Florida State University

2570 University Center Building-C

Tallahassee, FL 32306

(850) 644-3577

amyai8@gmail.com

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#### Kirsten Bibbins-Domingo, PhD, MD, MAS

###### Editor in Chief, Journal of The American Medical Association (JAMA)

Lee Goldman, MD Endowed Professor of Medicine and Professor of Epidemiology and Biostatistics

University of California San Francisco,

San Francisco, California, U.S.A.

Dear Dr. Bibbins-Domingo,

First, congrats for you to be the first woman of color to serve on this honorable position! Next, please find the manuscript, titled “*Cardiovascular Disease and* *Posttraumatic Growth*(PTG)*: A Meta-analytic Review,*” uploaded to the Journal of The American Medical Association (JAMA) submission site. We hope that itbe considered for review by your editorial board.

We assume that the finding will be of interest to the readers of *JAMA* because this interdisciplinary study provides information on an aggregated positive outcome, PTG, in CVD, the deadliest diseases for all Americans, especially African Americans. Because most CVDs cannot be completely cured, we hope that the under-investigated positive side outside of patients’ suffering may have important implications for patient-centered preventive and clinical care in coming decades, even though it is not among the traditional CVD outcomes.

All authors have contributed substantively to developing this manuscript and agreed to be a co-author. The authors declare that there are no conflicts of interest. Because this first meta-analysis on this topic in only published data, the human subject application is not relevant. *JAMA Psychiatry* has published PTG related research, but this study is about CVD patients. We therefore do not know which sub-journal under the system of *JAMA* will be suitable for this topic. But we trust that you will direct it to the appropriate one.

The manuscript has not been previously published nor is it under consideration at another outlet; furthermore, the findings have not been posted online nor published, posted, or submitted in any related papers. To make the manuscript short, all subgroup figures are in the Appendix for provision upon request. If you consider that they are acceptable within the desirable length, we can put it back. We look forward to hearing your editorial decision!

Amy L. Ai, PhD

FSU Distinguished Research Professor

**Cardiovascular Disease and Posttraumatic Growth: A Meta-analytic Review**

Amy L. Ai, PhD1

Guang Qiu, MS2

Crim Sabuncu, MSW3

George A. Stouffer, MD 4

**(Short Title: CVD and PTG)**

(09/28/2023, In Submission to Journal of the American Medical Association/JAMA)

### 1. Corresponding author: Distinguished Research Professor, Colleges of Social Work, Medicine (Social Medicine and Behavioral Science), and Nursing, 2570 University Center Building C, Florida State University (FSU), Tallahassee, FL, 32306; amyai8@gmail.com, 850 644-3577.

2. Department of Statistics, FSU, gq21@fsu.edu

3. Colleges of Social Work, FSU, csabuncu@fsu.ed

4. Division of Cardiology and McAllister Heart Institute, University of North Carolina, Chapel Hill, NC Rick\_Stouffer@med.unc.edu

**Cardiovascular Disease and Posttraumatic Growth: A meta-analytic Review**

(09/28/2023, In Submission Journal of American Medical Association /JAMA)

**Key Points**

**Question** Could posttraumatic growth (PTG) occur in patients suffering from cardiovascular diseases?

**Findings** In this meta-analysis of 21 studies including 5814 individuals found evidence for an association between CVD and PTG; the PTG phenomenon was associated with coping strategies and spirituality in subgroup analyses.

**Meaning** The findings suggest that PTG could occur in CVD patients and that attention to this positive side may be important for promoting the optimal behavioral care for cardiac diseases. (74 words)

**(Key Points—**Instructions:

In the manuscript, include a separate section called "Key Points" before the Abstract.

This feature provides a quick structured synopsis of the findings of your manuscript (required only for research and review manuscripts), following 3 key points: Question, Findings, and Meaning. Limit this section to 75-100 words or less.

Question: Focused question based on the study hypothesis or goal/purpose. Limit to 1 sentence.

Findings: Results of the study/review. Include the design (eg, clinical trial, cohort study, case-control study, meta-analysis). Focus on primary outcome(s) and finding(s). Do not emphasize secondary outcomes. Report basic numbers only but state if results are statistically significant or not significant; do not include results of statistical tests or measures of variance (see example below). Can include 1 to 2 sentences.")

**Abstract: Importance** While most cardiovascular disease(CVD)is not completely curable, Posttraumatic growth(PTG) may be a measure for positive clinical outcomes. Despite emerging evidence, no meta-analysis has been done on this association. **Objective** To conduct a meta-analysis and systematic review of a credible conclusion between CVD and PTG. **Data Source and Study Selection**. Ovid MEDLINE, PsycINFO, Academic Search Complete, and PubMed electronic databases were systematically searched from inception through June 30, 2023, to identify all empirical studies investigating an association between CVD and PTG. Data were screened and extracted independently by 3 investigators. Adjusted effect estimates were employed, and pooled analysis was conducted, using the DerSimonian and Laird random-effects model. Sensitivity and subgroup analyses were performed to assess the robustness of the findings. The Meta-analysis of Observational Studies in Epidemiology(MOOSE) reporting guideline was followed. **Results.** CVD events involved a composite of myocardial infarction, stroke, and non-transplant cardiac surgery and procedures. The search yielded 25 selected studies comprising 5814 participants of which 21 studies reported data on a CVD-PTG association. On pooled analysis, CVD was significantly associated with PTG as determined mostly by Posttraumatic Growth Inventory(Weighted mean: 45.90; 95% CI,39.33-52.47; *P*<.001), with a low heterogeneity in the analysis(*I*2=23.86%). Subgroup analyses indicated a link between cardiac risk and protective factors with PTG in CVD. **Conclusion and Relevance.** The findings indicate that CVD events could be associated with PTG as a potential optimal outcome. Future investigation should pursue more prospective design and explore the biobehavioral mechanisms underlying this relationship to promote PTG-related better quality-of-life in patient-centered care. (248 words).

***Keywords:*** Meta-analysis and systematic review, cardiovascular disease (CVD), post-traumatic growth (PTG), myocardial infarction, stroke, cardiac procedures

**Introduction**

Cardiovascular disease (CVD) is the leading cause of death worldwide and the most costly condition in the United States.1–3Extent research has made evident its association with adverse mental health, such as depression, anxiety, and posttraumatic stress disorder (PTSD), which are also CVD mortality risks.1,4–8 Given that few severe CVD conditions can be completely cured, more research is needed for examining the potential positive changes to boost behavioral modifications for better quality of life (QOL).9 One such outcome is posttraumatic growth (PTG), defined as the “experience of significant positive change arising from the struggle with a major life crisis”.10

Concerning the paradigm difference between CVD-related pathology factors (e.g., depression, PTSD) and PTG, Ai and colleagues highlighted two underlying forms of wellbeing, *hedonic* versus *eudaemonic well-being* in their research on cardiac events and non-cardiac environmental trauma*.*11,12The awareness of their different functions may have future clinical implications. Since Affleck et al.’sstudy on [myocardial infarction](https://en.wikipedia.org/wiki/Myocardial_infarction) (MI) in 1987, a growing body of research has identified the PTG phenomena in CVD patients including those with [myocardial infarction](https://en.wikipedia.org/wiki/Myocardial_infarction) (MI) congestive [heart failure](https://en.wikipedia.org/wiki/Heart_failure) (CHF), coronary artery disease (CAD) or undergoing open-heart surgery (OHS), percutaneous coronary intervention (PCI). 11,13–16 Emerging evidence has also shown correlates of PTG in CVDs, such as coping, spirituality, and social support.11,14,15,17–21

Nevertheless, it remains insufficient to conclude there is a positive link between CVD and PTG based on single studies due to limits in research design.22 A systematic meta-analytic review would provide more reliable and less biased conclusions to advance the area of research that bridges trauma psychology to behavioral CVD care. This meta-analytic review, thus, employed a systematic approach to synthesize empirical studies examining the magnitude of PTG in CVD, as well as associated factors.

# **Methods**

# **Data Sources and Searches**

This systematic meta-analytic review was performed and presented based on the recommendations of the Meta-analysis of Observational Studies in Epidemiology (MOOSE) reporting guideline.40 A systematic literature search of Ovid MEDLINE, PsycINFO, Academic Search Complete, and PubMed was conducted for empirical research articles published from 1987 since Afflick et al. investigated positive gain in MI patients, but especially 1995, when PTG was coined to 2023.23 The following Medical and Psychological Subject Heading terms were used to identify studies that assessed PTG in patients with CVD: posttraumatic growth, stress-related growth, adverse growth, then cardiovascular health, CVD, MI, acute coronary syndrome (ACS), cardiopulmonary resuscitation (CPR), OHS, stroke, angina, heart disease, CAD, coronary heart disease (CHD), ischemic heart disease, and arrhythmia. No language restriction was used to cover publications in both the United States and abroad. Furthermore, references from selected studies and relevant review articles were reviewed to identify additional publications.

# **Study Selection**

Three investigators (A.A., C.S., G.Q) independently reviewed the potential candidates for this review. Eligible studies were original empirical research articles that assessed posttraumatic and adulthood growth related terms in patients with various types of CVD conditions (e.g., MI, CHF, stroke, and cardiac procedures). Studies on non-CVD conditions only (e.g., cancer, other medical trauma) or mental health issues (e.g., PTSS, depression) only in CVD were excluded. Then, any studies that did not employ an established and validated scale that specifically focused on personal growth (e.g., PTG Inventory (PTGI)23; stress-related growth scales (SRGS)24,25) were not included. In other words, excluded studies might use other types of measures on broad positive changes (e.g., Benefit Finding Scale;26 Perceived Benefit Scale27), because certain gains did not pertain to adulthood growth. Open-ended measures of growth were also excluded due to the lack of validation. In the final selection, only studies with reported PTGI mean score with standard deviation or correlates with PTG were included.

**Data Extraction and Quality Assessment**

According to preplanned protocol and using a standardized form, two investigators (A.A., C.S.) independently reviewed selected titles first to identify abstracts for potential inclusion. Full text articles were obtained for all potentially eligible studies and were reviewed by the third investigator (G.Q.). Next, two reviewers (G.Q. and T.C.) independently extracted data from the selected studies. The following data were extracted: study characteristics (e.g., author, year of publication, sample size, study design), patient characteristics (e.g., age, sex, CVD diagnosis), PTG assessment tools, and estimates of the association between PTG and CVD (e.g., t-value or correlation coefficients). The quality of the selected studies was assessed using the Cochrane Risk of Bias tool.28

**Statistical Analysis**

R (version 4.3.0) was used to conduct the meta-analysis employing the DerSimonian and Laird random-effects model to estimate the correlation between PTG and CVD.29 Selection of articles included a reported mean and standard deviation (SD) of PTG as assessed by established instruments .23 For example, PTGI as the measure involved summing up ratings across 21 self-reported questions, resulting in a possible score range of 0 to 105. The weighted mean of PTGI identified the level of PTG in CVD patients, using a predetermined cutoff point: 45 or below.— This point indicated none to low levels of PTG, while scores of 46 or above indicated medium to high levels of PTG. This method allows for a clear distinction between individuals with varying levels of PTG and facilitates the interpretation of study findings. Both models will use I2 to assess the heterogeneity.30,31 Under 50% of I2 would be considered as a low level of heterogeneity and a fixed effect model would be applied instead of the random effect model. And forest plots were generated to summarize the results of multiple studies and compare the effect size of exposure across different studies. Random effects meta-analyses estimated correlations between PTG and various variables, conducted when data from at least three studies were available. The final effect size with 95% CI assessed the association between PTG and different variables, with I2 indicating heterogeneity levels, and 50% above showing medium to high heterogeneity.

**Results**

**Study Characteristics**

Figure 1 illustrates a flow diagram of the literature and related screening process. The search yielded 296 unique publications, of which 51 qualified for full-text review. In the end, twenty-one studies met the inclusion criteria for the main analysis.19,32–36 An additional four studies were added solely for subgroup analyses.11,17,20,37 Of these twenty-five included in the analysis, all but twoemployed PTGI to examine PTG in cardiovascular patients.11,17 Eleven were cross-sectional studies and seven were prospective studies.11,16,21,38–41 For the selected 25 studies involving a total of 6558 individuals, table 1 and table 2 present their overall characteristics.

Among the studies included in the analysis, four studies were performed in the United States,11,34,40,42 three in the United Kingdom,16,43,44 three in Poland,19,35,45 three in China,38,39,46 two in Canada.21,36 Further, one in Iran,47 one in both the United States and the United Kingdom,33 in Greece,48 in Turkey,20 in the Netherlands,17 in Pakistan,37 in Israel,32 in Germany,41 in Brazil,49 and in Cyprus.50

The most common condition was MI, presented in ten studies,19,20,32,35,37,44,45,47,48,50 with Bluvstein et al.32 also including acute coronary artery bypass graft (CABG) patients. Among the rest, seven studies enrolled patients with stroke,16,37–39,41,43,46 three studies enrolled cardiac outpatients,33,36,42 two enrolled patients undergoing non-emergent, non-transplant cardiac surgery (e.g., CABG, valve repair or replacement, and both),11,40 two enrolled heart failure (HF) patients,34,51 and one enrolled participants receiving inpatient care with various CAD diagnoses.36

Most studies were conducted at a single site,11,17,32,34,39,43,46–48,50,51 five studies were unclear as to number of site, 16,19,21,35,41 four evaluated patients at two sites, 38,40,44,45 three studies were conducted on four sites,20,37,42 one was multisite,33 and lastly, one recruited from eleven sites.36

**Main analysis**

The main included a total of 21 studies, involving a total of 5814 individuals. The sample size of these studies ranged from 25,50 to 2636.36 The percentage of males ranged from 57%,43 to 100%48 with a mean age of patients ranging from 53,41 to 75 years.16 A few studies did not provide data on mean age, indicating only that the participants were adults above 18-years old.38 The mean PTG ranged from 18.77,48 to 76.24,50 with varying standard deviation. Table 1 presents overall characteristics of all studies.

The meta-analysis was conducted using a fixed-effects model instead of the presupposed random-effect model due to low heterogeneity. The weighted mean [95% confidence interval (CI)] of the PTG score, was calculated to be 45.90 [39.33, 52.47] (figure 2). In this meta-analysis, an I2 value shown in table 3 of 23.86% was obtained, suggesting low to moderate heterogeneity among the selected studies.

**Subgroup Analyses**

Table 4 shows the summary of subgroup analyses, involving 13 studies. The variables that these studies focused on as determinants of PTG included depression, coping, spirituality, social support, age and gender.

***Depression***

The association of depression with PTG was presented in four selected studies with a total of 658 participants.11,17,20,38,43 The pooled effect size of -0.15 [-0.41, 0.11] was consistent with there being no relationship between depression and PTG but the broad range indicates considerable uncertainty in the effect estimate. A high I2 value of 91.96% showed substantial heterogeneity across these studies.

***Coping Strategies***

Various types of coping strategies were investigated with PTG in nine studies. Ai et al.11, Gangstad et al.43 and Kelly et al.16 focused on active coping strategies, while Łosiak and Nikiel 19 and Garnesfski et al.17 delved into cognitive coping strategies. Senol-Durak and Ayvasik 20 investigated "cognitive process coping," and Magid et al.42 explored coping strategies associated with alterations in cognition and mood. Furthermore, Javed and Dawood37 examined active emotional coping, problem-focused coping, and avoidant coping, and Sheikh33 discussed both problem-focused and emotion-focused coping. Building on these findings, an average was calculated from the results presented by these two papers which contain multiple coping strategies since their correlation are close to each other.33,37 Figure 4 shows the role of coping in PTG, assessed in the cited studies which collectively encompassed 941 participants.11,16,17,19,20,33,37,42,43 The pooled effect size yielded a value of 0.50 [0.33, 0.66], denoting a positive association between coping mechanisms and the degree of PTG (table 4). However, a significant level of heterogeneity across the examined studies was revealed due to the high I2 statistic of 93.04%.

***Spirituality***

Regarding spirituality, four studies were considered, involving a total of 519 participants.11,17,19,38 As shown in Figure 5, a moderately-high positive relationship was discerned between spirituality and PTG, as highlighted by an effect size of 0.56 [0.38, 0.75]. Nevertheless, the I2 statistic of 89.38% is indicative of considerable heterogeneity among the studies.

***Social Support***

The link between social support and PTG was investigated in seven studies, involving 983 people.11,16,20,33,37,38,46,47 In Figure 6, the effect size of 0.29 [-0.05, 0.62] indicated no correlation between social support and PTG. The high I2 value of 98.25% showed a significant heterogeneity among these studies.

***Age***

The influence of age on PTG was examined across five studies, involving a total of 688 participants.11,17,20,34,42 The pooled effect size yielded a value of 0.04 [-0.12, 0.20] indicating no correlation between age and PTG. The I2 statistic of 78.49% indicated a significant level of heterogeneity among the selected studies.

***Gender***

The relationship between gender and PTG was analyzed in four studies, with a total of 636 participants reveal.11,17,20,34 The pooled effect size revealed a small positive correlation shown in Figure 8, with a value of 0.10 [0.03, 0.18], indicating that gender plays a slightly positive role in the degree of PTG. The I2 statistic of 11.01% indicated a low level of heterogeneity among the examined studies, indicating a certain degree of consistency in the relationship.

**Discussion**

Our findings cast new light on the relationship between PTG and CVD. The weighted mean PTGI score of the selected studies demonstrates a moderate level of PTG in patients reporting CVD diagnosis or events that could lead to traumatic experiences. There was a low I2 statistic of 23.86% implying relatively little heterogeneity across selected studies, despite various types of CVD diagnoses, different time frames in which PTG was measured and different scales used to measure PTG. Two different scales were employed for assessing growth; most studies used PTGI, with one using personal growth scales (PGS) derived from PTGI,17 and another using SRGS.11 The assessment time ranged from 1 month,38 to 5 years.33

We found no association between depression and PTG in an analysis of rive studies.11,17,20,38,43 This finding was different from an inverse relationship observed in some individual studies.43 As noted above, however, the high I2 value of 91.96% suggests substantial heterogeneity across the studies, which may be due to differences in different CVD conditions, study design, measurement tools, or population characteristics.

We found a positive association between coping strategies, especially cognitive coping (e.g., positive refocusing, putting into perspectives, refocusing on planning, and positive reappraisal), which was and PTG when analyzing nine studies.11,16,18–20,33,37,42,43 These coping strategies are especially related to the *sense of self*, *relationship with others*, and *appreciation of life* dimensions of PTG. Cross-sectional 33 and prospective 16 studies also associate problem-based or active coping with PTG in CVD patient. This meta-analysis, thus, adds new evidence for their potential optimal function in CVD patients. However, future studies should examine if coping may serve as mediator or moderator, as a changing mechanism for adulthood growth, assumed by Tedeschi and Calhoun 52 and by Linley and Joseph.53

A second protective factor is spirituality, involving perceived spiritual support, positive religious coping, extrinsic religiousness, and frequent church attendance, as surveyed in three studies.11,40,54 Kearns et al.40 identified the related subdomains of PTG in CVD, such as *relationship to others*, *new possibilities*, and *personal strength*, that were especially sensitive to the spirituality effect. The significance of spirituality maybe reflected as an essential impetus to human life or it may be viewed as an internal resource that provides strength in coping with trauma and severe ailments. Both coping and spirituality exhibit their positive relationships with PTG at moderate levels, suggesting their positive roles in facilitating growth in patients with CVD. However, the high I2 statistics (92.26% for coping and 89.38% for spirituality) again underscore the presence of significant heterogeneity among the studies and warrant a cautious interpretation of the results.

A third positive factor, perceived social support, was examined in eight studies.11,16,20,33,37,38,46,47 The results indicate a null association between social support and PTG in CVD patients, although the wide confidence interval precludes definitive conclusions. This is consistent with null findings in both Ai et al.11 and Hu et al.38 studies; both were from patients with more several disabling conditions (e.g., stroke or post-OHS patients). The divergence suggests the need to consider the role of medical diagnosis and illness or trauma status in future investigation. In addition, the high I2 value of 98.25% indicates significant heterogeneity among the studies, which implies that other unexamined factors might be influencing this relationship.

The meta-analysis found no association between age and PTG in CVD patients. Given the wide confidence interval, a potential effect of age cannot be excluded but it might vary with CVD conditions. Ai et al.11 reported older individuals showing higher PTG scores, suggesting that with increased age, there may be an increase in the capacity for growth post-trauma. Other papers only focused on the association between age/gender with PTG instead of the classified categories like elder or female. However, among five studies that examined age, 11,17,20,34,42 three of them indicated a negative association between age and PTG.20,34,42 These variations may stem from differences in sample characteristics, measurement tools, or other factors that warrant further exploration. Also, the age range of these studies varies widely from one study involved aged 30s,17 to others up to mid-70s. It is important to note that the moderate I2 value of 78.49% for age indicated substantial variability among the selected studies.

Four studies revealed a weak positive correlation between gender and PTG among individuals with CVD.11,17,20,33 However, the low I2 value of 11.01% for gender shows low heterogeneity across the selected studies. Taken together, the finding for the final three factors should be considered as preliminary and need more studies with sound research design for more credible conclusions in CVD patients.

Taken together, the literature suggests certain overlapping areas between the emerging research on the scientific mechanism of PTG and the more established one on that of PTSD. Because PTSD, and other psychiatric disorders (e.g., depression) have been related to the poor prognosis of CVD, more interdisciplinary research on the mechanism PTG may assist better clinical CVD care through enhancement on CVD-related PTG in the future.

**Limitations**

The limitations of our meta-analysis should be acknowledged. Firstly, the sample sizes of many studies are small, which suggests the need for more rigorous design in future investigation. Second, important medical indices are missing in most studies; thus, we could not systematically assess their associations with PTG. Third, most studies are cross-sectional in nature, hindering the statement of causality, even though and a cross-sectional design was included in previous meta-analyses.55 Fourth, covariates included in studies vary wildly, which may account for the heterogeneity in our subgroup analysis. Fifth, some studies did not specify gender related to PTG. Sixth, to be conceptually sound, we excluded studies with scales without specific foci on growth and those with only unvalidated, single-item measures. This decision could exclude potentially valuable information.

In conclusion, this meta-analytical review provides compelling evidence for PTG associated with CVD diagnoses or events from 21 studies comprising 5814 participants. Subgroup analyses underscore the potential benefits of certain protective factors, such as coping strategies and spirituality, although perceived social support needs more evidence. Yet, it remains unclear whether such factors may mitigate negative impacts of specific medical indices and stressors, or function as moderators or mediators for the protection of the CVD-based PTG. Because certain psychiatric disorders are known as CVD mortality risks, more research is desirable to reveal the relationship between the two sides of outcomes in CVD patients.

Prospective designs with large samples for the PTG trajectory should be used to extend the tested associations to identify whether post-CVD-event PTG would predict better clinical outcomes. An unexplored area is using PTG to predict survival of CVD patients.

Investigations should provide more valid information for generalizability and causality. If the assumption that an altered worldview would enhance behavior changes or CVD rehabilitation is evident, interventional research should be developed to interdisciplinary cardiac care. The concept of PTG may have important implications for clinical practices with CVD patients, because it indicates a critical aspect of readjustment and better wellbeing after traumatic events such as severe ailments. Advancing this area of research may help ameliorate traumatic events in relation to CVD and, eventually, to improve the patient-centered CVD practice.

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**Figure 1: Flowchart of Study Selection**

A screenshot of a computer screen

Description automatically generated

**Table 1: Overview of the selected studies (k=21) for main analysis**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Source | Year | Sample size | Male,% | Age (mean) | Entry criteria | Follow up | PTG Mean | PTG SD |
| Bluvstein et al. | 2013 | 82 | 60 % | 64 | Coronary heart disease | 6 months | 41.3 | 27.3 |
| Hu et al. | 2020 | 65 | 70.80% | N/A (>18) | Stroke | 3 months | 56.94 | 9.11 |
| Kearns et al. | 2020 | 304 | 65.5% | 66 | Cardiovascular diseases | ~12 months | 55.5 | 33.0 |
| Kelly et al. | 2018 | 43 | 58% | 75 | Stroke | 6 months | 51.53 | 26.25 |
| Leung et al. | 2012 | 2636 | 75% | 65 | Coronary artery disease | 1 year | 47.3 | 8.5 |
| Leung et al. | 2010 | 1497 | 71.30% | 66 | Coronary artery disease | 9 months | 50.3 | 27.2 |
| Łosiak & Nikiel | 2014 | 53 | 60.37% | 57 | Myocardial infarction | ~5.5 weeks | 47.28 | 21.83 |
| Magid et al. | 2019 | 52 | 69.20% | 65 | Cardiac disease | 43 months | 35.25 | 15.93 |
| Maria et al. | 2021 | 44 | 100% | 63 | Myocardial infarction | N/A | 18.77 | 7.01 |
| Overbaugh & Parshall | 2017 | 103 | 76% | 74 | Heart failure | N/A | 48.6 | 28.6 |
| Rahimi et al. | 2016 | 166 | 84.9% | 55 | Myocardial infarction | ~7.78 months | 68.39 | 19.40 |
| Sheikh | 2004 | 110 | 79% | 64 | Heart disease | ~5 years | 55.85 | 24.19 |
| Aydındoğmuş, A., & Savaşan, A. | 2022 | 25 | 88% | 55 | Myocardial infarction | 3 months | 76.24 | 17.80 |
| De Oliveria et al. | 2023 | 63 | 65% | 65 | Heart failure | 1 year | 67.02 | 13.26 |
| Gangstad et al. | 2009 | 60 | 56.67% | 72 | Stroke | N/A | 50.33 | 19.92 |
| Huang et al. | 2021 | 158 | N/A | N/A | Stroke | 3 months | 54.89 | 23.08 |
| Karagiorgou & Cullen | 2016 | 47 | 79% | 66 | Myocardial infarction | N/A | 54.6 | 23.6 |
| Kuenemund et al. | 2016 | 42 | 64% | 53 | Stroke | ~ 21 months | 57.69 | 19.28 |
| Ogińska-Bulik, N | 2014 | 86 | 72.10% | 61 | Myocardial infarction | N/A | 61.54 | 16.75 |
| Oginska-Bulik, N., & Gurowiec, P. J. | 2020 | 63 | 61.90% | 67 | Myocardial infarction | N/A | 37.05 | 17.67 |
| Peng, & Wan | 2018 | 115 | 70.4% | 62 | Stroke | 6 months | 61.12 | 25.41 |

**Table 2 :** Overview of the selected studies (k=13) for subgroup analysis

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Source | Year | Sample size | Male,% | Age (mean) | Entry criteria | Follow up, y | Determinant |
| Ai et al. | 2013 | 262 | 60% | 62 | Cardiovascular diseases | 2.5 years | Depression, Coping, Spirituality, Social Support, Age, Gender |
| Garnesfski et al. | 2008 | 139 | 82% | 35-70 | Myocardial infarction | 3~12 months | Depression, Coping, Spirituality, Age, Gender |
| Hu et al. | 2020 | 65 | 70.80% | N/A (>18) | Stroke | 1 month | Depression, Spirituality, Social Support |
| Javed & Dawood | 2016 | 90 | 58% | 45-65 | Myocardial infarction | 1 month – 3 years | Coping, Social Support |
| Kelly et al. | 2018 | 43 | 58% | 75 | Stroke | 6 months | Coping, Social Support |
| Łosiak & Nikiel | 2014 | 53 | 60.37% | 57 | Myocardial infarction | ~5.5 weeks | Coping, Spirituality |
| Magid et al. | 2019 | 52 | 69.20% | 65 | Cardiac disease | 43 months | Coping, Age |
| Overbaugh & Parshall | 2017 | 103 | 76% | 74 | Heart failure | N/A | Age, Gender |
| Rahimi et al. | 2016 | 166 | 84.9% | 55 | Myocardial infarction | ~7.78 months | Social support |
| Sheikh | 2004 | 110 | 79% | 64 | Heart disease | ~5 years | Coping. Social Support |
| Senol-Durak & Ayvasik | 2010 | 132 | 11.4% | 52 | Myocardial infarction | N/A | Depression, Coping, Social Support, Age, Gender |
| Gangstad et al. | 2009 | 60 | 56.67% | 72 | Stroke | N/A | Depression, Coping |
| Peng & Wan | 2018 | 115 | 70.4% | 62 | Stroke | 6 months | Social Support |

**Figure 2 : Forest Plot of Main Analysis**A graph with numbers and lines

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**Table 4 : Results Summary of subgroup analysis**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Correlate** | **K** | **N** | **ES** | **95% CI lower** | **95% CI upper** | **I2** |
| Depression | 5 | 658 | -0.15 | -0.41 | 0.11 | 91.96% |
| Coping Strategies | 9 | 941 | 0.50 | 0.33 | 0.66 | 93.04% |
| Spirituality | 4 | 519 | 0.56 | 0.38 | 0.75 | 89.38% |
| Social Support | 8 | 983 | 0.29 | -0.05 | 0.62 | 98.25% |
| Age | 5 | 688 | 0.04 | -0.12 | 0.20 | 78.49% |
| Gender | 4 | 636 | 0.10 | 0.03 | 0.18 | 11.01% |

**Appendix**

**Table 3: Statistical result of Main Analysis**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Fixed-Effects Model (k=21)** |  |  |  |  |  |  |  |
|  | Estimate | SE | Z | p | CI Lower Bound | CI Upper Bound |  |
| Intercept | 45.9 | 3.35 | 13.7 | <0.001 | 39.332 | 52.474 |  |
| **Heterogeneity Statistics** |  |  |  |  |  |  |  |
|  | Tau | Tau2 | I2 | H2 | df | Q | p |
|  | 0.000 | 0 (SE=N/A) | 23.86% | 1.313 | 20.000 | 26.267 | 0.157 |

**Figure 3: Forest plot for Depression related PTG among CVD people**

A graph with numbers and a line

Description automatically generated

**Figure 4: Forest plot for Coping Strategies related PTG among CVD people**

A graph with numbers and a line

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**Figure 5: Forest plot for Spirituality related PTG among CVD people**

A graph with black dots and numbers

Description automatically generated

**Figure 6: Forest plot for Social Support related PTG among CVD people**

A graph with numbers and a line

Description automatically generated  **Figure 7: Forest plot for Age related PTG among CVD people**

A graph with numbers and lines

Description automatically generated

**Figure 8: Forest plot for Gender related PTG among CVD people**

A graph with numbers and a line

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