1	1	1	7
Carson 2010	1	1	1	1	1	1	1	7
Chen 2009	0	0	1	1	0	1	1	4
Chung 2012	0	0	1	0	0	1	0	3
Cohen 2008	0	0	0	1	1	1	1	4
Culos-Reed 2006	1	1	0	1	1	1	1	6
Danhauer 2009	1	1	0	1	0	1	1	5
Dhruva 2012	1	1	0	0	1	1	1	5
Donesky 2009	1	0	0	1	0	1	1	4
Field 2012	1	0	1	0	0	1	1	4
Hartfiel 2011	1	1	0	0	0	1	1	4
Janakiramaiah 2000	1	1	0	1	1	1	1	6
Javnbakht 2009	1	1	1	1	1	1	0	6
John 2007	1	1	1	1	0	1	1	6
Khalsa 2012	1	1	1	1	0	1	1	6
Khalsa 2009	0	1	0	1	1	1	1	5
Kroner-Herwig 1995	1	0	0	0	0	1	1	3
Kuttner 2006	1	1	0	0	1	1	1	5
Marefat 2011	1	0	0	1	1	1	0	4
Mitchell 2007	1	1	1	1	0	1	1	6
Noggle 2012	1	1	0	1	1	1	1	6
Raghavendra 2009	1	1	1	1	1	1	1	7
Rocha 2012	0	0	0	1	1	1	0	3
Shahidi 2011	1	0	1	0	0	1	1	4
Tekur 2012	1	1	1	1	1	1	0	6
Vancampfort 2011	1	0	0	0	0	1	1	3
Visceglia 2011	1	1	0	1	1	1	0	5
Vogler 2011	1	1	0	1	0	1	1	5

Wang 2010	0	1	0	1	0	1	1	4
Woolery 2004	1	1	0	0	0	1	1	4
Total	28	22	13	25	16	34	26	165

### Post-test effects

The effect yoga has on mental health will be displayed in the following order. First the effect of yoga of all studies will be displayed together showing a complete effect on mental health. After this the effect on depression and third the effect of yoga on well-being will be shown. In the end of this chapter, follow up effects will be described, the subgroup analysis and publication bias will be described and illustrated.

The main effect analysis consists of 34 studies with 30 individual outcomes on depression and 11 on well-being (5 EWB, 3 PWB and 3 SWB). Take note that some studies have been used more than once, because they have more than one outcome. The forest plot shows two substantial outliers that match the 2.5 criteria for removal. These are Banerjee (2007) with an effect size of 7.57 on depression and John (2007) with an effect size of 4.08 on depression. These two studies have been removed from all further analyses. The analysis now consisted of 32 studies with 39 individual effects. In this pool of studies, heterogeneity was low and not statistically significant;  $Q=40.51$  and  $I^2=10.87$  with a  $p$ -value of 0.28. For this reason a fixed model was chosen. A medium and statistically significant effect size (Hedge's  $g$ ) was found for all studies ( $n=38$ );  $g = 0.52$  (95% CI [0.41, 0.62],  $Z=9.69$ ,  $p<.01$ ). This result is an indication that yoga has a substantial positive effect on mental health.

### Depression

From the pool of 34 studies taken in this meta-analysis, 30 measured depression or depressive symptoms. This was lowered to 28 studies after the removal of the two outliers. From these 28 studies, 27 (96%) studies show a positive effect on depression, from which 11 (39%) studies are significant and 1 (4%) study shows a negative effect, but this is not statistically significant (using  $p$ -value  $< 0.05$ ). In this pool of studies, heterogeneity was low and not statistically significant;  $Q$ -value of 34.15 and  $I^2=23.87$  with a  $p$ -value of 0.13. For this reason a fixed model was chosen. A medium and statistically significant effect size (Hedges  $g$ ) was found;  $g=0.49$  (95% CI [0.37, 0.60],  $Z=8.22$ ,  $p<.01$ ). See figure 3 for an illustration of the results of yoga on depression.

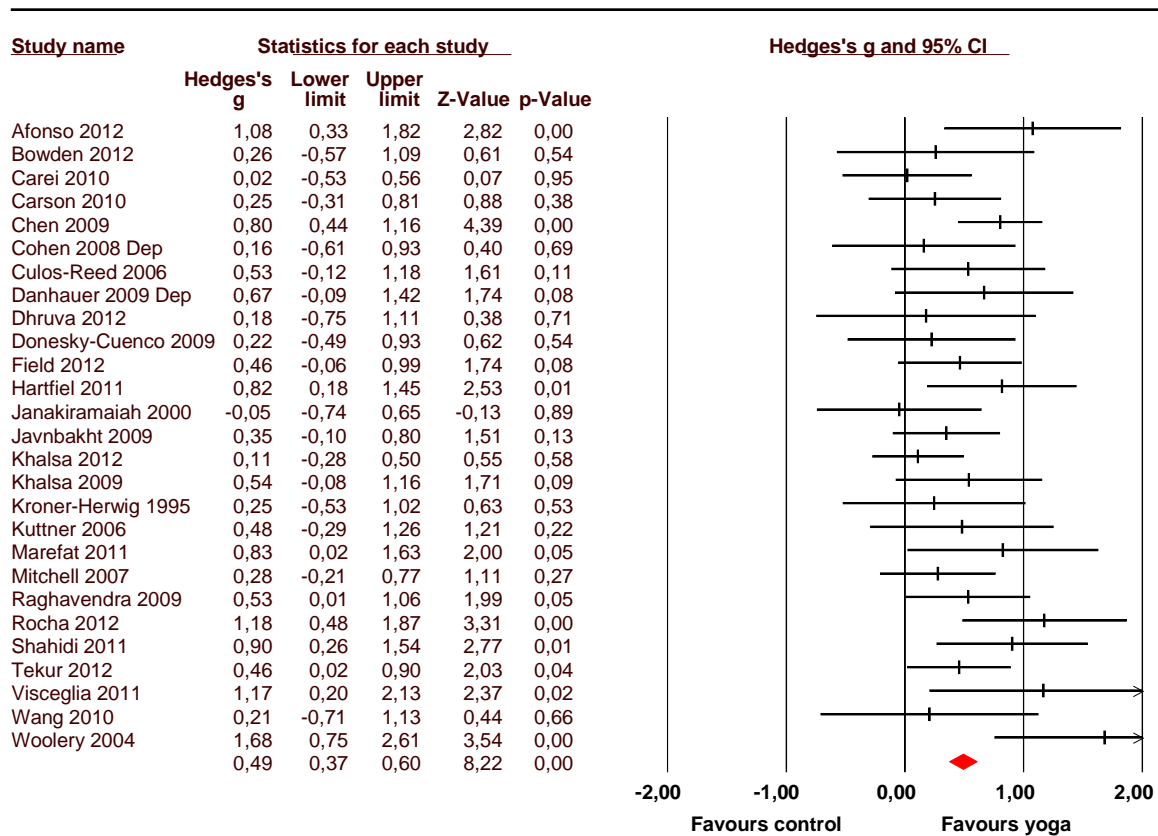
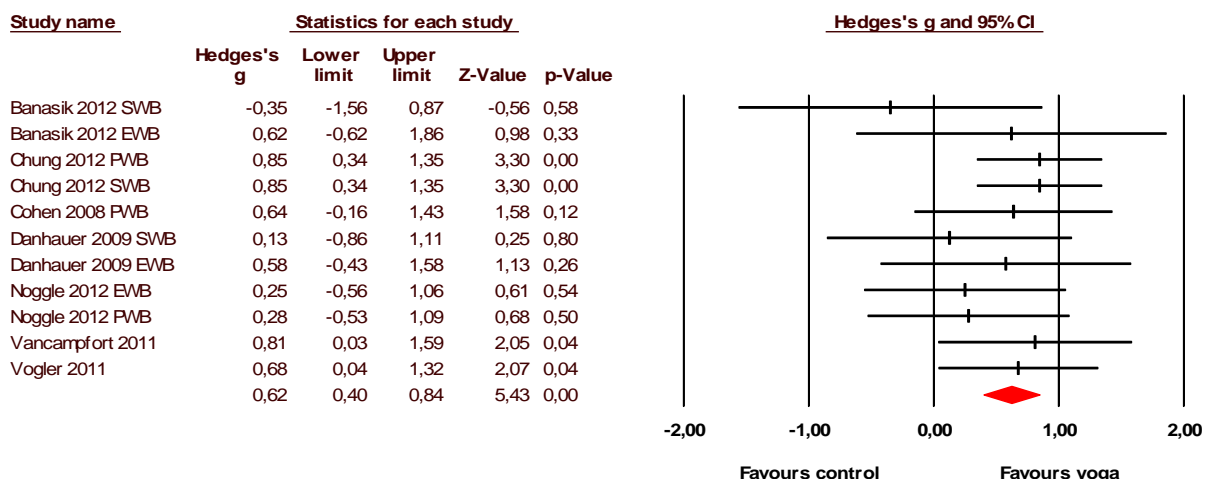


Figure 3. Posttest effects of yoga on depression

### Well-being

From the pool of 34 studies taken in this meta-analysis, 7 studies measured the effect of yoga on 11 outcomes for well-being. 10 (91%) studies show a positive effect on well-being, from which 4 (36%) are significant and 1 (9%) study shows a negative effect on well-being but, it's not significant (using a  $p$ -value  $< 0.05$ ). In this pool of studies, heterogeneity was low and not statistically significant;  $Q$ -value is 6.71 and  $I^2=0$  with a  $p$ -value of 0.75. For this reason a fixed model was chosen. A large and statistically significant effect size (Hedges  $g$ ) was found;  $g=0.62$  (95% CI [0.40, 0.84],  $Z=5.43$ ,  $p<.01$ ). This main construct is made up from three domains; emotional, psychological- and social well-being. Emotional well-being was measured by 5 studies. A large and statistically significant effect size (Hedge's  $g$ ) was observed for emotional well-being  $g=0.56$  (95% CI [0.24, 0.88],  $Z=3.41$  and  $p<.01$ ). Psychological well-being was measured by 3 studies. A medium and statistically significant effect size (Hedge's  $g$ ) was observed for psychological well-being, hedge's  $g=0.53$  (95% CI [0.25, 0.81],  $Z=3.66$  and  $p<.01$ ). Social well-being was measured by 3 studies. A medium and statistically significant effect was found when using a fixed model, hedges  $g=0.42$  (95% CI [0.12, 0.72],  $Z=2.75$  and  $p<.01$ ). See figure 4 for an illustration of the results of yoga on well-being.



Note. Vancampfort (2011) and Vogler (2011) measured EWB.

Figure 4. Posttest effects of yoga on well-being

### Follow-up

Only three of 34 studies reported follow-up measurements. All three measured depression. Khalsa (2009) did a follow-up ten months post-intervention and reported only, that there were no lasting significant effects on depression. Kroner-Herwig (1995) did a follow-up three months post-intervention and only reported that the follow up effect of yoga on depression is significant with a p value of <0.05. Carei (2010) posted an adequate dataset to analyse, but the follow-up effect on depression is non-significant.

### Subgroup analyses

Moderators in the studies could have had an effect on the outcomes in this meta-analysis. To get a better understanding of the effect of yoga on mental health the following moderators were looked at and presented in table 3. These moderators are; populations inclusion, quality of study, control group type and duration of yoga in a study. Emotional, psychological and social well-being have been pooled together into well-being, because analysing them separately would have given too small groups for a proper analysis.

For depression one out of four tests for subgroup differences is significant. Meta regression and the Q score indicate that the lower the quality score, the higher the effect size and the higher the quality score the lower the effect size. All population, control group and quality rating types show positive and significant effects on depression.

For well-being there are no significant differences between subgroups, although there was a recognizable trend seen at the subgroup quality rating in the same direction as was seen with depression. This also indicates for studies on well-being that, the lower the quality rating, the higher the effect size. All population types show a positive significant effect on well-being. For the criterion

quality rating, subgroups low and medium rated studies show a significant effect on well-being. For the criterion control group type, care as usual and waiting list have a significant effect on well-being.

Table 3

*Moderator effects on the effect of yoga: subgroup analysis (post-test)*

Construct	Criteria	Subgroup	n	Hedges g (95% CI)	Test for subgroup differences
<b>Depression</b>	Population	Healthy	10	0.52 (0.35.- 0.69) ***	Q=0.52 df=2 (p=0.77)
		Somatic patients	9	0.42 (0,20 - 0,64) ***	
		Psychopathology	8	0.49 (0,26 - 0.73) ***	
	Quality rating	Low (3)	3	0.86 (-0,15 - 1,83)***	Q=11.95 df=2 (p<0.01)
		Medium (4-5)	15	0.64 (0,18 - 1,07) ***	Slope = -0.166 Z=-3.42 (p<0.01)
		High (6-7)	9	0.28 (0,49 - 1,50) ***	
	Control group type	Care as usual	6	0.46 (0.21 - 0.71) ***	Q=1.30 df=2 (p=0.52)
		Waiting list	16	0.53 (0.38 - 0.68) ***	
		Some sort of intervention	5	0.36 (0.08 - 0.63) **	
	Amount of yoga		25		Slope = 0,00007 Z=0.86 (p=0.39)
<b>Well-being</b>	Population	Healthy	3	0,45 (0,02 - 0,87) *	Q=0.97 df=2 (p=0.62)
		Somatic patients	7	0,67 (0,39 - 0,95) ***	
		Psychopathology	1	0,81 (0,03 - 1,59) *	
	Quality rating	Low (3)	3	0,84 (0,52 - 1,16) ***	Q=3.83 df=2 (p=0.15)
		Medium (4-5)	6	0,48 (0,11 - 0,85) **	Slope=-0.179 Z=-1.79 (p=0.07)
		High (6-7)	2	0,26 (-0,31 - 0,84) ns	
	Control group type	Care as usual	2	0.85 (0.49 - 1.20) ***	Q=3.27 df=2 (p=0.20)
		Waiting list	7	0.54 (0.21 - 0.87) ***	
		Some sort of intervention	2	0.26 (-0.31 - 0.84) ns	
	Amount of yoga		11		Slope= 0,00018 Z=1,04 (p=0,30)

\* p<0.05; \*\* p<0.01; \*\*\* p<0.001; ns=non significant

Note. Two studies have not been taken into account in subgroup analysis for depression amount of yoga due to missing data, these studies are Dhruva (2012) and Kuttner (2006)

## Publication Bias

In scientific literature there is a tendency to publish studies with better result more than those with lesser results. This is known as publication bias and was assessed to see if this is the case with the studies included in this meta-analysis. This was done by making funnel plots (figure 5, 6 and 7), calculating Egger's test and fail safe N.

For the effect of yoga on mental health (n=38) the Egger's regression test intercept value (b) is 0.14, with a 95 % confidence interval from -0.97 to 1.24 and a p-value of 0.40 (one-tailed). The failsafe N is 1170 using a one-tailed criterion (or 813 using a two-tailed criterion). The funnel plot seems symmetrical (figure 5). There is no indication of publication bias in the results of yoga on mental health.

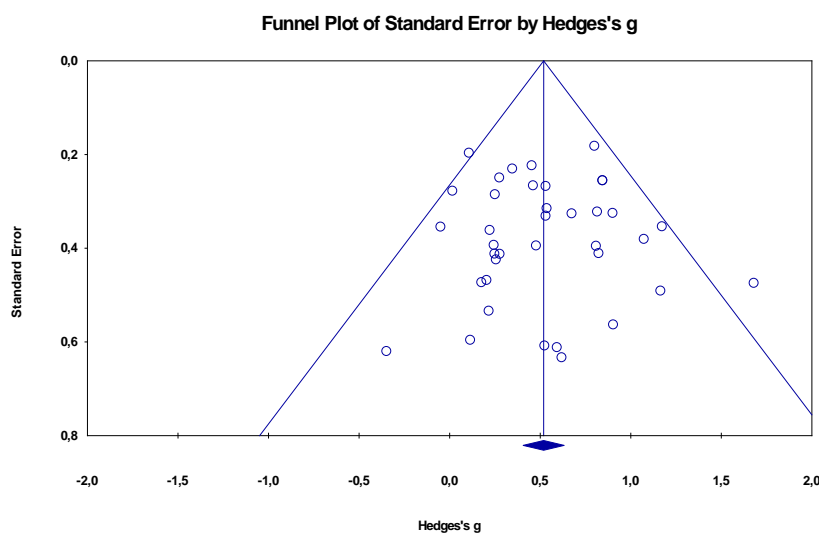


Figure 5. Funnel plot of all studies measuring yoga's effect on mental health

For depression (n=27) Egger's regression test intercept (b) is 0.85, with a 95 % confidence interval from -0.80 to 2.50 and a p-value of 0.14 (one-tailed). The failsafe N is 651 using a one-tailed criterion (or 451 using a two-tailed criterion). The funnel plot seems symmetrical (Figure 6). There is no indication of publication bias in the results of yoga on depression.



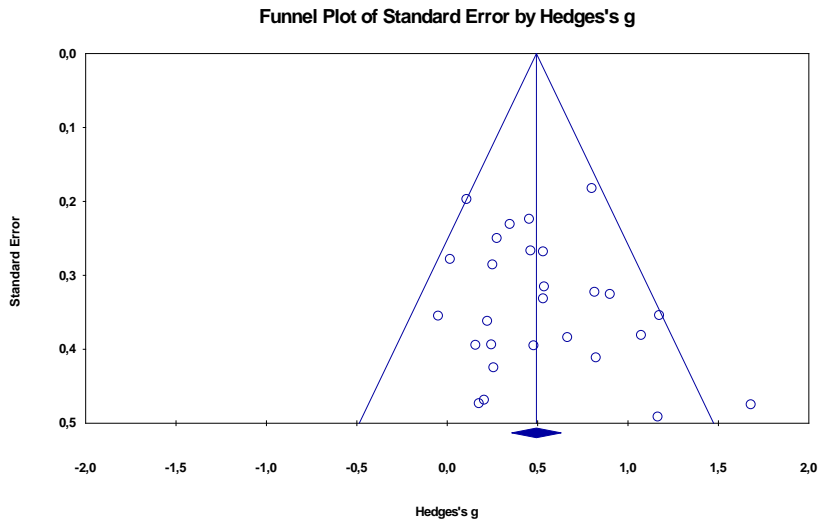


Figure 6. Funnel plot of studies measuring depression

For well-being (n=11) Egger's regression test intercept (b) is -2.02, with a 95 % confidence interval from -3.37 to -0.67 and a p-value <0.01 (one-tailed) . The failsafe N is 77 using a one-tailed criterion (or 51 using a two-tailed criterion). The funnel plot looks a-symmetrical, with Egger's test confirming the funnel plot that smaller studies report lower effect sizes. There is no indication of publication bias in the results of yoga on well-being

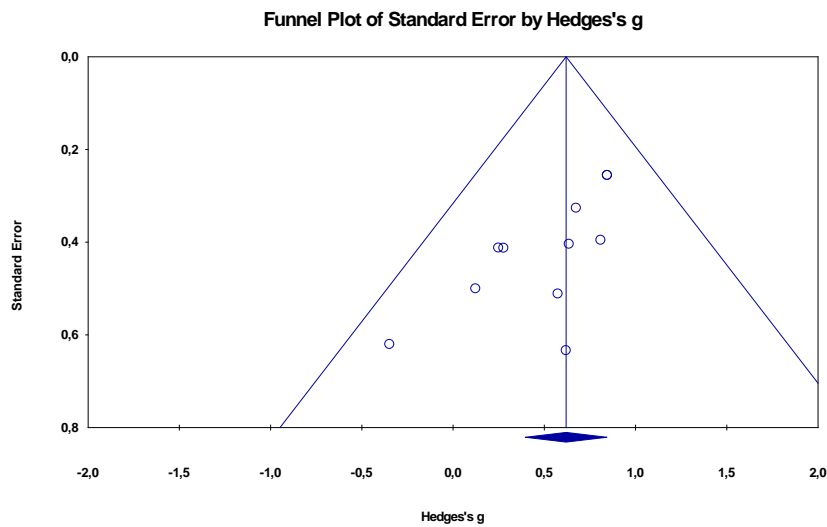


Figure 7. Funnel plot of studies measuring well-being

## 5 Discussion

### Main findings

This meta-analysis shows a more complete picture of the effect of yoga on mental health by taking on a dual perspective. Following a systematic literature search, 34 studies were included and 32 were analyzed after removal of outliers. These studies had 39 individual measurements of which 15 were statistically significant. Results show that yoga has a statistically significant and substantial positive effect size of 0.52 on the primary outcome mental health. The effect size for depression and depressive symptoms is 0.49 which is a confirmation of earlier research, showing that yoga can reduce depression (Cramer, Lange, Klose, Paul, & Dobos, 2012; ten Damme, 2013; Mehta, & Sharma, 2010; Pilkington, Kirkwood, Rampes, & Richardson, 2005; Uebelacker et al., 2010). For well-being an effect size of 0.62 was found, indicating that yoga can contribute to the improvement of well-being for individuals. This is a confirmation of existing literature, indicating that yoga can improve well-being and satisfaction with life (Impett, Daubemier, & Hirschman, 2006). The three constructs that make up well-being and the effect sizes, are emotional well-being with 0.56, psychological well-being with 0.53 and social well-being with 0.42. The lower effect on social well-being might be interpreted because, yoga doesn't improve social roles and relations directly. Not much can be said about lasting effects of yoga. Only three studies did a follow up measurement, from which two made adequate reports. One reported a significant lasting effect on depression and the other found no lasting effect.

Several characteristics of the study moderated the effect of yoga. In general, lower quality rated studies showed higher effect sizes and higher rated studies lower effect sizes. This was significant for the studies measuring depression. Effectiveness research in psychotherapy shows that effect sizes are relatively small in high-quality studies compared with low-quality studies (Cuijpers, Straten, Bohlmeijer, Hollon, & Andersson, 2010). This might also be true for yoga interventions.

Yoga is effective in a broad population. Significant effects on mental health were seen on populations that have somatic illness, psychopathology and also healthy populations. Yoga can also compete with other mental health interventions, shown by the significant results of the control group types. Although the result on well-being (some sort of intervention) was not significant, it should be taken into account, that this group had a low number of studies. Long and short yoga interventions show also good results in improving mental health. This for example seen at the study of Vancampfort (2011), whereby the yoga intervention lasted only 30 minutes, but still resulted in a effect size of 0.81 (EWB).

From a public health perspective, even short yoga interventions can serve as a cheap and effective mental health promotion tool. Yoga can be given practically everywhere and doesn't require expensive materials, except maybe for an experienced trainer. It can even be done at home having had some form of (short) instruction. It can reach large groups of people, young, old and ill or healthy. This analysis shows that yoga intervention results in positive effects not only depression, but also on the positive functioning part of a person. This in turn doesn't only lighten symptoms but also adds preventive determinants against psychopathology. This possibly prevents the beginning and course of somatic diseases (Moussavi et al., 2007; Prince et al., 2007), social isolation and an overall decline in quality of life (Cuijpers & Smit, 2002).

### **Strengths and limitations**

The strength of this meta-analysis is that the aggregation of the medical- and positive perspective on mental health, give a broader picture of the effect of yoga on mental health. This study shows that yoga doesn't only cure or reduce symptoms, but can also strengthen positive parts in individuals and thus improve their mental health. This inclusion of the positive part of mental health is also as strength of this study. By researching and combining existing literature about this construct, well-being was properly conceptualized in this study. This was not the case with the individual studies that were analyzed in this meta-analysis. Well-being is a broad construct and studies often measure it partly and often without a good theoretical framework of what it is they are actually measuring. Another strength of this meta-analysis is that there is no indication found of publication bias. Although it doesn't prove that is not present, it indicates that it's probable that the effect is close to the real effect size. This meta-analysis had a pool of studies which included various populations with different ages, (mental) health level and socioeconomic groups. This is a considerable strength of this meta-analysis.

This study has several limitations. First, the amount of studies in the well-being groups are barely adequate. Results given on these groups are more uncertain and unreliable. Also these constructs were measured by taking comparable constructs, which may not fully cover the well-being constructs described in the theory. On the basis of the theory (Diener, 1984; Diener, Suh, Lucas, & Smith, 1999), the sub construct emotional well-being seemed to be covered best, by the individual studies in this analysis. Measurement of psychological well-being and social well-being seemed less covered by the theory that was given (Keyes, 1998; Ryff, 1989). For instance the questionnaire WHOQOL-BREF used by Chung et al. (2012) measures psychological health and social relations, comparable with psychological and social well-being but not quite the same. Unfortunately, it was necessary to pick less comparable constructs, because well-being is not yet widely investigated in the study of yoga. Considering the heterogeneity results of well-being, the numbers of studies, was lower, and the power of this test in such circumstances is low (Higgins, Thompson, Deeks, & Altman, 2003; Higgins, Sterne & Egger, 2001). Perhaps the real heterogeneity is higher in the well-being analysis.

### **Implications for practice**

Yoga could be used for healthy people and people with mental or physical illnesses as an intervention who suffer from depression or depressive symptoms. It can also be deployed as a preventive measure against psychopathology, by its improvement of well-being. Taking moderators into account, yoga can even be effective when practiced for short periods like 30 minutes. Not only can yoga strengthen psychological and emotional resilience but also strengthen and improve physical health (Pilkington et al., 2005). Looking at earlier results (Impett, Daubenmier & Hirschman, 2006; Pilkington et al., 2005) and the ones in this study, it can be said that yoga improves mind and body. This is in line with recent developments and thought of positive psychology, with more on interventions that focus on the improvement of well-being. Yoga could well be an addition to the list of positive interventions.

Yoga is popular, which is already in use by a large number of people. It is simple to perform, like chair yoga and it can be used as a self-management technique where a yoga exerciser does not need to go to the hospital or therapist. An individual could well use yoga their entire lifetime and when used for example, as a first step in stepped care approach, no stigmatisation takes place, because the

ill and healthy can all participate. This could well make yoga interventions attractive for health policymakers, because yoga is a simple, open and effective way, to improve (mental) health.

### **Recommendations for research**

There is need for research on the effects of yoga on major depression, there were no studies in this analysis investigating it. Another recommendation for further research would be to investigate more thoroughly what the psychological mechanism is behind yoga and deciphering what exactly makes it work. For example a question would be if yoga works because of asanas, dyhana or pranayama and in what proportion? Also it is important to research if effects of yoga are lasting. And the last recommendation would be to do more primary RCT studies on the effects of yoga on well-being, with proper sample sizes and adequate questionnaires that cover the total concept of well-being.

### **Conclusion**

This meta-analysis shows that yoga interventions can be effective in reducing depression, depressive symptoms and the promotion of well-being. This is the case for a broad selection of populations, e.g. with people that are healthy, have psychopathology or somatic illness. Yoga could be a good addition to the list of positive interventions on mental health, in view of its possibilities.

## References

(with \* in reference is study included in analysis)

\*Afonso, R. F., Hachul, H., Kozasa, E. H., Souza Oliveira, D., Goto, V., Rodrigues, D., et al. (2012). Yoga decreases insomnia in postmenopausal women: a randomized clinical trial. *The North American Menopause Society*, 19 (2), 186-193. Doi:10.1097/gme.0b013e318228225f.

American Psychiatric Association (2000). *Diagnostic and statistical manual of mental disorders Fourth edition – Text Revision [DSM-IV-TR tm]*. Washington, DC: American Psychiatric Association.

\*Banasik, J., Williams, H., Haberman, M., Blank, S.E., & Bendel, R. (2011). Effect of Iyengar yoga practice on fatigue and diurnal salivary cortisol concentration in breast cancer survivors. *Journal of the American Academy of Nurse Practitioners*, 23 (3), 135-142. Doi:10.1111/j.1745-7599.2010.00573.x.

\*Banerjee, B., Vadiraj, H. S., Ram, A., Rao, R., Jayapal, M., Gopinath, K. S., et al. (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 (3), 242-250. Doi: 10.1177/1534735407306214.

Biswas-Diener, R., Vitterso, J., & Diener, E. (2005). Most people are pretty happy, but there is cultural variation: The Inughuit, the Amish, and the Maasai. *Journal of Happiness Studies*, 6, 205-226.

Bock, M., Wapenaar, M. (2010). *Yoga voor dag en nacht, praktische oefeningen*. Rotterdam: BBNC.

Bolier, L., Haverman, M., Westerhof, H. J., Riper, H., Smit, E., & Bohlmeijer, E. (2013). Positive psychology interventions: a meta-analysis of randomized controlled studies. *BMC Public Health*, 13, 119. Doi:10.1186/1471-2458-13-119.

\*Bowden, D., Gaudry, C., An, S. C., & Gruzelić, J. (2012). A Comparative Randomised Controlled Trial of the Effects of Brain Wave Vibration Training, Iyengar Yoga, and Mindfulness on Mood, Well-Being, and Salivary Cortisol. *Evidence-Based Complementary and Alternative Medicine*. Article ID 234713. Doi: 10.1155/2012/234713.

\*Carei, T. R., Fyfe-Johnson, A. L., Breuner, C.C., & Brown, M. A. (2010). Randomized Controlled Clinical Trial of Yoga in the Treatment of Eating Disorders. *Journal of Adolescent Health*, 46 (4), 346–351. Doi: 10.1016/j.jadohealth.2009.08.007.

\*Carson, J. W., Carson, K. M., Jones, K. D., Bennett, R. M., Wright, C. L., & Mist, S. D. (2010). A pilot randomized controlled trial of the Yoga of Awareness program in the management of fibromyalgia. *Pain*, 151 (2), 530-539. Doi: 10.1016/j.pain.2010.08.020.

\*Chen, K. M., Chen, M. H., Chao, H. C., Hung, H. M., Lin, H. S., & Li, C. H. (2009). Sleep quality, depression state, and health status of older adults after silver yoga exercises: Cluster randomized trial. *International Journal of Nursing Studies*, 46 (2), 154–163. Doi: 10.1016/j.ijnurstu.2008.09.005.

\*Chung, S.-C., Brooks, M.M., Rai, M., Balk, J.L., & Rai, S. (2012). Effect of Sahaja Yoga Meditation on Quality of Life, Anxiety, and Blood Pressure Control. *Journal of Alternative and Complementary Medicine*, 18 (6), 589-596. doi:10.1089/acm.2011.0038.

\*Cohen, B. E., Chang, A. A., Grady, & D., Kanaya, A. M. (2008). Restorative Yoga in Adults with Metabolic Syndrome: A Randomized, Controlled Pilot Trial. *Metabolic Syndrome and Related Disorders*, 6 (3), 223-229. Doi:10.1089/met.2008.0016.

Comptom, W.C., Smith, M.L., Cornish, K.A., & Qualls, D.L. (1996). Factor structure of mental health measures. *Journal of Personality and Social Psychology*, 71, 406-413.

Cramer, H., Lange, S., Klose, P., Paul, A., Dobos, G. (2012). Yoga for breast cancer patients survivors: A systematic review and meta-analysis. *BMC Cancer*, 12, 412.

Cuijpers, P., & Smit, F. (2002). Excess mortality in depression: a meta-analysis of community studies. *Journal of Affective Disorders*, 72(3), 227-236. Doi: 10.1016/S0165-0327(01)00413-X.

Cuijpers, P., van Straten, A., Bohlmeijer. E., Hollon, S.D., & Andersson, G. (2010). The effects of psychotherapy for adult depression are overestimated: a meta-analysis of study quality and effect size. *Psychological Medicine: A Journal of Research in Psychiatry and the Allied Sciences*, 40, 211-223.

\*Culos-Reed, S. N., Carlson, L. E., Daroux, L. M., & Hatley-Aldous, S. (2006). A pilot study of yoga for breast cancer survivors: physical and psychological benefits. *Psycho-Oncology*, 15 (10), 891-897. Doi:10.1002/pon.1021.

ten Damme, D. (2013). Het effect van yoga op de mate van depressie. Een systematische review. url: <http://purl.utwente.nl/essays/63198>.

\*Danhauer, S. C., Mihalko, S. L., Russell, G. B., Campbell, C. R., Felder, L., Daley, K., et al. (2009). Restorative yoga for women with breast cancer: findings from a randomized pilot study. *Psycho-Oncology*, 18 (4), 360-368. Doi: 10.1002/pon.1503.

Deci, E., & Ryan, R. (2008). Hedonia eudemonia, and well-being. An introduction. *Journal of happiness Studies*, 9, 1-11.

\*Dhruva, A., Miaskowski, C., Abrams, D., Acree, M., Cooper, B., Goodman, S., & Hecht, F. M. (2012). Yoga Breathing for Cancer Chemotherapy–Associated Symptoms and Quality of Life: Results

of a Pilot Randomized Controlled Trial. *The Journal of Alternative and Complementary Medicine*, 18 (5), 473-479. Doi: 10.1089/acm.2011.0555.

Diener, E. (1984). Subjective well-being. *Psychological Bulletin*, 95, 542-575.

Diener, E., Suh, E.M., Lucas, R.E., & Smith, L.H. (1999). Subjective Well-being: Three Decades of Progress. *Psychological Bulletin*, 125 (2), 276-302.

\*Donesky-Cuenca, D., Nguyen, H.Q., Paul, S., & Carrieri-Kohlman, V. (2009). Yoga Therapy Decreases Dyspnea-Related Distress and Improves Functional Performance in People with Chronic Obstructive Pulmonary Disease: A Pilot Study. *Journal of Alternative and Complementary Medicine*, 15 (3), 225-234. Doi:10.1089/acm.2008.0389.

\*Field, T., Diego, M., Hernandez-Reif, M., Medina, L., Delgado, J., & Hernandez, A. (2012). Yoga and massage therapy reduce prenatal depression and prematurity. *Journal of Bodywork and Movement Therapies*, 16 (2), 204-209. Doi: 10.1016/j.jbmt.2011.08.002.

de Graaf, R., ten Have, M., Van Dorsselaer, S. (2010). *NEMESIS-2: De psychische gezondheid van de Nederlandse bevolking. Opzet en eerste resultaten*. Utrecht: Trimbos-instituut.

Greenwood, P., & Sasklofske, D. (2001). Toward an integration of subjective well-being and psychopathology. *Social Indicators Research*, 54, 81-108.

Grossman, P., Niemann, L., Schmidt, S., & Walach, H. (2004). Mindfulness-based stress reduction and health benefits: A meta-analysis. *Journal of Psychosomatic Research*, 57 (1), 35-43.

Headey, B., Kelley, J., & Wearing, A. (1993). Dimensions of mental health: Life satisfaction, positive affect, anxiety, and depression. *Social Indicators Research*, 29, 63-82.

Higgins, J.P.T., Green, S. (2005). *Cochrane Handbook for systematic reviews of interventions* (4.2.5). Chichester: John Wiley.

Higgins, J.P.T., Thompson, S.G., Deeks, J.J., & Altman, D.G. (2003). Measuring inconsistency in meta-analyses. *Br Medical Journal*, 327, 557-560.

\*Janakiramaiah, N., Gangadhar, B. N., Naga Venkatesha Murthy, P. J., Harish, M. G., Subbakrishna, & D. K., Vedamurthachar, A. (2000). Antidepressant efficacy of Sudarshan Kriya Yoga (SKY) in melancholia: a randomized comparison with electroconvulsive therapy (ECT) and imipramine. *Journal of Affective Disorders*, 57 (1-3), 255-259. Doi:10.1016/S0165-0327(99)00079-8.

\*Hartfiel, N., Havenhand, J., Khalsa, S. B., Clarke, G., & Krayner, A. (2011). The effectiveness of yoga for the improvement of well-being and resilience to stress in the workplace. *Scandinavian Journal of Work, Environment and Health*, 37 (1), 70-76. Doi:10.5271/sjweh.2916.

Impett, E.A., Daubenmier, J.J., & Hirschman, L.A. (2006). Minding the Body: Yoga, Embodiment, and Well-Being. *Journal of Sexuality Research & Social Policy*, 3 (4), 39-48.

\*Javnbakht, M., Hejazi Kenari, R., & Ghasemi, M. (2009). Effects of yoga on depression and anxiety of women. *Complementary Therapies in Clinical Practice*. 15 (2), 102-104.  
Doi:10.1016/j.ctcp.2009.01.003.

\*John, P. J., Sharma, N., Sharma, C. M., & Kankane, A. (2007). Effectiveness of Yoga Therapy in the Treatment of Migraine Without Aura: A Randomized Controlled Trial. *Headache: The Journal of Head and Face Pain*, 47 (5), 654-661. Doi:10.1111/j.1526-4610.2007.00789.

Keengan, L. (2001). *Healing with complementary & alternative therapies*. Delmar Thomson Learning, Albany, NY.

Keyes, C.L.M. (1998). Social well-being. *Social Psychology Quarterly*, 61, 121-140.

Keyes, C.L.M. (2005). Mental illness and/or mental health? Investigating axioms of the complete state model of health. *Journal of Consulting and Clinical Psychology*, 73, 539-548.

\*Khalsa, S. B. S., Hickey-Schultz, L., Cohen, D., Steiner, N., & Cope, S. (2012). Evaluation of the Mental Health Benefits of Yoga in a Secondary School: A Preliminary Randomized Trial. *The Journal of Behavioral Health Services & Research*, 39 (1), 80-90. Doi: 10.1007/s11414-011-9249-8.

\*Khalsa, S. B. S., Shorter, S. M., Cope, S., Wyshak, G., & Sklar, E. (2009). Yoga Ameliorates Performance Anxiety and Mood Disturbance in Young Professional Musicians. *Applied Psychophysiology and Biofeedback*, 34 (4), 279-289. Doi: 10.1007/s10484-009-9103-4.

Kruese, J. (2013). Het effect van yoga op de mate van angst. Een systematische review. url: <http://purl.utwente.nl/essays/63198>.

\*Kröner-Herwig, B., Hebing, G., Van Rijn-Kalkmann, U., Frenzel, A., Schilkowsky, G., & Esser, G. (1995). The management of chronic tinnitus—Comparison of a cognitive-behavioural group training with yoga. *Journal of Psychosomatic Research*, 39 (2), 153-165. Doi: 10.1016/0022-3999(94)00098P.

\*Kuttner, L., Chambers, C. T., Hardial, J., Israel, D. M., Jacobson, K., & Evans, K. (2006). A randomized trial of yoga for adolescents with irritable bowel syndrome. *Pain Research and Management*, 11 (4), 217-223.

Lipsey, M.W., & Wilson D.B. (1993). The efficacy of psychological, educational, and behavioral treatment. Confirmation from meta-analysis. *American Psychologist*, 48 (12), 1181-1209.

Long, L, Huntley, A., & Ernst, E. (2001). Which complementary and alternative therapies benefit which conditions? A survey of the opinions of 223 professional organizations. *Complementary Therapies in Medicine*, 9 (3), 178-185.



Ma, S. H. & Teasdale, J. D. (2004). Mindfulness-Based Cognitive Therapy for Depression: Replication and Exploration of Differential Relapse Prevention Effects. *Journal of Consulting and Clinical Psychology, 72* (1), 31-40.

\*Marefat, M., Peymanzad, H., & Alikhajeh, Y. (2011). The Study of the Effects of Yoga Exercises on Addicts' Depression and Anxiety in Rehabilitation Period. *Procedia - Social and Behavioral Sciences, 30*, 1494-1498. Doi: 10.1016/j.sbspro.2011.10.289.

Masse, R., Poulin, C., Dassa, C., Lambert, J., Belair, S., & Battaglini, A. (1998). The structure of mental health higher-order confirmatory factor analyses of psychological distress and well-being measures. *Social Indicators Research, 45*, 475-504.

Mehta, P., Sharma, M. (2010). Yoga as a Complementary Therapy for Clinical Depression. *Journal of Evidence-Based Complementary & Alternative Medicine, 15* (3), 156-170. Doi:10.1177/1533210110387405.

Monk-Turner, E. & Turner, C. (2010). Does yoga shape body, mind and spiritual health and happiness: Differences between yoga practitioners and college students. *International Journal of Yoga, 3* (2), 48-54.

Moussavi, S., Chattaji, S., Verdes, E., Tandon, A., Patel, V. & Ustun, B. (2007). Depression, chronic diseases, and decrements in health: Results from the world Health Surveys. *Lancet, 370*, 851-858.

\*Mitchell, K. S., Mazzeo, S. E., Rausch, S. M., & Cooke, K. L. (2007). Disordered eating: Evaluating dissonance-based and yoga interventions. *International Journal of Eating Disorders, 40* (2), 120-128. Doi: 10.1002/eat.20282.

\*Noggle, J.J., Steiner, N.J., Minami, T., & Khalsa, S.B.S. (2012). Benefits of Yoga for Psychosocial Well-Being in a US High School Curriculum: A Preliminary Randomized Controlled Trial. *Journal of Developmental & Behavioral Pediatrics, 33* (3), 193-201. Doi:10.1097/DBP.0b013e31824afdc4.

Pilkington, K., Kirkwood, G., Rampes, H., Richardson, J. (2005). Yoga for depression: The research evidence. *Journal of Affective Disorders, 18* (3), 13-24. Doi: 10.1016/j.jad.2005.08.013

Prince, M., Patel, V., Saxena, S., Maj, M., Maselko, J., Philips, M.R. et al. (2007). No health without mental health. *Lancet, 370*, 859-877.

Promoting mental health: Concepts, emerging evidence, practice. Geneva: WHO; 2005.

\*Raghavendra, R. M., Nagarathna, R., Nagendra, H. R., Gopinath, K. S., Srinath, B. S., Ravi, B. D., et al. (2009). Effects of a Yoga Program on Cortisol Rhythm and Mood States in Early Breast Cancer

Patients Undergoing Adjuvant Radiotherapy: A Randomized Controlled Trial. *European Journal of Cancer Care*, 16 (6), 462-474. Doi: 10.1177/1534735409331456.

Riley, D. (2004). Hatha yoga and the treatment of illness (commentary). *Alternative Therapy in Health and Medicine*, 10 (2), 20-21.

\*Rocha, K. K. F., Ribeiro, A. M., Rocha, K. C. F., Sousa, M. B. C., Albuquerque, F. S., Ribeiro, S., et al. (2012). Improvement in physiological and psychological parameters after 6 months of. *Consciousness and Cognition*, 21 (2), 843-850. Doi: 10.1016/j.concog.2012.01.014.

Ryan, R.M., & Deci, E.L. (2001). On Happiness and human potentials: A review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology*, 52, 141-166,

Ryff, C.D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology*, 57, 1069-1081.

Ryff, C.D., & Essex, M.J. (1991). Psychological well-being in adulthood and old age: Descriptive markers and explanatory processes. *Annual Review of Gerontology and Geriatrics*, 10, 144-171.

Ryff, C.D., & Singer, B. (1998). The contours of positive human health. *Psychological Inquiry*, 9, 1-28.

Ryff, C.D., & Singer, B. (2008). Know thyself and become what you are: A eudemonic approach to psychological well-being. *Journal of Happiness Studies*, 9, 13-39.

Romijn, G. A., Ruiter, M., Smit, F. (2008). *Meer effect met depressiepreventie? Strategieën voor publieksvoorlichting, vroegherkenning en terugvalpreventie*. Utrecht: Trimbos-instituut.

Seligman, M. E. P., Csikszentmihalyi, M. (2000). Positive psychology: An introduction. *American Psychologist*, 55, 5-14. Doi: 10.1037//0003-066X.55.1.5.

\*Shahidi, M., Mojtahed, A., Modabbernia, A., Mojtahed, M., Shafiabady, A., Delavar, A., et al. (2011). Laughter yoga versus group exercise program in elderly depressed women: a randomized controlled trial. *International Journal of Geriatric Psychiatry*, 26 (3), 322-327. Doi:10.1002/gps.2545.

Simon, G. E., Goldberg, D. P., Von Korff, M., & Ustun, T. B. (2002). Understanding cross-national differences in depression prevalence. *Psychological Medicine*, 32, 585-594.

Sterne, J.A.C., & Egger, M. (2001). Funnel plots for detecting bias in meta-analysis: guidelines on choice of axis. *Journal of Clinical Epidemiology*, 54, 1046-55.

Suldo, S.M., & Shaffer, E.J. (2008). Looking beyond psychopathology: The dual-factor model of mental health in youth. *School Psychology Review*, 37, 52-68.

\*Tekur, P., Nagarathna, R., Chametcha, S., Hankey, A., & Nagendra, H. R. (2012). A comprehensive yoga programs improves pain, anxiety and depression in chronic low back pain patients more than exercise: An RCT. *Complementary Therapies in Medicine*, 20 (3), 107-118.

Doi:10.1016/j.ctim.2011.12.009.

Uebelacker, L. A., Epstein-Lubow, G., Gaudiano, B. A., Tremont, G., Battle, C. L., & Miller, I. W. (2010). Hatha yoga for depression: Critical review of the evidence for efficacy, plausible mechanisms of action, and directions for future research. *Journal of Psychiatric Practice*, 16 (1), 22-33.

Doi:10.1097/01.pra.0000367775.88388.96.

\*Vancampfort, D., De Hert, M., Knapen, J., Wampers, M., Demunter, H., Deckx, S., Maurissen, K., & Probst, M. (2011). State anxiety, psychological stress and positive well-being responses to yoga and aerobic exercise in people with schizophrenia: a pilot study. *Disability and Rehabilitation*, 33 (8), 684–689. Doi: 10.3109/09638288.2010.509458.

\*Visciglia, E., & Lewis, S. (2011). Yoga Therapy as an Adjunctive Treatment for Schizophrenia: A Randomized, Controlled Pilot Study. *The Journal of Alternative and Complementary Medicine*, 17 (7), 601 - 607. Doi: 10.1089/acm.2010.0075.

\*Vogler, J., O'Hara, L., Gregg, J., & Burnell, F. (2011). The impact of a short-term iyengar yoga program on the health and well-being of physically inactive older adults. *International Journal of Yoga Therapy*, 21, 61-72.

\*Wang, D.S. (2010). Feasibility of a yoga intervention for enhancing the mental well-being and physical functioning of Older Adults Living in the Community. *Activities, Adaptation & Aging*, 34 (2), 85-97. Doi:10.1080/01924781003773559.

Waterman, A. (1990). The relevance of Aristotle's conception of eudemonia for the psychological study of happiness. *Theoretical and Philosophical Psychology*, 10, 39-44.

Westerhof, G. J., Bohlmeijer, E. (2010). *Psychologie van de Levenskunst*. Amsterdam: Boom.

Westerhof, G.J., Keyes, C.L.M. (2010). Mental illness and mental health: the two continua model across the lifespan. *J Adult Dev*, 17, 110–119.

Westerhof, G. J., & Keyes, C. L. M. (2008). Geestelijke gezondheid is meer dan de afwezigheid van geestelijke ziekte. *Maandblad Geestelijke Volksgezondheid*, 63(10), 808-820.

\*Woolery, A., Myers, H., Sternlieb, B., & Zeltzer, L. (2004). A yoga intervention for young adults with elevated symptoms of depression. *Alternative Therapies in Health and Medicine*, 10 (2), 60-63.

World Health Organisation. (2005) *Promoting mental health: Concepts, emerging evidence, practice*. Geneva: WHO.