BACKGROUND
Overweight and obesity in particular, are major public health problems. Having excess weight is associated with disorders like high blood pressure, high blood cholesterol and other dyslipidaemias, cardiovascular diseases, diabetes type 2, various types of cancer, osteoarthritis and fatty liver disease. Globally the number of people that is overweight has severely increased. Therefore, overweight should be treated and prevented, to avoid a rise in overweight-related diseases.

The work setting is a viable place for population-based interventions for weight management. However, weight management programs are not routinely offered in the Dutch work setting and evidence of their effectiveness is mixed. Furthermore, participation from employees in worksite programs is hampered by constraints of time and location. Worksite programs offered by e-mail and phone could overcome these barriers. In other settings, e-mail and phone interventions have shown potential to change lifestyle behaviors and reduce body weight.

In the ALIFE@Work study a lifestyle program with distance counseling by phone and e-mail, called ‘Leef je Fit’, was developed for overweight employees. This thesis describes the effectiveness, cost-effectiveness and cost-utility of this distance counseling lifestyle program as compared with the provision of general lifestyle brochures.

DESIGN OF THE STUDY
Chapter 2 explains the design of the ALIFE@Work study. The study population consisted of 1386 employees with a Body Mass Index (BMI) ≥ 25 kg/m². The study was a controlled trial, with randomization to three arms: a control group (460 participants), a phone based intervention group (462 participants) and an internet based intervention group (464 participants).

The intervention was based on a cognitive behavioral approach, addressing physical activity and diet. Ten modules guided the participants through the process of lifestyle behavior change. The modules contained educational content combined with behavior change strategies. Assignments in each module helped participants to apply these strategies to everyday life. The phone group received the materials in written form. The internet group accessed the modules on a website. Between each module, participants received feedback from a trained personal counselor. Depending on the group they were randomized to, counseling was either by phone or by e-mail. The intervention lasted six months. All groups, including the control group, received general brochures on lifestyle and overweight, but participants in the control group were not counseled.

The primary outcome of the study was body weight. Other outcomes were diet and physical activity, waist circumference, sum of skin folds, blood pressure, total blood cholesterol level and aerobic fitness. Furthermore, cost-utility and cost-effectiveness were secondary outcomes of the study. Physiological outcomes were measured at baseline and after 6 and 24 months. Other outcomes, as well as cost measurements necessary for the economic evaluation, were assessed by questionnaire at baseline and after 6, 12, 18 and 24 months.
ACCURACY OF SELF-REPORTED ANTHROPOMETRICS

In chapter 3, we present the answer to a secondary question of the study: what is the accuracy of self-reported body weight, body height and waist-circumference in a sample of the Dutch working population? To address this question, self-reported outcomes were compared with outcomes that were directly measured by research personnel. We found that body weight was under-reported, on average by 1.4 kg. Conversely, body height was over-reported by 0.7 cm. As Body Mass Index (BMI) is calculated from the ratio of body weight relative to body height, an under-reporting of BMI was found by 0.7 kg/m². For waist circumference over-reporting by 1.1 cm was observed. Despite the mean misreport, agreement between measured and self-reported values was satisfactory. We recommend the use of self-reported body weight, height and waist circumference to assess the prevalence of overweight/obesity and increased waist circumference in overweight working populations. However, there were considerable individual differences in the accuracy of self-reported anthropometrics. Direct measurements should therefore be used to correctly classify individuals as overweight or obese.

EFFECTIVENESS OF THE INTERVENTION

Chapter 4 considers the results on body weight, waist circumference, diet and physical activity, directly after conclusion of the intervention at six months. Because of missing data, multiply imputed datasets were created for the main analyses of changes in body weight. We found that body weight reduced by 1.5 kg in the phone group and by 0.6 kg in the internet group, compared with the control group. In study participants who had complete data, weight and waist circumference in the phone group were reduced with 1.6 kg and 1.9 cm respectively, 27% vs. 11% had lost at least 5% of their body weight, fat intake decreased with 1 fat point (representing 1 to 4 grams of fat) per day and physical activity increased with 866 MET-minutes (equivalent to 108 minutes cycling at 19-22 km/hour or 289 minutes walking at 4 km/hour) per week, compared with the control group. The internet intervention resulted in a weight loss of 1.1 kg, a reduction in waist circumference of 1.2 cm, and 22% vs. 11% losing at least 5% of their body weight in comparison with the control group. No statistically significant differences between the intervention groups and the control group were seen for the consumption of fruit and vegetables. The phone group appeared to have more and larger changes than the internet group, but direct comparisons between these groups revealed no differences. Consequently, we concluded that at six months lifestyle counseling by phone and e-mail is effective in producing small average weight losses in overweight employees.

In chapter 5 we examined the effectiveness of the intervention with regard to the same outcomes two years after baseline. In the main analyses, in which missing body weight data were multiply imputed for 43% of the participants, no differences in weight control were observed between the intervention groups and the control group. However, in participants with complete data, a weight reduction of 1.2 kg in the internet group compared to the control group was seen. Also, in participants with complete
data, phone group participants were more likely to lose 5% of their body weight than control group participants. Participants who completed the study had been counseled on more modules than participants for whom data was missing. The comparison of waist circumference, fat and vegetable consumption, and physical activity between groups showed no statistically significant differences, although the direction of the differences was generally in favor of the intervention groups. Again, no differences were found between the two counseling modes except for weight gain following the intervention period. Corrected for weight loss during the intervention phase, participants in the internet group gained 1 kg body weight less than participants in the phone group. In conclusion, the internet intervention could be effective for small, but sustained long term weight losses in those participants who engaged in the program with a median of five (out of ten) counseling sessions. The results further suggest that the internet intervention is more effective in preventing weight regain than the phone intervention. However, due to large amounts of missing data, no robust conclusions can be drawn.

We also studied the effectiveness of the intervention on the cardiovascular risk factors body weight, waist circumference, sum of skinfolds (a measure of body fatness), blood pressure, total blood cholesterol and aerobic fitness in a subsample of each study group, after six months and two years. These results are reported in chapter 6. Analyses were done for 141/276 participants randomized to the subsample. No differences were found between the study groups, except for lowered total blood cholesterol, -0.23 mmol/l, between the phone and control group at six months. These results indicate limited effectiveness of the lifestyle intervention in modifying cardiovascular risk in overweight employees not selected for known comorbidities.

ECONOMIC EVALUATION OF THE INTERVENTION
Chapter 7 concerns the economic evaluation of the lifestyle intervention from a societal perspective, after two years. We assessed cost-effectiveness for body weight loss and the cost-utility of the two versions as compared with the control intervention. Missing data were multiply imputed; 976/1386 (70%) had (partially) missing data on body weight or costs. The phone intervention did not appear cost-effective. The mean incremental cost-effectiveness ratios (ICERs) of the internet intervention were €16/kg weight loss and €1337/QALY gained. The probability that the internet intervention was cost-effective at a ceiling ratio of €20,000 per QALY was 60%. In conclusion, the internet program with e-mail counseling showed promising results, but firm conclusions cannot be drawn due to high loss to follow-up.

DISCUSSION AND CONCLUSION
The final chapter, chapter 8, presents a summary of the main findings of this thesis. We discuss methodological considerations; make recommendations for further research and consider implications for public and occupational health.

Strengths of the study include the design: a randomized controlled trial in a real-world setting; the use of multiple imputation for missing data; and the long follow-up
period after discontinuation of the intervention. Some limitations of the study concern poor adherence to the intervention; the use of self-reported behavioral outcomes; and high loss to follow-up, in particular at two years after baseline.

Future research should be directed towards developing methods for collecting anthropometric and lifestyle behavior data that are more valid than the current self-report methods, and appropriate for use in large-scale studies. More emphasis should be placed on preventing dropout from weight-control studies and approaches to increase retention to trials should be sought. With regard to distance-counseling programs, further study should elucidate which elements influence their effectiveness and continued use. Furthermore, personal characteristics of users that determine initial and continued engagement should be studied.

The study showed that programs initiated in the work setting can attract substantial numbers of employees and therefore can have an impact on public and occupational health. It is unlikely that one intervention will fit everybody who wants to change their lifestyle habits. A variety of programs and methods is needed. The 'Leef je Fit' intervention is a candidate to add to this assortment of programs in occupational health care.