Internet programs targeting multiple lifestyle interventions in primary and secondary care are not superior to usual care alone in improving cardiovascular risk profile: A systematic review


Abstract

Objective: To review the effects of Internet delivered multiple modifiable lifestyle interventions complementary to usual care on cardiovascular risk factors in the primary and secondary healthcare setting.

Method: PubMed, EMBASE.com, CINAHL, PsycINFO, and the Cochrane Library were searched up to June 2012 for English written studies that 1) addressed multiple lifestyle interventions, 2) used Internet intervention through websites or email, 3) included at least one usual care group not using Internet, 4) aimed to improve any of cardiovascular risk factors and 5) targeted patients aged 18 or older.

Results: Our systematic search yielded 1857 citations of which 9 were selected for this review. Three studies reported significant differences in weight loss in favor of the intervention group and five studies reported non-significant differences between groups. From the 7 studies reporting on blood pressure (BP) measurements, two found significant improvement in favor of the intervention group, while the other studies found no significant differences. Only one study found a significant improvement of LDL-C in the intervention group compared to usual care. Another study found a significant improvement of HDL-C in the usual care group compared to the intervention group.

Conclusion: The addition of a multiple modifiable lifestyle Internet intervention in primary or secondary care is not superior to usual care with respect to prevention and treatment of cardiovascular risk factors. However, an Internet delivered program does have the potential of being successful in reducing the number of doctor’s visits and may therefore be cost-effective when applied in large scale.
1. Introduction

Presently, non-communicable diseases (NCDs) such as cardiovascular diseases, diabetes, cancer and chronic respiratory diseases are the main cause of death worldwide.\(^1\) Death under 60 years of age due to NCD ranges from 13% to 41% respectively in high- and low-income countries. In 2008, NCDs accounted for 89% of all deaths in the Netherlands, of which 31% was due to cardiovascular diseases and diabetes.\(^2\) Acute vascular events increase not only mortality, but also morbidity leading to chronic and invalidating complications. The consequent need for chronic medical care increases the burden on the healthcare budget. It has been predicted that the incidence of cardiovascular disease and related costs are going to increase even further in the future.\(^3\) Fortunately, most cardiovascular diseases are largely preventable by minimizing risk factors such as high blood pressure (BP), tobacco use, raised blood glucose, physical inactivity, overweight and obesity. Unfortunately, conventional healthcare provided by hospital outpatient departments (OPDs) or general practitioners (GPs) does not seem sufficient enough in proper treatment of these patients, since many do not reach their treatment goals such as adequate BP reduction\(^4\) or blood glucose control.\(^5\) In diabetic patients, intensifying treatment with tight glucose regulation, strict drug regimes and behaviour modification has been shown to decrease vascular complications and mortality.\(^6\) However, due to the expected increase in chronic healthcare consumption and imposed cost savings in healthcare, it does not seem feasible to provide intensive coaching/treatment for the majority of patients at-risk for cardiovascular diseases. Therefore, reorganization of the healthcare system with the aim of increasing efficiency using novel and innovative methods seems necessary. An example of a relatively new concept is the use of Internet and related technologies to deliver health services at distance, providing a promising method to maintain frequent contact between healthcare workers and patients, without overburdening of existing healthcare facilities. In addition, this type of healthcare can augment patient involvement and increase personal motivation to manage their own health. In the last decade, there has been a continuous stream of publications regarding the use of Internet in the prevention and treatment of cardiovascular diseases.\(^7\) Many studies investigated the effect of Internet delivered interventions on single risk behaviours such as physical activity\(^6\), smoking cessation\(^9\), alcohol consumption\(^10\) and dietary intake.\(^11\) However, cardiovascular diseases are generally related to a combination of multiple interrelated lifestyle risk factors which potentiate each other. Therefore, it can be said that cardiovascular prevention programs should focus more on multiple lifestyle interventions rather than a single intervention.\(^12,13\) To date, the effect of multiple lifestyle interventions in primary and secondary care is unclear. Evidence suggests that multifactorial lifestyle programs have small effects on the separate risk factors but that they are beneficial on major clinical outcomes because of their synergistic or summative effect.\(^14\) A disadvantage of multiple lifestyle interventions is that it might be burdensome and overwhelming for patients.\(^15,16\) Nevertheless, it has been demonstrated that simultaneously delivered lifestyle interventions can be equally successful as sequential delivered lifestyle interventions in obtaining multiple behaviour change.\(^17\)

We conducted a systematic review with the aim of evaluating whether Internet delivered care complementary to usual care improves cardiovascular outcomes. Because we believe that cardiovascular diseases need an integrated approach, we focused on original research articles that studied the effect of Internet-based multiple lifestyle interventions on cardiovascular outcomes on top of usual care (the conventional care delivered at the OPD), compared to patients receiving usual care alone.

2. Methods

2.1. Data sources and search terms

A comprehensive search was performed in the bibliographic databases PubMed, EMBASE.com, CINAHL (via EBSCO), PsycINFO (via EBSCO) and the Cochrane Library (via Wiley) up to June 25th, 2012. The search combined three topics: 1) prevention of cardiovascular disease, 2) lifestyle interventions, and 3) Internet. These topics were searched using controlled vocabulary (MeSH in PubMed, Emtree in EMBASE.com, etc.) and filtered to identify randomized controlled trials (RCTs) or case–control studies, meta-analysis, practice guidelines and (systematic) reviews. Meta-analysis, guidelines and reviews were included in the search to obtain additional information on this topic. Only free text terms were used in the Cochrane Library. The full search strategy is included in the appendix.

2.2. Selection criteria

Studies eligible for inclusion in this review were RCTs or case–control studies that (1) addressed multiple lifestyle interventions in two or more of the following domains: physical activity, dietary behaviour, alcohol use and smoking; (2) targeted adult patients in a primary or secondary healthcare setting with the aim of improving cardiovascular risk factors and preventing cardiovascular events; (3) included at least one group of patients receiving an ‘Internet–based’ intervention, which we defined as using either Internet websites or email contact for
information exchange, data transfer, feedback and/or communication; (4) included a ‘usual care’ control group defined as routine care received by patients in any primary or secondary healthcare setting; and (5) targeted improving cardiovascular risk profiles measured by at least one of the following outcome measures: weight (kilograms, kg), body-mass index (BMI, kg/m2), blood pressure (BP; mmHg), and laboratory investigations including total cholesterol (TC; millimoles per liter, mmol/L), triglycerides (TG; millimoles per liter, mmol/L), low-density lipoprotein cholesterol (LDL-C; millimoles per liter, mmol/L), blood glucose (millimoles per liter, mmol/L), high-density cholesterol (HDL-C; millimoles per liter, mmol/L), blood sugar (millimoles per liter, mmol/L) or hemoglobin A1C (HbA1c; %) levels. Primary outcome measurements had to be evaluated at baseline and during a predefined follow-up period. We excluded studies for this review if they: (1) included ‘usual care’ services that already incorporated Internet-based interventions in primary or secondary care delivery; (2) included patients aged 18 years or under; (3) were non-English articles; and (4) included pregnant woman. Book chapters, abstracts from conference proceedings, and dissertations were also excluded.

3. Results

3.1. Study selection
The search resulted in 1857 citations from which 122 were initially selected by a single reviewer based on title and abstract. Of these publications, 114 were excluded for several reasons: Studies not conducted in a primary or secondary healthcare setting (n = 37), without a ‘usual care’ control group (n = 10), without a control group at all (n = 6), comparison of Internet-based intervention to another technological intervention (Internet of telephome) (n = 23), Internet interventions for use by physicians or nurses only (n = 5), non-cardiovascular risk factor outcome measures (n = 9), manuscripts describing only the protocol without the results (n = 11), used data from identical study populations (n = 3), telephone-based intervention (n = 2), Internet intervention merely at baseline (n = 2), single cardiovascular risk factor interventions (n = 4), and full text article not available (n = 2). One publication impress was also added to the selection. As a result, nine publications were found eligible for inclusion in this review. See flowchart in figure 1.

3.2. Characteristics of the reviewed studies
Studies were published between 2003 and 2012. A total number of 2008 patients were enrolled in the nine studies at the time of inclusion with an average age of 54.9 years (range 45.3–62.0 years). The average intervention duration was 8.2 (range 2 to 12) months. Primary outcome measures of the studies were weight loss (n = 2) 18,19 cardiovascular disease risk management (n = 4) 20-23, hypertension control (n = 2) 24,25, and diabetes management (n = 1). 26 Mean lost to follow-up during the study period in the control groups was 14.6% (range 0–34.0%) and in the intervention groups 14.5% (range 0–29.3%).

3.2.1. Usual care
In all studies, usual care was defined as current standard healthcare services in the OPD. For a majority of the studies, patient visit frequencies were determined by the treating physician and therefore not further specified. 18-24,26 In the study of Park et al. 25, the usual care group was seen by the same hypertension specialist as the intervention group with a frequency of one or two times in 8 weeks. Adherence to standard of care was reported in only one article 24, and the primary care visits in this study were not different between usual care patients and both intervention groups, with an average of 3 visits in one year time.

3.2.2. Internet interventions
There was a large variety between the studies with regard to intervention intensity. In addition, all studies used a unique Internet program. Comparably, all Internet programs were designed for individual counseling with a personal login menu for each participant, allowing convenient and easy access. However, most studies advised patients to regularly use the website, varying from once every two weeks to at least three times a week (Table 1). Program adherence varied among the studies. Two studies reported that respectively 47% and 49% of patients never used the website. 19,20 Two studies did not report about the usage of the Internet program. 25,26 The other studies achieved their login goal on
average\textsuperscript{18,21-24}, however two of these studies also reported on login frequency during the study and found a decrease at the end of the study period. In one study, the motivational advice given on lifestyle and behavioural risk factors was generated by the computer system.\textsuperscript{19} The other eight studies complemented the website with a personal coach by the computer system.

A significant decrease of intervention group average body weight after 2 months of 1.6 kg (69.3 ± 10.3 to 67.7 ± 81 kg) compared to an increase of 1.0 kg (68.3 ± 10.1 to 69.3 ± 8.1 kg) in the usual care group (p = 0.034).

No significant changes were found in BMI between the groups at follow-up in the other studies reporting on this outcome.\textsuperscript{19-21,22,24} Broekhuizen et al.\textsuperscript{20} found a slight decrease of 0.1 kg/m\textsuperscript{2} (baseline BMI: 25.9 kg/m\textsuperscript{2}) compared to a steady BMI in the control group (baseline BMI: 27.1 kg/m\textsuperscript{2}) (mean difference −0.18; 95% CI −0.43 to −0.07) after 12 months. In the study conducted by Green et al.,\textsuperscript{24} groups started with a baseline BMI of 32.3 kg/m\textsuperscript{2}. The BMI of both the usual care and the intervention group increased after 12 months with 0.2 kg/m\textsuperscript{2} (difference of 0.0 kg/m\textsuperscript{2}; 95% CI −1.1–1.2), while the BMI of the extended intervention group decreased with 0.7 kg/m\textsuperscript{2} (mean difference of 0.9 kg/m\textsuperscript{2}; 95% CI −2.1–0.3). In the study of McConnon et al.,\textsuperscript{19} both intervention groups lost a significant amount of weight over a period of 12 months with a non-significant difference between groups of 0.6 kg (95% CI: −1.4–2.5; p = 0.56). The usual care group lost more weight compared with the intervention group, namely 1.9 kg and 1.3 kg respectively. In addition, a non-significant decrease in BMI was found between the intervention and usual care groups of 0.3 kg/m\textsuperscript{2} (95% CI −0.5–1.0), with a mean baseline BMI of 34.4 kg/m\textsuperscript{2} in both groups. Vernooij et al.\textsuperscript{23} reported a small increase in BMI from 28.2 kg/m\textsuperscript{2} to 28.6 kg/m\textsuperscript{2} in the intervention group and from 27.5 kg/m\textsuperscript{2} to 27.9 kg/m\textsuperscript{2} in the usual care group (mean difference −0.1 kg/m\textsuperscript{2}; 95%CI−0.5–0.4) after 12 months. In the study performed by Zutz et al.,\textsuperscript{21} a non-significant decrease was shown on BMI after 3 months in both groups, from 28.1 ± 3.1 kg/m\textsuperscript{2} to 27.5 ± 3.5 kg/m\textsuperscript{2}, and 26.1 ± 3.7 kg/m\textsuperscript{2} to 25.8 ± 2.4 kg/m\textsuperscript{2} in respectively the control and intervention group.

3.3. Effect on lifestyle behaviours

Physical activity (PA) was targeted in all studies, but was reported as an outcome measure in merely five studies using the following validated questionnaires: the Short Questionnaire Assessing Health-enhancing PA (SQUASH)\textsuperscript{20}, self-efficacy and the stages of exercise behaviour\textsuperscript{24}, the Baecke physical activity questionnaire\textsuperscript{19}, and the comprehensive evaluation of the Minnesota Leisure Time Physical Activity Questionnaire.\textsuperscript{21} One study reported minutes of weekly exercise.\textsuperscript{22} None of these studies found significant changes in PA between intervention and control groups. All nine studies intervened on dietary behaviour, of which three reported it as an outcome measure. Questionnaires used were: Food Frequency Questionnaire (FFQ)\textsuperscript{19}, a short Dutch questionnaire to measure fruit, vegetable and saturated fat intake\textsuperscript{20}, and the MEDFICTS score.\textsuperscript{22} None of the studies reported significant treatment effects between intervention and control groups. Three studies reported on tobacco use.\textsuperscript{20,22,23} Only one study found a significant treatment effect on smoking cessation, in favor of the Internet intervention group.\textsuperscript{23} None of the studies included in this review reported alcohol consumption neither at baseline nor at follow-up.

3.4. Effect on outcome measures

3.4.1. Weight and BMI

Results on weight and/or BMI were reported in all but one study (Table 2).\textsuperscript{26} Three studies found a significant decrease of BMI/weight in the intervention group compared to the control groups.\textsuperscript{18,22,25} Bennett et al.\textsuperscript{18} found a significant decrease in BMI of 0.94 kg/m\textsuperscript{2} in the intervention group (baseline BMI: 35.0 ± 3.5 kg/m\textsuperscript{2}) after 3 months compared to an increase of 0.13 kg/m\textsuperscript{2} in the control group (baseline BMI: 34.6 ± 3.2 kg/m\textsuperscript{2}), with a mean difference between groups of 1.07 kg/m\textsuperscript{2}; 95% CI 1.49–0.64. Mean weight difference between groups was 2.56 kg (95% CI −3.60–1.53). Southard et al.\textsuperscript{22} found a significant decrease in the intervention group BMI after 3 months from 30.9 to 30.3 kg/m\textsuperscript{2} compared to an increase in the control group BMI from 29.2 to 29.3 (p = 0.003). Mean difference in weight loss between these groups was 1.9 kg (p = 0.003). Park et al.\textsuperscript{25} reported a significant decrease of intervention group average body weight after 2 months of 1.6 kg (69.3 ± 10.3 to 67.7 ± 81 kg) compared to an increase of 1.0 kg (68.3 ± 10.1 to 69.3 ± 8.1 kg) in the usual care group (p = 0.034).

No significant changes were found in BMI between the groups at follow-up in the other studies reporting on this outcome.\textsuperscript{19-21,22,24}
Table 1
General description of the included trials.

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Sample size (n)</th>
<th>Study population</th>
<th>Focus</th>
<th>Period (months)</th>
<th>Treatment strategy</th>
<th>Treatment intensity of the intervention group</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bensel, 2010</td>
<td>50</td>
<td>Hypertensive, obese patients in primary care</td>
<td>Weight loss</td>
<td>3</td>
<td>Visits to the internal medicine physician</td>
<td>Internet program for daily self-monitoring of blood pressure + health coach support</td>
<td>Moderate weight loss after 3 months</td>
</tr>
<tr>
<td>Brockshausen, 2010</td>
<td>159</td>
<td>PA patients in primary or secondary care</td>
<td>OVD+mg</td>
<td>12</td>
<td>Visits to GP or specialist</td>
<td>Internet program increased sedentary advice + face-to-face counseling</td>
<td>Improved physical activity + moderate weight loss after 12 months</td>
</tr>
<tr>
<td>Green, 2008</td>
<td>258</td>
<td>Hypertensive patients using antihypertensive medication in primary care</td>
<td>Hypertension control</td>
<td>12</td>
<td>Visits to GP or specialist</td>
<td>Internet program increased self-monitoring of BP + pharmacist care</td>
<td>Improvement in BP control of PH patients</td>
</tr>
<tr>
<td>McEniery, 2007</td>
<td>110</td>
<td>Obese patients in primary care</td>
<td>Weight loss, cost-efficiency</td>
<td>12</td>
<td>Visits to GP</td>
<td>Internet program increased tailored advice to manage weight loss</td>
<td>No additional effects of the website in weight loss or secondary outcomes of smoking cessation</td>
</tr>
<tr>
<td>Park, 2009</td>
<td>21</td>
<td>Patients with hypertension and obesity in primary care</td>
<td>Hypertension control</td>
<td>2</td>
<td>Visits to GP or specialist</td>
<td>Internet program increased self-monitoring of BP + self-monitoring</td>
<td>Significant decrease in BP levels</td>
</tr>
<tr>
<td>Southard, 2003</td>
<td>51</td>
<td>Patients with CVD or chronic heart disease in primary and secondary care</td>
<td>OVD+mg</td>
<td>6</td>
<td>Visits to GP or specialist</td>
<td>Internet program increased self-monitoring of BP and pharmacist care</td>
<td>Improvement in CVD outcomes</td>
</tr>
<tr>
<td>Tjønn, 2006</td>
<td>20</td>
<td>Patients with diabetes type 1 in primary and secondary care</td>
<td>Diabetes management</td>
<td>12</td>
<td>Visits to GP or specialist</td>
<td>Internet program increased self-monitoring of BP and pharmacist care</td>
<td>Improvement in blood glucose control</td>
</tr>
<tr>
<td>Veronese, 2012</td>
<td>166</td>
<td>Clinically nutricid OVD in primary or secondary care</td>
<td>OVD+mg</td>
<td>12</td>
<td>Visits to GP or specialist</td>
<td>Internet program increased self-monitoring of BP and pharmacist care</td>
<td>Improvement in CVD outcomes</td>
</tr>
<tr>
<td>Zuc, 2007</td>
<td>7</td>
<td>Patients attending cardiac rehabilitation programs in secondary care</td>
<td>OVD+mg</td>
<td>3</td>
<td>Visits to GP and on-site visits</td>
<td>Internet program increased self-monitoring of BP and pharmacist care</td>
<td>Improvement in cardiac rehabilitation outcomes</td>
</tr>
</tbody>
</table>

Table 2
Laboratory results for total cholesterol (TC), low density lipoprotein cholesterol (LDL-C), high density lipoprotein cholesterol (HDL-C), triglycerides (TG), and hemoglobin A1C (HbA1C).

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Δ TC (mmol/L)</th>
<th>Δ LDL-C (mmol/L)</th>
<th>Δ HDL-C (mmol/L)</th>
<th>Δ TG (mmol/L)</th>
<th>Δ glucose (mmol/L)</th>
<th>Δ HbA1c (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breskin, 2010</td>
<td>-0.1</td>
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<td>-0.0</td>
<td>-0.1</td>
<td>-0.1</td>
<td>-</td>
</tr>
<tr>
<td>Park, 2009</td>
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<td>-0.10</td>
<td>-0.04</td>
<td>-0.09</td>
<td>-0.03</td>
<td>-</td>
</tr>
<tr>
<td>Southard, 2003</td>
<td>0.0</td>
<td>0.10</td>
<td>0.04</td>
<td>0.01</td>
<td>0.04</td>
<td>-</td>
</tr>
<tr>
<td>Tjønn, 2006</td>
<td>-0.01</td>
<td>-0.03</td>
<td>-0.02</td>
<td>-0.01</td>
<td>-0.02</td>
<td>-</td>
</tr>
<tr>
<td>Veronese, 2012</td>
<td>-0.1</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-</td>
</tr>
<tr>
<td>Zuc, 2007</td>
<td>-0.02</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-0.01</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: C: control group; I: Internet intervention group; CVD: cardiovascular disease; BP: blood pressure; OVD: open design; PA: physical activity; HbA1c: hemoglobin A1C; TG: triglycerides; LDL-C: low density lipoprotein cholesterol; HDL-C: high density lipoprotein cholesterol; Δ: change from baseline to follow-up assessment; NS: not significant; Δ: baseline-value — follow-up-value; NS: not significant; Δ: mean difference (baseline-value — follow-up-value in the usual care group) — (baseline-value — follow-up-value in the intervention group).
significantly in both intervention groups, respectively with -8.9 mm Hg (95% CI -11.4 to -6.3; p b 0.001) and -6.0 mm Hg (95% CI-8.5 to -3.5; p b 0.001). In addition, diastolic BP (DBP) also significantly decreased in the group receiving intervention—plus with a net change of -3.5 mm Hg (95% CI -4.9 to -2.1; p b 0.001). Park et al.25 demonstrated a mean SBP decrease after 2 months within the intervention group by -9.1 mm Hg, from 135.7 ± 8.8 mm Hg to 126.6 ± 8.7 mm Hg (p b 0.05). There was a significant interaction between groups (p = 0.001), with an increase in the control group SBP from133.9 ± 9.3 mm Hg to 136.7 ± 9.1 mm Hg. DBP also differed between groups (p = 0.045), with a decrease of -7.2 mm Hg within the intervention group. Bennett et al.18 found no group differences for respectively SBP (mean difference -1.30 mm Hg; 95% CI -3.38–5.99), or DBP (mean difference - 0.38 mm Hg; 95% CI -4.03–3.27) after an intervention period of 3 months. Vernooij et al.23 found a slight decrease in SBP in the intervention group from 140 ± 17 mm Hg to 137 ± 18 mm Hg compared to an increase from 139 ± 18 mm Hg to 140 ± 19 mm Hg in the usual care group (mean difference -3.7 mm Hg; 95% CI -7.6–0.2). DBP went from 81 ± 18 mm Hg to 80 ± 18 mm Hg in the intervention group, compared to 80 ± 17 mm Hg to 79 ± 17 mm Hg in the usual care group after 12 months. Broekhuizen et al.20 only reported on SBP and found a decrease of 126.3 ± 15.7 mm Hg at baseline to 125.2 ± 14.4 mm Hg after 12 months in the usual care group, compared to no difference in the intervention group with a baseline SBP of 123.0 ± 14.4 mm Hg (mean difference 0.003 mm Hg; 95% CI -2.28–2.28). Southard et al.22 reported no significant changes in BP after 6 months. SBP decreased from 130.9 mm Hg to 128.8 mm Hg in the usual care group, and from 131.7 mm Hg to 129.4 mm Hg in the intervention group. DBP slightly decreased from 72.1 mm Hg to 71.8 mm Hg in the control group, compared to changes in the intervention group of 74.4 mm Hg to 72.5 mm Hg. Zutz et al.21 measured after 3 months a SBP of 121 ± 8 mm Hg at baseline and 117 ± 8 mm Hg at follow-up in the usual care group compared to a slight increase of 4 mm Hg in the intervention group (baseline 123 ± 14 mm Hg, follow-up 127 ± 27 mm Hg). DBP decreased with 4 mm Hg (baseline 75 ± 8 mm Hg, follow-up 71 ± 7 mm Hg), compared to a 1 mm Hg decrease in the intervention group (baseline 81 ± 10 mm Hg, follow-up 80 ± 12 mm Hg). Two of the studies demonstrating no significant differences did not use BP self-monitoring in the intervention program.18,20 Zutz et al.21 provided intervention participants with a home BP monitor and heart rate monitor, but the sample size was considered too small to detect any significant differences. Vernooij et al.23 encouraged intervention patients to measure BP at home, and observed an improvement in BP.

3.4.3. Laboratory investigations: cholesterol, blood glucose and HbA1c

Laboratory investigations including TC, TG, LDL-C, HDL-C, glucose or HbA1c were performed in six out of the nine studies (Table 3).20-23,25-26 Merely two studies found a significant difference of some of these laboratory values between groups.23,25 Park et al.25 found a significant mean increase in HDL-C for the intervention group after two months from 1.30 mmol/L to 1.40 mmol/L (p b 0.05), with a non significant decrease in the control group from 1.33 mmol/L to1.31 mmol/L. TC, TG and LDL-C did not differ significantly within or between groups. Vernooij et al.23 reported a significant difference between groups in LDL-C change after 12 months of - 0.3 mmol/L (95% CI-0.5 to-0.1; p b 0.001) in favor of the intervention group. Noticeably, HDL-C and HbA1c tended to worsen in both study groups. Zutz et al.21 found that TG, HDL-C, and TC:HDL-C ratios in the Internet intervention group significantly improved after 3 months. There was no significant within-group difference for blood cholesterol values in the usual care group. Tjam et al.26 reported no significant difference in the control group from 2.30 mmol/L to 1.9 mmol/L after 6 months (p = 0.04) versus no significant difference in the control group from 2.0 mmol/L to 2.04 mmol/L. The decrease in TG levels in the intervention group was maintained after 1 year. After 3 months, the HbA1c levels dropped from 6.7% to 6.5% in the intervention group compared to no significant changes in the control group, an effect that was also maintained after 1 year. No significant between group differences were found for FBG, TC, LDL-C, and HDL-C. This study reported a lack of power to detect difference due to small sample size, especially for the 6 month and 1 year follow-up. Broekhuizen et al.20 reported no significant treatment effects on laboratory results. A decrease of 0.1 mmol/L in LDL-C was found in both groups. Furthermore, both groups showed no changes in HDL-C and a slight decrease of TC and glucose were found after 12 months. Southard et al.22 reported no significant between group differences in TC, LDL-C, HDL-C and TG between pre- and posttest after 6 months.

4. Discussion

In summary, most of the studies using multiple Internet interventions in addition to usual care (all primary and secondary outpatient healthcare services), did not demonstrate a significant reduction in cardiovascular risk factors compared to usual care alone. Most effects on the risk factors were comparable to results in the usual care group.
Although a few studies demonstrated significant improvement in various risk factors, clinical relevance of these differences is questionable. Our search revealed that limited research has been performed on this specific subject. Systematic review of the included studies demonstrated that it was difficult to compare Internet studies with one another because of the diversity in intervention program and overall study design. In addition, a previous review noted that Internet intervention studies often lack methodological quality, which is supported by the results from this review. The presence of a control group, defined as ‘usual care’, was frequently missing and many studies were performed outside primary or secondary healthcare setting, such as studies performed among business employees. After a strict study selection for this review, it turned out that the Internet program designs, protocol intensity for program use, and the level of self-management differed widely between the included studies. The contact frequency of patients and their physicians in the usual care and intervention groups was merely described in two studies. Therefore we cannot conclude how the usual care and intervention groups in the included studies relate to one another. Despite the heterogeneity in study design and indistinctness of the delivered care, the authors came to a similar conclusion: lifestyle counseling through Internet may have the potential of improving cardiovascular outcome measures for patients, but at this moment, evidence to demonstrate its superiority above usual care is lacking. These results are not surprising as most studies were small sampled, had a short follow-up duration and had high attrition rates. Recently, a systematic review similarly concluded that robust evidence supporting a beneficial effect of Internet technologies on the quality of care is lacking. Two studies in this review were relatively successful in achieving clinically important BP reduction through an Internet program on top of usual care. In both studies, Internet programs were adapted to treat specific individual health issues, used an integrated intervention approach with self-monitoring of BP, and had healthcare professionals delivering the Internet-based care. Weight was significantly reduced in the Internet intervention groups in three studies. The effect of these studies in the intervention group might have been attributable to the patient’s focus and program adherence. In the study of Southard et al., participants mostly chose weight loss as their program ‘treatment goal’ and had an average website login frequency of approximately two times per week. The study by Bennett et al. also primarily
focused on weight loss, and high patient program adherence was achieved by human personal coaching calls and by using a graphically rich self-monitoring tool to track individual progress, including the display of average progress of other participants. In the study by Park et al.25 obese hypertensive participants were requested to frequently report their personal weight, challenging them to continue weight loss. Unfortunately no information was reported on the utilization rates of the website. All three aforementioned studies had study periods shorter than 12 months. The majority of the studies demonstrating no significant difference in weight or BMI were intervention periods lasting over 12 months.19,20,23,26 Two of these studies reported low engagement with the intervention tool.19,20 Green et al. focused primarily on self-monitoring of BP, less on weight.24 One study that included self-report of weight in the intervention program was conducted over a 3 month period, but the number of participants was too small to detect a significant treatment effect. These results suggest that incorporating a competitive element in addition to personalizing the intervention programs by letting patients formulate their own treatment goals, enhancing involvement and self-management, stimulates patients to put in more effort to reach their individual treatment goals. In addition, shorter intervention duration of 1 year or less may positively influence intervention program adherence and may benefit outcome results on at least weight and BMI. Overall, the introduction of Internet-based interventions in primary or secondary care does not seem superior over only face-to-face contact with healthcare physicians with respect to cardiovascular outcomes. Study results for both types of healthcare delivery are comparable, suggesting that it does not make a difference whether lifestyle advices are communicated directly through face-to-face physician–patient contact or with the help of Internet programs. It is possible that the attention from healthcare physicians and the Hawthorne effect of ‘being observed’ stimulate healthy behaviour for both Internet– and office consultations. As mentioned before, undertreatment of CVD is still an everyday issue. Despite regular treatment in a primary or secondary healthcare setting, 54% of hypertensive patients in the Netherlands still had high blood pressures.23 Poor treatment adherence29 and physician non-compliance with treatment guidelines30 are some examples of shortcomings in the current standard of care, increasing the risk of adverse patient events and healthcare costs. More frequent physician–patient contact through Internet-based interventions on top of the standard of care could represent a relatively cheap way to closely monitor these patients and thereby, improve therapy adherence and reduce healthcare costs. Unfortunately, cost-efficiency of Internet-based interventions is questionable according to Black et al., having found no supporting evidence on cost-effective claims. Two studies in this review also evaluated cost-efficiency besides the targeted cardiovascular outcomes. Firstly, McConnen et al.19 first found higher costs for the Internet group because a special website had to be designed for the intervention program, but after excluding these fixed costs, total costs were lower for the Internet intervention group. Secondly, Southard et al.22 calculated lower costs for the Internet group because less cardiovascular events occurred among these participants. Perhaps, Internet interventions can become cost-efficient if used on a larger scale. Currently its use is limited to a specific group of patients with access to Internet and who are motivated enough to engage in their own healthcare. As more people are using the Internet globally in both the developed and the developing world, it is expected that the scope of computerized health behaviour interventions will continue to rise. It is a development which suits the modern patient, since the Internet is being accessed more often to seek health information.35 Self-management and self-monitoring can improve the awareness of people and knowledge about their health condition. In addition, they can seek advice whenever convenient to them and it can reduce the number of visits to a healthcare worker. The most challenging aspect is keeping patients motivated for an Internet-based intervention. High attrition and low utilization rates of websites are common in studies evaluating the effectiveness of Internet healthcare interventions.34 For example, only 49% of participants logged on and completed at least one advice module in the intervention group from Broekhuizen et al.20 In addition, in the study by McConnen et al., 47% of participants never used the website at all. A recently published review36 identified key elements which are essential in maintaining user engagement in Internet-based behavioral interventions for chronic illnesses, which included addressing specific participants with pressing health concerns and providing them with personally tailored advice and feedback. Other motivational strategies are giving patients the ability to monitor personal progress with self-monitoring, human support, sending them reminders, increasing the amount of personalized feedback, and limiting burdensome advice. For these reasons, most Internet intervention programs are managed by a nurse or health coach.

5. Conclusion

In conclusion, there is no evidence supporting an additional value of Internet-based interventions in the integrated approach of preventing and treating
cardiovascular diseases in primary or secondary care. Results between usual care and additional Internet intervention were mostly comparable. An Internet delivered program has the potential to be successful in reducing the number of visits to the physician and may therefore be cost-effective, but it is challenging to keep patients motivated to proceed with the program. In order to enhance program adherence, it seems beneficial to personalize the intervention programs, let patients formulate their own treatment goals, and to limit the duration of the intervention period. No studies evaluating the efficacy of Internet-based interventions over a longer period of time (patient follow-up duration of years) have been performed. We believe that face-to-face contact between the physician and the patient cannot be entirely replaced by an Internet-based intervention program as affection is especially expressed by nonverbal behaviour. This has shown to be of utmost importance in patient satisfaction, adherence and clinical outcomes. For this reason, we think that most patients will desire to see their healthcare physician occasionally and that Internet communication may only complement usual care for specific patient populations.

Learning points

- Limited research has been performed about Internet delivered multiple lifestyle interventions to improve cardiovascular risk factors in the primary and secondary care.
- High attrition and low utilization rates of the website are common in Internet interventions.
- Internet-based intervention studies demonstrate great variety in design.
- Overall, no clinically relevant benefits in health outcomes were found with the introduction of an Internet program in a primary or secondary healthcare setting.
- An Internet delivered program has the potential to be successful in reducing the number of visits to the physician and may therefore be cost-effective when applied on a large scale.

References

2. World Health Organization. Noncommunicable diseases country profiles 2011; [Ref Type: Report].


