The use of mindfulness-based-stress-reduction (MBSR) on patients with hypertension or heart disease

A descriptive literature review

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Abstract

Background Cardiovascular diseases (CVDs) is a major public health problem around the world, which heavily impacts on patients’ mortality, disability and quality of life. It was reported that CVDs correlated with specific psychological states. Besides, psychological factors as an independent risk factor were found that can contributed to the onset and development of CVD. Recently, Mindfulness Based Stress Reduction (MBSR), as a promising psychotherapy, was advocated to improve well-being of individuals who are suffering from CVDs.

Aim To describe effects of mindfulness-based stress reduction (MBSR) on patients with hypertension or heart disease.

Methods Descriptive literature review of randomized control trials. The data mainly gained from PubMed from 2000 to March 2019. Articles were screened independently by two reviewers. Data extraction and quality appraisal were performed by one reviewer and checked by a second with discrepancies. The disagreements were resolved by discussion.

Results Six randomized control trials articles about hypertension (n = 2) and heart disease (n = 4) meeting inclusion criteria were selected in the final review. Synthesizing the results of six studies, significant effects on physical and psychological health were found.

Conclusion This review indicated that MBSR interventions generated beneficial effects on physical and psychological health in patients with hypertension or heart disease, supporting its position in clinical treatment as a complementary psychotherapy.

Key words: Cardiovascular Diseases, Heart Disease, Hypertension, Mindfulness-Based Stress Reduction.
摘要

背景 严重影响人类死亡率，致残率和生活质量的心血管疾病仍旧是当今世界主要的公共健康问题。据报道这种病和心理状态存在关联性。此外，心理问题作为一种独立的危险因素又对心血管疾病的发生与发展起着重要作用。而最近，一种有前景的心理干预方式 - 正念减压正在被提倡着去改善心血管病人的状况。

目的 描述正念减压疗法对患有高血压或心脏病病人的疗效。

方法 随机对照实验描述性综述。主要来自数据库 PubMed 的资料收集从 2000 年到 2019 年 3 月。文章被两名人员独立筛选，一名人员进行资料提取，另一名重新提取，通过讨论解决分歧。

结果 六篇关于高血压（n = 2）和心脏病（n = 4）的随机对照实验且符合纳入标准的文章被最终确定。通过综合分析得出正念疗法在改善患有高血压或心脏病的病人的生理和心理健康方面有重要作用。

总结 本篇文章表明正念疗法对于改善患有高血压和心脏病的病人的身体和心理方面有有益的作用，同时也支持其在临床实际中作为一种互补治疗方法的地位。

关键词 心血管疾病、心脏病、高血压、正念减压疗法
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1. Introduction

Cardiovascular disease (CVD) remains a major chronic public health problem all over the world and is one of the leading causes of global mortality and disability (WHO, 2010). Besides, it is reported that 17 million people in the world died from this kind of disease in 2011 (Klainin-Yobas, Ng, Stephen & Lau, 2016). Cardiovascular diseases that are resulted from imbalances of the heart and circulatory system, mainly contain two categories, they are heart diseases and blood vessels abnormalities, respectively (Pappas, Všetečková, Poduval, Tseng & Car, 2017). As for the former, for instance, includes heart failure, cardiomyophy and so on, the latter, has hypertension, coronary artery disease etc.

Physical risk factors reported by American Health Association can contribute to increased odds to develop CVD such as high blood sugar, high blood pressure, high cholesterol, smoking, fat diet, high body mass index, low physical activity (Lloyd-Jones et al., 2010; Loucks et al., 2015). In return, cardiovascular disease itself also indirectly influence these risk factors mentioned above because individuals who have CVDs maybe are more prone to have psychological burden and then express negative emotion through unhealthy behaviors including smoking, alcohol assumption, drug abuse and so on (Abbott et al., 2014). Additionally, mental factors containing anger, stress, depression, anxiety and so on also will influence the development of this disease (Richardson et al., 2012). Notably, many studies have reported that psychological problems as independent risk factors especially anxiety, stress and depression are highly relevant to the development of CVDs (Neylon et al., 2013; Richardson et al., 2012). From the viewpoint of physiology, long term stress and anxiety will disturb the balance between sympathetic and parasympathetic, release more hormones and neurotransmitters such as adrenaline and norepinephrine, induce metabolic imbalance and generate series of physical response like tachycardia, tachypnea, endothelia thickness and high blood pressure (Vrijkotte, van Doornen, & de Geus, 2000; Brunner et al., 2002; Ghiadoni et al., 2000). In total, factors interact, interdependent and influence with each other. That’s why researchers and some guidelines about hypertension and cardiac rehabilitation emphasize the importance of controlling stress and depression or other emotional problems to manage CVDs as a kind of therapy in recent years (Leon et al., 2005; Skinner & Minhas, 2007).

Therefore, an effective intervention is needed to teach and help patients with CVDs manage their negative thoughts in order to decrease the probability of deterioration (Klainin-Yobas et al., 2016).
Mindfulness as a concept can be dated back to 3,000 years ago (Tusaie & Edds, 2009). It refers to a capacity to keep an intentional awareness that holds non-judgemental and open attitude toward a person’s physical and mental experiences taking place at present moment (Kabat-Zinn, 1982; Demarzo et al., 2014; Brown & Ryan, 2003). It’s also recognized as a favorable state for a person’s mind (Nyklíček & Kuijpers, 2008). From the general definition it stresses that (1) individuals need to adjust themselves attention and awareness to focus on immediate events, and (2) at the same time keep positive attitude such as openness, non-judgment toward their experiences at present, (3) it presents that it’s a skill and ability paying attention to concentration will be gained though practices (Demarzo et al., 2017). With the development and prevalence of mindfulness, some mindfulness - based - interventions are developed gradually. Mindfulness -Based - Stress - Reduction (MBSR) is designed for controlling chronic pain at first, but now it is broadly applied to mental disorders, becoming popular as a kind of psychotherapy to reduce stress, influence passive factors and reach desired outcomes in clinic (Kabat-Zinn, 1982; Abbott et al., 2014). Generally, in eight weeks MBSR training, several core techniques containing meditation, yoga, cognitive reappraisal are taught for participants to accept a particular awareness advocated by mindfulness (Bishop et al., 2004). In recent years, its successful effects on managing different patient groups including healthy individual or mental diseases such as chronic pain, breast cancer, diabetes, depression and anxiety have been demonstrated in scientific studies (Abbott et al., 2014; Freedenberg, Hinds, & Friedmann, 2017; Nyklíček & Kuijpers, 2008; Haller et al., 2017; Khoo et al., 2019; Sharma & Rush, 2014). The findings suggest that mindfulness therapy can not only influence individuals’ physical and mental health but also provide a psychological therapy to take care patients in a specific way for clinical workers (Klainin-Yobasa et al., 2016).

1.1 Theory

Neuman’s system model was used to support the study. Neuman states that living organisms can be served as an open system that dynamically interact with intrapersonal, interpersonal and extrapersonal environment all the time (Alligood, 2014). In her eyes, living organisms are defined as an individual, family, group, community or social issue and are viewed as a whole that consists of physiological, psychological, sociocultural, developmental and spiritual aspects, holding wholistic perspective toward clients.
It keeps a continuous interaction about input, output, feedback and so on of various information and energy in this open system (Alligood, 2014). Stress in Neuman’s opinion refers to the nonspecific response from body and meanwhile, readjustment and adoption are required when stress comes out in order to keep balance and stability (Alligood, 2014). All life are undergoing the interplay of balance and imbalance when connect with the surroundings, and if all components in this system cooperate well or demands are met, an optimal status will be achieved (Alligood, 2014). That means if human beings can appropriately cope with tension-producing stimuli that have potential to destroy the system and adjust themselves to it, they will keep health stability, by contrast, if not, the balance will be broken, stabilizing process fails, then illness may develop (Alligood, 2014).

In her theory, the client system model consists of (1) inner circle: basic structure representing client’s features and basic survival factors; (2) lines of resistance: surrounding the inner circle that is regarded as protective factors against stressors; (3) normal line of defense and (4) flexible line of defense; for the latter two, if two lines expand, which stand for an enhanced wellness state (Alligood, 2014). Therefore, Neuman puts forward three levels prevention (primary, secondary and tertiary) as nursing intervention that links four meta-paradigm concepts to help the clients adjust themselves or the situation to retain and maintain system stability as to achieve the desired goal that is to reduce patient’s reactions or responds to stressors and keep health (Alligood, 2014).

The reasons why Neuman’s theory support the present study is that mindfulness - based - stress - reduction can be considered a kind of nursing intervention, which will makes difference by influencing the external environment surrounding clients. Introducing what the mindfulness is and training methods, because this is an open and dynamic system based on Neuman theory, people can receive information or knowledge and exchange information or energy through the homeostasis process, next, it will works and alters clients’ internal environment such as mood and cognitive reappraisal. Finally, people will not only expand the normal line of defense and flexible line of defense after learning MBSR because they have gotten ready to receive and adopt stressors but also to keep balance between health and disease due to the stabilizing process reestablished after readjustment the relationships with outer world by the homeostasis, equilibrium process.

1.2 Problem statement
At present, cardiovascular diseases have become a global burden and threat for people’s health and quality of life due to its symptoms and complications, which result in high rate of mortality and disability. Many risk factors from physical and psychological perspectives are associated with the onset and development of CVD. It has been reported that especially stress, anxiety, depression can deteriorate the disease. Therefore, it is essential for patients to strike balance between health and emotion management. Mindfulness-based stress-reduction as a novel psychological intervention, by regular training, emphasizes that an individual should accept and concentrate on present reality or experiences without any judgement, which aims to let people face events in a peaceful attitude and decrease negative feelings derived from immediate events as much as possible. Since research have found that diseases and psychological status will impact each other. Nurses should not only focus on patients’ physical health but also emotional problems. An effective psychological intervention will help care patient better, improving quality of nursing and patients’ quality of life. In addition, it has been demonstrated by lots of research the successful influences of MBSR on diseases and mental disorders like chronic pain, depression, anxiety. Besides, a previous systematic review reported that mindfulness-based interventions as psychological therapy had effect on vascular diseases (Abbott et al., 2014). Klainin-Yobasa et al. (2016) also conducted a review to find out what psychological outcomes on patients with CVD after using mindfulness. Lawrence, Booth, Mercer and Crawford (2013) review stated that patients who suffer from stroke and transient ischemic attack can benefit from following mindfulness-based interventions. Although there are some reviews about the use of MBSR in patients with cardiovascular disease, reviews seldom investigate effects on just hypertension and common heart disease. To our best knowledge, there is only one review reporting MBSR effects on blood pressure yet including only 5 articles. Therefore, in order to clarify the effects of MBSR on hypertension and heart disease, we did a descriptive review about that.

1.3 Aim and Research question

The aim of the review was to describe the effects of mindfulness-based stress-reduction (MBSR) on patients with hypertension or heart disease.

What is the effects of MBSR on patients with heart disease or hypertension?

2. Methods
2.1 Design

The study was conducted as a descriptive review (Polit & Beck, 2017).

2.2 Search strategy

The database PubMed was searched in March 2019. The search used “((cardiovascular disease OR heart disease OR hypertension)) AND (Mindfulness)” as key terms (Polit & Beck, 2017). To maximize the search outcomes to get enough articles, we used “text words” of these key terms. Then we restricted the years from 2000 to 2019, and set the limit that language should be in English. Considering the lack of articles, the authors also read the reference lists of included articles to expand the resource of possible articles. The search strategy was presented in Table 1.

Table 1. Search results through databases

<table>
<thead>
<tr>
<th>Databases</th>
<th>Limits and search date</th>
<th>Search terms</th>
<th>Number of hits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PubMed</td>
<td>2000 to 2019, English, 2019-03-20</td>
<td>cardiovascular disease OR heart disease OR hypertension</td>
<td>1366005</td>
</tr>
<tr>
<td>PubMed</td>
<td>2000 to 2019, English, 2019-03-20</td>
<td>Mindfulness</td>
<td>6067</td>
</tr>
<tr>
<td>PubMed</td>
<td>2000 to 2019, English, 2019-03-20</td>
<td>((cardiovascular disease OR heart disease OR hypertension)) AND (Mindfulness)</td>
<td>161</td>
</tr>
<tr>
<td>Total</td>
<td>After removed duplicate</td>
<td></td>
<td>161</td>
</tr>
</tbody>
</table>

2.3 Selection criteria

Inclusion criteria were: (1) articles should be related to the study’s topic; (2) Quantitative articles using interventions must be mindfulness-based-stress-reduction; (3) Participants more than 18 years old diagnosed with CVDs (heart disease or hypertension.)

Exclusion criteria were: (1) Literature review and Qualitative articles; (2) Cardiac patients with other disease, such as mental illness, kidney disease, diabetes and so on.
2.4 Selection process

First of all, the database PubMed was searched. The sum of articles after duplicates removed was 161. Then titles of the articles were screened to acquire all possible articles as long as they mentioned or probably contained both mindfulness and cardiac disease. In total, 119 articles had to be removed because they were totally off the point. Then, the abstracts of the remaining articles were read in order to find whether they met the inclusion criteria, and 27 articles were excluded: 24 reviews, 2 qualitative studies and 1 protocol. Finally, authors carefully read the full-text of the remaining articles. However, 2 articles could not be obtained because of problems with access authority; and 7 articles did not meet the inclusion criteria. 3 articles whose participants were not conforming to the norm; 3 articles were interfered by other therapies, such as art therapy; 1 article was suitable for the criteria “cardiovascular disease”, but authors were only interested in heart disease and hypertension, so it was excluded as well. Thus, 6 articles were suitable for the study. The process of selecting articles is presented in Figure 1.

![Diagram showing the selection process]

Records screened (n = 161)

Records excluded (n = 119)
Articles were excluded because they were irrelevant for the aim of the degree project after reading the titles.

Records after titles screened (n = 42)

Records excluded (n = 27)
24 reviews, 2 qualitative studies, and 1 protocol.

Records after abstracts screened (n = 15)

Records excluded (n = 9)
3 articles were removed because of the unmatched participants, 3 articles were interfered by other intervention, 1 was out of interest, 2 were inaccessible.

Articles assessed for eligibility (n = 6)
2.5 Data analysis

First, the authors read all six articles separately, and after they gave a sum about the findings of these articles. When different opinions occurred, authors discussed until agreements were reached, then the data were extracted and analyzed, see appendix. Authors summarized the important information of each article and extracted the results. After careful reading, authors put together similar data to extract topics, and then classified them into physiological and psychological aspects. The data analysis was completed with the help of three tables because using a table was a good method to collect, analyze and organize results of articles (Polit & Beck, 2017). One table contains studies’ author, title, design, participants, data collection and data analysis. The other one includes authors, aim and results contains. The last table is carefully and clearly presented the analysis of similarities between outcomes of using mindfulness for patients with CVD, see Table 2. 3. and 4.

2.6 Ethical consideration

The authors followed ethical guidelines, and plagiarism was strictly prohibited. The authors described articles objectively and interpreted with precision instead of holding a part as whole and prejudging the outcomes. The processed results were not be falsified against the results of the included studies.

3. Results

3.1 Basic information about articles

The six articles all randomized control trials were published between 2002 to 2017. These trials were conducted in Canada, Iran, Netherlands (n=2) and USA (n=2), respectively. Sample sizes ranged from 18 to 324, with three of the six trials involving more than 100 participants (Blom et al., 2014; Gotink et al., 2017; Younge et al., 2015a). In total, 845 participants were recruited in these trials and they who met the eligibility were suffering from hypertension (n=2 trials) or heart disease (n=4 trials). Three trials had a wait-list control design (Blom et al., 2014; Robert-Mccomb, Tacon, Randolph, & Caldera, 2004; Tacón, McComb, Caldera & Randolph, 2003). Two used a pragmatic
randomized control design (Gotink, et al., 2017; Younge et al., 2015a). One was a single blind RCT (Momeni, Omidi, Raygan & Akbari, 2016).

Two trials only contained females as study subject (Robert-Mccomb et al., 2004; Tacón et al., 2003). There was only one trial that reported statistically significant difference in participants’ psychological health prior to intervention (Momeni et al., 2016). The remaining five studies didn’t report any base-line differences in psychological health and the eligibility only depended on physical condition alone (Blom et al., 2014; Gotink et al., 2017; Momeni et al., 2016, Robert-Mccomb et al., 2004; Tacón et al., 2003; Younge et al., 2015a).

3.2 Intervention

All trials were MBSR intervention and met the basic requirement with treatment that once a week for a range of 1.5 to 2.5 hour per week with the addition of daily homework for 30 - 40 minutes for six days per week. Most trials had eight weeks of intervention (n=4), one lasted a 12 weeks (Younge et al., 2015a) and another lasted 12 months (Gotink et al., 2017).

3.3 Data collection method

Most trials measured physical parameters like using sphygmomanometer to measure blood pressure, 6 minutes walking test (MWT) to test exercise tolerance and various scales like Visual Analogue Scale, Hospital Anxiety and Depression scale, Perceived Stress Scale, Perceived Social Support Scale concentrating on psychological conditions or questionnaires to acquire basic information before intervention, to report and compare whether variables would yield differences or not at the end of the intervention (Blom et al., 2014; Gotink et al., 2017; Momeni et al., 2016; Robert-Mccomb et al., 2004; Younge et al., 2015a). Two of the six trials used laboratory tests as well including blood sampling laboratory tests - NT-proBNP (Gotink, et al., 2017; Younge et al., 2015a). One contained specific devices such cycle ergometer, Quinton EKG Monitor to test physical function response and submaximal exercise (Robert-Mccomb et al., 2004).

3.4 Data analysis method

All studies involved repeated measure analysis of variance in different groups and time (Blom et al., 2014; Momeni et al., 2016; Robert-Mccomb et al., 2004; Tacón et al., 2003; Younge et al., 2015a). The t test was also used in specific outcomes (Blom et al., 2014;
Gotink et al., 2017; Robert-Mccomb et al., 2004; Younge et al., 2015a). The Log linear and Chi-square respectively were used by Momeni et al. (2016) and Tacón et al. (2015). Three trials used intention - to -treat analysis (ITT) (Gotink et al., 2017; Momeni et al., 2016; Tacón et al., 2003). Two contained the same analysis method such as ITT , as-treated (AT), Cohen’s d and so on (Momeni et al., 2016; Younge et al., 2015a). More information is presented in Table 2.

3.5 Outcomes

Three trials reported both physical and psychological outcomes (Momeni et al., 2016; Gotink et al., 2017; Younge et al., 2015a). Two trials conducted by the same researchers consisted of similar primary outcomes - 6MWT and secondary outcomes - heart rate, BP, respiratory rate, NT-proBNP, SF-36, stress and social supports (Momeni et al., 2016; Younge et al., 2015a). Two only involved physical results on blood pressure (Blom et al., 2014; Robert-Mccomb et al., 2004). One focused on psychological parameters including anxiety, expression of negative emotion, expression negative feelings and coping styles (Tacón et al., 2003). In addition, there were two studies comparing gender differences, one regarding blood pressure, the other exercise capacity with respect to 6MWT (Blom et al., 2014; Gotink et al., 2017).

3.6 Synthesis by outcomes

In total, the majority of selected studies (n=5) mentioned positive effects on physical health of MBSR. The synthesized outcomes can be seen in Table 4.

3.6.1 Effects on physical health - Decreased Heart Rate

One study reported that MBSR decreased heart rate in patients who were suffering from heart disease. Using unadjusted data, heart rate statistically significantly decreased (beats per minute: -2.8, 95% CI: 0.2 to 5.4, p =0.033), additionally, Cohen’s d effect sizes showed small, but significant improvement about heart rate d = 0.20, 95% CI 0.04 to 0.36 in the intention-to-treat analyses (Younge et al., 2015a).

3.6.2 Effects on physical health - Improved Exercise Tolerance

Two trials used 6MWT as primary outcome conducted by Gotink et al. (2017) and Younge et al. (2015a).
A follow-up assessment at 12 months observed an improvement of 17.9 meters on 6MWT compared with control group. However, the intervention effect was not statistically significant (p = 0.055), meanwhile, Cohen's d presented statistical support d = 0.22, 95% CI 0.05 to 0.39 (Gotink et al., 2017).

One trial lasting 12 weeks showed a borderline significant improved 6MWT - 13.4 meters, 95% CI: -0.02 to 26.4, p = 0.050. Using the AT analysis, improved significantly, with small effect sizes: d = 0.19, 95% CI 0.02 to 0.36 (Younge et al., 2015a).

Only one trial investigated MBSR effects on stress hormones, physical functioning, and submaximal exercise responses within female. The results demonstrated that ventilation [F(2,32)=7.65, p<0.01, f=0.8] and breathing frequency [F(1,16) =8.84, p<0.01, f=0.8 changed significantly between the two groups (Robert-Mccomb et al., 2004).

3.6.3 Effects on physical health - Decreased Systolic BP

Four studies assessed the effects of MBSR on BP. All of them presented statistically significantly decrease for systolic blood pressure (SBP) and no notable difference in diastolic blood pressure.

Blom et al. (2014) found, in the unadjusted data, a small but statistically significant decrease of 1.8 ± 6.9 mm Hg for 24-hour SBP was found p = 0.01 and a small but statistically significant decrease of 2.1 ± 7.1 mmHg for awake SBP p = 0.01. Besides, in this study researchers also found that female subjects’ 24 hours SBP decreased by 1.8 ± 6.0 mm Hg, while increased in male subjects by 1.9 ± 8.3 mm Hg p = 0.02 (Blom et al., 2014).

Gotink et al. (2017) found a small but significant decrease on SBP using ITT analyses, d = 0.19, 95% CI 0.03 to 0.36 and in the AT analysis, SBP decreased significantly with 5.5 mmHg (p = 0.045) compared to usual care (UC), d = 0.23, 95% CI 0.05 to 0.41.

Momeni et al. (2016) confirmed that auscultatory BP decreased from 134.16 mmHg to 118.33 mmHg : F = 12.84, P < 0.001 and automated oscillometric BP (AOBP) decreased from 130.16 mmHg to 113.88 mmHg: F = 18.32, P < 0.001.

The trial by Younge et al. (2015a) found decreased SBP d=0.20, 95% CI 0.03 to 0.37.

3.6.4 Effects on psychological health - Decreased Depression, State-Anxiety, Stress and Anger
Beneficial effects on depression were reported by two studies. In Gotink et al. (2017) Cohen’s $d = 0.18$, 95% CI 0.02 to 0.35 compared to usual care (UC) and $d = 0.17$, 95% CI 0.01 to 0.33 in Younge et al. (2015a). These effects were observed in people with heart disease. Assessment of depression was derived from the Hospital Anxiety and Depression scale.

As for anxiety that was assessed by State-Trait Anxiety Inventory (STAI), one trial presented the state anxiety scores decreased from Mean $=37.88$; SD $= 10.91$ at the beginning of the intervention to Mean $= 29.11$; SD $= 7.37$ after the assessment, $F (1,16) = 6.79$, $p < 0.01$ in female participants with heart disease (Tacón et al., 2003).

Two trials had outcomes on stress. The perceived stress scores in the MBSR group decreased from 30.25 to 16.74, for control group from 37.50 to 33.46 and $F=107.62$, $p < .001$ (Momeni et al., 2016). Using AT analysis in study of Younge et al. (2015a) $d = 0.21$, 95% CI 0.04 to 0.38.

One trial observed decreased scores of all domains of State -Trait Anger Expression Inventory for experimental group with more decrease than control group. The greatest and the lowest pretest-posttest difference was the “feel like expressing anger physically” ($F=166.33$, $p < .001$) and the “anger expression” domains ($F=11.47$, $p < .001$) (Momeni et al., 2016).

### 3.6.5 Effects on psychological health - Negative Feeling, Coping Styles and Mental functioning

Both negative feeling and coping styles including reactive, reflective and suppressive copings were mentioned in the same study. Scores of Suppress or Control the expression of negative emotions decreased, $F (1,16) = 6.26$, $p < 0.02$ and improvement in Expressing negative feelings from pre-intervention (mean = 62.11; SD = 4.85) to post-intervention (mean = 57.44; SD = 5.00) scores (Tacón et al., 2003).

Only reactive coping had a significant effect out of three kind of coping styles. Initial scores decreased from Mean $=15.33$; SD $= 2.34$ to Mean$=13.77$; SD$=1.78$ when ended the intervention. $F (1,16) = 5.52$, $p < 0.03$ (Tacón et al., 2003).

One study assessed participants’ health status using SF-36, and found that participants improved their mental functioning in the MBSR group: $d= 0.22$, 95% CI 0.05 to 0.38 (Gotink et al., 2017).
<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
<th>Design</th>
<th>Participants</th>
<th>Intervention</th>
<th>Data collection method(s)</th>
<th>Data analysis method(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blom (2014)</td>
<td>Hypertension Analysis of Stress Reduction Using Mindfulness Meditation and Yoga: Results From the Harmony Randomized Controlled Trial</td>
<td>RCT with wait-list control</td>
<td>101 Persons aged 20 to 75 years old with unmedicated stage 1 hypertension</td>
<td>MBSR: 2.5h per week with homework of 45 min/day lasting 8 weeks</td>
<td>An automated BP measurement device was used to confirm eligible participants and provided baseline information.</td>
<td>Repeated measures analysis of variance was performed for the primary outcome between-group and secondary outcome within group analysis.</td>
</tr>
</tbody>
</table>

Ambulatory BP was measured at 15-minute intervals during the day (7:00 am to 11:00 pm) and at 30-minute intervals at night (11:00 pm to 7:00 am).

Laboratory tests electrocardiogram (ECG) were obtained to rule out

The Primary Analysis, aimed to compare change in awake and 24 hour ambulatory BP from baseline to 12 weeks between two treatment arms. The data was analyzed.
target organ damage and diabetes. according to a grouping variable (GROUP) with two levels (immediate treatment vs. wait-list control) by
TIME with 2 levels
(baseline and 12-weeks after baseline).

The Secondary Analysis, examined within participant BP change over 3 time points (baseline, post-intervention, and study close) and persistence of effect of the MBSR on BP 24 weeks from baseline.

Additional secondary analyses that evaluated effects on nighttime BP also used the same method.
Exploratory analyses evaluated correlations between amounts of MBSR homework practiced, class attendance, and BP change and the existence of sex/gender effects.

t test and McNemar tests of independence were used to evaluate the baseline comparison.

SAS version 9.2

| Gotink | Online mindfulness | Single blind, 324 Persons aged 18 to 65 with MBSR:12 months | Intention-to-treat analysis (ITT) was used to determine Primary outcome measure: |
promising method to improve exercise capacity in heart disease: 12-month follow up of a randomized controlled trial

Diagnosed heart disease (ischemic, valvular, congenital heart disease, or cardiomyopathy) mindfulness training in addition to usual care

6 Minute Walking Test (6MWT).

Secondary outcome measures:

Physical parameters (blood pressure, respiratory rate, and heart rate),

Blood sampling laboratory test (NT-proBNP),

Hair cortisol to test stress (ELISA),

Quality of life (Short-Form Health survey; Visual Analogue Scale),

Anxiety and stress (Hospital Anxiety and Depression scale),

whether offering a mindfulness training was effective compared to usual care (UC).

As-treated (AT) analysis was performed to address whether the mindfulness training was beneficial if actually performed.

Repeated measurements analysis using a multivariate linear regression mixed model were performed to check intergroup effects and to account for the correlation between the repeated
Perceived stress
(Perceived Stress Scale),
Social support
(Perceived Social Support Scale).

measurements of each patient and for missing values.

Cohen's d.

Log linear regression analyses, to see which participants were most likely to adhere to the training, and if adherent, what characteristics predicted the most benefit from the training.

$p < .05$ was considered to be statistical significance.
All data were analyzed with IBM SPSS statistics version 21.0

Momeni (2016) The effects of mindfulness based stress reduction on cardiac patients’ blood pressure, perceived stress, and anger: a single-blind randomized controlled trial

Single-blind RCT

60 People aged 35-60 years old diagnosed with any cardiac problems.

MBSR: Eight 2.5-hour weekly sessions

Auscultatory BP Measurement, Automated oscillometric BP (AOBP),

The Cohen’s Perceived Stress Scale (PSS-14),

The Spielberger’s State-Trait Anger Expression Inventory (STAXI-2)

The analysis of covariance was done for comparing the groups in terms of the MBSR scores while eliminating the effects of baseline scores.

Intention-to-treat analysis.

Independent samples t test was performed to compare patients’ demographic characteristics and clinical parameters.
| Robert-McComb (2004) | A Pilot Study to Examine the Effects of a Mindfulness Based Stress Reduction and Relaxation Program on Levels of Stress Hormones, Physical Functioning, and 18 women documented heart disease. | RCT with wait-list control | MBSR: 2 hours per week lasting 8 weeks plus additional daily homework practice | Resting blood pressure and heart rate (HR) were taken during the initial meeting after the participants had rested in a recumbent position for 20 minutes. | Questionnaire packets for getting demographic information (Speilberger’s State Anxiety Questionnaire; the Medical Outcomes Study) | The IBM SPSS statistics software (v. 16.0) The Physical Component Summary Measure was analyzed for physical function between group and time using a 2 (group) by 2 (time) ANOVA with repeated measures. Pre-post test hormonal measurement were analyzed for levels of cortisol and total catecholamines using a 2 (group) by 2 (time) analysis of variance |
Submaximal Exercise Responses

36-item Short Form Health Survey), (ANOVA) with repeated measures.

Physiological measurement (Cycle ergometer for 24 minutes at a constant 50 WATT workload with 8-minute stages)

The MedGraphics CardiO2 Breath-by-Breath System (oxygen consumption (VO$_2$), ventilation (VE), breathing frequency (Fb), tidal volume (Vt)),

Submaximal exercise responses (VO$_2$, HR, Fb, VE, and Vt) analyzed by A 2 (group) by 3 (time) ANOVA with repeated measures.

The Quinton EKG Monitor (heart rate HR).
Mindfulness Meditation, Anxiety Reduction, and Heart Disease A Pilot Study

RCT with wait-list control

18 Women aged 48 to 74 years old with heart disease (angina, hypertension, cardiovascular disease, and cardiac valve disorders).

MBSR: 2h per week plus additional daily homework practice lasting 8 weeks

State-Trait Anxiety Inventory (STAI),

Degree of control for feelings of anxiety, sadness, and anger

The Courtauld Emotional Control Scale (CECS),

Coping tendencies the reflective or thoughtful style, the reactive or impulsive style, and the suppressive or controlled style. The Problem-Focused Styles of Coping (PF-SOC) measure,

Multidimensional Health Locus of Control (MHLC) scale an internal health locus, powerful

Analysis of variance (ANOVA) were used to compare the intervention and control groups on demographic variables to identify potential covariates.

Chi-square analyses were conducted with group status and religion, ethnicity, marital, and work status and education to test for categorical covariates. Chi-square also test the correlation between demographic factors and the dependent variables (anxiety, emotional control,
Repeated measures analysis of variance (ANOVA) were conducted to test for treatment effects.

**Younge (2015)**

Web-Based Mindfulness Intervention in Heart Disease: A Randomized Controlled Trial

Single blinded, pragmatic RCT

324 Patients (mean age 43.2 years) with heart disease including ischemic, valvular, congenital heart disease and cardiomyopathy

MBSR: 12-week online mindfulness training in addition to usual care (UC)

**The primary outcome**

The 6 minute walk test (6MWT).

**Secondary outcomes**

Physical parameters (heart rate, blood pressure, respiratory rate),

Descriptive analyses described the baseline characteristics of demographic and clinical variables.

A repeated measurements analysis using multivariate linear regression mixed
Blood sampling laboratory tests (NT-proBNP),

Subjective health status (The Short-Form Health survey 36 (SF - 36))

Subjective perceived Quality of Life (A Visual Analogue Scale (VAS))

Psychological well-being (The Hospital Anxiety and Depression scale ),

Stress (The Dutch version of the)

model was performed to determine intergroup effects and to account for correlation between the multiple measurements of each patient and dropout.

An intention-to-treat (ITT) analysis was used to address whether offering a mindfulness training was effective compared to UC.

An as-treated (AT) analysis was performed to address whether the mindfulness training was beneficial if actually performed.
Perceived Stress Scale (PSS)),
Social supports
(The Dutch version of the
Perceived Social Support Scale
12 Blumenthal (PSSS12)).

Cohen’s D was calculated to
enable comparison of effect
sizes.
p < 0.05 statistical
significance.

IBM SPSS Statistics version
21.0.

Note: RCT = randomized control trial, MBSR = mindfulness based stress reduction, BP = blood pressure, ECG = electrocardiogram.

**Table 3. Significant Outcomes**

<table>
<thead>
<tr>
<th>Author</th>
<th>Aim</th>
<th>Significant outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study</td>
<td>Country</td>
<td>Overview</td>
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<tr>
<td>------------------</td>
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<td>---------------------------------------------------------------------------</td>
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</tbody>
</table>
| Blom (2014)      | Canada (1)    | To determine whether an 8-week MBSR therapy program could lower ambulatory BP among untreated participants with stage 1 hypertension | In the secondary outcome: within MBSR group from pre- to post-intervention.  
△A small but significant decrease of 1.8 ± 6.9 mm Hg for 24-hour systolic BP (p = 0.01).  
△A small but significant 2.1 ± 7.1 mmHg for awake systolic BP (p = 0.01).  
Exploratory outcome: Analyses of sex/gender effects: interaction for the within-group  
△Female subjects’ 24 hours systolic BP decreased by 1.8 ± 6.0 mm Hg, while increased in male subjects by 1.9 ± 8.3 mm Hg (p = 0.02). |
| Gotink (2017)    | Netherlands (2)| To reported the direct 3-month results of an online modified mindfulness-based stress reduction training in patients with heart disease, and evaluate the effect at 12-month follow-up | After the intervention: In the ITT analyses, |
An improvement of 17.9 meters on mean 6MWT at 12 months in Mindfulness Group, which was not statistically significant compared to usual care (p = 0.055).

Cohen's d presented significant improvements on:

- 6MWT (d = 0.22, 95% CI 0.05 to 0.39),
- Systolic blood pressure (d = 0.19, 95% CI 0.03 to 0.36),
- Mental functioning (d = 0.22, 95% CI 0.05 to 0.38),
- Depression (d = 0.18, 95% CI 0.02 to 0.35) compared to UC.

In the AT analyses,

- Systolic blood pressure decreased significantly with 5.5 mmHg (p = 0.045) compared to UC.
- Cohen’s d showed similar outcomes compared to ITT analyses on:
  - 6MWT (d = 0.17, 95% CI 0.00 to 0.34),
  - Systolic blood pressure (d = 0.23, 95% CI 0.05 to 0.41),
Momeni (2016) Iran (3) Aiming at assessing the effects of mindfulness-based stress reduction on cardiac patients’ blood pressure, perceived stress, and anger

Mental function (d = 0.18, 95% CI 0.01 to 0.35) and Depression (d = 0.25, 95% CI 0.08 to 0.42).

After the intervention: in the MBSR group

△SBP: Auscultatory BP decreased from 134.16 mmHg to 118.33 mmHg: F = 12.84, p < 0.001;

△Automated oscillometric BP (AOBP) decreased from 130.16 mmHg to 113.88 mmHg: F = 18.32, p < 0.001);

△Perceived stress: the scores in the MBSR group decreased from 30.25 to 16.74, for control group from 37.50 to 33.46. (F=107.62, p < .001).

△State-Trait Anger Expression inventory: the greatest and the lowest pretest-posttest difference was the “feel like expressing anger physically” (F = 166.33, p < .001) and the “anger expression” domains (F = 11.47, p < .001).

Robert-Mccomb (2004) USA To examine the effects of an 8-week mindfulness-based stress-reduction program on the resting levels of stress

After the intervention, in the MBSR group:
hormones, physical functioning, and submaximal exercise responses in women with heart disease.  

Δ Significant main effects between groups for ventilation [F(2,32) = 7.65, p < 0.01, f = 0.8].  
Δ And for breathing frequency between-group [F(1,16) = 8.84, p < 0.01, f = 0.8] and time [F(2,32) = 10.42, p < 0.01, f = 0.9].

Tacón (2003)  
USA  
Investigating the effectiveness of Kabat-Zinn’s mindfulness-based stress reduction and relaxation training in reducing anxiety in women with heart disease. 

After the intervention, in MBSR group:  
Δ State anxiety: The anxiety scores decreased from Mean = 37.88; SD = 10.91 at the beginning of the intervention to Mean = 29.11; SD = 7.37 after the assessment. F (1,16) = 6.79, p < 0.01.  
Δ Sores of Suppress or Control the expression of negative emotions decreased, F (1,16) = 6.26, p < 0.02.  
Δ Improvement in Expressing negative feelings from pre-intervention (mean = 62.11; SD = 4.85) to post-intervention (mean = 57.44; SD = 5.00) scores.
Reactive style of coping: Initial scores decreased from Mean =15.33; SD = 2.34 to Mean=13.77; SD=1.78 when ended the intervention. F (1,16) = 5.52, p < 0.03.

After the intervention, in the MBSR group:

- A borderline significant improved 6MWT (meters: 13.2, 95% CI: -0.02 to 26.4, p = 0.050).
- Heart rate significant lowered (effect size, beats per minute: -2.8, 95% CI: 0.2 to 5.4, p =0.033).

In the intention-to-treat analyses,

Cohen’s d effect sizes showed small, but significant improvement on:

- Heart rate (d = 0.20, 95% CI 0.04 to 0.36)
- Depression (d = 0.17, 95% CI 0.01 to 0.33).

In the As-treated analysis,

Improved significantly, with small effect sizes:

- Exercise capacity (d = 0.19, 95% CI 0.02 to 0.36),
Heart rate (d = 0.20, 95% CI 0.03 to 0.37),
Systolic blood pressure (d = 0.20, 95% CI 0.03 to 0.37) and
Stress (d = 0.21, 95% CI 0.04 to 0.38).

Note: “Δ” means significant results, MBSR = mindfulness based stress reduction, BP = blood pressure, SBP = systolic blood pressure,
SD = standard deviation, ITT = intention to treat, AT = as treated, 6MWT = 6 minutes walking test
<table>
<thead>
<tr>
<th>Synthesized findings</th>
<th>Result outcomes</th>
<th>Statistics</th>
<th>Authors</th>
</tr>
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<tbody>
<tr>
<td>Physiological Health</td>
<td>Decreased Heart Rate</td>
<td>ΔHeart rate significant lowered (effect size, beats per minute: -2.8,</td>
<td>Younge et al</td>
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<td>95% CI: 0.2 to 5.4, p = 0.033).</td>
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<td></td>
<td>Heart rate (d = 0.20, 95% CI 0.04 to 0.36).</td>
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<tr>
<td>Improved Exercise Tolerance</td>
<td>ΔAn improvement of 17.9</td>
<td>An improvement of 17.9 meters on mean 6MWT at 12 months in</td>
<td>Gorink et al</td>
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<td>meters on mean 6MWT</td>
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<td></td>
<td>95% CI: -0.02 to 26.4, p = 0.050).</td>
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</table>

*In the As-treated analysis,*
Improved significantly, with small effect sizes: Exercise capacity (d = 0.19, 95% CI 0.02 to 0.36)

After the intervention, in the MBSR group:

Significant main effects between groups for Ventilation \[F(2,32) = 7.65, p < 0.01, f = 0.8\]. And for Breathing Frequency between-group \[F(1,16) = 8.84, p < 0.01, f = 0.8\] and time \[F(2,32) = 10.42, p < 0.01, f = 0.9\].

Decreased Systolic Blood Pressure

In the secondary outcome: within MBSR group from pre- to post-intervention.

A small but significant decrease of 1.8 ± 6.9 mmHg for 24-hour Systolic Blood Pressure (p = 0.01).

A small but significant decrease of 2.1 ± 7.1 mmHg for Awake Systolic Blood Pressure (p = 0.01).
Female subjects’ 24 hours systolic BP decreased by 1.8 ± 6.0 mm Hg, while increased in male subjects by 1.9 ± 8.3 mm Hg (p = 0.02).

Systolic Blood Pressure (d = 0.19, 95% CI 0.03 to 0.36).

In the AT analyses,

Systolic Blood Pressure decreased significantly with 5.5 mmHg (p = 0.045) compared to UC.

Systolic Blood Pressure (d = 0.23, 95% CI 0.05 to 0.41).

Systolic Blood Pressure: Auscultatory BP decreased from 134.16 mmHg to 118.33 mmHg: F = 12.84, p < 0.001; AOBP decreased from 130.16 mmHg to 113.88 mmHg: F = 18.32, p < 0.001).

Systolic Blood Pressure (d = 0.20, 95% CI 0.03 to 0.37)
<table>
<thead>
<tr>
<th>Psychosocial Health</th>
<th>Decreased Depression</th>
<th>Δ Depression (d = 0.18, 95% CI 0.02 to 0.35) compared to UC.</th>
<th>Gotink et al</th>
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<td>Δ Depression (d = 0.17, 95% CI 0.01 to 0.33).</td>
<td>Younge et al</td>
</tr>
<tr>
<td>Decreased Anxiety</td>
<td>State anxiety: The anxiety scores decreased from Mean =37.88; SD = 10.91 at the beginning of the intervention to Mean = 29.11; SD = 7.37 after the assessment. F (1,16) = 6.79, p &lt; 0.01.</td>
<td>Tacón et al</td>
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<tr>
<td>Decreased Stress</td>
<td>Perceived stress: the scores in the MBSR group decreased from 30.25 to 16.74, for control group from 37.50 to 33.46. (F = 107.62, p &lt; .001).</td>
<td>Momeni et al</td>
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<td>Δ <strong>In the As-treated analysis</strong>, Stress (d = 0.21, 95% CI 0.04 to 0.38).</td>
<td>Younge et al</td>
<td></td>
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<tr>
<td>Decreased Anger</td>
<td>State-Trait Anger Expression Inventory, scores of all domains in the experimental group decreased more than control group. The greatest and the lowest pretest-posttest difference was the “feel like expressing anger physically” (F = 166.33, p &lt; .001) and the “anger expression” domains (F = 11.47, p &lt; .001).</td>
<td>Momeni et al</td>
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<tr>
<td>Enhanced Expression of Negative feeling</td>
<td>( \Delta ) Sores of Suppress or Control the expression of negative emotions decreased, ( F(1,16) = 6.26, p &lt; 0.02 ). Tacón et al</td>
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<td></td>
<td>( \Delta ) Improvement in Expressing negative feelings from pre-intervention (mean = 62.11; SD = 4.85) to post-intervention (mean = 57.44; SD = 5.00) scores.</td>
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<tr>
<td>Coping style</td>
<td>( \Delta ) Reactive style of coping: Initial scores decreased from Mean = 15.33; SD = 2.34 to Mean = 13.77; SD = 1.78 when ended the intervention. ( F(1,16) = 5.52, p &lt; 0.03 ). Tacón et al</td>
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<tr>
<td>Mental functioning</td>
<td>( \Delta ) Mental functioning (( d = 0.22 ), 95% CI 0.05 to 0.38). Gotink et al</td>
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</table>

**Note:** “\( \Delta \)” means significant results. MBSR = mindfulness based stress reduction, 6 MWT = 6 minutes walking test, BP = blood pressure, UC = usual care, SD = standard deviation.
4. Discussion

4.1 Main results

Six RCTs articles from 2002 to 2017 examining effects of mindfulness-based stress reduction on heart disease or hypertension generated beneficial outcomes on physical and psychosocial health after comparing two treatment arms. As for physical health, this descriptive literature review reported significant results on declined heart rate, improved exercise tolerance and decreased systolic blood pressure across different clinical populations. The beneficial psychosocial health aspects also were observed within patients with heart disease, which consisted of decreased depression, anxiety, stress and anger, enhanced expression of negative feeling and coping style as well.

4.2 Results discussion

Theses results about physical and psychosocial health aspects synthesized across six RCTs were aligned with findings from other reviews. Abbott et al. (2014) reported effectiveness of MBSR and MBCT in patients with vascular disease including heart disease, hypertension and diabetes. In that systematic review, 578 participants took part in randomized control trials and finally the meta-analyses showed reduction in blood pressure, stress (−0.36; 95% CI −0.67 to −0.09; p = 0.01), depression (−0.35; 95% CI −0.53 to −0.16; p = 0.003) and anxiety (−0.50; 95% CI −0.70 to −0.29; p = 0.001).

Likewise, Younge, Gotink, Baena, Roos-Hesselink and Hunink (2015b) conducted a systematic review and meta-analysis about mind-body practices for patients with cardiac disease, which revealed effect sizes 0.48 (95% CI 0.27 - 0.69) for systolic blood pressure and 0.36 (95% CI 0.15 - 0.57) for diastolic blood pressure, 0.61 (95% CI 0.23 - 0.99) for depression, 0.52 (95% CI 0.26 - 0.78) for anxiety. Sharma and Rush (2014) collected studies to assess whether MBSR can be an efficacious way to decrease stress in healthy individual and they reported positive results.

Heart rate

Different effects of MBSR on heart rate (HR) were observed in our review. In this review, two trials reported HR, one was Younge et al. (2015a) who stated a positive influence on decreased heart rate in treatment group. However, Gotink et al. (2017) observed a small effects size (-0.04; 95% CI -0.21 to 0.13) using ITT analyses and thus the authors thought no significant difference from usual care group, although the heart rate level decreased in
both two groups over time. These varied phenomena maybe result from different time, dose and frequency of intervention. As the former, the intervention lasted 8 weeks whereas the later maintained one year, thus it gave suggestion for future researchers to investigate whether the benefits of intervention relate to time. However, a pilot study by Owen et al. (2016) evaluating MBSR for treatment palpitation demonstrated a significant reduction in palpitation in treatment group after 8 weeks. In addition, a previous review also mentioned mind - body practice could generate an overall small effect for HR of d = 0.15; 95% CI -0.08 - 0.39 (Younge et al., 2015b).

**Blood pressure**

Our review presented that blood pressure decreased in participants who suffered from hypertension and heart disease, but the beneficial effects were for systolic blood pressure although both SBP and DBP were tested during intervention. There was no statistic difference on DBP when compared two groups. Conversely, some previous studies and reviews confirmed that both SBP and DBP decreased in MBSR group. Abbott et al. (2014) summarizing previous studies about the effects of MBSR in blood pressure showed a moderate effect on reduction of SBP and DBP. Palta et al. (2012) observed absolute changes in systolic and diastolic blood pressures in a particular population - low income African - American who had hypertension or at risk of it. Average SBP decreased 21.92 mmHg, p = 0.02 and for average DBP 16.70 mmHg, p = 0.003 in terms of intragroup comparison from baseline to post-intervention (Palta et al., 2012). Hughes et al. (2013) undertook a RCT about mindfulness-based stress reduction for prehypertension (SBP 120–139 mm Hg or DBP 80–89 mm Hg), and the outcome was that MBSR generated substantial and statistically significant reductions in the primary outcomes of clinic SBP and DBP compared with an active control group (progressive muscle relaxation). Although our study was not in accordance with them regarding DBP, our review indicated that MBSR can bring significant change in SBP, which was in accordance with previous studies. The reasons why our results differed with others might be as follows. First, the different objects, our inclusion criteria were participants must be diagnosed with hypertension or heart disease, but studied populations of Palta et al. (2012) and Hughes et al. (2013) were healthy or unhealthy. Second, various intervention ways, as for research of Hughes et al. (2013), they adopt an active control group - progressive muscle relaxation training (PMR), however, the majority of our selected studies used a wait-list control group. Therefore, there is highlight point for other researches in the future who are
interested in the same field to investigate whether MBSR will has more advantages than other psychological intervention.

**Exercise capacity**

A new result found in this review was that MBSR can increase exercise capacity referring to 6MWT, ventilation and breathing frequency. To our knowledge, few published articles mentioned it. Two trials in this review reported 6MWT, and MBSR increased walk distance in participants with heart disease with effect size = 0.22 and 0.19 (Gotink *et al.*, 2017; Younge *et al.*, 2015a). Only one trial stated decreased ventilation and breathing frequency, therefore, perhaps it worthwhile for further researchers to investigate whether MBSR can produce benefits in that.

**Psychological health problems**

As we have mentioned earlier, CVDs are associated with psychological problems and they can influence each other. However, MBSR, as a promising complementary therapy, has been reported to manage negative emotions like stress, anxiety, anger, depression and so on in various populations such as breast cancer, chronic pain, diabetes, kidney disease and even healthy individuals (Haller *et al.*, 2017; Khoo *et al.*, 2019; Park, Lyles & Bauer -Wu, 2014). Similarly, beneficial psychosocial health outcomes was found in our review containing decreased stress, anger, anxiety and depression. Results were consistent with other studies. Khoo *et al.* (2019) compared MBSR with cognitive behavioral therapy in patients who constantly suffer from chronic pain, and found effects of depression (SMD of $-0.49$, $95\%$ CI $-1.89$ to $-0.10$) in favour of MBSR group. Haller *et al.* (2017) assessing effects of MBSR/MBCT in women with breast cancer also confirmed significant outcomes in stress, anxiety and depression. These statistics indicate that MBSR has an impact on adjusting emotion.

All these significant effects indicate that MBSR can be a nursing intervention. Using Neuman’s theory of influencing external environment surrounding the clients, participants receive knowledge about mindfulness, how to implement and exchange information through the homeostasis process. Next, it will alters and restabilize clients’ internal environment such as mood and cognitive reappraisal. Finally, people will expand the normal line of defense and flexible line of defense after learning MBSR because they have gotten ready to receive and adopt stressors, for example, if it is regarded as the primary intervention, it works for healthy individuals, avoiding appearance of
cardiovascular diseases’ complications, which have been demonstrated in review of Sharma and Rush (2014), if as secondary intervention, it can make effects in clinical patients. Furthermore, it keeps balance between health and disease due to the stabilizing process reestablished by the homeostasis, equilibrium process.

4.3 Method discussion - Strengths and Limitations

All selected articles in this review were from authorized search databases and the section of results were presented objectively. Besides, all articles are randomized clinical trials and analyzed by standard methodological analysis. Furthermore, the final outcomes were discussed by two authors until achieving agreement. Therefore, this review has relatively high quality and at low risk of bias.

As for limitations, firstly, the biggest shortcoming is the number of studies. This review only collected six studies about the effectiveness of MBSR on targeted populations and we restricted to specific participants - hypertension and general heart disease, specific intervention - MBSR and specific language - English. Meanwhile, MBSR as a promising adjunct intervention is being advised and advocated to apply to practice, additionally it is still in the stage of development and there are not sufficient experiments to explore the effects on hypertension and heart diseases. Thus, all of these may result in difficulty in accumulating academic articles. Secondly, relatively low generalizability. Small number of studies is a factor. In addition, our review only explored patients with hypertension and common heart disease but other kind of CVDs and healthy persons didn’t involve. In other words, whether MBSR also works in different diseases or other population our study can’t reach it. Thirdly, there were two particular trials only investigating the relationship between MBSR and female. However, we didn’t analyze them separate from the rest of four studies. Fourthly, gender differences were mentioned only in two trials in selected articles. Nevertheless, it was neither as primary outcomes nor secondary outcomes in studies instead it was observed when analyzing and comparing two treatment arms. Perhaps further study can explore whether gender difference are associated with MBSR.

4.4 Clinical implications for nursing

Substantial research have reported that the onset and development of cardiovascular diseases are linked with psychological health. Therefore, emotion problem or inner environment is equally crucial when it comes to treat disease. Our review and other studies have demonstrated the beneficial effect of MBSR on physical and psychological health outcomes in patients with CVDs (Abbott et al., 2014; Freedenberg et al., 2017; .
And, it is advocated to assist treatment in various clinical populations, recently (Abbott et al., 2014; Klainin-Yobasa et al., 2016). The strength of MBSR is that it is not difficult to learn and convenient for participants. Once they have learned, it can be performed in own home, online even by telephone. Health care providers can integrate it into nursing practice, conducting and training their clients how to cultivate mindfulness through teaching some basic skills like body scan exercise, sitting meditation, yoga exercise, reappraisal and so on and encourage them to persist in order to achieve long term effects.

4.5 Suggestions for future research

Future studies are advised to design long-term follow up, because most trials included in our review maintain 8 weeks. Some studies report that the time course of intervention maybe generate difference in outcomes (Younge et al., 2015b; Owen et al., 2016). Furthermore, studies in the future should consider to provide an active control group to investigate whether mindfulness itself is more advantaged compared others. In addition, it is not clear from previous studies regarding sex difference response to MBSR.

5. Conclusion

This review indicates that MBSR intervention generate beneficial effects on physical and psychological health in patients with hypertension or heart disease, supporting its position in clinical treatment as a complementary psychotherapy.
6. References


on Clinical Cardiology (Subcommittee on Exercise, Cardiac Rehabilitation, and Prevention) and the Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity), in collaboration with the American Association of Cardiovascular and Pulmonary Rehabilitation. *Circulation, III*, 369–376.


doi:10.1007/s12160-008-9030-2


doi:10.1007/s11524-011-9654-6


7. Appendix

7.1. Appendix. Aim and results of articles

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Aim</th>
<th>Results</th>
</tr>
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</table>
| Blom (2014)  | To determine whether an 8-week MBSR therapy program could lower ambulatory BP among untreated participants with stage 1 hypertension | **Before the intervention:**
|              |                                                                      | No significant baseline differences between the treatment arms. |
|              |                                                                      | The mean baseline 24-hour ambulatory blood pressure (BP) was 35 ± 7.9/82 ± 5.8 mmHg; mean awake ambulatory BP was 140 ± 7.7/87 ± 6.3 mm Hg; and mean nighttime ambulatory BP was 122 ± 11.1/71 ± 7.4 mmHg. |
|              |                                                                      | **After the intervention**
|              |                                                                      | *In the primary outcome,* |
|              |                                                                      | No significant differences in the changes in 24-hour ambulatory BP from baseline to 12 weeks between MBSR group (−0.4 ± 6.7/0.0 ± 4.8 mmHg) and wait-list group (−0.4 ± 7.8/−0.4 ± 4.6 mm Hg). |
|              |                                                                      | No significant difference between groups in the changes in awake (MBSR group:−0.9 ± 7.0/−0.3 ± 5.3 mmHg, wait-list group: −0.5 ± 7.6/−0.7 ± 4.9 mmHg and nighttime ambulatory BP (MBSR |
group: 0.7 ± 8.7/0.8 ± 5.1 mmHg, wait-list group: −0.08 ± 12.2/−0.1 ± 7.5 mmHg) from baseline to 12 weeks.

**In the secondary outcome:**

△A small but significant decrease of 1.8 ± 6.9 mm Hg for 24-hour systolic BP (p = 0.01) and 2.1 ± 7.1 mmHg for awake systolic BP (p = 0.01) from pre- to post-intervention.

No achieved statistical significance was found in the persistence of effect 12 weeks (from baseline to study close):(24-hour BP: -1.4 ± 8.3/−0.6 ± 5.0 mmHg, p = 0.15/0.29; Awake BP: −1.8 ± 8.1–1.2 ± 4.9 mmHg, p = 0.07/0.05; Nighttime BP: -0.9 ± 11.9/0.2 ± 7.5 mmHg, p = 0.52/0.78).

**Exploratory outcome:** No significant correlations between or within groups for all ambulatory BP parameters were found when it comes to minutes of MBSR homework completed or number of MBSR classes attended and change in ambulatory BP.

△Analyses of sex/gender effects showed an interaction for the significant within-group finding: In female subjects’ 24 hours systolic BP decreased by 1.8 ± 6.0 mmHg, while increased in male subjects by 1.9 ± 8.3 mmHg (p = 0.02).
To reported the direct 3-month results of an online modified mindfulness-based stress reduction training in patients with heart disease, and evaluate the effect at 12-month follow-up.

**Before the intervention:**

No significant differences were found between the groups at follow-up about demographic and clinical variables.

**After the intervention: In the ITT analyses,**

△ An appear improvement of 17.9 meters on mean 6MWT at 12 months in Mindfulness Group, which was not statistically significant compared to UC (p = 0.055).

No significantly difference between two groups on other physiological parameters (Heart rate, systolic and diastolic blood pressure, and hair cortisol level) decreased in treatment group,

Heart rate decreased from 68 to 67 (p = 0.897);

Systolic and Diastolic Blood Pressure decreased from 127.5 mmHg to 123.8 mmHg (p = 0.085), 78 mmHg to 77 mmHg (p = 0.240), respectively;

Hair cortisol level decreased from 35.8 to 35.0 (p = 0.902);

While in control group, Heart rate decreased from 69 to 68; SBP was the same compared with pre-intervention and DBP decreased from 79.7 to 77.1 mmHg; hair cortisol level decreased from
40.2 to 30.0.

No significant differences between the groups on Psychological outcomes. Although scores of Anxiety, Depression and Stress decreased stronger in the mindfulness group (Anxiety from 8.2 to 7.5, depression from 3.8 to 3.3 and stress levels from 22.4 to 20.2) than in UC (Anxiety from 9.0 to 7.6, Depression scores was the same and stress level from 22.0 to 21.1), not statistically significantly because their $P$ values were 0.156, 0.143 and 0.189.

$\Delta$ Cohen's $d$ represented significant improvements on the 6MWT ($d = 0.22$, 95% CI 0.05 to 0.39), Systolic blood pressure ($d = 0.19$, 95% CI 0.03 to 0.36), Mental functioning ($d = 0.22$, 95% CI 0.05 to 0.38) and Depression ($d = 0.18$, 95% CI 0.02 to 0.35) compared to UC. And all other outcomes showed no significant differences.

In the AT analyses,

$\Delta$ Systolic blood pressure decreased significantly with 5.5 mmHg ($p = 0.045$) compared to UC. The other outcomes were similar to the ITT analysis.

$\Delta$ Cohen’s $d$ showed similar outcomes compared to AT analyses on 6MWT ($d = 0.17$, 95% CI 0.00 to 0.34), Systolic blood pressure ($d = 0.23$, 95% CI 0.05 to 0.41), Mental function ($d = 0.18$, 95% CI 0.01 to 0.43).
95% CI 0.01 to 0.35) and Depression (d = 0.25, 95% CI 0.08 to 0.42).

Women (β = 0.86, p = 0.045), and with a higher diastolic blood pressure (β = 0.04 mmHg, p = 0.031) are more often compliant. When compliant to the online training, men (β = -23.1, p = 0.015) with a lower BMI (β = -2.1 kg/m, p = 0.048) improve more on the 6MWT. Also having higher stress levels (PSS β = 2.6, p = 0.007) and experiencing little mental hindrances (MCS β = 1.7, p = 0.011) are associated with a better effect of the training on the 6MWT.

Momeni (2016) Assessing the effects of mindfulness-based stress reduction (MBSR) on cardiac patients’ blood pressure (BP), perceived stress, and anger

**Before the intervention,**

No significant differences between the study groups concerning patients’ demographic characteristics (such as gender, age, educational status, and the type of cardiac problem), the scores of the STAXI-2 and its domains and DBP, and SBP.

The baseline values of perceived stress was statistically significant between two groups (MBSR 30.25 and Control 37.50, p = .001).

**After the intervention,**

SBP was statistically significant in the MBSR group (auscultatory BP from 134.16 mmHg to
118.33 mmHg: F = 12.84, p < 0.001; AOBP from 130.16 mmHg to 113.88 mmHg: F = 18.32, p < 0.001;

No significant difference between the groups toward DBP (Auscultatory BP from 81.66 mmHg to 80.00 mmHg: F = 3.65, p = 0.061; AOBP from 78.00 mmHg to 75.74 mmHg: F = 1.88, p = 0.17).

△ Patients’ Perceived stress had a significant difference between the groups: In MBSR, the scores from 30.25 to 16.74, for control group from 37.50 to 33.46 (F=107.62, p < .001).

△ In MBSR, scores of all domains of State-Trait Anger Expression inventory more decreased than control group, though both groups’ scores decreased:

<table>
<thead>
<tr>
<th></th>
<th>In MBSR:</th>
<th>In Control group:</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Anger</td>
<td>24.33 to 14.37;</td>
<td>27.13 to 28.03</td>
</tr>
<tr>
<td>Feeling angry</td>
<td>9.73 to 4.33</td>
<td>9.36 to 8.66</td>
</tr>
<tr>
<td>Feel like expressing anger</td>
<td>9.40 to 5.51</td>
<td>9.26 to 10.10</td>
</tr>
<tr>
<td>Feel like expressing anger physically</td>
<td>8.20 to 4.51</td>
<td>8.50 to 9.26 (F = 166.33)</td>
</tr>
<tr>
<td>Trait anger</td>
<td>25.43 to 17.44</td>
<td>26.73 to 26.3</td>
</tr>
<tr>
<td>Angry temperament</td>
<td>10.20 to 7.29</td>
<td>10.26 to 11.20</td>
</tr>
</tbody>
</table>
Angry reaction 10.86 to 7.22 11.63 to 10.43
Anger expression-out 18.66 to 14.62 17.60 to 17.50
Anger expression-in 17.60 to 14.85 18.36 to 17.80 (F = 11.47)
Anger control-out 18.10 to 25.92 16.93 to 17.73
Anger control-in 17.36 to 23.88 16.63 to 15.80
Anger Expression Index 48.80 to 27.66 50.40 to 49.76

Besides, the greatest and the lowest pretest-posttest difference was respectively related to the “feel like expressing anger physically” (F = 166.33, p < .001) and the “anger expression” domains (F=11.47, p < .001).

No significant correlation between the amount of time spent on performing mindfulness homework and the patients’ BP, perceived stress, and anger (p < .127).

**Before the intervention,**

No significant differences between groups for any of the descriptive measurements except for Age, $t(16) = 2.55, p < 0.05$.

**After the intervention,**

No significant main effects or interaction for the resting levels of stress hormones: (Catecholamine levels $F = 0.07, f = 0.07, \text{power} = 0.09$; Resting cortisol levels, $F = 1.99, f = 0.35, \text{power} = 0.57$) or physical function ($F = 1.94, f = 0.34, \text{power} = 0.57$). Whereas, there was a decreased tendency in the resting levels of cortisol in the intervention groups while the control group had no change.

No significant interactions for the other submaximal exercise responses: oxygen consumption $F = 0.45, f = 0.16, \text{power} = 0.14$; heart rate: $F = 0.17, f = 0.10, \text{power} = 0.09$;

$\triangle$ An improvement on breathing pattern.

$\triangle$ Significant main effects between groups for ventilation $[F(2,32) = 7.65, p < 0.01, f = 0.8]$, and for breathing frequency between-group $[F(1,16) = 8.84, p < 0.01, f = 0.8]$ and time $[F(2,32) = 10.42, p < 0.01, f = 0.9]$. 
Before the intervention

No significant differences about participants’ demographic variables like age, group status, religion, ethnicity, marital, work status, education, anxiety, emotional control, health locus of control, or coping styles.

After the intervention

State anxiety had significant effect $F(1,16) = 6.79, p < 0.01$. The anxiety scores at the beginning of the intervention in the MBSR group (mean = 37.88; SD = 10.91) were significantly lower after assessment (mean = 29.11; SD = 7.37).

A little change was observed in the control group about anxiety scores, before intervention (mean = 43.22; SD = 12.26) and after intervention (mean = 43.55; SD = 13.29).

Scores of suppress or control the expression of negative emotions also decreased, $F(1,16) = 6.26, p < 0.02$. Participants in the mindfulness program showed an improvement in expressing negative feelings from pre-intervention (mean = 62.11; SD = 4.85) to post-intervention (mean = 57.44; SD = 5.00) scores.

A little change in scores from assessment at first (mean = 53.77; SD = 4.46) to 8 weeks later (mean = 55.55; SD = 6.04) in control group.
In coping item, reactive style of coping showed an important significance, $F(1, 16) = 5.52, p < 0.03$. Initial scores in the MBSR group (mean = 15.33; SD = 2.34) brought a statistically significant decrease when ended the intervention (mean = 13.77; SD = 1.78) in the use of an impulsive, reactive coping style.

Scores for women who in the control group showed a slight increase from initial (mean = 14.11; SD = 5.34) to after assessment (mean = 16.22; SD = 3.86).

No significant group mean differences in scores on the reflective or suppressive coping style before and after intervention.

No significant differences was yielded in Health locus of control including internal health locus, powerful others locus, and chance locus of control.

**Before the intervention,**

No significant differences about patients’ baseline characteristics such as age ($p = 0.98$), gender ($p = 0.28$), systolic and diastolic blood pressure and so on between intervention and control group.
training in patients with heart disease

**After the intervention,**

A borderline significant improved 6MWT in mindfulness group when at the 12th week (effect size, meters: 13.2, 95% CI: -0.02 to 26.4, p = 0.050).

A significant lower heart rate in the mindfulness group at the 12th week (effect size, beats per minute: -2.8, 95% CI: 0.2 to 5.4, p = 0.033).

No significant differences between the groups on the PCS (effect size, -0.4, 95% CI: -2.0 to 1.3, p = 0.668) and MCS (effect size, 0.74, 95% CI: -1.4 to 2.8, p = 0.489) of the SF-36.

No significant differences were found in the intergroup comparison in the 12 weeks, although the following parameters all decreased in two groups:

Mean Systolic (effect size, intergroup, -2.2, 95% CI: -1.6 to 1.7, p = 0.268)
Mean Diastolic blood pressure (effect size, intergroup, 1.6, 95% CI: -0.8 to 4.0, p = 0.186),
Anxiety levels (effect size, intergroup, 0.6, 95% CI: -0.2 to 1.4, p = 0.145),
Depressive symptoms (effect size, intergroup, -0.4, 95% CI: -1.1 to 0.2, p = 0.203), Perceived stress scores (effect size, intragroup, -2.4, intergroup, -1.0, 95% CI: -2.7 to 0.6, p = 0.226), Perceived social support(effect size, intragroup, 0.6, intergroup, 0.4, 95% CI: -1.6 to 2.4, p = 0.685).

**In the intention-to-treat analyses,**
Cohen’s d effect sizes showed small, but significant improvement on heart rate (d = 0.20, 95% CI 0.04 to 0.36) and depression (d = 0.17, 95% CI 0.01 to 0.33). In the As-treated analysis, improved significantly, with small effect sizes: Exercise capacity (d = 0.19, 95% CI 0.02 to 0.36), heart rate (d = 0.20, 95% CI 0.03 to 0.37), systolic blood pressure (d = 0.20, 95% CI 0.03 to 0.37) and stress (d = 0.21, 95% CI 0.04 to 0.38).

Note: “Δ” means significant results. MBSR = mindfulness based stress reduction, BP = blood pressure, SBP = systolic blood pressure, DBP = dilated blood pressure, ITT = intention - to - treat, AT = as - treated, UC = usual care, 6MWT = 6 minutes walking test, BMI = body mass index, PSS = Dutch version of the Perceived Stress Scale, MCS = mental component summary measure, STAXI - 2 = the Spielberger’s State - Trait Anger Expression Inventory, SD = standard deviation, PCS = physical component summary measure, SF - 36 = Short - Form Health survey 36.