SUMMARY

The aim of this thesis was to describe the development and evaluation of an individual-based lifestyle intervention among workers in the construction industry with an elevated risk of cardiovascular disease (CVD). In **chapter 1**, an introduction to this topic was provided. CVD is a chronic and degenerative disease, of which the risk is strongly influenced by lifestyle behaviors such as diet, physical activity, and smoking. There is evidence for the effectiveness of individual-based interventions aimed at lifestyle behavior change among workers. In the construction industry, the proportion of workers who are overweight or at risk of CVD is relatively large, and no guideline for CVD risk reduction yet exists. In this study, the feasibility and (cost-) effectiveness of a lifestyle intervention in the construction industry was investigated. In this thesis, the following objectives were addressed:

1) To provide an overview of the evidence for the effectiveness of workplace lifestyle interventions on precursors of CVD;
2) To describe the design of the Health under Construction study, the characteristics of the participants, and the evaluation of the intervention process;
3) To present the short- and long-term effects of the Health under Construction study on lifestyle and precursors of CVD, as well as an economic evaluation.

Chapter 2 concerned a systematic literature review on the effectiveness of workplace lifestyle interventions. To the 31 studies that fulfilled the inclusion criteria, a best-evidence system was applied, taking into account the quality of the study and the consistency of effects. Strong evidence was found for a positive effect of workplace lifestyle interventions on body fat, one of the strongest predictors of CVD risk. Among populations with an elevated risk of CVD, there was strong evidence for a positive effect on body weight as well. Due to inconsistencies in results between studies, there was no evidence for the effectiveness of workplace lifestyle interventions on blood pressure, cholesterol, triglycerides, and HbA1c. Populations with an elevated risk of CVD seemed to benefit more from lifestyle interventions than populations not at risk, and supervised exercise interventions appeared less effective than group or individual counseling. For future intervention studies we recommend to report participants' compliance with the intervention and the lifestyle changes achieved, in order to gain better insight into the mechanisms that led to the intervention effects.

In **chapter 3**, the design of Health under Construction study was thoroughly described. Health under Construction is a randomized controlled trial for male workers in the construction industry, both those involved in construction activities and in administration, supervision, and management, with an elevated risk of CVD, in which usual care is compared to an individual-based lifestyle intervention. The intervention was based on opinions of employers, employees, and occupational physicians, and on a literature search on the current evidence for the effectiveness of lifestyle interventions. The intervention

consisted of three face to face and four telephone contacts with an occupational physician or nurse, on either improving diet or physical activity behavior, or smoking cessation. The counselors followed a stepwise protocol and used motivational interviewing as a counseling style. Measurements took place at baseline, 6, and 12 months. By means of questionnaires, data were collected on e.g. lifestyle behavior and absenteeism. Doctors' assistants measured body weight, HDL and total cholesterol, systolic and diastolic blood pressure, and HbA1c.

In **chapter 4**, we provided insight into the factors associated with non-participation and dropout in the Health under Construction study. To examine the associations between (non-) participation and CVD risk factors, and the associations between (non-)dropout and CVD risk factors, we used crude and multiple logistic regression models. By means of questionnaires, the reasons for non-participation and dropout were assessed. The participants, i.e. 20% of all invited, had a worse CVD risk profile than non-participants with respect to blood pressure, cholesterol, tiredness and/or stress, and chest pain and/or shortness of breath. The worse CVD risk profile was mainly explained by the difference in age; participants were 3.8 years older than non-participants. Dropouts were 4.6 years younger than those who completed the study, and more likely to smoke. Thus, the study completers were on average older and less likely to be a smoker at baseline than those invited. The main reasons for non-participation were 'no interest', 'current (para-)medical treatment', and 'feeling healthy', and for dropout the main reason was a lack of motivation.

In **chapter 5,** we evaluated the practical execution of the intervention, as well as the opinions of the counselors and participants. The adherence of the 27 counselors to the intervention protocol was determined by registration of the number of sessions and items discussed, and by measuring the quality of motivational interviewing using expert scoring of random segments of 19 counseling sessions. Counselors' competence was rated by participants and counselors separately. Associations between three process indicators and body weight loss between baseline and 6 months were determined using linear regression analyses. Two-thirds of all participants attended five or more sessions, and 38.5% attended all seven sessions. In 90.2% of all cases, the counselor discussed all obligatory items in the first session. Adherence to motivational interviewing was reached in only one audio taped fragment. 86.3 Percent of all participants agreed with the counselor being competent. Neither perceived counselors' competence, nor number of sessions or items discussed, was significantly associated with body weight loss.

In **chapter 6,** the effects of the intervention on lifestyle behaviors were described. Complete data were available for 595 participants. Participants who had chosen to aim at diet and physical activity (energy balance) were analyzed separately from the ones who aimed at smoking cessation. Effect sizes were determined by linear and logistic regression analyses in which the baseline value was added as a covariate. In the energy balance

subgroup, the intervention had a significant beneficial effect on snack intake (pieces per week: β -1.9, 95%CI -3.7; -0.02) and fruit intake (pieces per week: β 1.7, 95%CI 0.6; 2.9) at 6 months. The effect on snack intake remained significant at 12 months (β -1.9, 95%CI -3.6; -0.2). At 6 months, 31.3% of participants had quit smoking, as compared to 13.4% in the control group (OR for smoking 0.3, 95%CI 0.1; 0.7), but this effect was not sustained until 12 months (OR 0.8, 95%CI 0.4; 1.6). Both control and intervention group participants substantially increased their leisure time physical activity by almost 1.5 and 2.5 hours per week respectively.

In **chapter 7**, we described the intervention effects on precursors of CVD, i.e. the biological risk factors. Complete data were available for 517 participants. The intervention had significant effects at 6 months on body weight (β -1.9, 95%CI -2.6; -1.2) and diastolic blood pressure (β -1.7, 95%CI -3.3; -0.1). The effect on body weight effect was sustained until 12 months (β -1.8, 95%CI -2.6; -1.1). Among participants who had aimed at energy balance, the intervention had a significant effect on body weight at 6 (β -2.1, 95%CI -2.9; -1.3) and 12 months (β -2.2, 95%CI -3.1; -1.3), and on HDL cholesterol (β 0.05, 95%CI 0.01; 0.10) and HbA1c (β,-0.06, 95%CI -0.12; -0.001) at 12 months. The effects on HDL cholesterol and HbA1c over time, as determined by longitudinal analysis, were not significant. On average, the obese participants achieved the largest improvements in body weight, blood pressure, and HDL cholesterol. Among participants who had aimed at smoking cessation, the intervention had no significant effects; beneficial changes in blood pressure and cholesterol were found in both groups, and even body weight decreased in the intervention group.

In **chapter 8**, the cost-effectiveness from the societal perspective, and the cost-benefit from the employer's perspective were described. We included only those participants who had chosen to aim at energy balance, i.e. 573. All missing data were imputed by multiple imputations. For the cost-effectiveness analyses, all costs for the intervention, health care use participants purchases related to lifestyle, and absenteeism were totaled and divided by the incremental effect on body weight. For the cost-benefit analysis, the costs for the intervention were subtracted from the incremental benefits associated with absenteeism. An incremental cost-effectiveness ratio was calculated, of which the uncertainty was estimated by bootstrapping cost/ effect pairs. The intervention was more effective but also more expensive than usual care. For one additional kg of body weight loss, the costs for the society would be €145. In case of a willingness to pay of €2,000, the probability of cost-effectiveness would be 0.95. The net employer costs resulting from the intervention were €254 (95%CI; -1,070; 1,536); thus the intervention cannot be regarded as cost-saving.

In **chapter 9**, we summarized and discussed our findings, outlined the strengths and limitations of our study, described the public and occupational health context, and provided recommendations for research and practice. In conclusion, this systematically

developed, well-appreciated, and partly feasible intervention led to sustained improvements in diet and body weight. The results can be generalized to the older male workers in the construction industry with an elevated risk of CVD, both the ones involved in construction activities and those in supervision and management. At 12 months, the intervention was more effective but also more expensive than usual care. Still, a workplace intervention that is effective in making sustained changes in lifestyle and health is of high relevance for occupational health, as it may contribute to sustained employability in this aging population. Therefore, after incorporating our suggestions for improvement, we recommend implementation of this intervention.