Quantifying the Effect of Cardiopulmonary Resuscitation Quality on Cardiac Arrest Outcome: A Systematic Review and Meta-Analysis

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Background

Evidence has accrued that cardiopulmonary resuscitation (CPR) quality impacts cardiac arrest outcome. However, the relative contributions of chest compression components (such as rate and depth) to successful resuscitation remain unclear.

Objectives

We sought to measure the effect of CPR quality on cardiac arrest outcome via systematic review and meta-analysis.

Methods

A comprehensive search of the published and unpublished literature was performed with the use of PubMed Plus, MEDLINE (Ovid), the Cochrane Library, ClinicalTrials.gov, grey literature sources (OpenGrey, CAB Abstracts), related articles, hand-searching of reference lists, and direct author contact. We sought any clinical study assessing CPR performance on adult cardiac arrest patients where survival was a reported outcome, either as return of spontaneous circulation (ROSC), survival to admission, or survival to discharge.

Statistical Methods

Effect sizes were reported as mean differences. Missing data were resolved by author contact. Estimates were segregated by CPR metric (chest compression rate, depth, no-flow fraction, and ventilation rate), and a random-effects model was applied to estimate an overall pooled effect. Evidence for statistical heterogeneity was tested via goodness of fit (X^2) and the I^2 measure. The Begg adjusted-rank correlation test and funnel plots were performed to assess publication bias. Analyses were completed using a statistical software package (STATA 11; StataCorp, College Station, TX) with α set at 0.05.

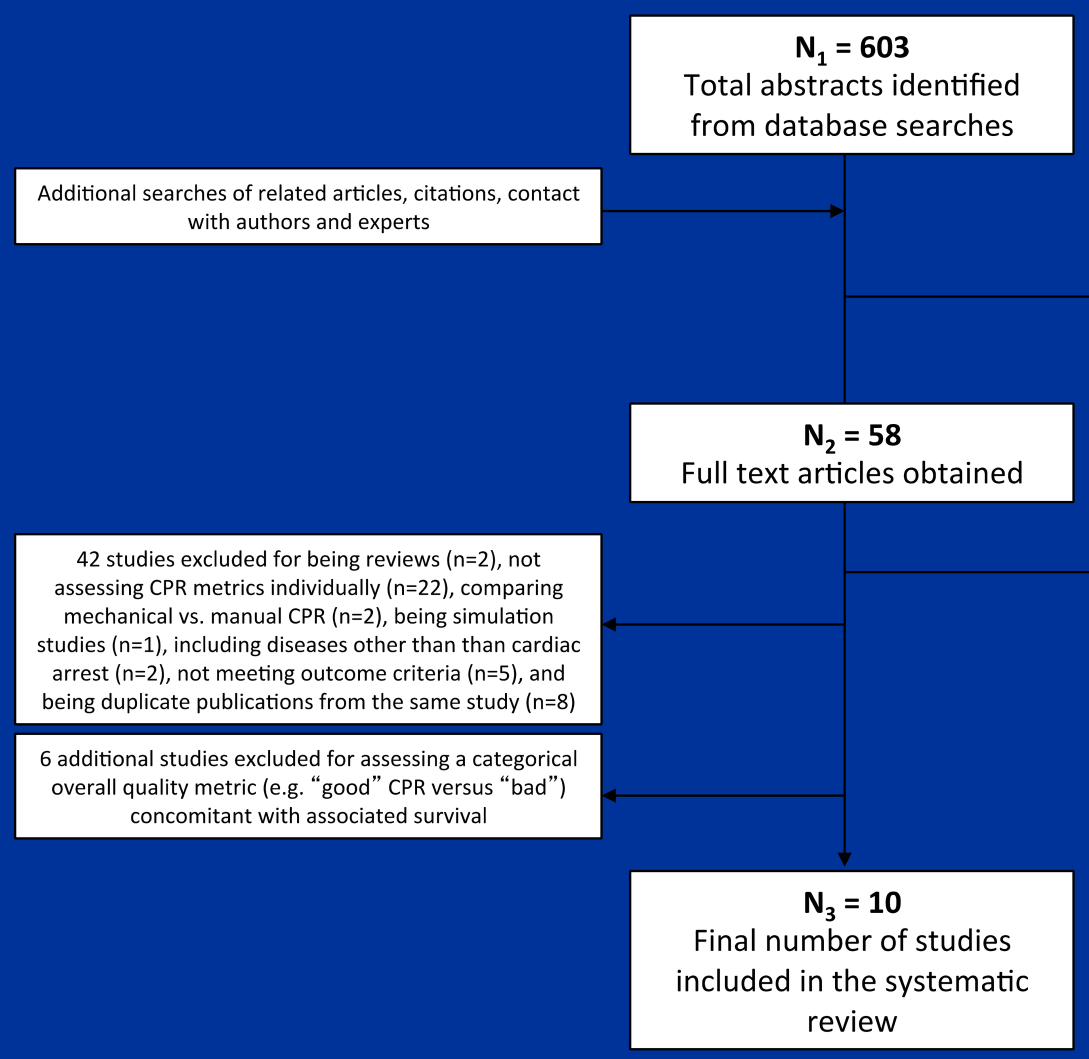

Figure 1. Screening and selection process for studies of CPR quality and survival outcomes.

Results

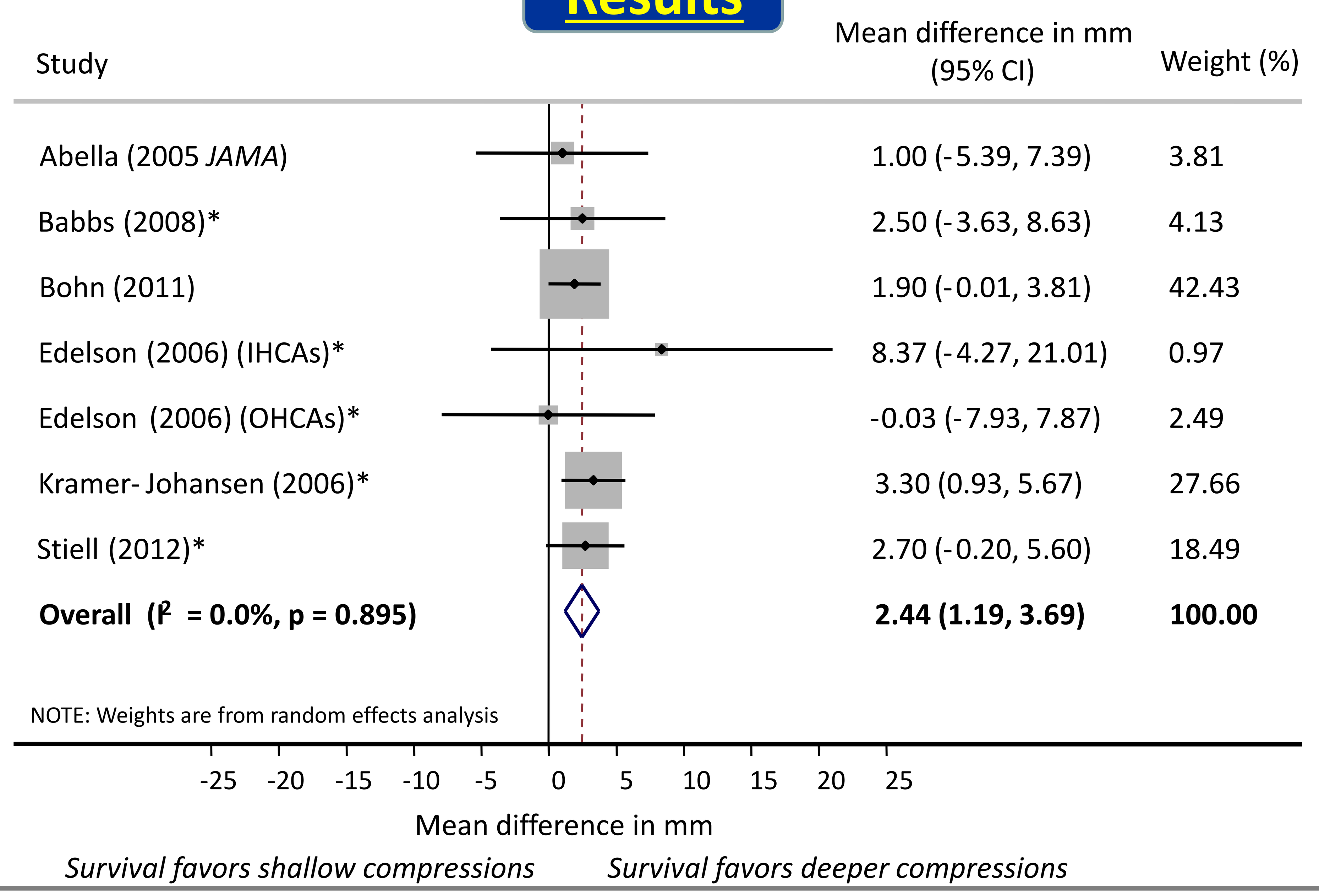

Figure 2. Random-effects meta-analysis of mean differences **in chest compression depth (mm)**, survivors vs. non-survivors. Includes 4 cohort studies and 2 post-hoc analyses of clinical trials, representing 77 IHCA and 1,815 OHCA events. Positive values indicate that survival favors deeper chest compressions. Tests for heterogeneity were not significant. The size of the data marker corresponds to the weight of that study. Error bars represent 95% confidence intervals. *Indicates estimates derived from new data requested from authors.

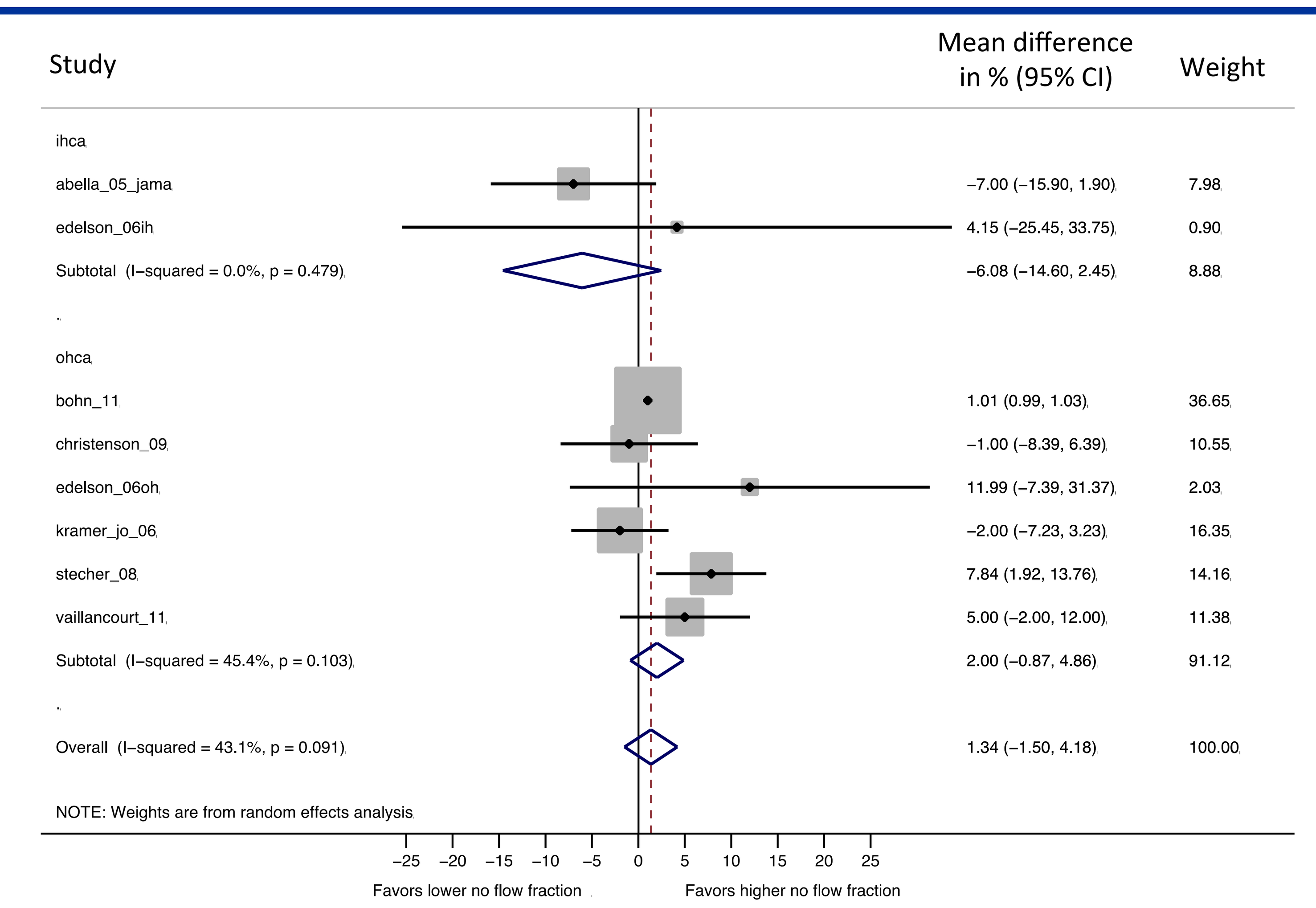

Figure 3. Random-effects meta-analysis of mean differences in **no-flow fraction (%)**, survivors vs. non-survivors, stratified by OHCA vs. IHCA. Includes 5 cohort studies and 2 post-hoc analyses of clinical trials, representing 79 IHCA and 3,345 OHCA events. Tests for heterogeneity were not significant.

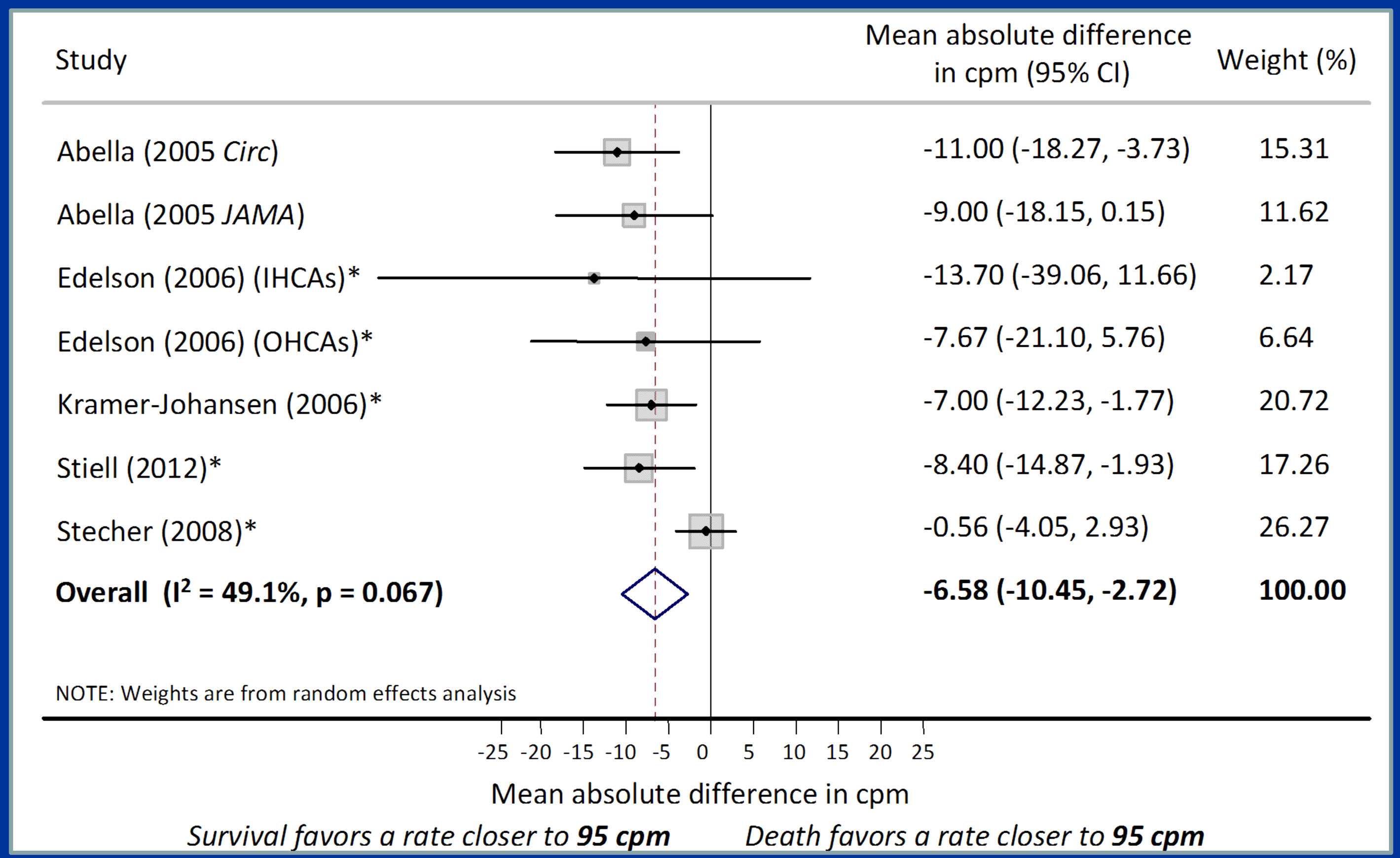

Figure 4. Random-effects meta-analysis of the mean absolute difference in **chest compression rate (cpm)** from a set point of 95 cpm, survivors vs. non-survivors. Includes 5 cohort studies, 1 post-hoc analysis of a clinical trial, 176 IHCA, and 1,465 OHCA. Negative values indicate that survival favors proximity to the specified rate set point. Tests for heterogeneity were not significant. A significant relationship with survival was observed at set points of 85 cpm, 90 cpm, and 100 cpm (data not shown).

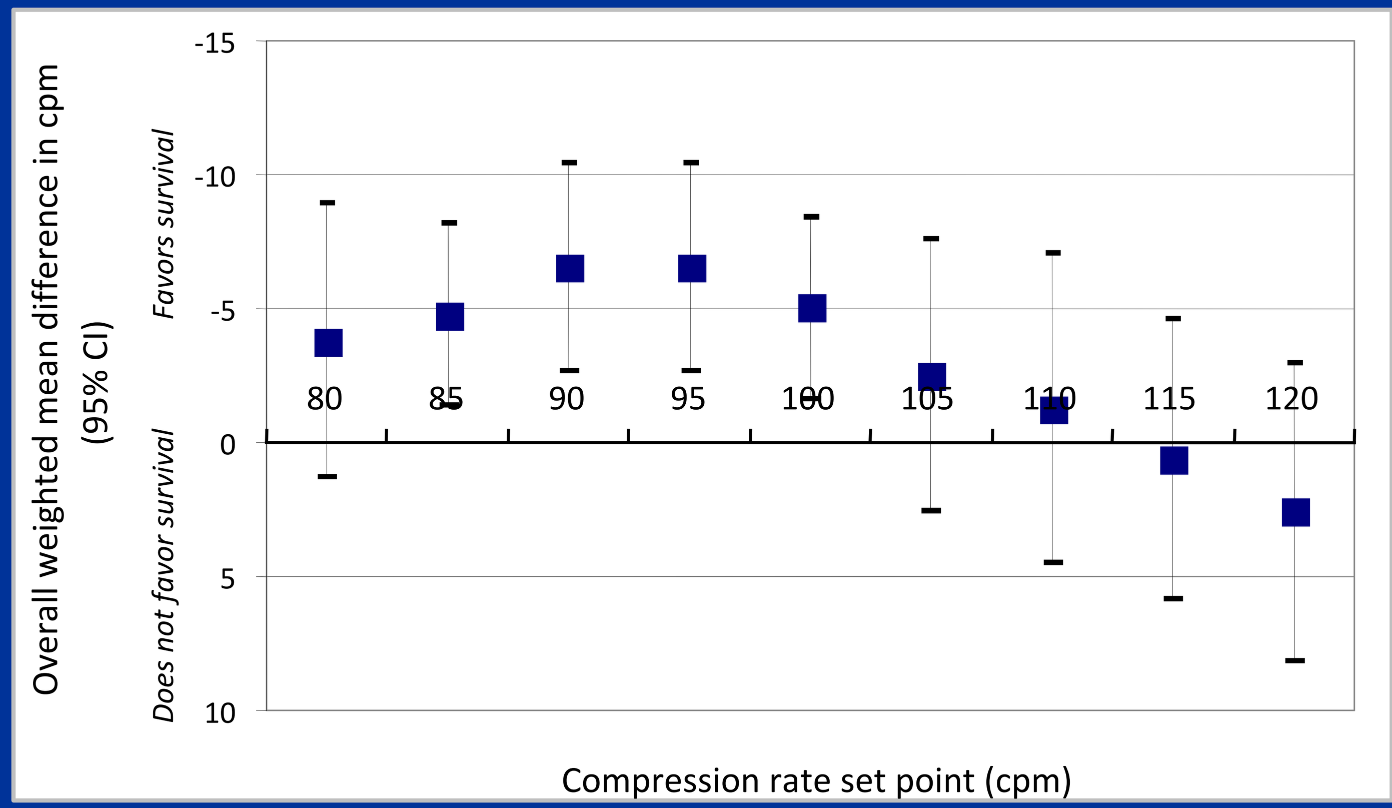

Figure 5. Overall mean absolute differences in chest compression rate (cpm), survivors vs. non-survivors, plotted for rate set points between 80 cpm and 120 cpm. Each data marker represents the overall weighted result from a meta-analysis at that specific set point. Negative values indicate that survival favors proximity to the specified rate set point. Error bars represent 95% confidence intervals. Survival favored chest compression rates between 85 and 100 cpm. Survival did not significantly favor rates ≤80 or ≥105 cpm

Conclusions

Deeper chest compressions and rates closer to 85-100 cpm are significantly associated with improved survival from cardiac arrest.

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