

# The Dutch Heart Health community intervention 'Hartslag Limburg': results of an effect study at individual level

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# The Dutch Heart Health community intervention 'Hartslag Limburg': results of an effect study at individual level

GABY RONDA<sup>1</sup>, PATRICIA VAN ASSEMA<sup>1</sup>, MATH CANDEL<sup>2</sup>,  
ERIK RULAND<sup>3</sup>, MIEKE STEENBAKKERS<sup>3</sup>, JAN VAN REE<sup>4</sup> and  
JOHANNES BRUG<sup>5,6</sup>

<sup>1</sup>Department of Health Education and Promotion, <sup>2</sup>Department of Methodology and Statistics,

<sup>4</sup>Department of General Practice and <sup>5</sup>Department of Health Education and Promotion,

Maastricht University, Maastricht, The Netherlands, <sup>3</sup>Department of Public Health of the Regional Public Health Institute Maastricht, Maastricht, The Netherlands and <sup>6</sup>Department of Public Health, Erasmus MC Rotterdam, Rotterdam, The Netherlands

## SUMMARY

'Hartslag Limburg' (Dutch for Heartbeat Limburg), a regional cardiovascular diseases (CVD) prevention program, integrates a community strategy and a high-risk strategy to reduce CVD risk behaviors. The present paper focuses on the effects of the community intervention on fat intake and physical activity. The project was based on community organization principles and health education theories and methods. In order to implement the intervention, nine local Health Committees were set up, each organizing activities that facilitate and encourage people to adopt a healthier lifestyle. A pre-test-post-test control group design with two post-tests was used to evaluate the

intervention. At baseline, representative random cohort research samples were selected in the Maastricht region and in a control region. Data on fat intake and physical activity, and on the psychosocial determinants of these behaviors, were gathered by means of mail surveys. The present study indicates that the intervention had a significant effect on fat reduction, especially among respondents aged ≤48 years (median age). Respondents in the Maastricht region were also more realistic about their fat intake at post-test as compared with the control region. Only a limited effect on intentions to increase physical activity was found.

**Key words:** cardiovascular diseases; community-based prevention; evaluation

## INTRODUCTION

In 1998, a regional cardiovascular diseases (CVD) prevention program called 'Hartslag Limburg' (Dutch for Heartbeat Limburg), integrating a community strategy and a high-risk strategy, was started in the Maastricht region of the province of Limburg. Hartslag Limburg is a joint project of the municipal authorities, the Regional Public Health Institute (RPHI), social work organizations, the community health care

organization, general practitioners, the University and University Hospital, and various local organizations, clubs and companies in the Maastricht region. The project aims to establish an organizational structure in which the collaboration between the main partners is given a formal and permanent basis, to ensure long-term attention to the prevention of CVD. In January 2001, the World Health Organization (WHO)

selected Hartslag Limburg as one of 12 so-called 'field projects', based on its potential to meet pre-established criteria of the WHO project 'Towards Unity for Health' (Boelen, 2001). The major goal of the community intervention is to reduce CVD risk among the 180 000 inhabitants of the region by encouraging behavioral change, i.e. dietary (saturated) fat reduction, increased physical activity and smoking cessation. The project continues to date.

The present article presents the methods and results of the effect study of the community intervention on individual behaviors, i.e. the effects on dietary fat intake and physical activity, as well as the effects on the psychosocial determinants of these behaviors. A description of the full intervention has been published elsewhere (Ruland *et al.*, 1999).

### **The community intervention program and its evaluation study**

The conceptual framework of Hartslag Limburg's community project is based on program planning and evaluation models, and indicates how the program is expected to produce its postulated effects (Table 1) [e.g. (Green and Kreuter, 1999)]. The framework serves as the program planning as well as evaluation framework (Ronda *et al.*, 2003). The main community organization principles included in the project are participation of the community in the planning and implementation of the project, intersectoral collaboration between local organizations, link-up with the current situation (e.g. supporting existing CVD health-promoting initiatives), a social network approach, an environmental strategy (e.g. providing healthier food choices in cafeterias), and a multi-media and multi-method strategy.

The specific intervention activities are based on different theoretical concepts, i.e. the Precaution Adoption Model (Weinstein, 1988) and the Attitude-Social influence-Self-efficacy (ASE) model (De Vries *et al.*, 1988; Ajzen, 1991).

In order to implement the intervention, nine local Health Committees were set up: one in each of the four smaller municipalities, one in each of four underprivileged Maastricht neighborhoods, and one to coordinate and implement regional activities. Each Health Committee organizes, within its district or municipality, activities that facilitate and encourage people to adopt a healthier lifestyle. Prior to the official start of the project, in the spring of 1998, community analyses were conducted to introduce the project in the communities, to achieve early community involvement, and to assess which people, organizations and community sectors should be approached for participation in the Health Committees. Throughout the rest of 1998, the Health Committees were set up. Each Health Committee consists of ~10 members, who represent local organizations that may play a key role in healthy behavior-promoting activities, such as health organizations, women's associations and associations of the elderly. The Health Committees meet ~10 times a year.

The community intervention was officially started in October 1998, with a regional campaign to promote physical activity among individuals >55 years of age (NOC\*NSF, 1999). At about the same time, the Health Committees officially started their activities. In order to facilitate the work of the Health Committees, the RPHI encourages and assists them in organizing as many healthy behavior-promoting activities as possible, which have been carefully selected on the basis of earlier studies (Ronda and

**Table 1:** Conceptual framework of the community intervention program and its evaluation study

A. Health	B. Risk behaviors	C. Psychosocial determinants	D. Prevention activities	E. Community principles	F. Project components
CVD	High fat intake Smoking Not enough physical activity	Attitudes Social influences Self-efficacy Awareness Intention	Number Reach Effects	Participation Intersectoral collaboration Link-up with current situation Social network approach Environmental strategy Multi-media and multi-method strategy	Community analyses Health committees Quality control

Van Assema, 1997). Moreover, each Committee is supported by a health educator, a social worker and a civil servant of the municipality. At 32 months into the project, 293 activities had been registered. One hundred and sixty-six of these activities concerned nutrition, 84 physical activity and 15 smoking, and 28 activities were more general and targeted more than one risk behavior. Specific activities were tested in controlled preliminary studies. Examples of such (ongoing) activities include computer-tailored nutrition education (Brug *et al.*, 1998), nutrition tours in supermarkets (Van Assema *et al.*, 1998), a regional daily television program 'Heartbeat on the Move' to promote physical activity (Ronda *et al.*, 2001a), walking and cycling months (Ruland *et al.*, 2001), a regional smoking cessation campaign (Ruland *et al.*, 2001), and a non-smoking campaign for the parents of children in playgroups (Ruland *et al.*, 2001). In addition, there are ongoing activities trying to draw attention to the project and its specific activities, such as commercials on local television and radio, newspaper articles, and posters and pamphlets.

Evaluation measures were developed for all stages of the intervention and evaluation framework (Table 1), except for stage A (health), since no detectable effects at this level can be expected within a limited number of years. The evaluation study consisted of an effect study at individual and organizational levels, and a process study.

The research questions for the present paper focused on the individual level and were: (i) has there been a positive change in dietary fat intake and physical activity levels in the Maastricht region compared with the control region?; and (ii) has there been a positive change in the psychosocial determinants related to decreasing dietary fat intake and increasing physical activity in the Maastricht region compared with the control region?

## METHODS

### Design and sample

To assess differences between the Maastricht and control region (where there was no community intervention), a pre-test–post-test control group design was used, with two post-tests (Cook and Campbell, 1979). The baseline measurement was conducted in May 1998, the first post-test in

May 2000 and the second post-test in May 2001. At baseline, representative random cohort research samples were selected in both regions. In the Maastricht region, a stratified random sample of 1450 inhabitants (aged  $\geq 14$  years), based on the number of inhabitants in each of the five municipalities, was selected from the population registers of each of the five municipalities. A stratified random sample of 1200 inhabitants (aged  $\geq 14$  years), based on the number of inhabitants in each municipality, was selected from the population registers of six municipalities of a comparable control region. These sample sizes were based on a power of 0.95 to detect a priori hypothesized effect sizes at a significance level of 0.05.

The control region was comparable with respect to the incidence and prevalence of CVD, number of inhabitants, number of municipalities and degree of urbanization.

### The questionnaire

Data on dietary fat intake and physical activity level, and on the determinants of these behaviors, were gathered by means of mail surveys. Non-responders were reminded once at baseline and twice at follow-up.

### Risk behaviors

Dietary fat intake was assessed using a validated questionnaire covering 19 (groups of) food products that contribute most to the consumption of saturated fat in The Netherlands. A fat consumption score ranging from 0 to 80 points was calculated (Van Assema *et al.*, 2001). Fat scores of 15 points for women and 18 points for men are the approximate upper levels of recommended dietary intake. Physical activity levels were assessed with a validated short questionnaire (Koremans *et al.*, 2000; Ronda *et al.*, 2001b) that allows a physical activity score to be calculated in minutes and in sessions per week. In addition, respondents were asked to indicate directly on how many days a week they were physically active for at least 30 min. Respondents who had a physical activity score of at least 150 min per week and at least five sessions per week, and who indicated that they were physically active for at least 30 min a day on at least 5 days a week, were classified as meeting the recommended target.

### **Psychosocial determinants**

Important determinants of the risk behaviors, i.e. attitudes, social support, self-efficacy expectations and intentions related to decreasing dietary fat intake and increasing physical activity, as well as self-rated dietary fat intake and physical activity level were assessed, mostly with single items, in order to assess intermediate intervention effects (De Vries *et al.*, 1988; Weinstein, 1988; Ajzen, 1991; Brug *et al.*, 1994; Ronda *et al.*, 2001b). Respondents were asked to evaluate their attitudes towards the different behaviors on a 'bad–good' scale, and for physical activity also on an 'unpleasant–pleasant' scale (e.g. how good or bad do you think it would be for you to be more physically active/eat less fat). Afterwards, one score for attitude towards increasing physical activity was calculated by computing the mean score of the two items ( $r = 0.52$ ). Furthermore, the questionnaire asked respondents if they intended to change each of the two behaviors in the future (intention), how confident they were about their ability to make such changes (self-efficacy), and if they experienced support from important others to change the behaviors (directly perceived social support). All items, with the exception of perceived social support (yes/no), could be answered on bipolar five-point scales.

Self-rated dietary fat intake and self-rated physical activity were assessed by asking respondents whether they rated their own fat intake and physical activity level as low or high (on a bipolar five-point scale). Respondents whose fat consumption levels were low, but who rated them (rather) high were classified as unaware of their intake level. Respondents whose fat consumption levels were not low, but who rated them as intermediate or low, were also classified as unaware of their intake level. The remaining respondents were classified as realistic. A similar procedure was used to classify respondents on awareness of physical activity. Furthermore, the first and second post-test included a question measuring respondents' familiarity with a health project in their municipality. Finally, respondents were questioned about their sex, age and education.

### **Statistical analysis**

Descriptive statistics (frequencies and means) were used to describe demographic characteristics, dietary fat consumption, physical activity level, and familiarity with a health project. Multiple

logistic regression analyses were conducted to identify potential dropout bias (with attendance versus dropout as the dependent variable, and the baseline values for gender, age, education, fat consumption, physical activity level and condition as independent variables) and potential baseline differences between the Maastricht region and the control region (with study region as the dependent variable and the baseline values for gender, age, education, fat consumption, and physical activity level as independent variables). Only respondents who completed all surveys were included. These preliminary analyses were performed using the SPSS 10.0 statistical package (SPSS, 2000). Variables identified as being statistically different ( $p < 0.05$ ) between respondents who participated in all three surveys and dropouts, and between respondents from the Maastricht region and the control region, were included as independent variables in subsequent regression analyses of differences between the Maastricht region and the control region.

To study differences in risk behaviors and their psychosocial determinants between the Maastricht and the control region, multi-level regression analysis was used for all outcome variables (continuous, dichotomous and ordinal) using the MLwiN (Rasbash *et al.*, 1999) statistical package and the MIXOR statistical package (Hedeker and Gibbons, 1996). Multi-level regression analysis was used to take into account possible dependencies among individuals within the same municipality (Hedeker *et al.*, 1994; Snijders and Bosker, 1999). In the cases in which multi-level analysis revealed that the individuals within municipalities could be regarded as independent (i.e. all cases, except with fat scores as the dependent variable), analyses were repeated using 'ordinary' regression within the SPSS statistical package. Results in SPSS (SPSS, 2000) were consistent with the results found with 'one level' models in MLwiN (Rasbash *et al.*, 1999) and MIXOR (Hedeker and Gibbons, 1996).

The main independent variable included in all analyses was condition (Maastricht region versus the control region). Furthermore, several other independent variables were included, on the basis of their known or suspected relation with the outcome variables. First, we controlled for the pre-intervention scores on the relevant effect indicators. Furthermore, gender, age, education and familiarity with a health project, and the interaction terms of these variables with condition, were included as independent variables in all analyses.

Also, the intention to change behavior at baseline, self-rated behavior at baseline, and their interaction terms with condition were included as independent variables in the analyses of behavioral change. In the cases for which significant ( $p < 0.05$ ) interactions were found, subsequent 'simple effects analyses', i.e. subgroup analyses, were done. For subgroup analyses concerning age, this variable was dichotomized at the median (48 years).

All analyses were done in a so-called 'top down' procedure, in which all variables were first included in the model, after which non-significant variables (with the exception of condition) were excluded from the model in a hierarchical and stepwise procedure.

All of the analyses used a two-sided significance level of 5% (with the exception of random cluster effects, for which a one-sided significance level of 5% was used, since these random parameters are 0 or  $> 0$ ).

## RESULTS

### Respondents

Response to the baseline survey was 55.5% [ $n = 1444$ ; 820 (57.5%) in the Maastricht region and 624 (52.9%) in the control region (46 questionnaires were undeliverable)]. Fifteen cases were excluded from analysis because of incomplete data, leaving 809 respondents in the experimental region and 620 in the control region. Attrition rate from baseline (T0) to second post-test (T2) was 37.2% in the total group. Because of 92 undeliverable questionnaires in 2000 and 28 undeliverable questionnaires in 2001, the net attrition rate from T0 to T2 was 31.5%. Overall, 897 respondents completed all three questionnaires: 505 in the experimental region and 392 in the control region. Attrition did not differ between the two regions. However, dropouts were found to be younger and less educated than those who participated in all three measurements. Table 2 shows baseline demographic characteristics, dietary fat intake and physical activity level at baseline, first and second post-test, and familiarity with a health project at first and second post-test.

### Dietary fat intake and psychosocial determinants

Table 3 shows the parameter estimates for dietary fat intake and its determinants at the first (T1) and second (T2) post-test. There was an

**Table 2:** Demographic characteristics at T0, and key variables at T0, T1 and T2 in the Maastricht region ( $n = 505$ ) and the control region ( $n = 392$ )

Variable	T0	T1	T2
Age, mean (SD) <sup>a</sup>			
Maastricht group	47.8 (16.9)		
Control group	49.3 (15.8)		
Gender (%) <sup>a</sup>			
Male			
Maastricht	43.2		
Control	33.7		
Female			
Maastricht	56.8		
Control	66.3		
Education			
Low			
Maastricht	30.5		
Control	37.8		
Intermediate			
Maastricht	44.8		
Control	40.8		
High			
Maastricht	24.8		
Control	21.4		
Fat score, mean (SD) <sup>a</sup>			
Maastricht	18.6 (6.2)	18.7 (6.1)	18.3 (5.8)
Control	20.1 (6.9)	20.0 (6.3)	19.4 (6.3)
Physical activity level (percentage not meeting the target)			
Maastricht	57.2	60.8	57.9
Control	51.8	54	50.9
Familiarity with a health project (percentage familiar) <sup>b</sup>			
Maastricht	–	23.2	23.2
Control	–	17.9	17.3

<sup>a</sup>Significant baseline differences between Maastricht and control region (logistic regression analysis).

<sup>b</sup>Significant differences between Maastricht and control region (logistic regression analysis).

overall condition effect on the fat score at T1. Respondents in the Maastricht region had a lower fat score at T1 than respondents in the control region. Furthermore, there was an interaction effect between age and condition on the fat score at T1. Further exploration of this interaction showed that the overall condition effect on the fat score was fully attributable to the younger half (<49 years) of the population studied. Respondents younger than 49 years in the Maastricht region had a lower fat score than respondents of that age in the control region ( $B = -1.207$ ;  $p = 0.003$ ). A similar interaction effect between age and condition on the fat score was detected at T2, and again respondents younger than 49 years in the Maastricht region had a lower fat score than respondents of the same age

**Table 3:** Dietary fat intake and psychosocial determinants at T1 and T2: parameter estimates [linear regression estimates (unstandardized coefficients), and binary and ordinal logistic regression estimates]

Variable (measurement level)	Fat score <sup>a</sup> (linear)		Attitude <sup>b</sup> (ordinal)		Social support <sup>b</sup> (dichotomous)		Self-efficacy <sup>b</sup> (ordinal)		Intention <sup>b</sup> (ordinal)		Awareness of fat intake <sup>b</sup> (dichotomous)	
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Pre-intervention score	0.588 ( <i>p</i> = 0.000)	0.557 ( <i>p</i> = 0.000)	0.814 ( <i>p</i> = 0.000)	0.748 ( <i>p</i> = 0.000)	1.608 ( <i>p</i> = 0.000)	1.315 ( <i>p</i> = 0.000)	1.078 ( <i>p</i> = 0.000)	0.825 ( <i>p</i> = 0.000)	0.969 ( <i>p</i> = 0.000)	0.892 ( <i>p</i> = 0.000)	1.051 ( <i>p</i> = 0.000)	0.954 ( <i>p</i> = 0.000)
Condition <sup>c</sup> (Maastricht region = 1, control region = 0)	-0.698 ( <i>p</i> = 0.020)							-0.274 ( <i>p</i> = 0.037)			0.337 ( <i>p</i> = 0.034)	
Age											-0.011 ( <i>p</i> = 0.007)	
Gender (female = 1, male = 0)	-1.429 ( <i>p</i> = 0.000)	-1.289 ( <i>p</i> = 0.000)			-0.429 ( <i>p</i> = 0.008)	-0.622 ( <i>p</i> = 0.000)						
Self-rated fat intake T0 (scores ranging from much = 1 to little = 5)	-0.666 ( <i>p</i> = 0.000)											
Familiarity with a health project (aware = 1, unaware = 0)					0.380 ( <i>p</i> = 0.045)							
Fat score at T0	-	-						-0.020 ( <i>p</i> = 0.042)	-0.023 ( <i>p</i> = 0.029)	-0.121 ( <i>p</i> = 0.000)	-0.111 ( <i>p</i> = 0.000)	
Age × condition	0.048 ( <i>p</i> = 0.008)	0.007 ( <i>p</i> = 0.000)										
Gender × condition											0.833 ( <i>p</i> = 0.012)	
Familiarity × condition		-1.974 ( <i>p</i> = 0.011)										

<sup>a</sup>Lower score indicates a more positive behavior.

<sup>b</sup>Higher scores indicate more positive determinants.

<sup>c</sup>Significant overall condition effects are reported for models without any interactions.

in the control region ( $B = -0.992$ ;  $p = 0.026$ ). A further interaction effect between familiarity with a health project and condition on the fat score was present at T2. Respondents who were familiar with a health project in the Maastricht region had a lower fat score than respondents who were familiar with a health project in the control region, but this effect was not statistically significant ( $p = 0.078$ ).

Respondents who were familiar with a health project in their community reported more social support towards decreasing their fat intake at T2 than those who were not familiar with such a health project [odds ratio (OR) = 1.463;  $p = 0.045$ ]. Besides, there was an overall condition effect on self-efficacy in the opposite direction at T2. Respondents in the control condition had higher self-efficacy expectations towards decreasing their fat intake than respondents in the Maastricht region (OR = 1.31;  $p = 0.037$ ). There was also an overall condition effect on awareness of one's own fat intake at T1. Respondents in the Maastricht region were more realistic about their fat intake at T1 than respondents in the control region (OR = 1.401;  $p = 0.034$ ). Finally, there was an interaction effect between gender and condition at T1 on awareness of one's own fat intake. Further exploration of this interaction effect showed that the overall condition effect on awareness of one's own fat intake was fully attributable to the women in the population studied. Women in the Maastricht region were more realistic about their own fat intake at T1 than women in the control region (OR = 1.869;  $p = 0.003$ ).

### **Physical activity and psychosocial determinants**

Table 4 shows the parameter estimates for physical activity and its determinants. There were no overall condition effects on physical activity and its determinants. At T1, the attitude (OR = 1.397;  $p = 0.029$ ) and self-efficacy (OR = 1.742;  $p = 0.001$ ) towards increasing physical activity were more positive among respondents who were familiar with a health project in their community than among those who were not familiar with such a health project. Furthermore, there was an interaction effect between age and condition on the intention to increase physical activity in the future at T1. The intention towards increasing physical activity level was more positive among respondents younger than 49 years in the Maastricht region than among

respondents of the same age in the control region (OR = 1.543;  $p = 0.015$ ). There was also an interaction at T2 between familiarity with a health project and condition on awareness of one's own physical activity level. Respondents who were familiar with a health project in the Maastricht region were more realistic about their physical activity level than respondents who were familiar with a health project in the control region, but this effect was not statistically significant ( $p = 0.056$ ).

## **DISCUSSION**

The present study found significant and thus promising community intervention effects on dietary fat intake and physical activity intentions, especially among respondents younger than 49 years. Respondents in the Maastricht region were also more realistic about their fat intake. Lower self-efficacy expectations towards decreasing their fat intake were found in the Maastricht region, but this may not be incompatible with the decline in fat intake, because self-efficacy was measured in relation to behavior change (i.e. 'eating less fat') and not in relation to present behavior (i.e. 'eating a low fat diet').

As we mentioned in the Introduction, most of the registered activities in the Maastricht region were aimed at nutrition, and this might be an explanation for the positive results on dietary fat intake. Furthermore, preliminary analysis of the process evaluation data reveal, for example, that there is a growing participation of local organizations and community members, and intersectoral collaboration between local organizations in the Maastricht region, so longer-term measures of individual behaviors may show greater changes.

It is difficult to compare the effects of the Hartslag Limburg community intervention with those observed in other Dutch or foreign community projects, because effect measurements differed between projects, different behaviors were studied, and effects were measured over different time periods. Nevertheless, some comparisons can be made. Like the present study, the most recent community-based CVD prevention programs found few significant program effects [e.g. (Winkleby *et al.*, 1997)]. Some earlier projects studying the same behaviors as the present study, however, reported some positive effects on dietary behavior or reported an

**Table 4:** Physical activity and psychosocial determinants at T1 and T2; parameter estimates (binary and ordinal logistic regression estimates)

Variable (measurement level)	Physical activity <sup>a</sup> (dichotomous)		Attitude <sup>a</sup> (ordinal)		Social support <sup>a</sup> (dichotomous)		Self-efficacy <sup>a</sup> (ordinal)		Intention <sup>a</sup> (ordinal)		Awareness of physical activity level <sup>a</sup> (dichotomous)	
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Pre-intervention score	1.208 ( <i>p</i> = 0.000)	1.322 ( <i>p</i> = 0.000)	1.330 ( <i>p</i> = 0.000)	1.167 ( <i>p</i> = 0.000)	1.717 ( <i>p</i> = 0.000)	1.255 ( <i>p</i> = 0.000)	.829 ( <i>p</i> = 0.000)	.843 ( <i>p</i> = 0.000)	1.049 ( <i>p</i> = 0.000)	.903 ( <i>p</i> = 0.000)	.976 ( <i>p</i> = 0.000)	1.084 ( <i>p</i> = 0.000)
Condition (Maastricht region = 1, control region = 0)												
Age	-0.010 ( <i>p</i> = 0.032)			-0.010 ( <i>p</i> = 0.007)			-0.026 ( <i>p</i> = 0.000)	-0.020 ( <i>p</i> = 0.000)				
Gender (female = 1, male = 0)		0.421 ( <i>p</i> = 0.007)	-0.336 ( <i>p</i> = 0.009)				-0.519 ( <i>p</i> = 0.000)	-0.455 ( <i>p</i> = 0.001)		-0.025 ( <i>p</i> = 0.000)		0.338 ( <i>p</i> = 0.026)
Education 1 (low = 1, high = 0)							-0.418 ( <i>p</i> = 0.020)		-0.288 ( <i>p</i> = 0.031)			
Education 2 (intermediate = 1, high = 0)					-0.504 ( <i>p</i> = 0.009)		-0.426 ( <i>p</i> = 0.011)					
Self-rated physical activity at T0 (scores ranging from little = 1 to much = 5)	0.369 ( <i>p</i> = 0.000)	0.158 ( <i>p</i> = 0.024)										
Familiarity with a health project (aware = 1, unaware = 0)			0.334 ( <i>p</i> = 0.029)				0.555 ( <i>p</i> = 0.001)					
Fat score at T0							-0.031 ( <i>p</i> = 0.003)		-0.025 ( <i>p</i> = 0.011)	-0.030 ( <i>p</i> = 0.003)		
Age × condition								-0.020 ( <i>p</i> = 0.011)				
Familiarity × condition											0.819 ( <i>p</i> = 0.031)	

<sup>a</sup>Higher scores indicate a more positive behavior and more positive determinants.

increased prevalence of regular physical activity [e.g. (Van Assema *et al.*, 1994; Browson *et al.*, 1996; Tudor-Smith *et al.*, 1998)]. Possible explanations frequently mentioned for the modest or absent intervention effects in community CVD prevention programs are: secular trends, i.e. it might be difficult to generate enough additional exposure in experimental communities to exceed secular trends in control communities; smaller than expected net differences in behavior change; ineffective interventions; and inaccurate survey data and/or measures [e.g. (Carleton *et al.*, 1995; Browson *et al.*, 1996; Winkleby *et al.*, 1997)]. Although the present study found that the familiarity with a health project in the Maastricht region exceeded that in the control region, these data also suggest a substantial perceived exposure to health promotion interventions in the control region. Furthermore, preliminary analysis of the process evaluation data of the Hartslag Limburg Community Intervention revealed that although familiarity with nutritional as well as physical activity and smoking cessation activities was higher in the Maastricht region, actual participation in physical activity and smoking cessation activities was higher in the control region. Unfortunately, baseline values with regard to familiarity and participation are unknown. Also, the net differences in behavior change found in the present study were smaller than expected. Although there are several indications of effective individual components of the intervention program (Brug *et al.*, 1998; Van Assema *et al.*, 1998; Ronda *et al.*, 2001a), process data also showed that actual participation of the general population in activities did not exceed 15%, indicating that the intervention did not reach a large enough fraction of the population to show greater changes. Finally, the possibility of inaccurate survey data and/or measures can not be neglected, and therefore it is important to note some limitations of the present study. First, the response at baseline was 55.5%. This is certainly not optimal, although regarded as quite acceptable for a mail survey (Miller, 1994). Nevertheless, the response rate in the present study may indicate low external validity because the representativeness of the sample is not assured (Windsor *et al.*, 1994). Compared with the general Dutch population, more highly educated respondents were somewhat (5%) over-represented in the Maastricht region, while low education levels were somewhat (7%) over-represented in the control region (Statistics Netherlands, 1997).

Secondly, there was a substantial dropout in the sample from baseline to endpoint (31.5%), which is an intrinsic feature of the longitudinal nature of the study. Dropouts were found to be younger and less educated than those who remained in the sample. However, our analyses controlled for potential confounding or interaction with condition by the above-mentioned factors. A further disadvantage of the cohort design is repeated questioning, implying the possibility that the survey itself may have an effect on the behavior of participants, especially when there is differential re-examination bias in the intervention and control condition (Salonen *et al.*, 1986; Koepsell *et al.*, 1992). In addition, the results are based on self-reports. Although the relative validity and reliability of the instruments used in the present study have been found to be better than or comparable to those used in other studies (Block *et al.*, 1989; Pols *et al.*, 1996), self-reports are often biased. Respondents in the intervention condition in particular may be inclined to over-report desirable health behaviors and under-report undesirable behaviors (Koepsell *et al.*, 1992; Windsor *et al.*, 1994). To reduce this possible differential bias, questions about health-promoting activities were included in the questionnaire in both regions, suggesting to both intervention and control participants that they had been included in the intervention condition.

A further measurement issue is the use of single-item assessments for the determinants of the CVD risk behaviors, since single-item assessments may be not sensitive enough to detect small intervention effects. However, practical limitations (survey questionnaire size) made us decide to use these single items for assessment of determinants. Secondary analysis showed that these assessments had significant and quite strong associations with intentions, which is a clear indication of the predictive validity of the assessments of the psychosocial factors.

The study included only one intervention and one control region, and allocation to either was not random. Cost and feasibility considerations usually limit the intervention and evaluation to a small number of communities, and allocation to treatment groups is often done beforehand by funding agencies or the communities themselves (Koepsell *et al.*, 1992). Most community interventions have used the 'one-group-per-condition' design and this design is well accepted in community intervention research [e.g. (Carleton *et al.*, 1995; Tudor-Smith *et al.*,

1998; Vartiainen *et al.*, 1998)]. In an attempt to overcome this design weakness to some extent, the pre-intervention score of the outcome variables, and baseline differences between the Maastricht and control region were included as independent variables in the effect analyses.

The ability to adjust for baseline differences is one of the major advantages of the cohort design (Salonen *et al.*, 1986). Furthermore, multi-level analysis was used to take into account possible dependencies among individuals from the same municipality.

## CONCLUSION

Although there were few significant intervention effects, the decrease in dietary fat intake over time in the Maastricht region was a promising result. However, the results of the present study should be seen against the background of the results of the process evaluation and the results of the effect evaluation at the organizational level, to allow the effectiveness of the community intervention as a whole to be judged.

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### *Address for correspondence:*

Gaby Ronda  
Department of Health Education and Promotion  
Maastricht University  
P.O. Box 616  
6200 MD Maastricht  
The Netherlands  
E-mail: g.ronda@gvo.unimaas.nl

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