

Master thesis (10EC)
Positive Psychology and Technology

The impact of positive psychology interventions that improve gratitude, self-compassion or positive affect on the level of physical activity amongst post-Acute Coronary Syndrome patients

A systematic review

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Abstract

Background: Although the importance to engage in health behaviour, like increasing physical activity, is high, most post-Acute Coronary Syndrome (ACS) patients fail to commit to this beneficial behaviour. Previous research shows promising effects of including positive psychology interventions (PPI's) in order to increase their level physical activity. This systematic review aimed to further explore the effectivity and working mechanism of PPI's that improve gratitude, self-compassion or positive affect which might, in turn, increase the level of physical activity amongst post-ACS patients.

Methods: A systematic literature search using the databases Scopus and PubMed was conducted, by following PRISMA guidelines. Inclusion criteria were 1) the intervention needs to be a PPI focussing on increasing at least one of the mentioned psychological factors (self-compassion, gratitude or positive affect), (2) physical activity needs to be the outcome measure (physical activity in this research is moderate-to-vigorous intense cardiovascular activity (like walking, running or cycling) (3) The research is done amongst post ACS-patients. Five studies met the inclusion and exclusion criteria and were used in this systematic review. All studies were executed in America, written in English and published between 2000-2022. Sample sizes varied from n=47 to n=167. Most patients were aged 45-65 years.

Results: Amongst these five studies, no interventions were found that focus on improving gratitude or self-compassion. All five studies examined the Positive Emotions after Acute Coronary Events (PEACE) intervention, which seems to succeed in improving positive affect and physical activity. In this systematic review, the PEACE is used in different variations. Results of this systematic review show that when PEACE is combined with motivational interviewing, is offered in weekly sessions and provides booster sessions, the level of physical activity is even more increased. An additional, interesting finding in this research was that concerning older versus midlife age, the intervention seems to be most beneficial in midlife age groups (45-64 years).

Conclusion: However, only one study included a control group and two studies used data from existing research for their analysis, so conclusions about the results of this systematic review need to be carefully weighed. Also, a clear investigation about the explicit working mechanism of how the improved positive affect leads to increased physical activity, needs to be executed. A factorial design to identify which positive psychology exercise leads to the highest increase in physical activity could be beneficial, or to focus the positive psychology exercises directly on physical activity. Including control groups is highly recommended.

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1. Introduction

Acute coronary syndrome (ACS), also known as 'heart attack', describes a range of conditions associated with sudden, reduced blood flow to the heart (American Heart Association, 2022). One of the arteries leading to the heart becomes blocked and cuts off the blood flow, with heart attack as a result. Because of the lack of oxygen circulating in the body, the heart muscles start to die. ACS can lead to cardiovascular disease because it weakens the heart's ability to pump blood (Virani et al., 2021).

ACS and the associated cardiovascular disease are the leading cause of death globally, responsible for 17.9 million deaths each year (Virani et al., 2021). The burden of these diseases on patients, caregivers and the health-care system is high in a physical, mental/emotional and financial way. This is shown in morbidity (like hospitalization), mortality, the effect on a patients' health status (like quality of life or mental/emotional/physical well-being) and a patients' financial/economic situation (Toth & Gautier, 2021). To prevent post-ACS patients of developing a chronic cardiovascular disease, importance lies on the development of an effective treatment of ACS.

The American Heart Association (2021) found seven key health factors that are associated with the risk of heart disease and (recurrence of) heart attacks. These 'Life's Simple 7' are: 1) not-smoking, 2) physical activity, 3) healthy diet, 4) body weight, 5) control of cholesterol, 6) blood pressure and 7) blood sugar. Engagement in beneficial health behaviours related to these factors can prevent or reverse many chronic conditions (van Cappellen et al., 2018). For example, post-ACS patients who increase physical activity, follow a low-fat diet and adhere to medication are less likely to suffer recurrent events or mortality (Chow et al., 2010; Gehi et al., 2007).

Although the importance to enhance in good health behaviours is critical, a lot of patients don't succeed to engage in these behaviours (Corotto et al., 2013; Lemon et al., 2010). An explanation for this lack of adherence to lifestyle advice can be found in psychological health. Mental issues, such as depression and anxiety, are highly common amongst patients with heart failure. These negative psychological factors in turn are linked to weak health behaviour adherence, such as smoking and physical inactivity (Celano et al., 2018; Dempe et al., 2013; McGrady et al., 2009). So, negative psychological health and its negative influence on engagement in health behaviours (and vice-versa) is a vicious circle that needs a breakthrough.

On the brighter side, evidence is found that positive psychological factors play an important role in adhering to beneficial health behaviours (Sheeran et al., 2018; Kiviniemi et

al., 2007; Lawton et al., 2009). For example, measures of psychological wellbeing, such as optimism and positive affect, are associated with, amongst other things, increased physical activity (Boehm et al., 2018; Millstein et al., 2016; Trudel-Fitzgerald et al., 2019). Knowing this, it seems to be beneficial to include positive psychology interventions (PPI's) in behavioural change programs to increase physical activity amongst post ACS-patients.

1.1 Positive psychological interventions and physical activity

Millstein et al. (2020) gave an explanation about how positive psychological factors affect physical activity engagement in their qualitative research amongst individuals at high risk for chronic health conditions. They found that beneficial factors are positive affect, energy, determination and optimism. When these factors are high, people are more likely to engage in physical activity. After engaging in physical activity, these same factors are positively influenced.

The 'broaden-and-build theory' (Fredrickson & Joiner, 2002; Fredrickson, 2004) and the related 'upward spiral theory of lifestyle change' (van Cappellen et al., 2018) explain the bidirectional relation between positive psychological factors and physical activity. The broaden-and-build theory proposes that the experience of positive emotions (for example joy, interest, contentment and love) broaden people's thought-action repertoire. For example, when joy is experienced, the urge to play is heightened, when interest is experienced, it sparks the urge to explore, and so on. Experiencing positive emotions promotes the discovery of new and creative actions, ideas and social bonds, which in turn help to build personal resources. These personal resources can be biological (like cardiac vagal tone), cognitive (like mindfulness), psychological (like purpose in life) or social (positive relations with others) (Fredrickson, 2004).

The 'upward spiral theory of lifestyle change' (van Cappellen et al., 2018) explains how positive affect can facilitate long-term adherence to positive health behaviours, as shown in Figure 1. The model exists of two circles, shown in Figure 1 as grey and black. The inner circle (grey) of this model shows that when positive affect is experienced during beneficial health behaviours, it creates nonconscious motives that are associated with that health behaviour. These motives, in turn, support repeated decisions to engage in that behaviour.

The outer circle (black) of the upward spiral theory of life-style change is based on the broaden-and-build theory. It shows that the experience of positive affect during health behaviours build important personal resources, that eventually strengthen the positive affect and non-conscious motives.

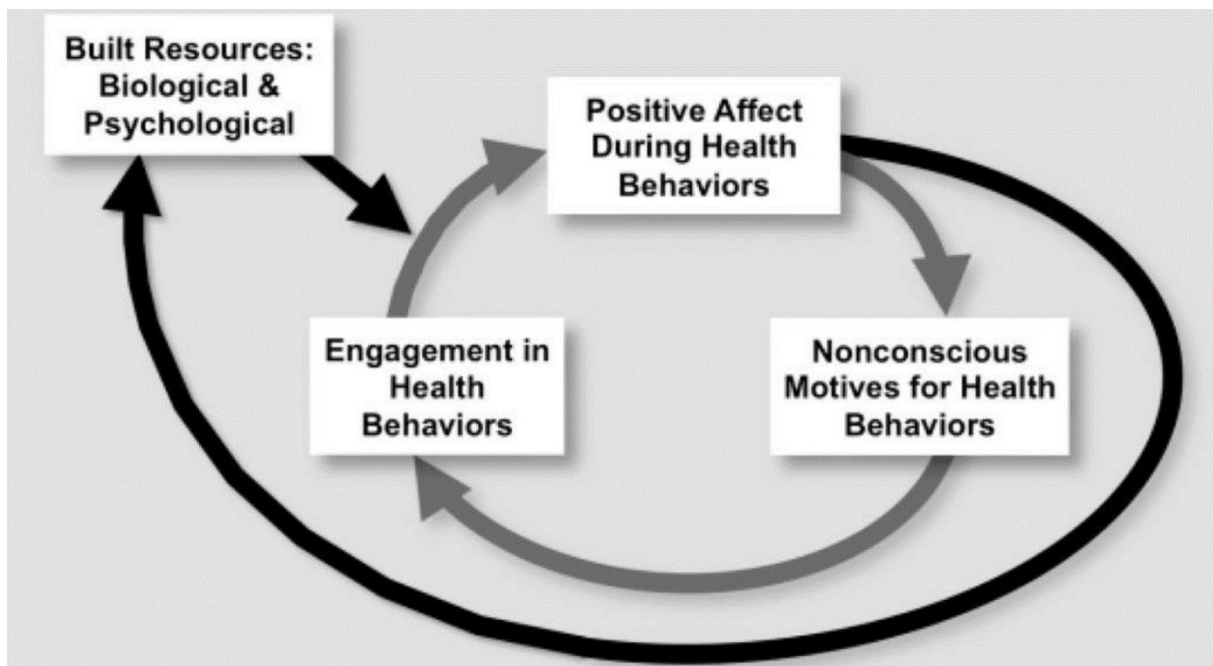


Figure 1. Model articulated by the *upward spiral theory of lifestyle change* (Fredrickson, 2013; Van Cappellen et al., 2016).

Summarizing, interventions that boost the positive affect during beneficial health behaviours stand to facilitate repeated decisions to engage in those health behaviours by cultivating nonconscious and increasing motives for those behaviours (Van Cappellen et al., 2018).

In this systematic research, additional to PPI's that focus on increasing positive affect, PPI's are included that increase self-compassion or gratitude, since promising effects of these psychological factors on the level of physical activity are also shown. The exact meaning of the concepts positive affect, gratitude and self-compassion will be explained in the next paragraphs.

1.1.1 *Self-compassion*

'Self-compassion is the ability to treat oneself with the same kindness and compassion as one would treat others in the same situation (Neff, 2003a). Self-compassion needs us to move away from the tendency to be hard on ourselves and instead ask the question; "how would I react if it was my best friend going through this (hard) situation?" The complete definition involves three core elements which, all together, help us to strengthen our self-compassion: self-kindness, common humanity (the recognition that everyone make mistakes and feels pain) and mindfulness.

Neff and colleagues have studied self-compassion since 2003 and discovered that it

contributes largely to psychological health. They also found that the level of self-compassion can predict the efficacy of behavioural changes (Leary et al., 2007; Neely et al., 2009; Neff et al., 2005). Philips and Hine (2019) performed a meta-analysis regarding self-compassion and its effect on people's physical health and health-related behaviour in general. Self-compassion appeared to be positively associated with both physical health and health behaviour. However, in this research physical health and health behaviour are two umbrella terms, existing of several subcategories. For example, 'physical activity' was part of 'exercise and nutrition', which was one of the seven subcategories of health behaviour. In our systematic review interest lies to further explore the direct link between the level of improved self-compassion (via a PPI) and the level of physical activity.

1.1.2 Gratitude

“Gratitude is a thankful appreciation for what an individual receives, whether tangible or intangible. With gratitude, people acknowledge the goodness in their lives. As a result, gratitude helps people connect to something larger than themselves as individuals—whether to other people, nature, or a higher power” (Harvard Medical School, 2021).

Legler et al. (2019) did a study amongst 152 patients with a recent ACS. In their research, they found that gratitude for one's health two weeks after the heart attack was associated with increased physical activity six months later. However, over time this association seemed to be weakened. Huffman et al. (2016) found a contrary result; post-ACS optimism, but not gratitude, was prospectively and independently associated with physical activity. Further exploration about the potential benefits of a heightened gratitude on the level of physical activity is needed, hence it is included in this systematic review.

1.1.3 Positive emotions/positive affect

According to Fredrickson, *positive emotions include feelings of hope, joy, compassion, gratitude, love, interest pride and amusement. Positive emotions can be cultivated or learned, and are direct indicators for 'flourishment', which is a term used in positive psychology to describe “an optimal range of human functioning”* (Fredrickson, 2001). *When positive emotions are integrated into daily life and visualized for the future, it improves habitual thinking and acting. Positive emotions can undo the harmful effect of negative emotions* (Tugade & Fredrickson, 2004).

Physical activity and healthy eating seem to be protective measures against experiencing stress and negative affect as well as increase positive affect. Counteractively,

people reduce physical activity and healthy eating when they are facing stress and negative affect. Correspondingly, these behaviours increase when people experience positive affect (Schultchen et al., 2019). As positive affect is comprised of different aspects, like hope, joy, happiness and optimism, research has been done from different perspectives. For example, enjoyment of physical activity predicts physical activity intentions and behaviour in healthy populations (Mullen et al., 2011). But beyond enjoyment, optimism and positive affect ‘in general’, also play a role in adherence to physical activity and related health behaviours (Lawton et al., 2009; van Cappellen et al., 2018).

1.2 Aim of the study

This systematic review systematically explored whether and how PPI’s that focus on improving self-compassion, gratitude or positive affect stimulate physical activity amongst post-ACS patients. The research question “*(How) do positive psychology interventions based on improving self-compassion, gratitude or positive affect influence the level of physical activity amongst post-ACS patients?*” was used. Research has shown great potential of including PPI’s in order to support health behaviour changes, like an increase in physical activity. Improving self-compassion, gratitude or positive affect might be promising ingredients in these interventions. Interest lies in the exploration of the effectivity of these PPI’s and their working mechanism. ACS and the related heart diseases are a worldwide problem with a continuously growing number of patients and a high rate of mortality. It puts a heavy burden on patients, caregivers and/or the healthcare systems. The importance of developing an effective treatment is high, hence this systematic review aims to provide the necessary information.

2. Methods

A systematic review was performed on articles that research PPI’s and their effect on the level of physical activity amongst post-ACS patients. We selected physical activity as the primary outcome measure because physical activity plays a major role in cardiovascular and overall health (Warburton & Bredin, 2017). There has been evidence that psychological factors (like gratitude, optimism and positive affect) influence the level of physical activity, more than they influence diet or medication intake (Duque et al., 2019). Another reason for choosing physical activity is that when it is increased, it is the key to preventing the development or recurrence of ACS and other medical illnesses (van Cappellen et al., 2018;

Feig et al., 2020). In this systematic research, physical activity means moderate-to-vigorous intense cardiovascular activity (running, walking, cycling). Physical activity based on strength (fitness/weightlifting) or flexibility/mindfulness (yoga/tai chi) is not used in this research.

2.1 Search strategy

This systematic review was conducted by following the reporting checklist of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA, Liberati et al., 2009). The databases PubMed and Scopus were used. After formulating synonyms for the search terms, the following search string was executed in these two databases: (self-compassion OR "self compassion" OR "self-kindness") OR ("positive emotion" OR "positive mood" OR "positive affect") OR (gratitude OR thankfulness OR gratefulness) AND ("physical activity" OR "physical exercise" OR "health behaviour") AND ("heart disease" OR "heart failure" OR "heart attack" OR "Coronary*" OR "Cardiac*" OR "cardiovascular*"). These terms were searched for in title, abstract and keywords.

A total of 127 articles were found (Scopus 70 results, PubMed 57 results). After that, only the articles were selected which (1) were written in English, (2) had full text availability, (3) were peer-reviewed, (4) were a primary study (meta-analyses and reviews are excluded) and (5) were written between 2000 – 2022 were used (because around the year 2000 positive psychology emerged). Amongst the remaining 106 articles, 31 duplicates were excluded. In total, 75 articles were compatible for further research. Mendeley Reference Manager was used as an online library to structure the data search.

2.2 Selection strategy

This further research was done by screening the title and reading the abstract simultaneously. Inclusion criteria were (1) the intervention needs to be a PPI focussing on increasing at least one of the mentioned psychological factors (self-compassion, gratitude or positive affect), (2) physical activity needs to be the outcome measure (physical activity in this research is moderate-to-vigorous intense cardiovascular activity (like walking, running or cycling). So physical activity based on strength (fitness/weightlifting) or flexibility/mindfulness (yoga/tai chi) are excluded). (3) The research is done amongst post ACS-patients. Research about the risk of getting heart failure or living with chronic heart failure were excluded. No restrictions were made concerning study design, since in this research we aimed to be as inclusive as possible.

Twenty-seven articles met the inclusion requirements and their full text was screened.

Twenty-two articles were excluded after full text screen, due to one of five reasons. (1) One article focusses only on the prevention of heart disease. (2) Eleven articles focus on patients with chronic heart disease or another disease like asthma, hypertension or diabetes. (3) One article was excluded because it is a systematic review. (4) Five articles research psychological constructs like gratitude, optimism or joy and their direct influence on physical activity, without including a PPI. (5) Four articles used an intervention to increase physical activity, but didn't use positive psychology constructs in their intervention. Physical exercises (breath work or relaxation techniques) and/or meditation practices (mindfulness) were used in these interventions. Five articles met all requirements and were systematically reviewed.

2.4 Data analysis

One researcher executed this systematic research. To re-assure that the data was selected well, the researcher started the first literature search in September 2021 and re-did the searching process in December 2021. Although some differences were found in the identification and screening phase, the same five full-text articles were identified as compatible in the last phase of the searching process. Figure 2 shows the second and final search (December 2021). Because in this systematic research only five studies are included, the results of each study are extensively described, starting with answering our research question and finishing with an additional, interesting finding. As our research question indicates, not only the effectivity of the PPI's is explored, but also interest lies in the working mechanisms of the interventions. This is why qualitative and quantitative studies were included.

3. Results

3.1 Included articles

This systematic literature search identified 106 records. After excluding 31 duplicates, 75 studies were screened on title and abstract. Of these, 27 studies were examined in detail for further consideration. Overall, five studies met the inclusion criteria and were included in the systematic review. A PRISMA flow diagram of the study identification process is presented in Figure 2.

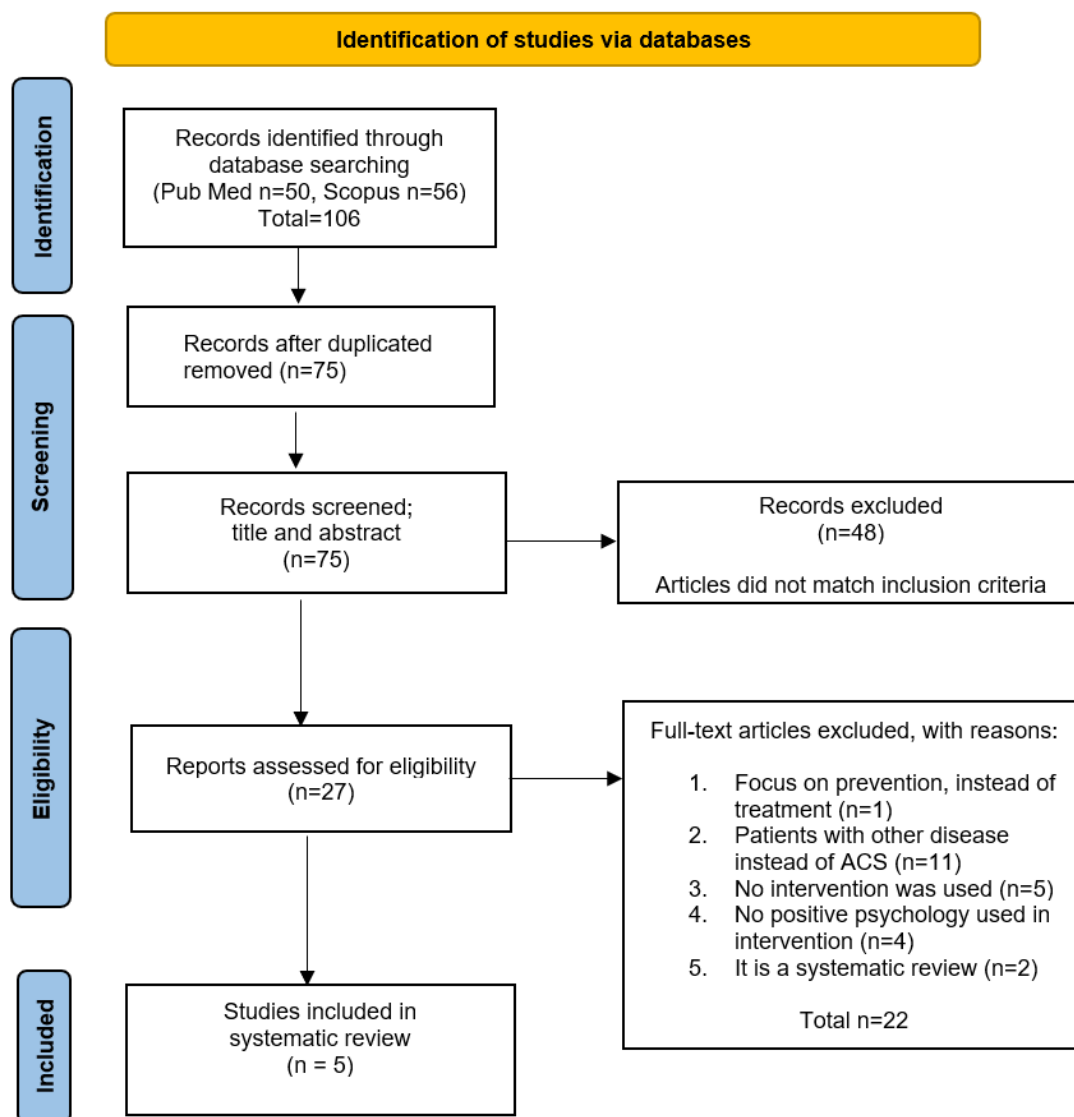


Figure 2. PRISMA Flow Diagram

3.2 Study characteristics

In this systematic research, five studies were included. All were executed in the United States of America and written in English. Four articles were published between 2010 – 2019 and one study was published between 2020 – 2022. The sample size varied from n=47 to n=164. Most patients were aged in midlife; 45-65 years. One article focussed on older participants as well: 65+ years.

All studies aimed to promote health behaviours after ACS, using the PP-based behavioural intervention Positive Emotions after Acute Coronary Events (PEACE). PEACE is a multiphase intervention development program utilizing Multiphase Optimization Strategy (MOST) (Collins et al., 2005) to develop and optimize a PP-based intervention to promote physical activity. This means that PEACE I was the first PPI which was developed and

researched on its effect on physical activity. PEACE II was the improved version of PEACE I, PEACE III was the improved version of PEACE II, and so on. The PEACE intervention focusses on different aspects of positive psychology: (1) gratitude for positive events, (2) using personal strengths, (3) expressions of gratitude/gratitude letter, (4) capitalizing on positive events, (5) remembering daily success/remembering past success, (6) enjoyable and meaningful activities, (7) humour in everyday life, (8) performing acts of kindness and next steps. The goal of using this PEACE intervention is to increase positive affect, which increases the level of physical activity. An example of a PEACE intervention is shown in Table 1.

Table 1. The Positive Emotions After Acute Coronary Events III (PEACE III) Behavioural Interventions (Huffman et al., 2017).

| Exercise title | Participant task (Daily condition) | Participant Task (Weekly condition) |
|---|--|--|
| Week 1: Gratitude for Positive Events | Recall and write about a positive event daily | Recall and record three such events from the week |
| Week 2: Using Personal Strengths | Choose one or two personal strengths and use them each day for the next week | Choose a personal strength and find a new way to use it in the next 24 hours |
| Week 3: Expressions of Gratitude/Gratitude letter | Write expressions of gratitude once daily thanking a person for an act of kindness | Write a single letter of gratitude thanking a person for an act of kindness |
| Week 4: Capitalizing on Positive Events | Identify one good event daily and ‘boost’ the positive feelings by sharing the event with others or celebrating it in some way | Recall three good events over the course of the week and ‘boost’ the positive feelings as in the daily condition |
| Week 5: Remembering Daily Successes/Remembering Past Success | Identify and record a success every day, focusing on the feelings evoked and the skills necessary for that success | Identify and record a single prior success, focusing on feelings and skills as in daily condition |
| Week 6: Enjoyable and meaningful activities | Complete an activity daily that varies between those that bring immediate boosts in mood and those that are more deeply meaningful | Perform a total of three such activities over the course of the week |
| Week 7: Humour in Everyday Life | Recall one funny event daily and describe why the event was amusing | Recall three funny things from the prior week and describe why they were amusing |
| Week 8: Performing Acts of Kindness and Next Steps | Complete and reflect on one act of kindness daily. Discuss ways to use skills from the program in daily life going forward | Complete and reflect on three acts of kindness in one day. Discuss ways to use skills from the program in daily life going forward |

In the studies examined in this systematic review, different variations of the PEACE are used (PEACE I, PEACE II, PEACE III or PEACE IV). For example, some studies combine motivational interviewing with the positive psychology exercises. The intervention varies in intensity (weekly versus daily sessions) and are offered with or without booster sessions. These studies aimed to identify the most optimal variation in which the PEACE should be executed to be most effective in increasing physical activity. The PEACE

intervention in our systematic review has been used in different lengths, varying from 8 weeks, 12 weeks or 16 weeks. For the measurement of positive affect, PANAS (range 10-50) (Watson et al., 1988) is used. Physical activity is measured via Medical Outcomes Study Specific Adherence Scale (MOS-SAS) which is a scale that measures self-reported overall health behaviour adherence divided in items about, amongst others, physical activity, medication intake and diet. Some studies also measure moderate-to-vigorous physical activity (MVPA) via Actigraph GT3X+ accelerometers (in steps per day). A detailed overview of the study characteristics is given in Table 2.

An important note in this systematic research is that not all five included articles are original studies or provide useful information. One article (Huffman et al., 2017), is a description of a research that was executed. However, in this article no results or final conclusions are given because the research is still in progress. The results and conclusions about this research are given two years later, in Celano and colleagues' (2019) article, which is one of the five articles included in this systematic research. Furthermore, in Duque and colleagues' (2019) research they used data for their analysis which was drawn from the existing PEACE III factorial trial (Celano et al., 2019). The fifth article in this systematic research (Feig, 2021) uses data of 3 – already existing – PEACE trials, PEACE II, PEACE III and PEACE IV.

3.3 Findings

In relation to answering our research question “*(how) do positive psychology interventions based on improving self-compassion, gratitude or positive affect influence the level of physical activity amongst post-ACS patients?*” it became clear that little research has been done about PPI's and their effect on physical activity. Amongst the PPI's that were found in this systematic review, none focussed on improving gratitude or self-compassion in order to influence the level of physical activity. As discussed, the articles that were found all used the PEACE intervention, which aims to increase positive affect and physical activity. In this result section each study is described in a separate paragraph, structured as: 1) description of the study, 2) its effect on positive affect and physical activity and 3) if explained in the study; the association between positive affect and physical activity. The result section ends with an additional study outcome concerning the association of age and the effectiveness of the PEACE intervention. An extended overview of the results of the different studies is given in Table 3.

Table 2. Descriptive of the selected studies

| | Country | Sample Size | Mean age at baseline (SD); sex | Type PPI | Duration of PPI | Improved psychological quality; measurement | Measurement of physical activity | Study Design |
|------------------------------|---------|--|--|---|--|---|---|---|
| Celano et al. (2018) | USA | N = 128 | 63.1 (12.0); Female 59% | PEACE III | 8 weeks, phone-delivered | Positive affect; PANAS (range 10-50) | MOS-SAS (range 4 – 24), items for physical activity | Randomized factorial trial |
| Duque et al. (2019) | USA | N = 128 | 63.1 (12.0); Female 59% | PEACE III | 8 weeks, phone-delivered, Booster sessions in week 10, 12 and 14 | Positive affect; PANAS (range 10-50) | MOS-SAS (range 4 – 24), items for physical activity | Randomized factorial trial |
| Feig et al. (2021) | USA | N=164 (Midlife: 94 Older: 70) | Midlife: 56.49 (5.87); Female 47% Older: 73.63 (6.05); Female 79% | 1.PEACE II 2.PEACE III 3.PEACE IV | 1. 8 weeks 2. 8 weeks 3. 12 weeks All phone-delivered | Positive affect; PANAS (range 10-50) | Self-reported physical activity: MOS-SAS MVPA: Actigraph G3TX + accelerometers (Actigraph LLC, Pensacola, FL) | 1.Non-randomized proof-of-concept 2.Randomized factorial trial 3.Randomized pilot trial |
| Huffman et al. (2017) | USA | N=128 (Enrolled in the program: N=78) | Not mentioned | PEACE III | 8 weeks, phone-delivered | Positive affect; PANAS (range 10-50) | Self-reported physical activity: MOS-SAS MVPA: Actigraph G3TX + accelerometers (Actigraph LLC, Pensacola, FL) | Randomized factorial trial (2x2x2 complete factorial design) |
| Huffman et al. (2019) | USA | N=47 (PPI-MI: 24 Control: 23) | 60.8 (10.7); Female 23% | PEACE IV | 12 weeks, phone-delivered | Positive affect; PANAS (range 10-50) | Self-reported physical activity: MOS-SAS MVPA: Actigraph G3TX + accelerometers (Actigraph LLC, Pensacola, FL) | Randomized controlled trial |

Table 3. Results of the selected studies

| First author (year) | Effect PEACE intervention on positive affect | Effect PEACE intervention on physical activity | Association between positive affect and physical activity |
|-----------------------------|--|---|---|
| Celano et al. (2018) | <p>PANAS:</p> <p>* Baseline positive affect: 36.4</p> <p>* Week 16: 40.3; $z=4.89$; $p<0.001$; Effect Size $d=0.59$.</p> | <p>Self-reported physical activity across all conditions:</p> <p>MOS-SAS:</p> <p>* Baseline: 2.52 [out of 6],</p> <p>* Week 16: 3.95; $z=8.0$; $p<0.001$; Effect Size $d=0.92$.</p> <p>Results favoured the PEACE-MI intervention, booster sessions and weekly sessions.</p> <p>MVPA:</p> <p>* Continuation of the intervention beyond 8 weeks (via booster sessions), is associated with greater physical activity</p> <p>* Combining PEACE with motivational interviewing leads to greater results in increasing physical activity.</p> | Not examined |
| Duque et al. (2019) | <p>PANAS:</p> <p>Positive affect ($p<0.001$)</p> <p>Mean at baseline: 36.4 (SD = 7.5)</p> <p>Week 8: 38.3 (SD = 7.6)</p> <p>Week 16: 40.2 (SD = 6.8)</p> | <p>MOS-SAS:</p> <p>Physical activity ($p<0.001$)</p> <p>Mean at baseline: 2.5 (SD = 1.5)</p> <p>Week 8: 3.9 (SD = 1.6)</p> <p>Week 16: 4.0 (SD = 1.6)</p> | <p>The change from baseline (measured in week 8 and week 16) for positive affect is associated with health behaviour adherence ($\beta = 0.057$, 95% Confidence Interval [0.016, 0.097], $p = 0.006$). This relationship is primarily driven by physical activity ($\beta = 0.040$, 95% Confidence Interval [0.013, 0.067], $p = 0.004$).</p> |
| Feig et al. (2021) | <p>PANAS:</p> <p>Positive affect:</p> <p>After the PEACE intervention, compared with older participants, midlife participants had a larger reduction in depressive symptoms and a larger increase in positive affect after the intervention.</p> | <p>MVPA:</p> <p>After the PEACE intervention, midlife adults doubled the minutes of moderate-to-vigorous physical activity and increased 1.5 times the number of steps per day compared with older participants.</p> | Not examined |

| | | | |
|------------------------------|---|--|--------------|
| Huffman et al. (2017) | Research still in progress | Research still in progress | Not examined |
| Huffman et al. (2019) | <p>PANAS: Positive affect: the PEACE intervention combined with motivational interviewing was associated with greater improvements in positive affect at 12 and 24 weeks. Between-group differences PEACE-MI – MI control group; (12 weeks: Estimated Mean Difference 3.90 [SE 1.95], $p = 0.045$, Effect size $d=0.56$) (24 weeks: Estimated Mean Difference 7.34 [SE 2.16], $p < 0.001$, Effect size $d=1.12$)</p> | <p>MVPA: The between-group differences show that the PEACE-motivational interviewing intervention was associated with more daily steps at 12 weeks (Estimated Mean Difference = 1842.1 steps/day [SE = 849.8] $p = 0.030$, Effect Size $d=0.76$) and greater moderate-to-vigorous activity at 24 weeks (EMD = 15.1 minutes/day [SE=6.8], $p = 0.026$, Effect Size $d = 0.81$), compared to the MI-based control condition.</p> | Not examined |

3.3.1 Optimal variation of PEACE

Celano and colleagues (2018) did a research aiming to optimize an existing PP-based intervention. Their research was a follow-up study of two previous studies. One was the qualitative research Huffman and colleagues (2016) executed, in which they interviewed 34 post-ACS patients, to find out (1) which specific positive psychological states are experienced over the 3 months post-ACS, (2) if and which positive psychological states increase the likelihood of completing cardiac health behaviours, and (3) whether participation in health behaviours lead to more positive thoughts and feelings. The second study was a proof-of-concept trial, in which Huffman (2016) developed and tested the PEACE II (based on outcomes of their qualitative research) on its efficacy and feasibility amongst post-ACS patients.

Celano and colleagues (2018) further explored PEACE II, calling the current phase of development the “PEACE III”. In their randomized factorial trial eight conditions are executed, varying in 1) duration (presence/absence of booster sessions), 2) intensity (weekly/daily positive psychology exercises) and 3) content (PEACE alone or combined with motivational interviewing (MI)). The factorial design is conducted to provide information about which components would be selected for inclusion in an optimized PPI that would subsequently be tested in a future randomized controlled efficacy trial. Hundred-twenty-eight post-ACS participants (mean age 63.1 years, 59% female) joined in the research. The participants were randomized to one of the eight conditions. No control group was included.

For the measurement of positive affect, PANAS (range 10-50) (Watson et al., 1988) was used. Moderate-to-vigorous physical activity (MVPA) was measured via Actigraph GT3X+ accelerometers in steps per day. Medical Outcomes Study Specific Adherence Scale (MOS-SAS) items for diet, medications and physical activity (range: 4 - 24) were used to monitor overall health behaviour adherence. Significant improvements were found in positive affect (PANAS; baseline: 36.4, week 16: 40.3; $z=4.89$; $p<0.001$; Effect Size $d=0.59$). The impact of the PEACE intervention across all conditions for self-reported physical activity was positive (MOS-SAS item; baseline: 2.52 [out of 6], week 16: 3.95; $z=8.0$; $p<0.001$; Effect Size $d=0.92$). When analysing the MOS-SAS physical activity item, results favoured the PEACE-motivational interviewing intervention ($p=.19$; Effect Size $d=0.27$), booster sessions ($p=.22$; Effect Size $d=0.25$) and weekly sessions ($p=.84$; Effect Size $d=0.04$). Regarding MVPA, results show that continuation of the intervention beyond 8 weeks (via booster sessions), was associated with greater physical activity ($p=.064$; Effect Size $d=0.43$). Although in this research the optimal variation of the PEACE intervention was traced, leading

to the highest increase in positive affect and physical activity, no conclusion was given about the relationship between the increased positive affect and the increased physical activity.

3.3.2 Association positive affect and physical activity

Duque and colleagues (2019) explored in a randomized factorial trial whether optimism or positive affect was best to cultivate for improving medical adherence. The data they used for their analysis was drawn from Celano and colleagues' (2018) PEACE III factorial trial. The participants, the eight versions of the PEACE intervention and the measurement tools in Duque's research are exactly as described above. Also in this study, no control group was included. However, Duque did use the outcome of the Life Orientation Test – Revised (LOT-R) (Scheier et al., 1994) to identify the level of optimism, which was included but not described above.

First of all, Duque found that after completing the PEACE III, the scores participants had on positive affect in PANAS (score range 10-50) significantly ($p < 0.001$) increased from a mean of 36.4 (SD = 7.5) at baseline, to 38.3 (SD = 7.6) at week 8, to 40.2 (SD = 6.8) at week 16. Physical activity (measured via MOS-SAS, score range 1-6) significantly ($p < 0.001$) increased as well, from 2.5 (SD = 1.5) at baseline, to 3.9 (SD = 1.6) at week 8, to 4.0 (SD = 1.6) at week 16.

Duque and colleagues did investigate the association between the increase in positive affect and increased physical activity. They performed mixed effects linear regression models, that included both the baseline and change from baseline for positive affect and optimism (since this was included in their research too) in the same model. This allowed them to include all 128 participants in these analyses. They were primarily interested in the association between the change from baseline and adherence, as this estimated the association between changes in those constructs and changes in health behaviour adherence. The change from baseline (measured in week 8 and week 16) for positive affect appeared to be associated with health behaviour adherence ($\beta = 0.057$, 95% Confidence Interval [0.016, 0.097], $p = 0.006$) and this relationship is primarily driven by physical activity ($\beta = 0.040$, 95% Confidence Interval [0.013, 0.067], $p = 0.004$). Duque and colleagues thereby were the first to examine the relationship between increased positive affect and the level of physical activity. However, in their research no attention is given to examine the working mechanism of this relationship between improved positive affect and its effect on the level on physical activity.

3.3.3 PEACE combined with motivational interviewing

Huffman and colleagues (2019) executed a randomized controlled trial which they called the 'PEACE IV'. This PEACE IV intervention aimed to examine the feasibility and preliminary impact of an optimized 12-week, phone-delivered PEACE-MI intervention. The PEACE IV intervention was combined with motivational interviewing (MI) and compared with an attention-matched, MI-based health education control condition. Forty-seven participants (PEACE-MI $n = 24$; only MI $n = 23$) were enrolled and randomized. Seventy-seven percent men, mean age: 60.8 years. Health behaviour adherence was measured using the MOS-SAS items for diet, medication and physical activity, positive affect was measured with the PANAS (range 10-50) and physical activity (Moderate-to-vigorous physical activity (MVPA) and steps) were measured via waist-worn Actigraph G3TX+ accelerometer (Actigraph, Pensacola, Florida).

Compared with the MI-based control condition, the PEACE intervention combined with MI was associated with greater improvements in positive affect at 12 and 24 weeks. These are shown in in-between group differences (12 weeks: Estimated Mean Difference 3.90 [SE 1.95], $p = 0.045$, Effect size $d=0.56$; 24 weeks: Estimated Mean Difference 7.34 [SE 2.16], $p < 0.001$, Effect size $d=1.12$). Regarding physical activity, compared with the MI-based health education control condition, the PEACE-MI intervention was associated with more daily steps at 12 weeks (EMD = 1842.1 steps/day [SE = 849.8] $p = 0.030$, Effect size $d=0.76$) and greater moderate-to-vigorous activity at 24 weeks (EMD = 15.1 minutes/day [SE=6.8], $p = 0.026$, Effect size $d=0.81$).

Huffman and colleagues (2019) were the first who executed a randomized controlled trial. They concluded that combining the PEACE intervention with MI, led to a higher increase in positive affect and physical activity. However, the working mechanism leading to the increase of both factors was not examined.

3.3.4 Research in progress

One article that was found in this systematic research (Huffman et al., 2017) describes an optimization study of the PEACE III. The aim of this study was to find the ideal components of a PPI to improve post-ACS physical activity. Using a 2x2x2 factorial design, the PEACE III aims to: (1) evaluate the relative merits of using positive psychology exercises alone or combined with motivational interviewing, (2) assess whether weekly or daily positive psychology exercise completion is optimal, and (3) determine the utility of booster sessions. The study's primary outcome is Moderate-to-Vigorous Physical Activity (MVPA) at 16

weeks, measured via accelerometer (Actigraph, Pensacola, FL). Huffman uses a mixed-effects model with a random intercept to assess the main effects of each component (inclusion of motivational interviewing in the exercises, duration of the intervention, inclusion of booster sessions) from a full factorial model controlling for baseline activity. In this article the content of a 24 month-during research is described, in which, up until now, 78 participants are enrolled in the PEACE III intervention. No results of this study are described yet.

3.3.5 The association of age and the effectiveness of PEACE

Feig and colleagues (2021) researched the difference in effectiveness of PEACE between 94 midlife participants 45 – 64 years (57%) and 70 older participants 65+ years (43%). The average age of the midlife participants was 56.49, 47% was female. Older participants were aged meanly 73.63, of which 79% was female. Feig and colleagues used data from different versions of the PEACE intervention, including 23 participants from PEACE II, 119 participants from PEACE III and 24 participants from PEACE IV. For the measurement of positive affect, PANAS (range 10-50) was used. Overall adherence to health behaviour was measured with the MOS-SAS, which included items about the frequency of exercising regularly. In PEACE III and IV physical activity was measured through waist worn Actigraph G3TX + accelerometers (Actigraph LLC, Pensacola, FL), which were worn for 1 week, immediately after intervention completion (8 week for PEACE III, 12 weeks for PEACE IV). Participants were required to have 8 hours of wear time for 4+ days. Although Feig focussed on more topics, like depression, anxiety, optimism, etc., only relevant information to this systematic review is high lightened.

Older participants reported higher positive affect and adherence to health behaviours at baseline than midlife participants. After the PEACE intervention, compared with older participants, midlife participants had a larger reduction in depressive symptoms and a larger increase in positive affect after intervention. Despite reporting lower physical activity before their ACS, midlife adults ended the intervention with about double the minutes of moderate-to-vigorous physical activity and 1.5 times the number of steps per day compared with older participants. Feig and colleagues concluded that the increase in positive affect and physical activity was higher amongst midlife participants than older participants, but the association between the increased positive affect and physical activity was not examined.

4. Discussion

This systematic review examined whether and how PPI's that focus on improving self-compassion, gratitude or positive affect, influence the level of physical activity amongst post-ACS patients. Five studies were included in this systematic review. The main result is that only one PPI in various formats, called PEACE (PEACE I, PEACE II, PEACE III, PEACE IV) has been researched. The PEACE intervention seems to succeed in improving positive affect and physical activity. The association between these two has only been investigated in one research (Duque et al., 2019). Duque and colleagues showed that the change from baseline in positive affect is associated with health behaviour adherence and that this relationship is primarily driven by physical activity. Because no control group was included in this research, more exploration is needed in order to strengthen proof of this association. Without control group, it is difficult to be completely sure that the change in physical activity can be assigned to the change in positive affect. It could be possible that other variables (like feeling pressured to get physical active because of joining a research, or the idea of not wanting to fail on fellow participants) influence the level of physical activity.

Although the optimal (most effective) variation of PEACE (like intensity, duration, the use of booster sessions or combining PEACE with motivational interviewing) has been researched in the included studies, the working mechanism of increased positive affect and increased physical activity is still unknown. This lack of research is quite remarkable, since positive psychology and its beneficial influence on health behaviour change, has gained a lot of interest over the years. PPI's seem to be promising in the field of improved health behaviour, like diet, physical activity or medication intake (Boehm et al., 2018; Millstein et al., 2016; Trudel-Fitzgerald et al., 2019). As described in the introduction, improved health behaviour is the key for treating or preventing many chronic and worldwide diseases (van Cappellen et al., 2018). One would expect that exploration of the interventions' working ingredients should be getting more interest.

As written in the introduction, an explanation of this working mechanism of PPI's may be found in the broaden-and-build theory (Fredrickson & Joiner, 2002; Fredrickson, 2004) and the related upward spiral theory of lifestyle change (van Cappellen et al., 2018). Fredrickson and colleagues concluded that positive emotions, especially experienced during participation in a health behaviour such as exercise or healthy eating, are a powerful resource that may reinforce lasting health behaviour change (Fredrickson & Joiner, 2018). Those who experience positive emotions while participating in health behaviours experience non-conscious and conscious rewards that reinforce the behaviour, making it more pleasurable and

more desirable to engage in in the future (Kok et al., 2013).

Another important point to take into consideration concerning conclusions about a successful PPI has been brought to mind in the research Feig and colleagues (2021) executed. They found that midlife participants were more likely to increase in positive affect and physical activity than older participants. However, measurements at baseline for these psychological factors showed that older participants started with a higher baseline in positive affect and physical activity, than midlife participants. This is in line with prior research showing higher psychological well-being in older age than in midlife (Blanchflower et al., 2008). It may be that a ‘ceiling effect’ occurred within the group of older participants, which means that they reached a certain ‘upper score’ and the measurement tools weren’t able to identify the nuances in this upper score range. Because midlife participants had more potential to improve given that they started the intervention with lower positive affect (along with higher depression and anxiety and lower optimism, although these between-group differences were nonsignificant), in this research it seems that the PEACE intervention has more potential amongst midlife participants. Further exploration about the upper range scores would be valuable.

4.1 Strengths and limitations of the research

The strengths and limitations of this systematic review should be taken into account for final conclusions. A strength of this systematic review is that it has been quite specific in its research question and the inclusion and exclusion criteria of the selected articles. Because of this specificity, just a few studies met the inclusion criteria. Expertise in the field is an advantage because the conclusions are of great use in developing PPI’s that promote physical activity amongst post-ACS patients. If broader search terms were used, like for example ‘positive psychology’ instead of ‘gratitude’/‘positive affect’/‘self-compassion’, more information was found, but the information would also be less specific to apply. A solution could be to keep the specificity of our research, but include more databases in the search process. Another strength is that this research has been systematically executed, this is why it is called a ‘systematic review’ instead of just a ‘review’. By following the PRISMA guidelines, it became a transparent and structured research which could be re-done by following the prescribed methods. The last strength is that the researcher of this systematic review reassured that the data was selected well, by completing the whole data searching process twice, in September 2021 and December 2021.

A limitation of this systematic review is that no real proof of the results can be given.

Within the selected studies, overlapping results were found concerning the effectivity of the PEACE intervention on positive affect and physical activity. However, most are uncontrolled trials. Huffman and colleagues (2019) were the only ones that executed a research including a control group. They found an increase in positive affect, moderate-to-vigorous physical activity and daily steps in 12 weeks and 24 weeks, but not all results were convincingly significant. Another limitation is that in only part of our research question could be answered, because of the one-sidedness of the remaining articles. All articles focussed on promoting health behaviours after an acute coronary syndrome, using the PP-based behavioural intervention Positive Emotions after Acute Coronary Events (PEACE). In our research we aimed to investigate how improving gratitude, self-compassion or positive affect increased the level of physical activity amongst post-ACS patients. A clear review about the different constructs (gratitude, self-compassion and positive affect) and how they individually influence the level of physical activity at post-ACS patients cannot be given. The last and huge critical note concerning this systematic review, is that amongst the studies that were found, only two were the original studies. Two studies used the data of existing studies for their analysis and one study was a description of a research that was still in progress.

4.2 Recommendations for future research

This systematic research adds to the extant literature by highlighting what research has been done on the subject of PPI's and its positive influence on physical activity and which information is lacking. It became clear that potential lies in the PEACE intervention, because of its promising effect on increasing physical activity. In order to make the PEACE intervention or the development of other PPI's even more valuable, further exploration should be done on the working mechanisms of this intervention. Qualitative research can be executed on patients that are about to start or already completed the PEACE intervention. What would their explanation be about the increased physical activity? Did they notice change within themselves, concerning their level of gratitude, positive affect and/or self-compassion? If yes, would they explain that these changes led them to be more physically active?

Another way to specify the working ingredients of the PEACE Intervention is to use a factorial design. As seen in Table 1, the PEACE intervention focusses on different qualities of positive psychology, like gratitude, personal strengths, gratitude, capitalizing on positive events, remembering daily success/remembering past success, enjoyable and meaningful activities, humour in everyday life, performing acts of kindness and next steps. It could be interesting to investigate which specific exercise, leads to increased physical activity or

whether it is the combination of different exercises. If it, for example, appears that gratitude is held most accountable for the increased physical activity, it could be examined whether an intensification of these gratitude exercises, lead to a greater increase in physical activity.

Also, the question rises whether it would be interesting to focus the PPI directly on physical activity. So instead of first increasing positive affect, which, in turn, leads to a heightened level of physical activity, how would it be if the intervention is directly focussed on physical activity. For example, the gratitude exercise can be about gratitude towards the physical body or physical activity; ‘I am thankful to be able to engage physical activity’, ‘I thank my body for allowing me to run/move/walk’. Research could examine whether this approach leads to a bigger increase in physical activity. But most importantly, the effectivity of the PEACE intervention and the investigation about the working ingredients of the intervention should start with research that does include control groups so if results are found, the proof of these results can be strengthened.

5. Conclusion

Although including PPI's seems to lead to greater increase in the level of physical activity amongst post-ACS patients, the research about this topic is scarce. In this systematic review five articles were found, of which 2 uses information from an original research. The research that has been done about this subject, found that the PEACE intervention led to an increase in positive affect and physical activity. Especially when PEACE is combined with motivational interviewing, includes weekly sessions and booster sessions, the level of physical activity is even more increased. Concerning older versus midlife age, the intervention seems to be most beneficial in midlife age groups (45 – 64 years). However, not all studies included control groups, so the results that were found in this systematic research need to be carefully weighed. Before the PEACE intervention can be implicated, one should further explore the working mechanism of the PEACE intervention and execute it in a controlled trial, to find out whether the effect is indeed caused by the PEACE intervention and if yes, investigate what its working ingredients are.

6. References

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