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# Usage and Effect of a Web-based Intervention for the Prevention of Overweight; a RCT

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**Abstract**

*Web-based interventions can be effective in changing behaviour of people faced with health problems. However, it is unclear whether they are effective in preventing health problems like overweight. The aim of this study was to investigate usage and effectiveness of the Healthy Weight Assistant (HWA), a web-based application to increase healthy behaviour in adults with a healthy weight or slight overweight, by means of a Randomised Controlled Trial (RCT). 297 respondents were randomly assigned to the intervention (n=147) or the waiting list group (n=150). The intervention group received access to the intervention for 12 weeks. At pre- and post-test we measured dietary and physical activity behaviour (primary outcomes) and BMI, knowledge, attitude, self-efficacy, subjective behaviour and insight in behaviour (secondary outcomes). All participants, regardless of group, show improvement in healthy behaviour and subjective assessment of healthy behaviour. People who are older, score higher on dietary behaviour and under-estimate their dietary behaviour are more likely to use the HWA. Using the HWA leads to improvement in physical activity behaviour and insight in physical activity behaviour.*

***Keywords:***

Prevention, RCT, Use, Internet, Intervention Studies.

## Introduction

Overweight is a problem in modern society. It is closely related to a number of chronic conditions, including Diabetes Mellitus type II, and places a great burden on the health care system. We all know that losing weight is not as easy as it seems. It might be more (cost)efficient to prevent people from becoming overweight [1-3]. To achieve this goal, interventions aimed at the general public are needed, which must not only inform about the risks of unhealthy dietary and physical activity (PA) habits, but must also stimulate to adopt healthier behaviour. Previous research showed that information only does little to change behaviour, while tailored and interactive interventions are more successful at achieving this goal [1,4,5]. A way to get these interventions to reach the broad target population is through the Internet. Furthermore, by using a web-based application, the content of the intervention can be tailored to the users and the intensity can be varied according to the needs and wishes of these users. Research has already shown the potential of these applications for the achievement of weight loss [6,7] and to some degree weight management [8]. However, most studies are focused on applications aimed at treatment or secondary prevention. Many questions remain on the effectiveness of web-based applications for the prevention of health problems. It is likely that interventions for prevention emphasize different problems than interventions aimed a chronic condition or an urgent health problem. The problem of attrition [9] might pose an even bigger threat to this kind of interventions, considering people who do not experience an urgent health problem, might have less intrinsic motivation to change their behaviour. Therefore, it can be argued that the intervention needs to supply this motivation to a greater extent. Previous research into the user experience of the intervention central in this study, which employed user centred evaluation methods, supports this notion [10]. It showed that improvement of the intervention should be aimed at enhancing motivation to (keep) use(ing) the intervention and to change behaviour. The recommendations acquired from the pilot study were implemented in the application. The goal of the current RCT is to gain insight into the effectiveness, usage and users of the Healthy Weight Assistant (HWA). By gaining insight into the effectiveness we hope to prove that the HWA is a useful tool to be made freely available to the general public in the Netherlands. Furthermore we hope to add to the scientific knowledge base on the requirements for successful web-based interventions in prevention. By gaining insight into usage and users, we hope to clarify the problem of attrition specifically for prevention, when the intrinsic motivation of users might be low. The ultimate goal is to tailor the intervention to user profiles based on the results of this study.

## Methods

### Intervention

The HWA is a web-based lifestyle intervention developed by the Netherlands Nutrition Centre, which is a government funded organisation aimed at improving healthy dietary habits and preventing weight gain in the general population. The goal

of the HWA is to support people with a healthy weight and people who are slightly overweight (i.e. Body Mass Index (BMI) 18-28 kg/m$^2$) to achieve and maintain a healthy weight. The aim is not to achieve a given weight loss, but to support the achievement of healthy dietary and PA behaviour. The theoretical basis for behaviour change via the HWA is the Trans-theoretical model [11]. The HWA consists of 4 stages: assessing baseline status; motivation to change behaviour; relapse prevention; goal setting and monitoring achievement of goals.

### Design and Recruitment

Participants were recruited through advertisements about an online lifestyle intervention in local newspapers, supermarkets and on health-related websites. 297 respondents were interested in using an online lifestyle intervention and satisfied our inclusion criteria (BMI 18-28 kg/m$^2$; Dutch speaking). All participants were randomly assigned to either the web-based lifestyle coach or a waiting list. We used block randomization, stratified on age, sex and education with blocks of 4. A total of 150 participants were allocated to the waiting list group and 147 participants were allocated to the intervention group. Online questionnaires were filled out before the intervention period started and after the intervention period of 12 weeks. After this period, respondents in the waiting list group could use the intervention. The flowchart of the study can be found in Figure 1.

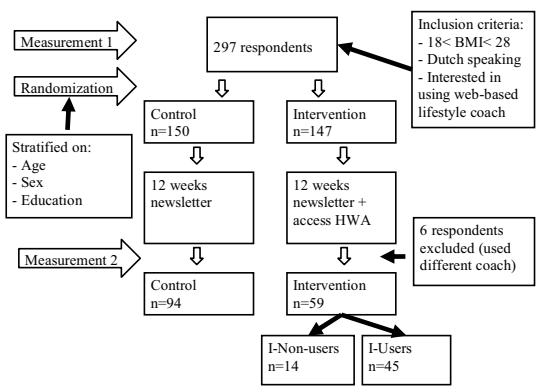


*Figure 1 – Flowchart study*

### Research instruments

BMI was calculated using self-reported weight and length. Dietary behaviour was measured using a 14 item questionnaire [12]. Physical activity behaviour was measured according to the Dutch Standard for Healthy Physical Activity, using a 4 item questionnaire [13]. Self-efficacy for diet and PA were both measured using a 3 item questionnaire with a 5 point Likert-scale [14]. Knowledge was assessed using a 10 item true/false questionnaire based on the Netherlands classification model [15] (diet) and a 10 item true/false questionnaire based on the Dutch Standard for Healthy Physical Activity [16] (PA). Insight in behaviour was calculated by comparing the objective and subjective assessment of dietary and PA behaviour [17]. Questionnaires at baseline and follow-up were identical, except additional items in the follow-up questionnaires: the use of a (e-)coach other than the HWA (both groups); the number of newsletters received and opened (waiting list group); satisfaction with the HWA (intervention group). Satisfaction was measured using 4 items with a 5 point Likert-scale on user friendliness, usefulness, recommending to others and willingness to keep using the HWA [18]. In addition to the online questionnaires, log-files were used to attain the number of times each respondent logged on to the HWA.

## Results

### Descriptive analyses of baseline variables

As shown in Table 1, most respondents in this study were female (62.2%; n=181) and higher educated (51.9%; n=151). Mean age was 40.9 years (sd=13.8).

*Table 1 – Baseline descriptives*

| | Control group | Intervention group | Total |
|---|---|---|---|
| Age (years) | 41.0 | 40.8 | 40.9 |
| Sex (% female) | 62.7 | 61.7 | 62.2 |
| Education (%) | | | |
| High | 53.3 | 50.4 | 51.9 |
| Moderate | 31.3 | 36.9 | 34.0 |
| Low | 15.3 | 12.8 | 14.1 |
| BMI (kg/m$^2$) | 23.9 | 23.9 | 23.9 |
| Reasons for use* | | | |
| Insight in lifestyle | 56.6 | 63.5 | 59.8 |
| Living healthier | 40.7 | 47.6 | 43.9 |
| Fun | 40.0 | 44.4 | 42.1 |
| Lose weight | 35.2 | 42.9 | 38.7 |

* Multiple answers possible, so cumulative percentages do not equal 100%

### Response rates

Of the 297 enrolled respondents, 159 respondents filled out the post-test questionnaire (response rate = 53.5%). In total the data of 153 respondents were analyzed to measure the effects of the HWA (Figure 1).

### Usage and users

55% (n=77) of the respondents in the intervention group used the HWA at least once. Of these respondents, 53% (n=41) used the application only once. Mean satisfaction score was 3.0 (on a scale from 1 tot 5; sd=0.72). There were differences between respondents in the intervention group who used the application (users) and the respondents in this group who did not use the HWA (intervention non-users). Users were significantly older than intervention non-users (respectively 43 and 38; F=4.361; P=0.039). Furthermore, there was a significant difference on dietary behaviour. More users had a healthy diet (34.7%, n=26) than intervention non-users (13.0%, n=6; F=7.912; P=0.019). Lastly, the groups differed on insight in dietary behaviour. Intervention non-users were more often over-estimators (they perceived their behaviour as healthier than it objectively is) (28.3%, n=13) than users (16.0%, n=12; F=7.703; P=0.021).

### Effect research

Pre- and post-test scores on outcome variables are shown in Table 2. Independent of group (intervention or waiting list), respondents significantly improved on dietary behaviour (F=7.548; P=0.007) and PA behaviour (F=4.189, P=0.042). Additionally, respondents perceived their behaviour as healthier on the post-test questionnaire (subjective assessment of dietary behaviour: F=8.559; P=0.004; subjective assessment of PA behaviour: F=8.008; P=0.005). Scores on attitude, self-efficacy and knowledge were high at baseline and showed no improvement.

### Effect intervention

For the assessment of the effects of the intervention we compared the differences on pre- and post-test scores between different groups (waiting list, intervention non-users, users) as depicted in Table 2.

#### *BMI, knowledge, attitude, self-efficacy, subjective assessment of behaviour*

We can show no significant effect of the intervention on these variables.

#### *Behaviour*

The significant improvement on dietary behaviour cannot statistically be attributed to the intervention. As seen in Figure 2, both the waiting list group and the users showed improvement in the percentage of respondents who have a healthy diet. Intervention non-users did not show this improvement. There were no significant differences between groups. On PA behaviour, the differences between groups were more pronounced (Figure 2). Both the waiting list group and the users showed significant improvement in the percentage of respondents who showed healthy PA behaviour (waiting list group: Z=-1.964; P=0.050; users: Z=-2.500; P=0.012). This effect was greater for users than for the waiting list group. Intervention non-users did not show this improvement, the percentage of respondents with healthy PA behaviour even declined.

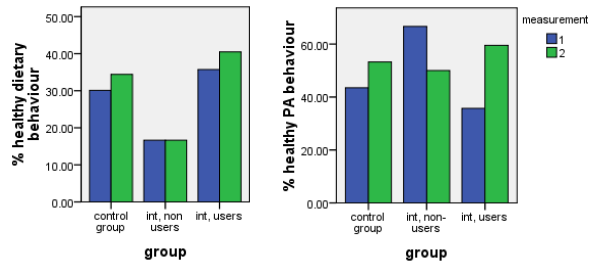


*Figure 2 –Healthy dietary and PA behaviour*

#### *Insight in behaviour*

We can show no significant effect of the intervention on insight in dietary behaviour. However, we did find significant effects on insight in PA behaviour. More users gained a realistic insight in PA behaviour (Z=-2.524; P=0.012). The waiting list group and the intervention non-users did not show a significant change between pre- and post-test. Further analyses of the change in insight of the users showed that the percentage of over-estimators dropped (50.0% pre-test and 23.8% post-test) while the percentage of respondents with a realistic insight increased with the same amount (47.6% and 73.8%). There was no change in percentage of under-estimators.

## Conclusion and future work

### Conclusions on usage and users

Only little more than half of the participants who received access to the HWA actually used the application. This finding is not unique for this study [see among others: 5,9,19] and stresses an important aspect of web-based interventions. Ostensibly, there is a barrier that prevents almost half of the participants in the intervention group to make use of a web-based intervention to change dietary and PA behaviour. This research sheds some light on the factors that might influence this

*Table 2 – Pre- and post-test scores on outcome variables*

| Variable | Control | | Intervention, non-users | | Intervention, users | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Pre-test | Post-test | Pre-test | Post-test | Pre-test | Post-test | Pre-test | Post-test |
| Diet (mean) | 59.1* | 60.6 | 54.7 | 57.0 | 60.5 | 61.7 | 59.1** | 60.6 |
| healthy (%) | 30.1 | 34.4 | 16.7 | 16.7 | 35.7 | 40.5 | 30.6 | 34.7 |
| PA (mean) | 5.14 | 5.38 | 5.92 | 5.67 | 5.05 | 5.52 | 5.18* | 5.45 |
| healthy (%) | 43.5* | 53.3 | 66.7 | 50.0 | 35.7* | 59.5 | 43.2 | 54.8 |
| BMI | 24.2 | 24.2 | 22.9 | 23.0 | 23.9 | 24.1 | 23.9 | 24.1 |
| Knowledge | 7.9 | 7.8 | 7.6 | 7.5 | 8.0 | 8.1 | 8.0 | 7.9 |
| Attitude | 4.1 | 4.1 | 4.3 | 4.3 | 4.1 | 4.1 | 4.1 | 4.1 |
| Self-efficacy | 2.1 | 2.1 | 1.9 | 2.0 | 2.3 | 2.2 | 2.1 | 2.1 |
| Subjective behaviour | 6.8** | 7.0 | 7.6 | 7.9 | 6.8 | 7.1 | 6.9** | 7.1 |
| Insight diet (%) | | | | | | | | |
| under-estimator | 20.4 | 18.3 | 0.0 | 0.0 | 23.8 | 21.4 | 19.7 | 17.7 |
| realistic | 59.1 | 61.3 | 50 | 58.3 | 61.9 | 61.9 | 59.2 | 61.2 |
| over-estimator | 20.4 | 20.4 | 50 | 41.7 | 14.3 | 16.7 | 21.1 | 21.1 |
| Insight PA (%) | | | | | * | | | |
| under-estimator | 1.1 | 1.1 | 0.0 | 0.0 | 2.4 | 2.4 | 1.4 | 1.4 |
| realistic | 62.0 | 66.3 | 66.7 | 58.3 | 47.6 | 73.8 | 58.2 | 67.8 |
| over-estimator | 37.0 | 32.6 | 33.3 | 41.7 | 50.0 | 23.8 | 40.4 | 30.8 |

* Significant difference between pre- and post-test score at the 0.05 level

** Significant difference between pre- and post-test score at the 0.01 level

barrier. First, it is important to notice that knowledge of healthy diet and healthy PA, attitude towards healthy behaviour and self-efficacy to perform healthy behaviour do not seem to have any influence on the choice to use or do not use the application. Significant differences between users and non-users were found on age, dietary behaviour and insight in dietary behaviour. The finding that the users are older, might seem counterintuitive, but it concurs with recent findings on the motivation to use e-consultation [20], which states that older people are more motivated to use this form of eHealth than younger people. The difference on dietary behaviour shows that the people who need the intervention least are most likely to use the application. These users might not feel they need it least, considering they are more inclined to underestimate their behaviour and therefore feel they should improve substantially to achieve healthy behaviour. The opposite might be true for the non-users. Although objectively they might have a greater need for behaviour change, they are more inclined to overestimate their behaviour, therefore they feel the HWA is of little use to them.

Apart from many potential users who refrain from using the HWA, we saw that the HWA is not used regularly. More than half of the users have used it only once. This might be explained by satisfaction scores which fall in the neutral category. If this is the main reason though, we would expect regular users to express higher satisfaction than occasional users. This, however, cannot be concluded from the data. An alternative explanation might be found in the reasons for use. As shown in Table 1, the most important reason for wanting to use the HWA is to gain insight in one's own behaviour. It might be that this goal is reached after using the HWA once. Participants who feel that their goal is reached, might not need to use the HWA again.

**Effects of the intervention**

Both the waiting list group and the intervention group show significant improvement on behaviour and subjective assessment of behaviour. Participating in a study on these behaviours in itself may provide some motivation to change behaviour by increasing awareness of current and desired behaviour. In this study we found no significant decrease in mean BMI. This indicates that participating in this study did not lead to weight loss. Although 38.7% of participants do want to lose weight (reasons for use, Table 1), this is not a goal central to the application. Therefore we do not feel that this result exhibits a negative effect of the intervention or study. Interestingly, variables known for their predictive value in behaviour change (knowledge, attitude, self-efficacy) cannot explain differences in behaviour in this study. Participants score very positive on these variables, but they remain stable. It appears that other factors might be of more importance in changing behaviours that are not in urgent need for change, as is the case in a preventive intervention as the HWA where people are more or less healthy and want to become healthier.

We have shown that the intervention has a positive effect on PA behaviour. On dietary behaviour this effect cannot be replicated. This might be due to the fact that users show healthier dietary behaviour at pre-test. This group is less likely to score much higher due to a ceiling effect. The results on insight in behaviour show that the intervention has a positive effect on insight in PA behaviour. Over-estimators who used the application are more likely to gain a realistic insight in their PA behaviour than over-estimators who did not use the HWA (intervention non-users and waiting list group). It seems that the HWA is particularly useful for these over-estimators, although we showed that they are less likely to use the HWA. This contrast poses a challenge to the implementation of the HWA: How to reach the people for whom the HWA is most useful? Returning to the research questions stated in the introduction we can say that:

- Using the HWA leads to improvement in PA behaviour and insight in PA behaviour. All participants, regardless of randomized group, show improvement in healthy behaviour and subjective assessment of healthy behaviour.
- People who are older, score higher on dietary behaviour and under-estimate their dietary behaviour are more likely to use the HWA.

**Limitations**

A major limitation for this research is that we measure effects for a limited group. Only half of the participants with access to the HWA have used it. We have shown that the intervention has positive effects on these people. But, to increase the efficiency of the HWA it is important to get more people to use the application. Furthermore, it might be that the effects are more pronounced for frequent users. This proposition cannot be proven by this research due to a small group of frequent users, but it holds face value and is supported by other studies in similar fields [21,22]. Therefore a major question for both science and practice is how to get people to keep using applications. A second limitation is the use of self-reported behaviours. Although we used questionnaires from literature, as always, there is a chance of biased results due to self-reported behaviour. Another limitation is related to the participants in this study. Most respondents were female and higher educated. Various studies report overrepresentation of this group [5,23], nevertheless, the question remains whether these results can be generalized to the broader target population of the HWA.

**Future work**

As mentioned in the previous paragraphs, usage is a major issue in research into the effects of eHealth applications. No matter how effective an application is, when there are few users the effects will only hold for a limited group of people. More research is needed into transforming potential users into actual users and into keeping users engaged with the application and thereby stimulating them to keep using the intervention. Attention should be paid to how technology can motivate users that are willing to change their behaviour. A framework which might be useful is provided by Fogg [24], who states that technology can stimulate the performance of a target behaviour by increasing motivators (pleasure, hope, social acceptance), by simplifying the target behaviour, and by providing triggers to perform the behaviour. Examples are found in serious gaming (pleasure as motivator), automating the collection

of data for monitoring (simplifying) and using mobile text messaging as reminders (trigger). By investigating different methods for motivating a target group to become active users, a large leap in efficiency of eHealth applications can be made.

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