Does self-monitoring reduce blood pressure? Meta-analysis with meta-regression of randomized controlled trials

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CRD summary
This review reported that self-monitoring in adults reduced blood pressure by a small but significant amount. Significant heterogeneity could not be explained by meta-regression. The authors' conclusions appeared to follow from the evidence presented, but limitations of data and analyses mean a cautious interpretation is advised.

Authors' objectives
To compare the effect on blood pressure and blood pressure control of self-monitoring compared with usual care in adults.

Searching
MEDLINE, EMBASE, Cochrane Database of Systematic Review, DARE, HTA Database, NHS EED and TRIP were searched for studies published up to January 2009. Search terms were reported. Previous systematic reviews and meta-analyses and the reference lists of included studies were screened for further studies.

Study selection
Randomised controlled trials (RCTs) that compared self measurement of blood pressure without professional intervention against usual care (not including patient self-monitoring) were eligible for inclusion in the review. Eligible studies had to report self measurement blood pressure and independently measured blood pressure (either systolic or diastolic office pressure or ambulatory monitoring expressed as mean daytime ambulatory pressure).

Where reported, included studies assessed automated (40%), manual (20%), digital/electronic (20%) and semi-automated (8%) measurement devices. Four studies made no adjustment for self-measured readings and six made adjustments (usually 5/5mmHg); the other studies did not report any information regarding adjustments. Control groups were mostly usual or routine care; three studies used drug treatment as a control. Most of the included studies reported a target office blood pressure of 140/85-95mmHg. Approximately half of the included studies included cointerventions and self-monitoring. Cointerventions included patient education, phone contact or home visits, family involvement and telemetry. Seven studies included more than one cointervention.

The mean age of included participants ranged from 47 to 77 years; most studies assessed participants with a mean age of less than 60 years. Patients were mostly recruited from primary care settings or the community. Most participants either had uncontrolled hypertension or were undergoing hypertensive treatment.

Reported outcomes were mean office systolic blood pressure and diastolic blood pressure, change in mean daytime ambulatory systolic blood pressure and diastolic blood pressure between baseline and follow-up, and change in the proportion of patients with office-measured blood pressure controlled below target between intervention and control groups.

Studies were selected by two independent reviewers.

Assessment of study quality
The authors did not state that they assessed validity.

Data extraction
Data were extracted using a standardised form. Standard deviations were extracted (or imputed from other data where necessary). Dichotomous data were reported as relative risks (RRs) with 95% confidence intervals (CIs). Any adjustments for self-monitored measurements in comparison with office measured blood pressure were extracted. Where data were reported for more than one follow-up time point, data for the longest follow-up were used. Study
authors were contacted for missing data.

Data were extracted independently by two reviewers. Disagreements were resolved through consensus or adjudication by a third reviewer.

**Methods of synthesis**

Studies were grouped according to outcome. Pooled weighted mean differences (WMDs) and relative risks with 95% CIs were calculated using a random-effects model. Publication bias was assessed using funnel plots. Heterogeneity was assessed using $X^2$ and $I^2$ tests. Where there was evidence of significant heterogeneity, this was explored further using meta-regression. Predefined variables were age, gender, length of follow-up, use of cointerventions, adjustment for self-monitoring and inclusion criteria for diastolic blood pressure. Sensitivity analyses were carried out to assess the effects of including multiple intervention arm studies and the impact of each study through stepwise removal.

**Results of the review**

Twenty-five RCTs with a total of 27 comparisons were included in the review. Follow-up duration ranged from eight weeks to 36 months; 36% of the studies had a follow-up duration of at least one year.

Compared with usual care, both office systolic blood pressure (WMD -3.82 mmHg, 95% CI -5.61 to -2.03; 21 RCTs, n=5,898) and diastolic blood pressure (WMD -1.45 mmHg, 95% CI -1.95 to 0.94; 23 RCTs and 25 comparisons, n=6,038) were significantly reduced in the self-monitored patients. The chance of meeting office blood pressure targets was significantly improved for self-monitored patients (RR 1.09, 95% CI 1.02 to 1.16; 12 RCTs and 13 comparisons, n=2,260). There was evidence of significant heterogeneity for each of the pooled estimates. There was no significant difference in daytime ambulatory blood pressure between the intervention and usual care groups.

Meta-regression largely failed to explain the presence of heterogeneity. There was some evidence that variations in use of additional cointerventions may have partly been responsible for the heterogeneity in office blood pressure targets.

The authors reported that funnel plots showed a risk of missing studies, but these were likely to have had small sample sizes and so little effect on the overall results.

**Authors’ conclusions**

Self-monitoring of blood pressure in adults reduced blood pressure by a small but significant amount. Evidence of significant heterogeneity could not be explained by meta-regression.

**CRD commentary**

This review addressed a clearly defined research question. A number of relevant literature sources were searched. Only published studies were eligible for inclusion, so there was a risk of publication bias. The authors concluded that missing studies were likely to have small sample sizes and unlikely to pose a significant risk. Risks of reviewer error and bias were likely to be low as two reviewers were involved in study selection and data extraction. Risk of bias within the included studies was not assessed and so the reliability of the data was unclear; some issues that may have impacted on the methodological quality of the studies were mentioned.

The authors reported a significant level of heterogeneity between the studies. Attempts to further investigate the source of this heterogeneity failed to provide an adequate explanation; the authors suggested that other factors, not investigated in this review, may have played a role. The pooled effect sizes in some cases included multiple treatment arms from the same studies that effectively led to duplication of control group data; this suggested that the pooled values were at risk of bias.

The authors’ conclusions appeared to follow from the evidence presented, but limitations of the data and analyses mean that a cautious interpretation is advised.

**Implications of the review for practice and research**

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Practice: The authors stated that target blood pressure goals for treatment as recommended by American Heart Association, American Society for Hypertension and Preventive Cardiovascular Nurses Association (<135/85mmHg or <130/80mmHg for high-risk patients) were not supported by robust evidence.

Research: The authors stated that further studies (possibly individual patient data) were required to investigate types of cointerventions and how different combinations may optimise effects of reducing blood pressure and reaching patients' target blood pressure. Future studies should carefully consider the design of their intervention and use of outcomes (such as ambulatory monitoring) that were less likely to be affected by habituation to blood pressure measurement. Potential sources of heterogeneity (such as timing of self-monitored readings, self-monitoring setting and treatment changes) should be investigated.

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