Canadian Journal of Cardiology 29 (2013) 613–621

Systematic Review/Meta-analysis

Reducing Blood Pressure With Internet-Based Interventions: A Meta-analysis

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ABSTRACT

Background: Elevated blood pressure is a leading risk factor for cardiovascular disease and mortality. Internet-based interventions (e-counselling) have the potential to deliver a wide range of preventive counselling services. The purpose of this review was to (1) assess the efficacy of e-counselling in reducing blood pressure and (2) identify key components of successful trials in order to highlight factors that may contribute significantly to blood pressure control.

Methods: MEDLINE, PubMed, EMBASE, PsycINFO, and the Cochrane Library were searched up to June 2012 with the following key words: Web-based, Internet-based, e-counselling, mobile health, blood pressure, and hypertension. Trials were selected in which blood pressure was reported as a primary or secondary outcome and whose participants had baseline systolic and diastolic blood pressure within the prehypertensive (120-139/80-89 mm Hg) or hypertensive ($\geq$ 140/90 mm Hg) range.

RÉSUMÉ

Introduction : L'hypertension artérielle est l'un des principaux facteurs de risque de maladie cardiovasculaire et de mortalité. Les interventions par Internet (counseling en ligne) ont le potentiel d'offrir une vaste panoplie de services en counseling préventif. Le but de cette revue était : 1) d'évaluer l'efficacité du counseling en ligne en ce qui a trait à la diminution de la pression artérielle; 2) de déterminer les composantes clés d'essais réussis pour souligner les facteurs qui peuvent contribuer de manière significative à la maîtrise de la pression artérielle.

Méthodes : Les bases de données MEDLINE, PubMed, EMBASE, PsycINFO et la Bibliothèque Cochrane ont été examinées jusqu'en juin 2012 à l'aide des mots clés suivants : sur le Web, sur Internet, counseling en ligne, santé mobile, pression artérielle et hypertension. Les essais ont été sélectionnés parmi ceux dont la pression artérielle était rapportée comme un critère de jugement primaire ou secondaire,

Hypertension is a leading risk factor for cardiovascular disease, as well as a precursor for many other debilitating chronic health problems such as renal disease and dementia. It is estimated that hypertension contributes to 7.6 million premature deaths globally every year.[1] Lifestyle counselling is recommended as a first-line therapy for the treatment of hypertension and to lower the risk for cardiovascular events.[2] Systematic reviews have reported that lifestyle interventions including exercise training and diet modification can reduce systolic blood pressure by 3.0 to 8.7 mm Hg relative to controls.[3,4] However, a major challenge for community-based preventive programs is to extend the reach of preventive programs to individuals with hypertension.

The rapid growth of Internet use presents an incredible opportunity for preventive health initiatives. Internet-based health interventions can now be delivered by means of Web pages and e-mails that can be accessed by multiple devices, such as desktop computers, laptops, tablets, or Smartphones. Approximately 80% of adults in Canada have personal access to the Internet;[5] this group includes 70% to 76% of Canadians in the 2 lowest income quartiles, 71% of older Canadians (aged 55 to 64 years), and 71% of individuals living in rural areas. Moreover, growth in the technical sophistication of the Web during the past decade has supported the development of e-based interventions that are increasingly self-guided,

Received for publication December 8, 2012. Accepted February 5, 2013.

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See page 620 for disclosure information.

http://dx.doi.org/10.1016/j.cjca.2013.02.007

Results: The search strategy identified 13 trials, and the mean reduction of systolic and diastolic blood pressure was −3.8 mm Hg (95% confidence interval [CI], −5.63 to −2.06 mm Hg; $P < 0.01$) and −2.1 mm Hg (95% CI, −3.51 to −0.65 mm Hg; $P < 0.05$), respectively. The greatest magnitude of blood pressure reduction was found for interventions that lasted 6 months or longer, used 5 or more behavior change techniques, or delivered health messages proactively.
Conclusion: Research on preventive e-counselling for blood pressure reduction is at an early stage of development. This review provides preliminary evidence of blood pressure reduction with Internet-based interventions. Future studies need to evaluate the contribution of specific intervention components in order to establish a best practice e-counselling protocol that is efficacious in reducing blood pressure.

Résultats : La stratégie de recherche a relevé 13 essais dans lesquels la diminution moyenne de la pression artérielle systolique et diastolique était respectivement de −3,8 mm Hg (intervalle de confiance [IC] à 95 %, −5,63 à −2,06 mm Hg; $P < 0,01$) et de −2,1 mm Hg (IC à 95 %, −3,51 à −0,65 mm Hg; $P < 0,05$). La plus importante diminution de pression artérielle a été observée suite aux interventions qui ont duré plus de 6 mois, qui ont utilisé 5 méthodes de changement de comportement ou plus ou lorsque les informations relatives à la santé ont été transmises proactivement.
Conclusion : La recherche sur le counseling préventif en ligne pour la diminution de la pression artérielle est à un stade précoce de développement. Cette revue fournit des données scientifiques préliminaires sur la diminution de la pression artérielle par des interventions par Internet. Des études subséquentes doivent comparer la contribution des composantes spécifiques d'intervention pour établir un meilleur protocole de pratique du counseling en ligne qui est efficace dans la diminution de la pression artérielle.

interactive, and tailored to individual priorities for behaviour change.[6] Meta-analyses and systematic reviews of Internet-based interventions have reported therapeutic benefit in improving daily physical activity, reducing symptoms of anxiety, and increasing quality of life for diverse patient groups.[7-9] However, to our knowledge, no meta-analysis has examined the efficacy of Internet-based lifestyle interventions to reduce blood pressure. Substantial differences in content and clinical methods exist among Internet-based interventions.[10] Intervention protocols may differ in duration, target behaviours to be modified (exercise or diet), method of delivery (proactive vs reactive),[8] support style (user driven or expert driven),[11] and use of an explicit behavioural theory or repertoire of techniques.[12] These differences make it challenging to specify critical components of preventive e-counselling that are designed to reduce blood pressure.

The primary objective of this review was to examine the efficacy of Internet-based interventions in reducing systolic blood pressure (SBP) and diastolic blood pressure (DBP). Our secondary objective was to identify intervention components that may have contributed to blood pressure reduction.

Methods

This meta-analysis was based on guidelines from the Cochrane Handbook for Systematic Reviews of Interventions.[13] Reporting of results followed the Preferred Items of Systematic Reviews and Meta-Analyses guidelines.[14]

Search strategy

MEDLINE, PubMed, EMBASE, PsycINFO, and the Cochrane Library were searched up to June 2012 with the following key words: Web-based intervention OR Internet intervention OR e-counselling OR mobile health AND blood pressure OR hypertension. Reference lists from the relevant identified articles, recent review articles, or reports of clinical trials were also searched.

Inclusion criteria

Human trials that investigated the effect of Internet-based lifestyle interventions on SBP and DBP were included. We operationally defined an Internet-based intervention as preventive e-counselling or advice using Web sites or e-mails to modify exercise or diet as a means of improving blood pressure control. These Internet-based interventions were primarily self-guided, and access was gained via desktop computer, laptop, tablet, or smart phone. The duration of each intervention had to be at least 8 weeks in order to achieve clinically meaningful outcomes, including the participant's ability to learn and adhere to complex new behaviours, and to allow for sufficient time to demonstrate a stable reduction in blood pressure.[4] SBP and DBP had to have been reported as a primary or secondary outcome, measured at a clinic or office. Subjects were required to have blood pressure in the range of prehypertension (SBP, 120-139 mm Hg; DBP, 80-89 mm Hg) or hypertension ($\geq$ 140/90 mm Hg).[15] By using the blood pressure classification schema of the Joint National Committee, we were able to capture additional studies for a more comprehensive analysis of the efficacy of Internet-based interventions. Furthermore, the majority of the studies (56%) in this meta-analysis were conducted in the United States, where the Joint National Committee blood pressure classification guideline was likely to have influenced the inclusion criteria for trials of e-counselling. Studies that included supplemental components such as mobile text messages, telephone, or in-person support were also included. Randomized controlled trials or case-control studies where included.

Data extraction and quality assessment

For studies that met the inclusion criteria, 2 reviewers (S.L. and S.D.) independently extracted their study characteristics and results. In the event of conflicting opinions, resolution was achieved by consensus. The data review form comprised the following categories: (1) authors and year of publication, (2) sample characteristics (sample size, body mass index, age, blood pressure, attrition), (3) study design (randomization

method, target behaviour, interventions, additional components to Internet-based intervention, method of delivery, and support style), (4) behavioural theories, (5) behavioural techniques, and (6) study outcome (reduction of SBP and DBP).

Intervention duration was classified as short term (< 6 months) or long term (≥ 6 months). A coding scheme developed by Michie et al.[16,17] was used to categorize the behavioural theories and techniques used in each trial. Interventions were coded as having a particular theoretical basis only if the report included an explicit reference to a theory that was used to develop or guide an intervention. In contrast, coding for behavioural techniques referred to specific strategies used to evoke change in exercise or diet, such as problem solving, goal setting, or self-monitoring. The total number of behaviour change techniques was summed for each trial.

Method of delivery for each Internet-based intervention was classified according to whether it proactively or reactively engaged the subjects. In proactive Internet-based interventions, the e-platform initiated the contact to provide health information or feedback to subjects. Conversely, reactive Internet-based interventions required subjects to request and extract health materials or feedback from the e-platform. The support styles were also categorized as expert driven (protocol driven, prescriptive messaging), user driven (collaborative protocol with supportive messaging), or a combined approach. Expert-driven support prescribed specific changes for lifestyle behaviour. This approach was designed to present an explicit goal for behaviour change without allowing the patient to alter the therapeutic plan. In contrast, the user-driven method allowed the patient to identify the behaviour to be modified (eg, exercise or diet), the goal for behaviour change, or the techniques used to reach this goal. The combined approach reinforced collaboration between the e-platform and the patient through the use of expert- and user-driven features, as described above.

Baseline and postintervention mean $\pm$ SD for SBP and DBP were recorded when provided, as well as any reported *P* values for differences between pretreatment and posttreatment. Trials that did not report postintervention values had these values computed from the available data in the publication (mean difference within or between groups) via standard formulas.[18] Authors were contacted to provide additional information when necessary. In keeping with conventional practice,[19] missing SD values were imputed from the pooled SD of trials used in this meta-analysis.

The evaluation of study quality was based on the method used by Haynes et al.,[20] which was adapted to focus on Internet-based interventions in a previous meta-analysis.[21] Each study was evaluated according to 5 criteria: (1) study design, (2) selection and specification of the study sample, (3) specification of the medical condition, (4) reproducibility of the study, and (5) outcome specification or the validity and reliability of the measurement instruments. Studies could receive a maximum score of 18 points, and studies with a score of ≥ 12 were retained for the meta-analysis.

Statistical analysis

Meta-analyses were performed using Comprehensive Meta-Analysis (version 2) software. Mean end points of SBP and DBP were compared for the Internet-based intervention vs control. The effect size (ES) of each trial was calculated with the Hedges g statistic and the baseline and posttreatment SBP and DBP for treatment and control groups. Data were expressed as standardized mean differences (SMDs) and 95% confidence interval (CI). The use of SMD allowed the pooling of blood pressure results among interventions that varied in duration and intensity. Publication bias was assessed by conducting a funnel plot, the Begg and Mazumdar rank correlation tests.[22] Heterogeneity statistics were assessed by the Q statistic and I^2 statistics.

Pooled analyses for the overall ES were conducted with a random-effects model. The influence of the intervention components on the ES of blood pressure reduction was investigated with a series of subgroup analyses. Thus, studies were divided into categorical subgroups according to the duration of the study (< 6 months vs ≥ 6 months), use of behavioural theories, number of behaviour change techniques (< 5 vs ≥ 5), method of delivery (proactive vs reactive), use of supplemental components (yes vs no), target behaviours (diet or exercise vs diet plus exercise), and support styles (user-driven, expert-driven, or a combination). Finally, pooled effects for each subgroup were calculated with the fixed-effects model.

Two methods were used to guide the clinical interpretation of results. First, Cohen's d criteria were used to determine whether the SMD was small (< 0.2), moderate (0.2 to 0.5), or large (> 0.5). Second, mean change of blood pressure between intervention and control was also reported as a marker of clinical significance.

Results

Article selection

A total of 908 studies were identified within our database search. After reviewing the abstract and removing duplicate publications, 54 full-text articles were reviewed. Out of these articles, 13 met the inclusion criteria (Fig. 1).

Study characteristics

Six of the studies were conducted in the United States, 3 in South Korea, 2 in Canada, 1 in Australia, and 1 in Germany. There were a total of 11 randomized control trials and 2 studies that matched controls by age, sex, body weight, and blood pressure. See Supplemental Table S1 for a summary of the study characteristics.

The pooled sample across the 13 studies was 2221 individuals. The sample size in each trial ranged from 49 to 778 participants. Four of the studies had fewer than 100 participants. In total, 56% of the participants were men. The age range of participants was 18 to 89 years, with a mean age of 55 years. The population groups studied in the 13 studies included individuals with hypertension,[23-28] individuals who were obese,[29-32] individuals with diabetes,[33,34] and postmenopausal women.[35]

All blood pressure measurements were assessed during a face-to-face visit with a trained research assistant[23-25,27-35] or a nurse.[26] In the majority of the studies[23-27,30,31,33,35] ($n = 9$), baseline and postintervention blood pressure were

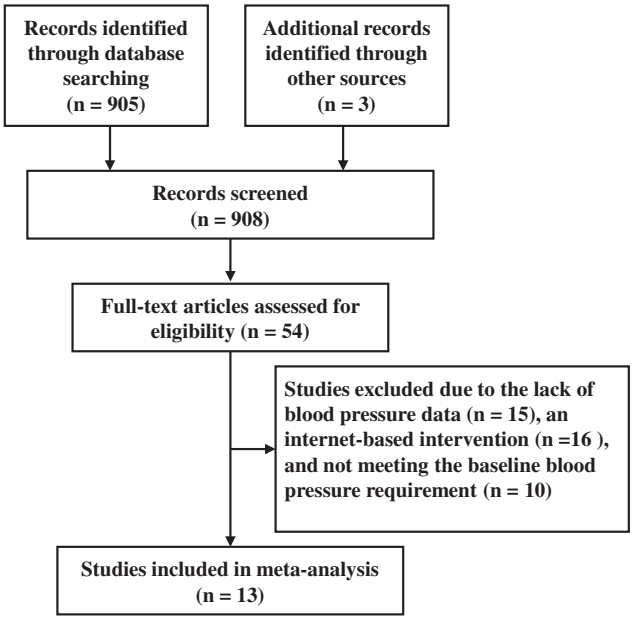

Figure 1. Flowchart illustrating literature search.

determined by averaging multiple (2 to 4) recordings. Studies with vs without multiple recordings for blood pressure outcome did not differ significantly in baseline adjusted reduction in SBP (mean ± SD: −4.3 ± 3.9 vs −2.9 ± 4.0 mm Hg; $P = 0.56$, respectively) and in DBP (−2.0 ± 3.0 vs −2.3 ± 2.8 mm Hg; $P = 0.87$, respectively). Baseline blood pressure across studies was 136 ± 6.4/82 ± 4.9 mm Hg (SBP ± SD/DBP ± SD). The mean body mass index was 31 ± 3.4 kg/m^2, which met criteria for obesity. Nine studies included blood pressure as the primary outcome, while 4 of the studies included blood pressure as a secondary outcome. Attrition ranged from 6% to 47% across the studies, with an overall mean of 21%.

Effectiveness of Internet-based intervention on blood pressure

Figures 2 and 3 provide forest plots of the main effects for SBP and DBP. Overall, Internet-based lifestyle intervention significantly reduced daytime SBP ($P = 0.002$) and DBP ($P = 0.03$), and the ES (SMD) for SBP and DBP was −0.27 (95% CI, −0.44 to −0.10) and −0.17 (95% CI, −0.33 to −0.01), respectively; see Figures 2 and 3. This ES translates into a decrease in SBP of 3.8 mm Hg (95% CI, −5.63 to −2.06) and DBP of 2.1 mm Hg (95% CI, −3.51 to −0.65). However, significant heterogeneity was observed for SBP (Q = 31.0; $P = 0.002$; $I^2 = 61$) and DBP (Q = 27.6; $P = 0.01$; $I^2 = 57$).

Publication bias

No publication bias was observed for SBP (Begg test, $P = 0.71$); however, the Begg test was significant for DBP ($P = 0.04$). The funnel plot for DBP indicates a bias toward studies that had large standard errors, and studies with null findings tended to be missing. This may be due to (1) the strict inclusion criteria, which resulted in the selection of only high quality studies, or (2) the smaller sample size observed in these studies. The failsafe N for DBP indicated that 27 studies with null findings would be required to assume an ES of zero.

The influence of specific attributes on study efficacy

Intervention duration. The mean intervention duration was 5.6 ± 3.6 months, with 8 of the 13 studies being short-term (< 6 months) and 5 being long-term (6-12 months). The ES of SBP was significantly greater ($P = 0.03$), for longer studies (ES = −0.44; 95% CI, −0.58 to −0.31) than for shorter studies (ES = −0.23; 95% CI, −0.36 to −0.10). The Q-statistic for SBP was 31.9 ($P = 0.001$). See Figure 4 for the forest plot. The change in mean SBP for long- and short-term studies was −5.8 mm Hg (95% CI, −4.3 to −4.1 mm Hg) and −3.47 mm Hg (95% CI, −5.2 to −1.7 mm Hg),

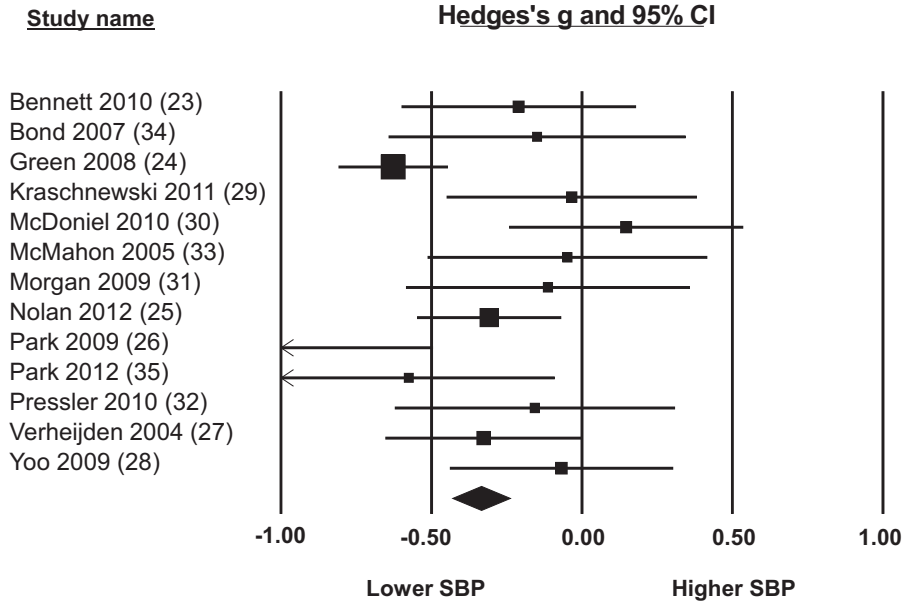

Figure 2. Forest plot of the effect of internet-based lifestyle intervention on systolic blood pressure (SBP) reduction. (**Squares**) Effect size with 95% confidence interval (CI) of a study;(**diamond**) overall effect size of all studies combined.

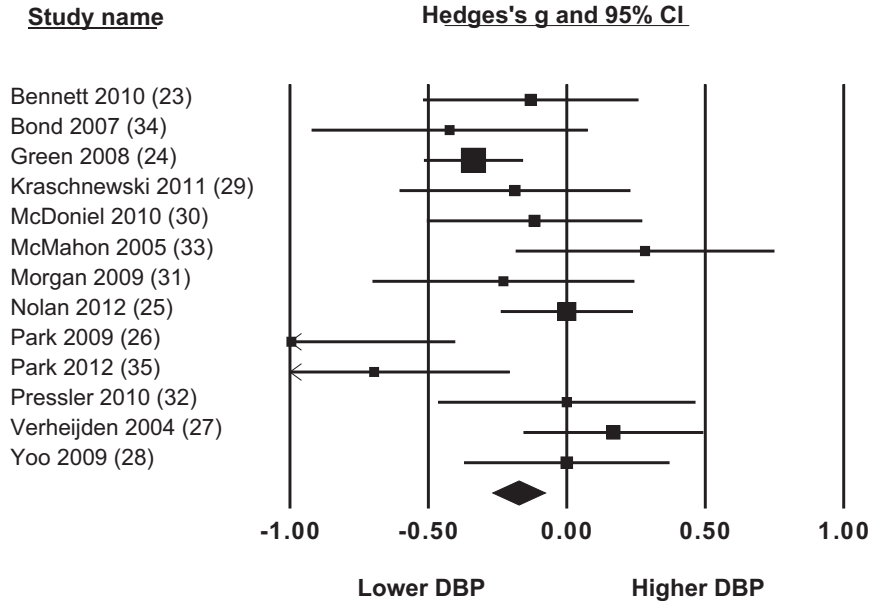

Figure 3. Forest plot of the effect of internet-based lifestyle intervention on diastolic blood pressure (DBP) reduction. (**Squares**) Effect size with 95% confidence interval (CI) of a study; (**diamond**) overall effect size of all studies combined.

respectively. No significant group difference was found for DBP ($P = 0.67$).

Theories and techniques of behaviour change. Only 3 studies[25,27,31] mentioned an explicit theoretical framework for their Internet-based intervention. Thus, this may have limited our ability to detect the effect of behaviour theories on intervention efficacy. However, we were able to identify the behaviour change techniques in all studies. The ES of SBP was significantly greater ($P = 0.01$) in those studies that used 5 or more behavioural change techniques (ES = −0.46; 95% CI, −0.60 to −0.33) as compared with studies that used fewer than 5 behaviour change techniques (ES = −0.19; 95% CI, −0.33 to −0.06). Similarly, a significant group difference for ES ($P = 0.002$) was observed with DBP. ES of DBP was −0.31 (95% CI, −0.44 to −0.18) and 0.001 (95% CI, −0.14 to 0.14) for those studies that used ≥ 5 and < 5 behaviour change techniques, respectively. The Q-statistics for SBP and DBP were 23.51 ($P = 0.001$) and 16.6 ($P = 0.12$), respectively. See Figure 5 for the forest plot. These results translate into a mean blood pressure reduction of −5.92/−2.45 mm Hg (95% CI, −7.43 to −4.42/−3.50 to −1.41)

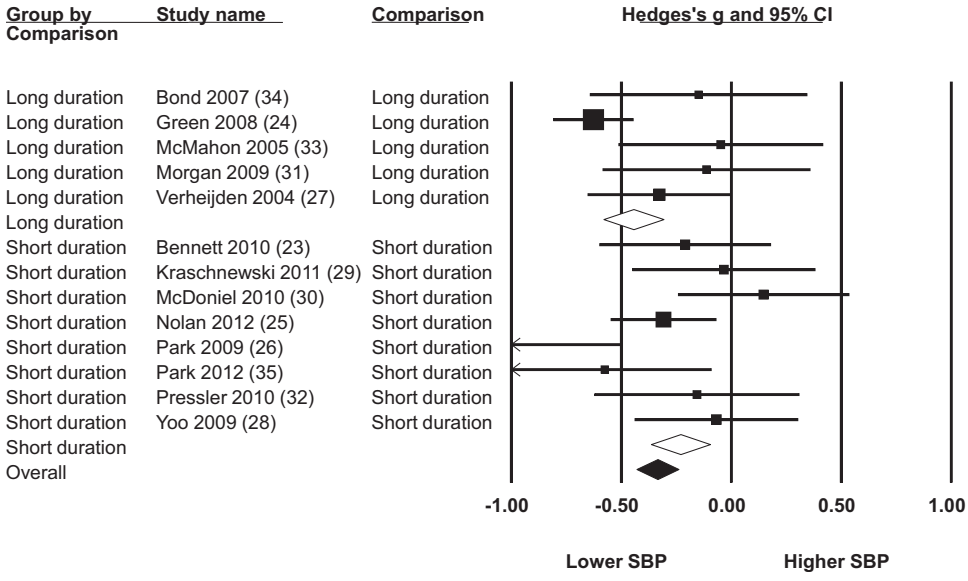

Figure 4. The overall change in effect size of systolic blood pressure (SBP) for short-term (< 6 months) versus long-term (≥ 6 months) internet-based interventions. (**Squares**) Effect size with 95% confidence interval (CI) of a study; (**white diamonds**) overall effect size of all studies combined in a subgroup; (**black diamond**) overall effect size of all studies combined.

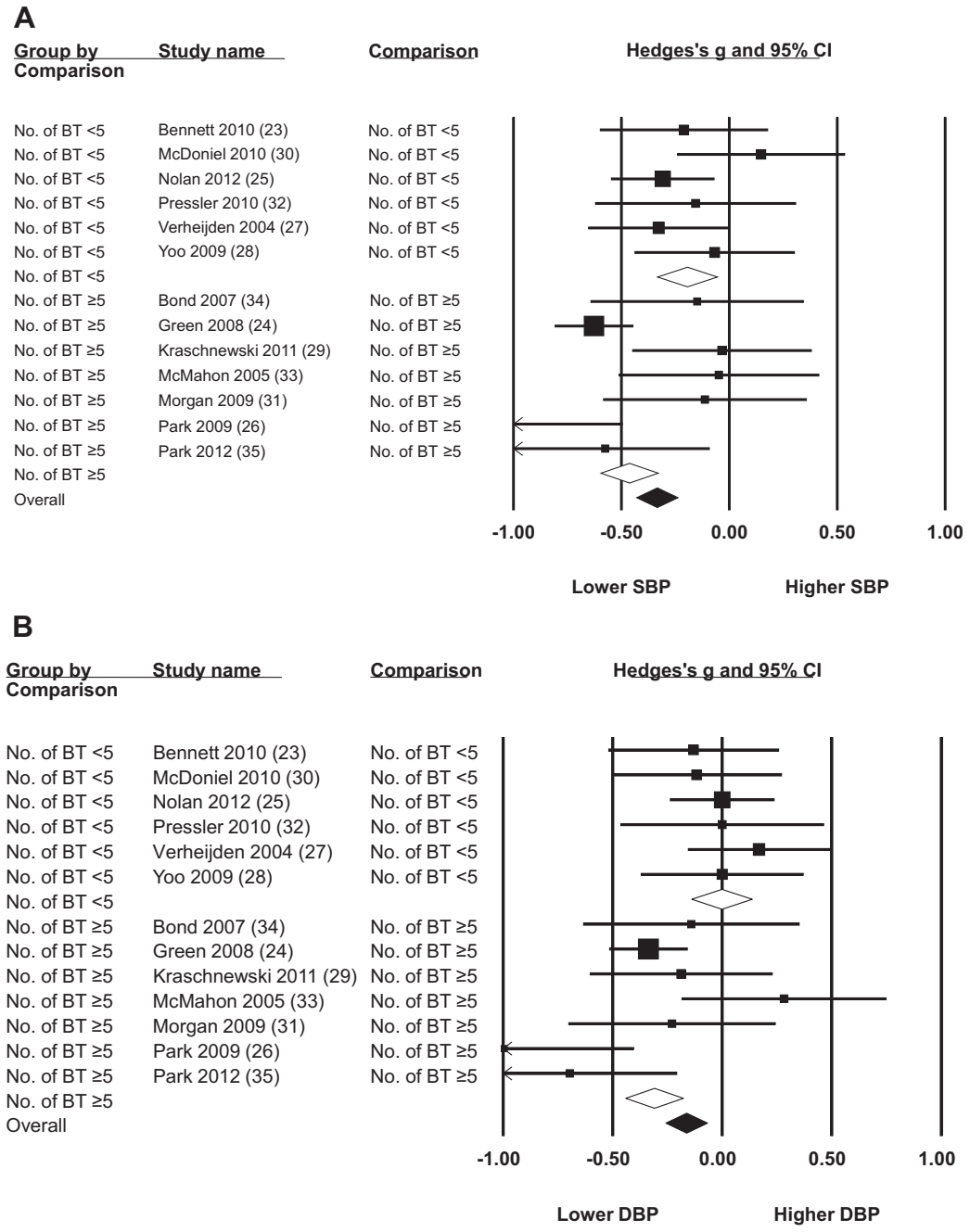

Figure 5. The overall change in effect size of systolic blood pressure (SBP) (**A**) and diastolic blood pressure (DBP) (**B**) for trials that used < 5 vs ≥ 5 behaviour changing techniques. (**Squares**) Effect size with 95% confidence interval (CI) of a study; (**white diamonds**) overall effect size of all studies combined in a subgroup; (**black diamonds**) overall effect size of all studies combined.

for those studies with < 5 behaviour change techniques and $-2.69/-0.02$ mm Hg (95% CI, -4.61 to $-0.78/-1.20$ to 1.17) for those studies with ≥ 5 behaviour change techniques.

Behaviour change techniques that were used in more than 50% of the successful Internet-based interventions included the following: providing information on consequences of behaviour in general (86% of studies), incorporating feedback on performance (86%), prompting self-monitoring of behaviours (71%), and giving instructions on how to perform the targeted change in behaviour (71%).

Method of delivery. We found significantly greater ES change for DBP ($P = 0.04$) using a proactive (ES $= -0.22$; 95% CI, -0.33 to -0.12) vs a reactive method (ES $=$ 0.04; 95% CI, -0.18 to 0.25). The Q-statistic was 27.67 ($P = 0.01$). The mean change of DBP for proactive and reactive was -1.78 mm Hg (95% CI, -2.62 to -0.93) and 0.36 mm Hg (95% CI, -1.78 to 2.49), respectively. Please see Figure 6 for the forest plot. No significant change for the ES of SBP was observed between these groups ($P = 0.41$).

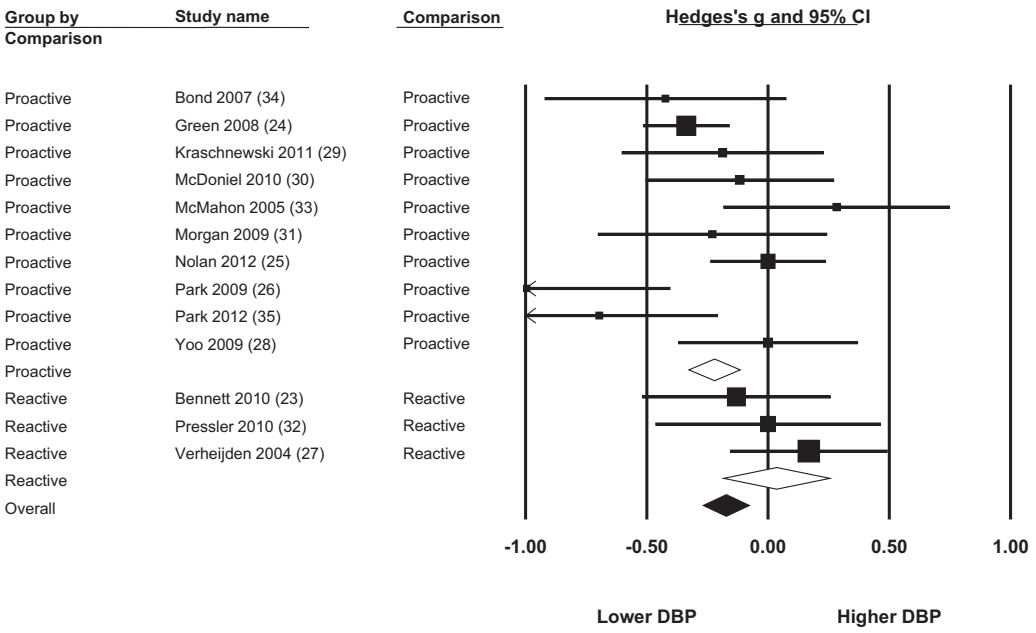

Figure 6. The overall change in effect size of diastolic blood pressure (DBP) for proactive vs reactive internet-based interventions. (**Squares**) Effect size with 95% confidence (CI) interval of a study; (**white diamonds**) overall effect size of all studies combined in a subgroup; (**black diamond**) overall effect size of all studies combined.

Supplemental components. Nine interventions had supplemental components that were not Internet-based, such as text messages (n = 3), in-person visits (n = 3), and live support (n = 3). No significant difference in ES for SBP ($P = 0.11$) or for DBP ($P = 0.26$) was found between those trials that included supplemental components vs those that did not.

Target behaviours. Ten studies targeted changes in both exercise and diet. Targeting both vs a single behaviour did not result in a significant difference in ES for SBP ($P = 0.20$) or DBP ($P = 0.27$).

Support style. The majority of Internet-based interventions in the studies used an expert-driven style (n = 9), and 1 study[24] used a combined user-driven and expert-driven approach. No significant SBP ($P = 0.88$) was found between support style groups. However, a statistical trend was observed for DBP ($P = 0.06$) favorable for expert-driven approach.

Discussion

The primary aim of the present meta-analysis was to evaluate the effectiveness of Internet-based interventions in reducing blood pressure in individuals with prehypertension or hypertension. We found that Internet-based interventions significantly reduced SBP by 3.8 mm Hg and DBP by 2.1 mm Hg. It is noteworthy that this change in SBP was comparable to the magnitude of blood pressure reduction reported in previous meta-analyses of face-to-face lifestyle counselling.[3,4] A reduction in SBP of 3 mm Hg is associated with an 8% reduction in stroke mortality and a 5% reduction in mortality from coronary heart disease.[36]

When evaluating specific intervention components, we found 3 attributes that may be associated with increased efficacy of e-counselling. First, Internet-based interventions that were at least 6 months in duration were associated with greater blood pressure reduction. This may be expected because the influence of lifestyle intervention on blood pressure may require a critical period of time in order to evoke a therapeutic change. Additionally, interventions with a longer duration may be required to facilitate comprehensive physical changes such as weight reduction, which in turn would result in a greater decrease in blood pressure.[37]

Second, we found that blood pressure was significantly reduced among interventions that provided a greater range of behaviour change techniques. The use of at least 5 techniques was the "tipping point" observed in our pooled sample. This finding raises several clinically relevant issues. It suggests that a critical number of techniques may be required to build a flexible repertoire of skills that are necessary to overcome situational stressors that might otherwise impede therapeutic lifestyle change. Further, the use of several techniques may be required to ensure that patients have the opportunity to develop a select set of skills in order to obtain positive efficacy and outcome expectations, which are necessary to sustain behaviour change and blood pressure reduction during the long term.[12,25] Finally, our review indicated that it is rare among trials of e-counselling to use an explicit model of behavioural counselling to evaluate the independent contribution of specific behaviour change techniques for blood pressure reduction. Therefore, a priority for future trials of preventive e-counselling is to design and evaluate e-counselling protocols according to theoretically grounded hypotheses. Indeed, this initiative would be consistent with the Consolidated Standards of Reporting Trials for E-health, which advises investigators to report sufficient details about their intervention to allow for replication and theory building.[38]

Third, the interventions that proactively sent e-messages to subjects were more effective than reactive interventions that

required them to log onto a Web site in order to receive e-counselling support. The proactive method of delivery may have enhanced the degree to which the e-program was perceived as providing sufficient support to modify exercise or diet. In addition, it has been reported that Internet-based interventions with greater than 5 proactive communications (e-mails or text messages) evoked significantly greater changes in physical activity than those with fewer contacts during the treatment program.[8,25] A dose-response relationship between e-counselling and therapeutic outcome requires further study.

The findings of this meta-analysis did not uncover evidence to support the hypothesis that blood pressure reduction is augmented with e-counselling programs that target multiple lifestyle behaviours or that provide supplementary components such as text messaging, in-person visits, and telephone support. These observations may have important implications when designing Internet-based interventions; however, future studies are needed to confirm our findings.

A historical challenge for preventive e-counselling has been a high attrition rate. This is of clinical concern since previous trials have reported a dose-response relationship between the number of log-ins to the e-counselling program and incremental improvement in treatment outcome.[25,39] It is unclear which methods or strategies are necessary to keep the users actively engaged in an e-counselling intervention. Ritterband et al.[40] suggested that engagement level for Internet-based intervention is influenced by both type of support and user characteristics (eg, readiness for change, demographics, beliefs and attitude, and intervention expectation). The majority of trials (n = 9) in this review used an expert-driven support (prescriptive, protocol driven), which limited the consideration of user characteristics (motivation, previous knowledge and skills). Future studies need to examine the influence of user characteristics on Internet-based intervention usage and intervention health outcome.

There are important limitations to this review. First, the ability to generalize our findings to the wider population with prehypertension or hypertension is limited by (1) the small number of clinical trials (n = 13) and by the restricted number of population groups that were enrolled in the available trials; (2) the relatively low baseline blood pressure, which may have contributed to a potential floor effect; and (3) the potential for publication bias when DBP was the reported outcome. The use of matched controls in 2 of the studies in our review would have increased the uniformity of characteristics in these samples, which may have added a further limitation to the generalizability of the results in this meta-analysis. Second, not all studies indicated that the outcome analysis was based on an intention-to-treat principle, and this oversight raises the possibility of bias in the reported results. In order to highlight potential limitations about the reported effectiveness of the intervention, it is important for future studies of Internet-based interventions to explicitly report whether the results are obtained according to the intention-to-treat principle by means of a per-protocol analysis. Finally, the majority of trials in this review did not specify whether the intervention was designed or organized according to an evidence-based theory of behavioural counselling. This lack made it challenging to interpret whether the behavioural techniques were used in a coherent and effective manner, and thus to their appropriate potential.

Conclusion

There is preliminary evidence supporting the efficacy of e-counselling as a complementary intervention for managing blood pressure. We found that Internet-based interventions may be more efficacious when a program lasts 6 months or longer, is delivered proactively, and provides at least 5 behaviour change techniques. In order to build an evidence-based guideline for preventive e-counselling, there is an immediate need to design trials that provide a direct comparison of specific intervention components (eg, duration, method of delivery) when evaluating program efficacy. An Internet-based strategy for preventive counselling is a relatively new tool that has the potential to complement medical therapy for blood pressure control.

Funding Sources

S. Liu was supported by the Ontario Student Opportunity Trust Fund.

Disclosures

The authors have no potential conflicts of interest.

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Supplementary Material

To access the supplementary material accompanying this article, visit the online version of the *Canadian Journal of Cardiology* at www.onlinecjc.ca and at http://dx.doi.org/10.1016/j.cjca.2013.02.007.