Patrícia Nyrönen

THE THERAPEUTIC EFFECTIVENESS OF MINDFULNESS-BASED STRESS REDUCTION PROGRAM ON THE CARDIOPULMONARY SYSTEMS: A SYSTEMATIC LITERATURE REVIEW

Degree Programme in Physiotherapy
2016

Satakunnan ammattikorkeakoulu
Satakunta University of Applied Sciences

THE THERAPEUTIC EFFECTIVENESS OF MINDFULNESS-BASED STRESS REDUCTION PROGRAM ON THE CARDIOPULMONARY SYSTEMS: A SYSTEMATIC LITERATURE REVIEW

Nyrönen, Patrícia
Satakunnan ammattikorkeakoulu, Satakunta University of Applied Sciences
Degree Programme in Physiotherapy
March 2016
Supervisor: Törne, Mari
Number of pages: 34
Appendices: 0

Keywords: physiology, cardiopulmonary, cardiovascular, respiratory, vascular, pulmonary, and circulatory

---

The purpose of this thesis was to investigate the therapeutic effectiveness of mindfulness-based stress reduction program on the cardiopulmonary systems. This was done by gathering and systematically reviewing research studies about the physiological effects of mindfulness-based stress reduction program on the cardiopulmonary systems. Additionally, this thesis includes superficial background information about the cardiopulmonary systems and mindfulness-based stress reduction program before going in depth on the systematic literature review.

The question and answer of this systematic literature review was designed using the PICO framework. The searching process was carried out in PubMed, ScienceDirect and EBSCO Academic Search Elite databases via the Satakunta Ammattikorkeakoulu online libraries. Research studies used were from the years 2006-2016. Quality of the research studies was assessed using to the PEDro scale for a score of $\geq$ 6/11 to be eligible for the systematic literature review. As a result, 4 research studies were selected and included in this systematic literature review. The selected research studies show that the mindfulness-based stress reduction program is an effective therapeutic tool on the cardiopulmonary system e.g. reducing inflammation, reducing blood pressure and strengthening the immune system.

CONTENTS

1 INTRODUCTION

The World Health Organization presents the most updated worldwide statistical analysis about the ten leading causes of death between the years 2000 and 2012. According to the World Health Organization, cardiopulmonary diseases accounted for most of the leading deaths in the world. Ischemic heart disease, stroke, chronic obstructive lung disease, lower respiratory infection, trachea bronchus and lung cancers remained the top cause of death through the years of 2000 to 2012 (Figure 1). (Website of the World Health Organization 2016) For this reason, the treatment of cardiopulmonary symptoms should be of primary concern.

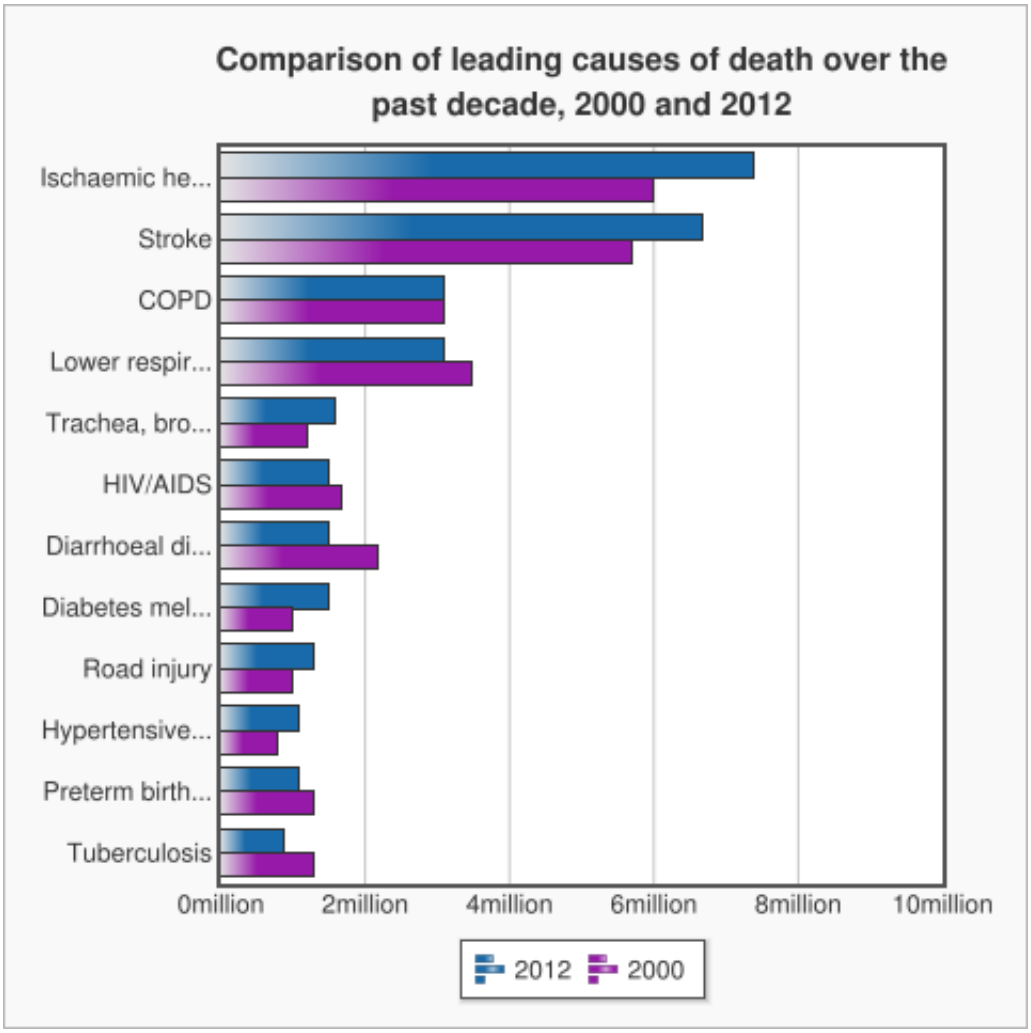

Figure 1 Comparison of leading causes of death over the past decade, 2000 and 2012 (Website of the World Health Organization)

Eastern cultures have used mindfulness to reduce suffering and increase well-being. This therapeutic practice has been adopted and adapted for use in the Western cultures. The adapted and well-researched versions of this therapeutic practice include the mindfulness-based stress reduction program, mindfulness-based cognitive therapy, dialectical behavior therapy and acceptance and commitment therapy. (Baer 2006, 3) This systematic literature review focuses on the use of the mindfulness-based stress reduction program developed by Jon Kabat-Zinn (Fraser 2013, 7).

Research studies have shown that mindfulness has therapeutic effects e.g. increasing awareness, concentration, self-control, relaxation, optimism, acceptance, compassion, memory, critical thinking, creative thinking and problem-solving. It reduces stress, fear, impulsivity, loneliness, depression and insomnia. (Gard, Hölzel & Lazar 2014, 3-10) It increases emotional control and reduces mental fatigue (Abbott, Whear, Rodgers, Bethel, Coon, Kuyken, Stein & Dickens 2014, 341-251). It improves resilience against pain (Chiesa & Serretti 2011, 83-93). Mindfulness has been mostly developed in the west in fields of psychology, cognitive therapy and neuroscience. Mindfulness is a growing interest for application at schools and work places. Interest on the research of the physiological effects is also growing. (Williams & Kabat-Zinn 2013, 2) Randomized control trials show that mindfulness has a positive effect on the cardiopulmonary systems, immune system and sexual function (Brotto, Erskine, Carey, Ehlen, Finlayson, Heywood, McAlpine, Stuart, Thomson & Miller 2012, 320-325).

This systematic literature review goes over a summarized background information on the cardiopulmonary systems and excavates available high-quality evidence of physiological effects by the mindfulness-based stress reduction program on the cardiopulmonary systems. The unearthing of this information will better equip health care professionals for evidence-based rationalization and clinical decision-making.

2 MINDFULNESS

Mindfulness is a state of mind that allows the practitioner to direct attention. Mindfulness is not about forcing the mind not to wander. It is about cultivating awareness of one's thoughts, emotions and senses and about redirecting the point of focus. (Kabat-Zinn, J. & Hanh, T. N. 1990, 20) Mindfulness can be practiced as body scanning, movement meditation, eating meditation and sitting meditation. Body scanning is practiced in any position, usually back lying. Examples of movement meditation include walking meditation, t'ai chi, qi gong and yoga. Types of sitting meditation include open awareness meditation, mindfulness of feelings meditation, mindfulness of breath meditation and mindfulness of sound meditation. There are other ways of practicing mindfulness that are not specified here. (Newman 2016)

2.1 Mindfulness-based stress reduction program

The mindfulness-based stress reduction is an eight-week mindfulness program founded by Jon Kabat-Zinn (Website of the University of Massachusetts Worcester Campus 2014). Once a week, the instructors and participants of the program meet for a group session of mindfulness activities. For the rest of the week, the participants of the program complete their assigned homework. (Baer 2006, 6-12) Table 1 shows the different mindfulness activities done throughout the eight weeks.

Table 1 Mindfulness-based stress reduction program activities

Week	**Mindfulness activity**	
	Session	**Homework**
1	Raisin eating, body scan, group inquiry	Meal eating, body scan, sitting meditation, activities of daily living mindfulness
2	Body scan, sitting meditation, pleasant moment awareness, group inquiry	Body scan, pleasant moment awareness, sitting meditation, activities of daily living mindfulness
3	Hatha yoga, sitting meditation, unpleasant moment awareness, group inquiry	Body scan, hatha yoga, pleasant and unpleasant moment awareness, sitting meditation, activities of daily living mindfulness
4	Sitting meditation, group inquiry	Body scan, hatha yoga, pleasant and unpleasant moment awareness, sitting meditation, activities of daily living mindfulness
5	Sitting meditation, group inquiry	Hatha yoga, pleasant and unpleasant moment awareness, sitting meditation, activities of daily living mindfulness
6	Sitting meditation, group inquiry	Hatha yoga, pleasant and unpleasant moment awareness, sitting meditation
7	Vow of silence, meal eating, body scan, sitting meditation, walking meditation, hatha yoga, group inquiry	Pleasant and unpleasant moment awareness, sitting meditation, activities of daily living mindfulness
8	Body scan, group inquiry	Pleasant and unpleasant moment awareness, sitting meditation, activities of daily living mindfulness

2.2 Activities of mindfulness-based stress reduction program

Raisin and meal eating: for the raisin eating exercise, the instructors give each program participant a raisin and ask them to visually examine it. The participants are instructed to feel the texture and smell the raisin before putting the raisin slowly into their mouths. Then, they observe the sensations and movements of the tongue, jaw and throat in chewing and swallowing the raisin. When thoughts and emotions develop during the exercise, the participants observe them without judgment and return attention to the raisin and instructions. This exercise is done on the group session of week one and as homework for one meal per day for all eight weeks. (Baer 2006, 6)

Body scan: participants sit or lie comfortably with their eyes closed as they are guided to focus their attention of different parts of their bodies. Recording are given to the participants so that they can practice the exercise at home. The duration of this exercise is forty minutes. This exercise is done on the group session of weeks one, two, and eight and as homework for the first four weeks. (Baer 2006, 6)

Sitting meditation: participants sit in a posture that is alert and relaxed. Generally, the back is straight and aligned with the neck and head. The eyes are closed or downward gazing. They observe the sensations and movements of breathing. When the mind wanders, the participants observe the thoughts or emotions without judgment and return attention to the breathing. The object of focus changes from breathing to body sensations, then to the sounds in the environment before the period of choiceless awareness. The duration of this exercise is ten to forty-five minutes. This exercise is done on the group session of weeks two to seven and as homework every week. (Bear 2006, 7-8)

Hatha yoga: hatha yoga is a slow movement exercise done with awareness of sensations and movements of the body and breath. The movements are adjusted to fix the strength and flexibility of the practitioners. This exercise is done on the group session of week three and as homework from weeks three to six. (Baer 2006, 8)

Walking meditation: walking meditation requires conscious slow walking with awareness. Awareness should be focused on sensations and movements of the body and breath. This exercise is done on the group session of week seven. (Baer 2006, 9)

Pleasant and unpleasant moment awareness: participants were given calendar journals that they used to for the pleasant and unpleasant moment awareness exercises. One pleasant or unpleasant moment that happened that day had to be written down. Thoughts, emotions, and sensations related to that moment had to be written down. The pleasant moment awareness exercise is done on the group session of week two and as homework every week. The unpleasant movement awareness exercise is done on the group session of week three and as homework every week. (Bear 2006, 9)

Activities of daily living: participants are instructed to apply mindfulness to their routine activities. Activities of daily living include cleaning the house, washing the dishes, showering, shopping and driving. This exercise is done as homework every week. (Baer 2006, 9)

Vow of silence: the participants vow to be silent. They are also instructed to avoid contact with one another and not to speak. This exercise is done on the group session of week seven. (Baer 2006, 12)

Group inquiry: during the group inquiries, instructors ask the participants to reflect and discuss their experiences with the group sessions and homework. The instructors create a safe space of non-judgement and encourage mindfulness in the discussions. This exercise is done on the group session of every week. (Baer 2006, 9-10)

3 CARDIOPULMONARY SYSTEMS

The organs of the cardiopulmonary systems, heart and lungs, are located within the thoracic cavity and the systems work together to provide oxygen for energy production and remove carbon dioxide waste product. Disease affecting the cardiovascular system has a direct effect on the pulmonary system and vice versa. Other body systems that influence the function of the cardiopulmonary systems include the integumentary, gastrointestinal, endocrine, immune, renal, nervous and musculoskeletal systems. (Hillegass 2011, 96-97) Vital signs are most important signs that indicate the status of the body's life-sustaining functions. There are four primary vital signs and they are all part of the cardiopulmonary systems: body temperature, blood pressure, heart rate, and breathing rate. (Website of Wikimedia Foundation 2016)

3.1 Cardiovascular anatomy and physiology

The cardiovascular system consists of the heart, blood vessels and blood. The heart is the essential organ of the cardiovascular system. The heart is divided into right and left halves. Each half of the heart is made up of a superior and inferior chamber. (Hillegass 2011, 38-80)

The blood vessels are made up of the arteries, arterioles, capillaries, veins, and venules (Tortora & Derrickson 2011, 728-802). The aorta originates from the left ventricle and runs down the spine before dividing and innervating the lower extremities. The subclavian arteries and common carotid arteries originate from the aorta. The subclavian arteries innervate the upper extremities. The common carotid arteries innervate the head. The pulmonary artery originates from the right ventricle and divides into the left and right pulmonary arteries. The right pulmonary artery connects to the right lung and the left pulmonary artery connects to the left lung. The blood vessels are shown on Figure 2. Blood is a bodily fluid mainly composed of plasma, red blood cells, white blood cells and platelets. (Ellen Hillegass 2011, 20)

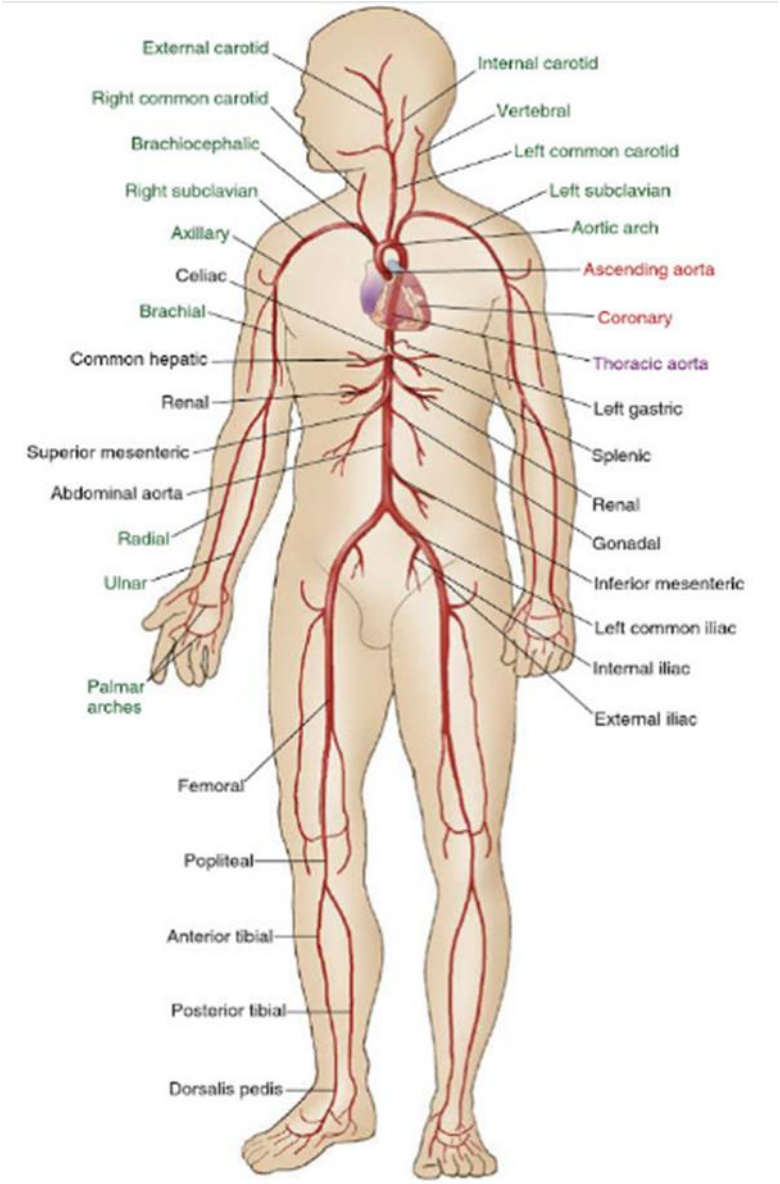

Figure 2 Cardiovascular branches (Hillegass 2011, 21)

The most important functions of the cardiovascular system are the transportation and distribution of substances to the tissues of the body and removal of cellular metabolism waste products. The amount of blood the heart pumps through the cardiovascular system in a minute is known as the cardiac output. On average, cardiac output is 4-6 liters per minute for sufficient tissue perfusion. On average, the heart beats 60-100 beats per minute; known as heart rate. On average, 70 milliliters volume of blood ejected out of the heart per beat; known as stroke volume. (Hillegass 2011, 141-148)

The heart provides blood pressure, the main force that pushes blood through the body. Blood pressure is the pressure of blood moving through the blood vessels. Systolic blood pressure is the maximum pressure of blood mobbing through blood vessels during one heartbeat. Diastolic blood pressure is the minimum pressure of blood moving through blood vessels in between two heart beats. Average resting systolic blood pressure is 120 mmHg and resting diastolic blood pressure is 80 mmHg. Blood pressure is affected by emotions, physical activity and diseases through the autonomic nervous systems and endocrine systems. Movement of the blood is also facilitated the smoothness and contractility of blood vessels, involuntary smooth muscle activation and skeletal muscle compression of veins during exercise and inhalation. Smoothness is reduced by the buildup of fatty deposits. Adequate blood, oxygen and healthy cardiac muscle cells are required for perfusion of a healthy heart. The autonomic nervous system controls unconscious bodily functions including the rate of heart pump. The autonomic nervous system is divided into sympathetic and parasympathetic nervous systems. Sympathetic stimulation, also known as fight-flight responses, increases rate of heart pump and blood flow while parasympathetic stimulation, also known as rest responses, decreases rate of heart pump and blood flow. (Hillegass 2011, 148-170)

Stroke volume is affected by preload, myocardial contractility and afterload.
Preload is the volume of the blood returning to the heart and it is influenced by end-systolic volume and venous return. End-systolic volume is volume of blood in a ventricle at the end of contraction, also known as systole, and beginning of filling, also known as diastole. Myocardial contractility is influenced by the degree of myocardial stretch caused by changes in the end-diastolic volume, sympathetic stimulation and myocardial oxygen supply. Afterload is the pressure in the wall of the left ventricle at the end of blood ejection and it is also the pressure against which the heart must contract to pump blood into the aorta. Afterload is influenced by aortic pressure and aortic valvular function. (Hillegass 2011, 150-156)

3.2 Pulmonary anatomy and physiology

The pulmonary system consists of the lungs, respiratory tracts and respiratory gases (Jardins 2012, 7- 27). The lungs are the essential organs of the pulmonary system. There are two lungs, each on either side of the heart. The right lungs consist of three lobes. The left lung is smaller than the right lung and has two lobes. (Hillegass 2011, 33-38) The upper respiratory tract is made up of the nasal cavity, oral cavity, pharynx and larynx. The nasal cavity opens externally through the nostrils, it is divided left and right by the nasal septum, and blends posteriorly with the pharynx. The oral cavity opens externally though the mouth and blends with the pharynx. The pharynx is a respiratory passage consisted of the nasopharynx, oropharynx, and laryngopharynx. The pharynx connects to the larynx which then connects to the lower respiratory tract. The lower respiratory tract is made up of the trachea which then divides into two sets of bronchi, as well as bronchioles and alveoli that innervate one lung on each side. (Ellen Hillegass 2011, 7-15) The tracheobronchial tree can be seen on Figure 3. Respiratory gases exchanged by the pulmonary system are oxygen and carbon dioxide (Hillegass 2011, 94).

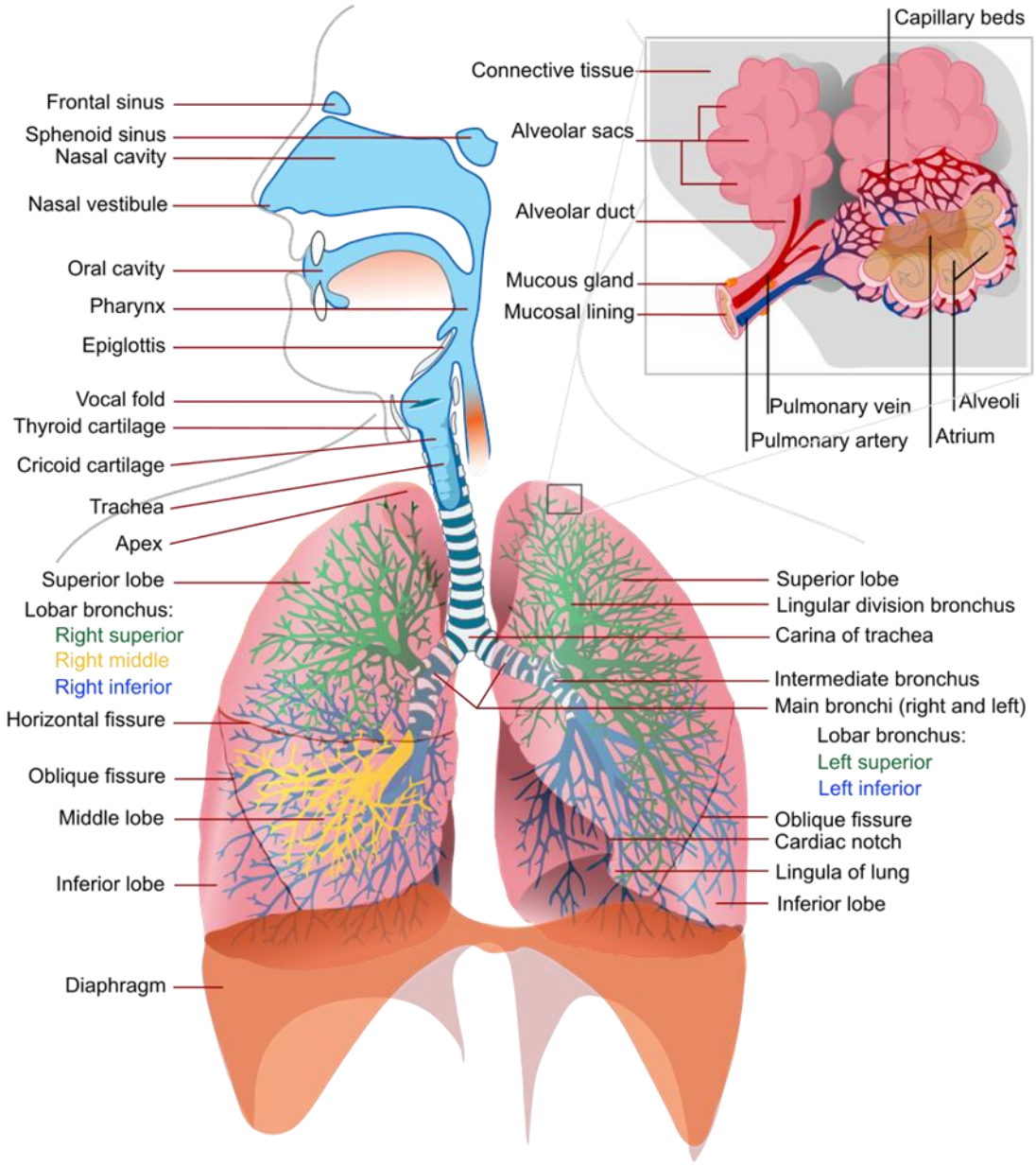

Figure 3 Tracheobronchial tree (Website of TeachMe 2016)

The most important function of the pulmonary system is to exchange oxygen and carbon dioxide between the environment, blood and tissue for energy production. Other functions include regulation of acid base balance, maintaining normal blood pH, temperature homeostasis and filtering and metabolizing toxic substances. These functions are carried out through breathing, gas exchange and transportation of gases in the body. On average, one breathes at a rate of 10-15 breathes per minute; known as ventilation rate. 350-500 milliliters of air if inhaled or exhaled with each breath; known as tidal volume. At rest, one breathes 5 liters per minute; known as minute ventilation. At maximum exercises, 70-120 liters per minute. (Hillegass 2011, 94-140)

Neurons in the brainstem provide control for automatic breathing and ventilation rate and tidal volume for gas exchange. Slow working neurons decreases breathing rate. Conscious breathing involves function of the motor cortex of the frontal lobe. Emotions alter breathing rate through input to the brainstem from the hypothalamus and limbic system; example, hyperventilation caused by anxiety. Chemoreceptors in the brainstem and peripheral arteries sense alterations in blood pH, oxygen and carbon dioxide levels. A decrease in blood pH increases breathing rate. An increase in carbon dioxide increases breathing rate. Irritant receptors in the airways stimulated by noxious gases or matter cause bronchial constriction and increased breathing rate. Stretch receptors in the airways stimulated by increased size and volume cause decreased breathing rate. Juxtapulmonary receptors near pulmonary capillaries stimulated by pulmonary capillary pressure increases breathing rate. Peripheral joint and muscle receptors stimulated by movement increase breathing rate. Weak respiratory muscles decrease breathing rate and contracted respiratory muscles increase breathing rate. Inhalation or relaxation of respiratory muscles increases lung volume and decreases lung pressure. Exhalation or contraction of respiratory muscles decreases lung volume and increases lung pressure. Atmospheric pressure above lung pressure facilitates inhalation and atmospheric pressure below long pressure facilitates exhalation. Elasticity of the lungs facilitates inhalation and elastic tension of the lungs facilitates exhalation. Viscous fluid facilitates the lungs to move smoothly in the chest during inhalation and exhalation. As the elasticity of the lungs facilitates expansion of the lungs and the walls of the thoracic cavity are pulled in, intrapleural pressure increases. This intrapleural pressure is normally lower than the pressure in the lungs during both inhalation and exhalation; this pressure difference is called transmural pressure. Transmural pressure causes the lungs to maintain near the chest wall. Reduced lung elasticity causes decreased inward pull of the lungs, allowing the transmural pressure disturbingly increase lung volume. This makes breathing harder by having accessory muscles overwork. Airflow resistance in the airways is affected by the diameter of the airways, which is influenced by transmural pressure. Transmural pressure is lower than airway pressure at inhalation, which reduces airflow resistance. Increase in parasympathetic nervous system activation constricts airways and increases airflow resistance. Mucus and edema in the airways from inflammation increases airways resistance. (Hillegass 2011, 97-126)

Gas exchange occurs through diffusion. The amount of individual pressure from each gas should be different between the alveoli and the pulmonary capillary to facilitate diffusion. The distribution of gas and blood at the alveolar capillary level must match for optimal gas exchange; an upright position allows for greater blood flow for gas exchange. Fluid accumulation in the lungs hinders gas exchange. Pulmonary constriction by low blood pH hinders gas exchange. (Hillegass 2011, 126-131) Oxygen is transported to peripheral tissue mostly through hemoglobin in red blood cells of the blood but also through blood plasma. Low levels of hemoglobin compromises oxygen transportation. Carbon dioxide is transported out of the body through the blood as a bicarbonate ion, binded to hemoglobin and through blood plasma. Metabolic acids are transported out of the body from the lungs through carbon dioxide, regulating blood pH to 7.4. (Hillegass 2011, 131-41)

4 SYSTEMATIC LITERATURE REVIEW

A literature review is a reproducible method used to find out what has already been studied by reviewing the primary research studies and making it available in more digestible form (Gough, Oliver & Thomas 2012, 1). There are two major branches of literature reviews, narrative and systematic. This literature review is systematic. Unlike the narrative literature review, the systematic literature review explicitly defines its research studies selection to ensure the review is transparent and can be replicated. (Onwuegbuzie & Frels 2016, 23-25)

A systematic literature review is designed to collect, appraise and synthesize the best available evidence relating to a specific research question to provide evidence-based information. The information provided can then be used to make decisions about how to deliver interventions and changes to policy. Systematic literature reviews are considered the best way to synthesize the findings of several research studies investigating the same question. (Boland, Cherry & Dickson 2014, 3)

Systematic literature reviews addressing questions about the effects of health interventions have widely agreed methods for setting the scope, judging the quality of research studies, and presenting the synthesized research studies, often using statistical meta-analysis of the results of randomized controlled trials. (Gough, Oliver & Thomas 2012, 7) Meta-analysis combines the results of multiple research studies statistically. Sometimes meta-analysis is not possible, for example, when there are important differences in the research studies in terms of populations, interventions, results and quality. (Khan, Kunz, Kleijnen & Antes 2011, 57-58) This systematic literature review does not incorporate meta-analysis.

The steps are recommended when doing a systematic literature review beginning with the formulation of a question. Secondly, search for and identify relevant research studies using defined eligibility criteria. Thirdly, apply quality appraisal criteria. Fourthly, summarize the findings. Lastly, interpret the findings. (Gough, Oliver & Thomas 2012, 8)

4.1 Thesis question

The purpose of this thesis was to investigate the therapeutic effectiveness of mindfulness-based stress reduction on the cardiopulmonary systems by a systematic literature review. The question of this systematic literature review is: What are the physiological effects of mindfulness-based stress reduction program on the cardiopulmonary systems?

The PICO framework was used to design the literature question:
P – Who are the relevant participants? Men and women of all races from the adult age group 18+ who are healthy and/or suffer from cardiopulmonary symptoms.
I – What is the intervention in question? Mindfulness-based stress reduction program.
(Optional) C – What intervention the intervention in question will be compared to? Not answered.
O – What I hope to accomplish, measure, or affect? To understand the physiological effects of mindfulness-based stress reduction on the cardiopulmonary systems. This

knowledge will help health care professionals with evidence-based rationalization and clinical decision-making.
(Rubin & Bellamy 2012, 20)

4.2 Database search

The search for research studies was carried out in the PubMed, ScienceDirect and EBSCO Academic Search Elite databases via the Satakunta Ammattikorkeakoulu (SAMK) online libraries on the 25th of October 2016. The research terms, also known as keywords, used were a combination of "mindfulness-based stress reduction" and "physiology*", "cardiopulmonary", "cardiovascular", "respiratory", "vascular", "pulmonary" and "circulatory". Filters added to the search included "published 2006-2016", "randomized controlled trial", and "available full text". As a result, 111 research studies were found. The database search and results are presented on Table 2.

Table 2 Database search results

Keywords		**PubMed SAMK**	**ScienceDirect SAMK**	**EBSCO SAMK**
Mindfulness-based stress reduction	physiology*	11	10	10
	cardiopulmonary	0	1	1
	cardiovascular	1	17	18
	respiratory	2	8	4
	vascular	0	19	2
	pulmonary	4	2	1
	circulatory	0	0	0
Total 111		18	57	36

4.3 Relevance search

111 research studies were found in total. After screening the titles and abstracts, 11 research studies remained. In case of doubt regarding the relevance of the research study after screening the title and abstract, the full version of the research study was screened. During screening of the research studies, the question designed using the PICO framework was referred to. After removing duplicates, 8 research studies were found relevant to the systematic literature review question. The relevance search and results are presented on Figure 4.

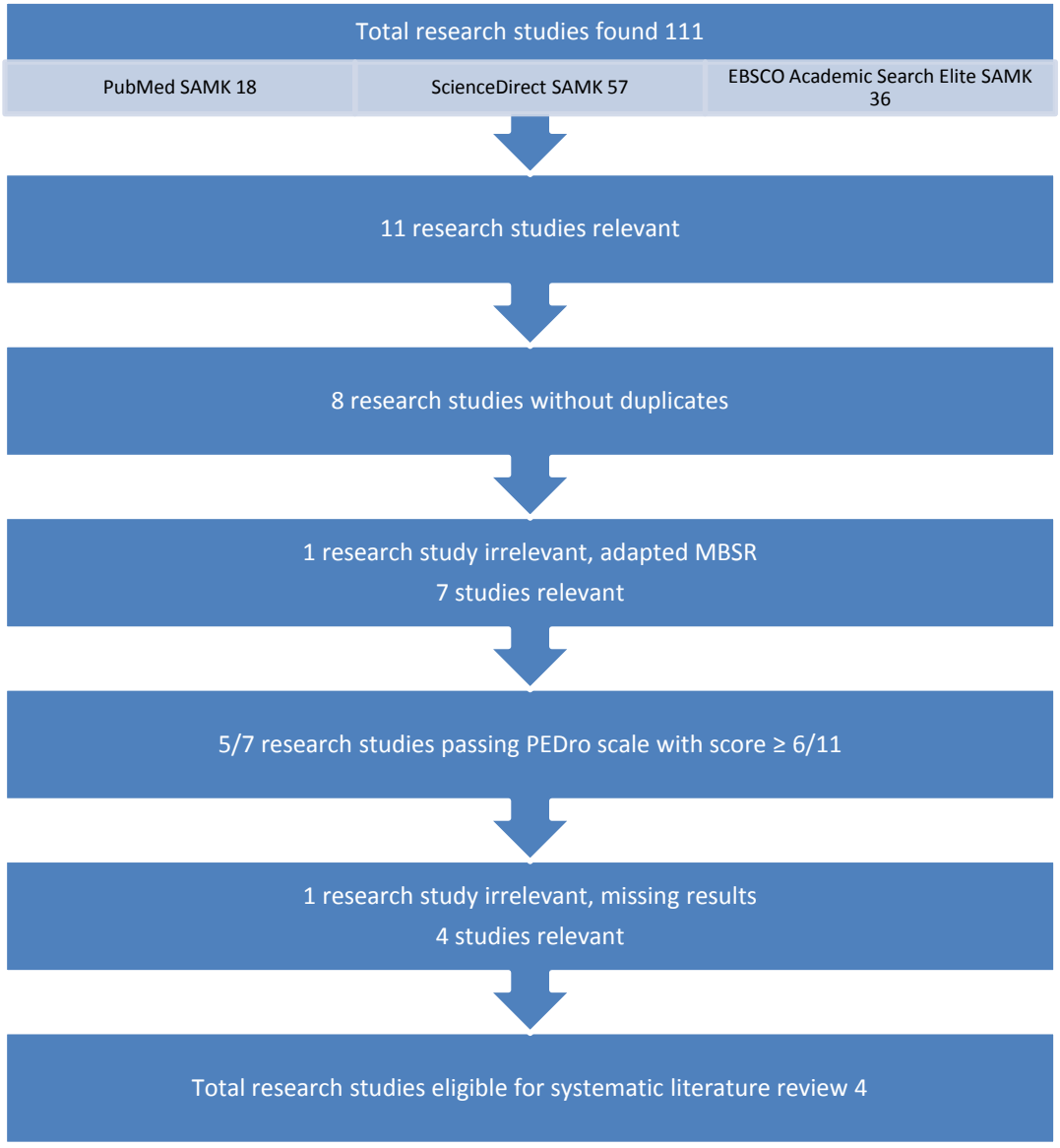

Figure 4 Flow chart of relevance search

4.4 Quality search

The quality of the research studies was assessed using the PEDro scale. The PEDro score is first searched for in the PEDro database. The PEDro score for the research studies without scores in the PEDro database are then calculated. The PEDro scale is commonly used to check the quality of research studies in physiotherapy. The PEDro scale addresses ten questions related to the research study quality. (Gresham 2016, 151) Moderate to high quality research studies scoring ≥ 6/11 were included in this systematic literature review. (Website of the PEDro database 2016) Table 3 presents the research studies that have undergone the PEDro scale assessment.

Table 3 PEDro scale quality search and results

Authors, publication year	**Research study type**	**PEDro scale score from PEDro website**	**PEDro scale score**										
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Sum**
Hayney, Coe, Muller, Obasi, Backonja, Ewers & Barrett 2014, 83-91	Randomized Controlled Trial	none found	×	✓	×	✓	×	×	✓	✓	✓	✓	✓	7/11
Pbert, Madison, Druker, Olendzki, Magner, Reed & Carmody 2012, 769–776	Randomized Controlled Trial	none found	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	8/11

Moynihan, Chapman, Klorman, Krasner, Duberstein, Brown & Talbot 2013, 34-43	Randomized Controlled Trial	none found	✓	×	×	×	×	×	×	✓	✓	✓	✓	5/11
Khan, Agito, Shah, Stetter, Gustafson, Socolow, Kunselman, Reibel & Legro 2015, 287–297	Randomized Controlled Trial	none found	✓	✓	✓	✓	×	×	✓	×	✓	×	×	6/11
Creswell1, Irwin, Burklund, Lieberman, Arevalo, Ma, Breen & Cole 2012, 1095–1101	Randomized Controlled Trial	none found	✓	✓	×	✓	×	×	✓	✓	✓	✓	✓	8/11
Hughes, Fresco, Myerscough, Dulmen, Carlson & Josephson	Randomized Controlled Trial	none found	×	✓	×	✓	×	×	✓	×	✓	✓	✓	7/11

2013, 721-728														
Gallegos, Hoerger, Talbot, Krasner, Knight, Moynihan & Duberstein 2013, 787–792	Randomized Controlled Trial		✓	✓	×	×	×	×	×	✓	×	×	×	3/11

5 RESULTS

Age and psychological influences on immune responses to trivalent inactivated influenza vaccine in the meditation or exercise for preventing acute respiratory infection (MEPARI) trial was made by Hayney, Coe, Muller, Obasi, Backonja, Ewers & Barrett 2014, 83-91. 149 participants completed the research study out of 154; 96.75%. The participants were randomly allocated to one of the research study groups. There was no mention of the blinding of the participants. There was no mention of the source of participants. The inclusion criteria included age of 50 or older, participants not having exercised regularly or engaged in any meditative practice prior to the research study and passing physical and mental health tests SF-12 and PSS-10. The research study was carried with intent to treat. The assessors were blinded. There was no mention of concealed allocation. The three groups were followed for 8 weeks: mindfulness-based stress reduction, exercise training and control groups. The primary result was the increase in influenza antibody concentrations. The secondary results were optimism by the Life Orientation Test, perceived stress by the Perceived Stress Scale and

anxiety by Spielberger's State Trait Anxiety Inventory. Assessments of relevant resultsmwere made at the end of the intervention and two and a half months after. No significant improvement comparison of antibody concentrations was found between the interventions. Interferon-γ, that plays a part in immunity against viruses, bacteria and infections, production at three weeks post vaccine was positively correlated with optimism (p=0.025) and stress reduction (p=0.043). No significant correlations between psychological traits and nasal immunoglobulin A were found. Influenza A virus antibody at three months was positively correlated with optimism (p=0.039).

Effect of Mindfulness Training on Asthma Quality of Life and Lung Function: A Randomized Controlled Trial was made by Pbert, Madi-son, Druker, Olendzki, Magner, Reed & Car-mody 2012, 769–776. 73 participants completed the research study out of 83; 87.95%. The participants' randomization was done using a computer-generated random allocation scheme. There was no mention of the blinding of the participants. The participants were recruited between October 2006 and December 2007 from outpatient primary care and pulmonary care specialty clinics at UMass Memorial Health Care in Worcester, Massachusetts. The inclusion criteria included physician-documented asthma diagnosis with either an objective indicator of bronchial hyper-responsiveness or ≥ 12% improvement in Tiffeneau-Pinelli index in response to inhaled bronchodilator on spirometry conducted at research study entry, meeting 2007 National Heart, Lung, and Blood Institute criteria for mild, moderate or persistent asthma. The exclusion criteria included having intermittent asthma e.g. symptoms less than once a week, brief exacerbations, nocturnal symptoms not more than twice a month and normal lung function between episodes, smoked in the past year, having lung diseases e.g. pulmonary hypertension, cystic fibrosis, chronic obstructive pulmonary disorder-emphysema, bronchiectasis and chronic bronchitis, having a cancer that is not non-melanoma skin cancer, receiving treatment for symptomatic cardiovascular disease e.g. congestive heart failure, unstable angina, myocardial infarction, ever having a positive tuberculosis test, having been hospitalized in a psychiatric hospital in the past two years and having experience with meditation and/or yoga. The research study was carried with intent to treat. There was no mention of the blinding of the assessors. There was no mention of concealed allocation. The two groups were followed for 8 weeks:

mindfulness-based stress reduction and educational control program. The primary results were quality of life assessed by the Asthma Quality of Life Questionnaire and lung function assessed by the change from baseline in two-week average morning peak expiratory flow, peak expiratory flow variability and Tiffeneau-Pinelli index by spirometry. The secondary results were asthma control assessed by 2007 National Heart, Lung, and Blood Institute guidelines and stress assessed by the Perceived Stress Scale. Relevant results included lung function assessed at week ten, month six and month twelve from baseline showed no significant change in two-week average morning peak expiratory flow ($p=0.705$), peak expiratory flow variability ($p=0.966$) and Tiffeneau-Pinelli index by spirometry ($p=0.917$).

Mindfulness-Based Stress Reduction Training Reduces Loneliness and Pro-Inflammatory Gene Expression in Older Adults: A Small Randomized Controlled Trial was made by Creswell1, Irwin, Burklund, Lieberman, Arevalo, Ma, Breen & Cole 2012, 1095–1101. 40 Participants completed the research study out of 40; 100%. The participants' randomization was done using a computer-generated random allocation scheme. There was no mention of the blinding of the participants. The participants were recruited via newspaper advertisements from the Los Angeles area, who indicated an interest in learning mindfulness meditation techniques. The inclusion criteria included age 55-85, speaking English, not currently practicing any mind-body therapies more than once per week e.g. meditation and yoga, being non-smokers, mentally and physically healthy for the last three months and not currently taking medications that affect immune, cardiovascular, endocrine or psychiatric functioning. The exclusion criteria included being left-handed, having non-removable metal or non-MRI safety approved implants, weighing more than three hundred pounds and if they scored < 23 on the Mini-Mental State Examination. The research study was carried with intent to treat. The assessors were blinded. There was no mention of concealed allocation. The two groups were followed for 8 weeks: mindfulness-based stress reduction program and wait-list control. The primary result was loneliness assessed by the UCLA-R Loneliness Scale. The secondary results were mindful skills assessed by the 39-item Kentucky Inventory of Mindfulness Skills test and pro-inflammatory gene expression profiling. Assessment of relevant results were made at the end of the intervention. There was a greater prevalence of pro-inflammatory NF-κB target genes in the set of genes in high-lonely individuals compared to genes in low-lonely individuals

(p=0.017). Genes up-regulated in association with loneliness to originate predominately from monocytes (p=0.003) and to a lesser from B lymphocytes (p=0.046). There was a reduction in pro-inflammation NF-κB target genes in mindfulness-based stress reduction program treated participants compared to wait-list controls (p=0.015). Monocytes were consistently the primary cellular carrier of genes down-regulated in mindfulness-based stress reduction program-treated participants (p=0.021).

Randomized Controlled Trial of Mindfulness-based Stress Reduction for Prehypertension was made by Hughes, Fresco, Myerscough, Dulmen, Carlson & Josephson 2013, numbers. 38 participants completed the research study out of 56; 67.85%. The participants' randomization was done using a computer-generated random allocation scheme and they were stratified by ethnicity and gender status. There was no mention of blinding of the participants. The source of participants was not mentioned. The inclusion criteria included age of 30-60 with unmedicated blood pressure in the prehypertensin range of systolic blood pressure 120-139 mmHg or dystolic blood pressure 80-89 mmHg. The exclusion criteria included taking antihypertensive medication, being experienced with meditation practices and being current smokers. The research study was carried with intent to treat. The assessors were blinded. There was no mention of concealed allocation. Two groups were followed for 8 weeks: mindfulness-based stress reduction program and progressive muscle relaxation training. The primary results were systolic blood pressure and diastolic blood pressure. The secondary results were ambulatory daytime and sleeping systolic blood pressure and diastolic blood pressure. Assessment of relevant results were made at the end of the intervention. Systolic blood pressure of the participants in the mindfulness-based stress reduction program reduced 4.8 mmHg, which was a significant reduction than the 0.7 mmHg reduction for the progressive muscle relaxation training group (p=0.016). Diastolic blood pressure of the participants in the mindfulness-based stress reduction program reduced 1.9 mmHg, which was a significant reduction than the 1.2 mmHg reduction for the progressive muscle relaxation training group (p=0.008). Daytime ambulatory systolic blood pressure in the mindfulness-based stress reduction program reduced 3.1 mm Hg, which was a significant reduction than the 1.5 mmHg reduction for the progressive muscle relaxation training group (p=0.009). Adding treatment condition to the model did not explain additional variance in change in daytime ambulatory (p=0.157). Sleeping ambulatory systolic blood pressure in the mindfulness-based

stress reduction program reduced 2.3 mm Hg, which was a significant reduction than the 0.8 mmHg reduction for the progressive muscle relaxation training group (p=0.043). Adding treatment group to the model did not explain additional variance in sleeping ambulatory (p=0.129). Daytime ambulatory diastolic blood pressure in the mindfulness-based stress reduction program reduced 1.4 mm Hg, which was not a significant reduction than the 2.2 mmHg reduction for the progressive muscle relaxation training group (p=0.476). No additional variance was explained by adding treatment condition to the model (p=0.795). Sleeping ambulatory diastolic blood pressure in the mindfulness-based stress reduction program reduced 1.7 mm Hg, which was not a significant reduction8 than the 0.6 mmHg reduction for the progressive muscle relaxation training group (p=0.286). Adding treatment group explain no additional variance in sleeping ambulatory (p=0.218).

6 CONCLUSION

Based on this systematic literature review, mindfulness is a functioning medical practice. It has therapeutic effects on psychology and physiology e.g. loneliness, pro-inflammatory genes and blood pressure. Health care professionals including physiotherapists can use mindfulness as a tool to treat various ailments including of the cardiopulmonary systems. Additionally, one should be conscious that there might be several research studies left out from this systematic literature review due to the mere factor of human being. Further research in larger properly powered and better designed research studies is warranted.

7 DISCUSSION

This systematic literature review was done by an inexperienced physiotherapy student This may have influenced the quality and reliability of the systematic literature review from topic selection to presentation of found relevant research studies. Mindfulness-

based stress reduction program may be used as a therapeutic tool for health care professionals. Positive points include that this tool is nonpharmacological and cost effective and can be used for psychological and physiological treatment.

These results do not account for all the research information available or all the information that can be interpreted from the results e.g. the effects could have surfaced from the physical activity rather than application of mindfulness. Points to consider when analyzing the results of the four include, the trivalent influenza vaccine from the research study "Age and psychological influences on immune responses to trivalent inactivated influenza vaccine in the meditation or exercise for preventing acute respiratory infection (MEPARI) trial" was used during 2009–2010 and probably very immunogenic. Hence, the results. It is also interesting to consider that mindfulness-based stress reduction program influences the asthma quality of life even though it has no effect on lung function. This is because the intervention effect is largely in emotional function. The findings support the view that stress, while affecting asthma quality of life, may not contribute to impairment in lung function.

To begin, the topic of physiological effects by mindfulness meditation was chosen. After research on the type of research studies that have been made on this topic, I decided to focus on the mindfulness-based stress reduction program because it is one of the mindfulness programs mostly used and studied as therapy in the west. I decided to focus on the physiological effects related to the cardiopulmonary systems because cardiopulmonary physiotherapy it is an important branch of physiotherapy that interests me as much as mindfulness interests me. I decided to focus on both systems instead of only the cardiovascular or pulmonary system because there are not many research studies on the physiological effects of mindfulness-based stress reduction program on either one of the systems. Another reason I focused on the physiological effects of mindfulness on the cardiopulmonary systems is that damage to these systems accounts for leading deaths in the world.

The PICO framework made it easy to formulate the question of the systematic literature review and provided guidance for relevant research study selection. The keywords chosen also provided guidance for relevant research study selection. PubMed, Sci-

enceDirect and EBSCO Academic Search Elite databases were easy to use via the Satakunta Ammattikoreakoulu online libraries. I decided to focus on the research studies from the years 2006-2016 so that updated information from a period of time that is not too short or long would be present in the systematic literature review. Quality of the research studies was assessed using to the PEDro scale for a score of $\geq$ 6/11 to be eligible for the systematic literature review according to the standards of PEDro.

Presenting the summary on the cardiopulmonary systems was challenging because they are complex systems of the body, making it difficult to summarize the physiology. It was also challenging to spot relevant information for presentation on all the physiology of the cardiopulmonary systems that could be potentially affected by mindfulness because I am not an expert on physiology or mindfulness. What also made the spotting of relevant information challenging for relevant research study selection and background information presentation was that the line between different systems to the cardiopulmonary systems is blurry e.g. immune system.

The most time-consuming part of making the systematic literature review included finding relevant research studies by screening the databases with the chosen keywords and systematic literature review PICO-formulated question in mind and using the PEDro scale.

A more detailed systematic literature review could be made on this topic where the background information is presented better by someone who understands the cardiopulmonary systems and physiology of mindfulness better, by using more research databases when finding relevant research studies, having more assessors working on the systematic literature review and by gaining access to research studies that had to be paid for. Further research can be made on the physiological effects of mindfulness-based stress reduction program on other body systems. It would also be interesting to research and compared the physiological effects of different mindfulness techniques from the mindfulness-based stress reduction program on the cardiopulmonary systems.

REFERENCES

Abbott, R. A., Whear, R., Rodgers, L. R, Bethel, A., Coon, J. T. 2014. Effectiveness of mindfulness-based stress reduction and mindfulness based cognitive therapy in vascular disease: a systematic review and meta-analysis of randomised controlled trials. Journal of Psychosomatic Research 76, 341-351.

Baer, R. A. 2006. Mindfulness-based treatment approaches: clinician's guide to evidence base and applications. London: Elsevier Inc.

Boland, A., Cherry, M. G., Dickson, R. 2014. Doing a systematic review: a student's guide. London: SAGE Publications Ltd.

Brotto, L. A., Erskine, Y., Carey, M., Ehlen, T., Finlayson, S., Heywood, M., Kwon, J., McAlpine, J., Stuart, G., Thomson, S. & Miller, D. 2012. A brief mindfulness-based cognitive behavioral intervention improves sexual functioning versus wait-list control in women treated for gynecologic cancer 2, 320-325.

Chiesa, A. & Serretti, A. 2011. Mindfulness-Based Interventions for Chronic Pain: A Systematic Review of the Evidence 1, 83-93.

Creswell1, J. D., Irwin, M. R., Burklund, L. J., Lieberman, M. D., Arevalo, J. M G., Ma, J., Breen, E. C & Cole, S. W. 2012. Mindfulness-Based Stress Reduction Training Reduces Loneliness and Pro-Inflammatory Gene Expression in Older Adults: A Small Randomized Controlled Trial 7, 1095–1101.

Ellen H. 2017. Essentials of cardiopulmonary physical therapy. 4th edition. Missouri: Elsevier Inc.

Fraser, A. 2013. The Healing Power of Meditation: Leading Experts on Buddhism, Psychology, and Medicine Explore the Health Benefits of Contemplative Practice

Gard, T., Hölzel, B. K., Lazar, S. W. 2014. The potential effects of meditation on age-related cognitive decline: a systematic review. Annals of the New York Academy of Sciences 1307, 89–103.

Gough, D., Oliver, S., Thomas, J. 2012. An introduction to systematic reviews. London: SAGE Publications Ltd.

Gresham, B. B. 2016. Concepts of evidence based practice for the physical therapist assistant. Philadelphia: F. A. Davis Company.

Hayney, M. S., Coe, C. L., Muller, D., Obasi, C. N., Backonja, U., Ewers, T. & Barrett, B. 2014. Age and psychological influences on immune responses to trivalent inactivated influenza vaccine in the meditation or exercise for preventing acute respiratory infection (MEPARI) trial 1, 83-91.

Hillegass, E. & Sadowsky, H. S. 2011. Essentials of Cardiopulmonary Physical Therapy. Missouri: Elsevier Saunders.

Hughes, J. W., Fresco, D. M., Myerscough, R., Dulmen, M., Carlson, L. E. & Josephson, R. 2013. Randomized Controlled Trial of Mindfulness-based Stress Reduction for Prehypertension 8, 721-728.

Jardines, T. D. 2012. Cardiopulmonary anatomy & physiology: essentials of respiratory care. New York: Delmar Cengage Learning

Kabat-Zinn, J., Hanh, T. N. 1990. Full catastrophe living: Using the wisdom of your body and mind to face stress, pain and illness. New York: Delacorte

Khan, N. R., Agito, K., Shah, J., Stetter, C. M., GustafsonT. S., Socolow, H., Kunselman, A. R., Reibel, D. K. & Legro, R. S. 2015. Mindfulness-Based Stress Reduction for Overweight/Obese Women With and Without Polycystic Ovary Syndrome: Design and Methods of a Pilot Randomized Controlled Trial 41, 287–297.

Khan, S. K., Kunz, R., Kleijnen, J., Antes, G. 2011. Systematic reviews to support evidence-based medicine, 2nd edition. Boca Raton: CRC Press.

Lengacher, C. A., Reich, R. R., Kip, K. E., Barta, M., Ramesar, S., Paterson, C. L., Moscoso, M. S., Carranza, I., Budhrani, P. H., Kim, S. J., Park, H. Y., Jacobsen,P. B., Schell, M. J., Jim, H. S. L., Post-White, J., Farias, J. R. & Park, J. Y. 2014. Influence of Mindfulness-Based Stress Reduction (MBSR) on Telomerase Activity in Women With Breast Cancer (BC) 4, 438-447.

Moynihan, J. A., Chapman, B. P., Klorman, R., Krasnerc, M. S., Dubersteina, P. R., Brownd, K. W. & Talbot, N. L. 2013. Mindfulness-Based Stress Reduction for Older Adults: Effects on Executive Function, Frontal Alpha Asymmetry and Immune Function 1, 34-43.

Newman, K. M. 2016. How to Choose a Type of Mindfulness Meditation. Referred 2.11.2016. http://greatergood.berkeley.edu/article/item/how_to_choose_a_type_of_mindfulness_meditation

Onwuegbuzie, A. J., Frels R. 2016. Seven steps to a comprehensive literature review: a multimodal and cultural approach. London: SAGE Publications Ltd.

Park, J., Lyles, R. H & Bauer-Wu, S. 2014. Mindfulness meditation lowers muscle sympathetic nerve activity and blood pressure in African-American males with chronic kidney disease 1, 93-101.

Pbert, L., Madison, J. M., Druker, S., Olendzki, N., Magner, R., Reed, G. & Carmody, J. 2012. Effect of Mindfulness Training on Asthma Quality of Life and Lung Function: A Randomized Controlled Trial 9, 769–776.

Tortora, G. J., Derrickson, B. 2011. Principles of anatomy and physiology. 13th edition. New Jersey: JohnWiley & Sons Inc.

Richardson, D. R., Randall, D. C., Speck, D. F. 1998. Cardiopulmonary structure and function. Baltimore: Port City Press.

Rubin, A. R, Bellamy, J. 2012. Practitioner's guide to using research for evidence-based practice. New Jersey: John Wily & Sons Inc.

Website of TeachMe. Referred 20.10.2016. http://teachmeanatomy.info/wp-content/uploads/The-Brochial-Tree.jpg

Website of the PEDro database. Referred 3.3.2016. http://www.pedro.org.au/

Website of Wikimedia. Referred 20.10.2016 https://en.wikipedia.org/wiki/Blood

Website of the World Health Organization. Referred 29.2.2016. http://www.who.int/mediacentre/factsheets/fs310/en/

Williams, J. M. G & Kabat-Zinn, J. 2013. Mindfulness: Diverse Perspectives on its Meaning, Origins and Applications. New York: Routledge Francis & Taylor Group.