

# NWO/GaMON Application Form

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Dossiernummer 014 - 11 - 435

## 1. Applicant(s)

*main applicant/ contact person*

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*other applicants*

names, titles, university and  
research school:

Mw. dr. A.E. van den Berg  
Wageningen University and  
Research Centre, Mansholt  
Graduate School

Dr. S. de Vries, Alterra (part of  
Wageningen University and  
Research Centre)

Dr. R.A.Verheij, NIVEL, CaRe

*Curriculum Vitae of the main applicant: appendix 2.*

## 2. Title of the research programme

Vitamin G: effects of green space on health, wellbeing, and social safety

## 3. Short summary of the problem definition

The briefest summary of our programme is in its title: Vitamin G, where G stands for the green space around us. Looking out on and being in the green elements of the landscape around us seems to affect health, wellbeing and feelings of social safety. The programme's goal is to gain insight into these relations and the mechanisms that cause the relationship between aspects of people's living environment, especially the amount and type of green space, and their health, wellbeing and feelings of safety. Previous (experimental) research in environmental psychology has shown that exposure to a natural environment has a positive effect on wellbeing through reduction of stress and attention restoration. Epidemiological research has shown a relationship between the amount of green space in the living environment and physical and mental health and longevity.

The programme has three aims. First, to document the relationship between the amount and type of green space in people's living environment and their health, wellbeing, and feelings of safety.

Second, to investigate the mechanisms connecting green space in the living environment and people's health and wellbeing. Mechanisms relate to exposure, leading to stress reduction and attention restoration healthy behaviour and social integration and selection. The first two are causal mechanisms, while the third refers to direct or indirect selection, possibly leading to a spatial redistribution of health and wellbeing, rather than an overall increase in public health. Selection may lead to environmental injustice, especially when considering the availability of and access to public green spaces. Third, to translate the results into policy on the crossroads of spatial planning, public health, and safety.

The programme consists of three projects at three different scales: at a macro scale using data on the country as a whole, at an intermediate scale looking into the specific effect of green space in the urban environment, and at micro scale investigating the effects of allotment gardens (volkstuinten).

#### 4. Titles of the different research projects

- Project 1: Vitamin G1: natural environments – healthy environments. Exploring the mechanisms (PhD project)
- Project 2: Vitamin G2: effects of greenery in urban neighbourhoods on health, wellbeing, and social safety (Postdoc project)
- Project 3: Vitamin G3: health benefits of allotment gardens (Postdoc project)

#### 5. Duration of requested subsidy

duration (years): 4 years to commence on (date): 1 January 2005

#### 6. Publications,

in which form will the results of this programme be published?

- Dissertation
- Articles in peer reviewed journals
- Articles in professional journals
- Meetings of the Nature & Health Policy Group (three meetings with health and spatial planning policy makers)
- Meetings of the Nature & Health Research Seminar (meetings of the programme team and other researchers in the field)

#### 7. Research team / project managers of the projects

name, titles	discipline / university	hours/ week	chargeable to	project number
Prof. dr. P.P. Groenewegen	Sociology, NIVEL, Utrecht University (Dep. of Sociology, Dep. of Human Geography),	4	NIVEL	1,2,3
Dr. R.A. Verheij	Human Geography, NIVEL	2	NIVEL	1
Dr. S. de Vries	Social psychology, Alterra (part of Wageningen University and Research Centre)	4	Alterra	2
Mw. dr. A.E. van den Berg	Environmental psychology, Wageningen University	18 (postdoc on the programme)	GaMON	3
Drs. P. Spreeuwenberg	Statistics, NIVEL	1	NIVEL	1,2
OIO	Social, geographic or health scientist, NIVEL/Utrecht University	36	GaMON	1
Postdoc	Sociology, human geography, Alterra WUR	18	GaMON	2

#### 8. Has this application been submitted elsewhere?

no

#### 9. Other funding for this project (nature, amount and source)

No, not yet. But additional funding will be actively sought in 2004 to extend the proposed research.

## 10. Description of the research programme

### 10.1 Scientific significance and relation to the GaMON research programme

Notions of beneficial effects of nearby green space have persisted throughout history (Van den Berg & Van den Berg, 2001). These notions have only recently been substantiated in controlled, experimental research. This research has focused mainly on demonstrating the relationship between exposure to green environments and wellbeing (Ulrich, 1984; Hartig et al., 2003). To maximize effects, scientists have selected extreme settings and concentrated on stress reduction and attention restoration as the most noticeable outcomes. Theoretical developments have followed this empirical focus, and the dominant theories in the field (Kaplan & Kaplan, 1989; Ulrich, 1984) all consider stress reduction and restoration as a central causal mechanism. Although this focus on extreme settings and restorative effects has highlighted the importance of green space to wellbeing, it potentially obscures the scope and underlying mechanisms of these effects. Very little is known about the positive effects of green space on wellbeing through mechanisms of increased and prolonged physical activity, and improved social cohesion. (Berkman, Kawachi, 2000; Humpel et al., 2002), and selection (Verheij et al., 1998). The first two are causal mechanisms, while the third refers to direct or indirect selection, leading to a spatial redistribution of health and wellbeing, rather than an overall increase in public health. Selection may lead to environmental injustice, especially when considering the availability of and access to public green spaces.

By taking a broad perspective on the relationship between green space and wellbeing that takes account of a wide range of settings, health outcomes and underlying mechanisms, the present research aims to do more justice to the scope and importance of this relationship. This broad perspective will also make the research relevant for the field of social or health geography. In this field, regional differences in health (urban – rural) have seldom been related to the amount of green space within the environment. The present research aims to fill this gap and thus provides a contribution to this field as well.

The scientific significance of this project is underscored by the fact that the Health Council of The Netherlands (Gezondheidsraad) has installed a committee to describe the state of the art of research about the relation between nature and health and wellbeing (two members of the research team are also members of this committee). Although the report is only due later in 2004, it is already clear that there are important lacunae in current knowledge about this relationship and its explanation. The project is important to GaMON, because it integrates aspects of two of its policy themes and focuses on one of the three central issues in the GaMON program, namely social wellbeing and behavioural effects.

### 10.2 Detailed problem definition

The general problem formulation is: how can the relationship between the amount of green space in people's living environment and their health, wellbeing and perceived safety be assessed and explained and how can the results be made useful for policy intervention?

Specific problem formulations:

1. how strong is the relationship between the amount of green space in people's living environment and their subjective health and wellbeing, and feelings of safety and is this relationship stronger for specific population segments and/or types of green space? How can this relationship be explained?
2. do neighbourhoods that differ in the amount and type of green space in the vicinity, also differ in the health, wellbeing and perceived safety of the people living in these neighbourhoods? Do neighbourhoods that went through a large change in the amount of green space, differ in these respects?
3. is having an allotment garden related to health, wellbeing and perceived safety in urban dwellers and how can this relationship be explained?

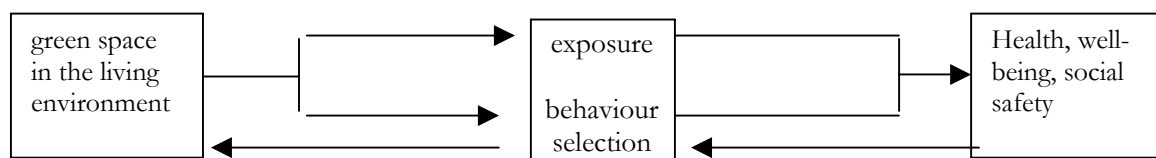
The first question will be addressed in a macroscopic project, establishing the strength of the relationships and testing hypotheses about the mechanisms that explain the association between green space and health and wellbeing, and feelings of safety. This project uses data on a national scale from secondary data sets, one on health and wellbeing, based on the Second National Survey of Morbidity and Interventions in General Practice (NS2) (Schellevis et al. 2003; Westert e.a., in press), and one on feelings of social safety, based on the Politiemonitor (2003). The central research question is: how can the relationship between the amount and type of green space in people's living environment and their subjective health and wellbeing,

and feelings of safety be explained? Hypotheses will be tested about the role of different mechanisms, about the impact on specific groups within the population (elderly, children, low SES, ethnic minorities, women), and about the impact on specific outcomes (specific aspects of health, wellbeing and perceived safety).

The second project, in which the second question is addressed, zooms in on the urban environment. Green space is scarcer in urban areas and access to it might be more skewed. This project mainly uses primary data to be collected by a postal survey, and additionally secondary data from local surveys of municipal health departments. The central research question is: do neighbourhoods that differ in the amount and type of green space in the vicinity, also differ in the health, wellbeing and perceived safety of the people living in these neighbourhoods? Additionally, data will be analysed for neighbourhoods that went through a large change in the amount of green space. Special attention will be given to issues of environmental justice.

The third project, addressing the third question, focuses on the micro geographic scale. Being also located in an urban environment, it uses primary data about people with and without an allotment garden. The central research question is: is having an allotment garden related to health, wellbeing and perceived safety in urban dwellers and how can this relationship be explained? Special attention will be given to testing hypotheses about the role of social integration in explaining the relationship (Armstrong, 2000; Philips, Wielers, 2001).

Our approach to answer these questions is based on analysing the multilevel relationships between environment and people (Coleman, 1990; Groenewegen, Huigen, 1992; Groenewegen, 1997). People live in a shared environment, influencing their wellbeing in a general sense, even partly by virtue of the fact that it is a shared environment (as in the case of social integration). These relationships can be schematised as follows:



*Exposure* to green space consists of direct physical exposure and the psychological processes through which exposure influences health and wellbeing. These psychological processes will be further developed, using theories about stress and restoration. A small but growing body of evidence shows that green environments are particularly effective in providing restoration from stress and mental fatigue (e.g., Van den Berg et al., 2003). Restorative effects can be achieved by merely looking at nature or natural elements, indicating that the aesthetic experience of nature may play an important role in this mechanism. Besides providing relief from stress, an aesthetically attractive living environment may also improve wellbeing by enhancing satisfaction, attachment, and a sense of responsibility. Related to stress reduction, (American) evidence suggests that exposure to natural environments may reduce feelings of anger, frustration and aggression (e.g., Kuo & Sullivan, 2001a). In turn, this may enhance feelings of social safety, and even reduce actual rates of aggressive behaviour and criminal activity (Kuo & Sullivan, 2001b).

The *behavioural mechanism* will be developed, using sociological theories about life style in the Weberian sense of combining structural aspects and opportunities (availability, social integration, selection) and choices people make (behaviour) (Ganzeboom, 1988; Joosten, 1995). Natural environments are perceived as more attractive than built environments. Because of this, green areas may stimulate residents to undertake healthy physical activities such as walking or cycling or to choose these activities as a mode of transport, and to spend more time on them (Taylor et al., 1998). Attractive green areas in the neighbourhood may serve as a focal point of tacit coordination for positive informal social interaction, strengthening social ties and thereby social cohesion (Kweon et al., 1998). Social cohesion by itself is thought to have a positive effect on wellbeing and feelings of safety.

Apart from these causal mechanisms, part of the effect may be the result of *selection*. Direct, when people's wellbeing influences their chances of living in a favourable environment; or indirect, as when people with certain characteristics, such as income, that are related to wellbeing can afford to live in a favourable environment (Verheij, 1999). Migration flows are related to such socio-demographic characteristics as age, income and education (Heins, 2002). When analysing the causal mechanisms, it is important to take into account and control for the possibility of selection.

More insight into the relative contributions of these mechanisms and their interrelations may help to improve the design, layout and maintenance of green areas and natural elements (such as street trees) in residential areas in order to obtain maximal benefits for residential wellbeing.

### **10.3 Originality and innovative nature of the proposed research**

The innovative character of our programme lies in the following points:

- We study several interrelated aspects of human wellbeing that until now have been studied separately: self perceived health, physical complaints, mental health, and perceived safety;
- We include a large number of different settings so that aspects of wellbeing can be linked to physical characteristics (amount and type of green space needed, visual quality, lay-out, management);
- Field studies will be conducted instead of experimental studies; this is especially important for applied purposes, because it provides a better indication of the relative size of the effects in real-life settings. Field studies also have higher ecological validity, a more direct social relevance, and a focus on long-term rather than on short-term effects (almost inevitable in the case of laboratory studies).
- The focus is on ordinary settings instead of 'extreme' settings in which people are especially stressed or frustrated (hospitals, prisons), or live in extremely poor or barren circumstances (as in some of the earlier studies: Takano et al., 1989; Kuo et al, 1989.; Kweon et al, 1998) provides insight into the generalizability of the effects and the relevance to the Dutch situation;
- A focus on different target groups within society increases the policy relevance;
- Distinguishing between individuals in their context, makes it possible to analyse these two levels with appropriate statistical models (multilevel analysis);
- The use of similar dependent measures in the three projects and the macroscopic to microscopic approach enables the comparison and integration of the outcomes of the different projects.

### **10.4 Methodology (relevance, availability of data, clearness, motivation)**

The first project only uses existing, large-scale survey data and land use data. The second project collects primary data through surveys and observation, to be combined with existing survey and neighbourhood data. The third project collects primary data through personal interviews. Our approach is motivated by the availability of survey data and the scope of the analysis: with the scope moving to the micro level, qualitative approaches become more important and feasible. The methodology of the three projects is briefly summarised as follows:

Project 1: national cross-section, combining existing survey data with geocoded data on land use (and relevant confounders), using up to date GIS and multilevel techniques. The NS2 contains basic data on 300.000 persons and extensive personal health interviews with circa 13.000. The Politiemonitor contains data of approximately 90.000 persons on feelings of safety. Both surveys contain geocodes.

Project 2: urban study, comparing contrasting and changing neighbourhoods, combining both primary data and existing (GGD) survey data and neighbourhood data from existing sources and direct observation (local green space situation), using multilevel techniques. Primary data will be collected by postal survey among circa 3.000 people, sampled from selected neighbourhoods.

Project 3: urban study, using primary data of people having an allotment garden, and two control groups (neighbours of those having an allotment garden), and people from the same social and neighbourhood background on the waiting list for an allotment garden. The size of each group will be circa 50. Data will be collected through personal interviews and keeping a diary.

### **10.5 Multi- and interdisciplinary character; relation with research in science and technology**

The research team consists of researchers with different disciplinary backgrounds: sociology, social psychology, environmental psychology, human geography. When necessary, experts from other areas, such as health scientists (NIVEL), GIS-experts (UU and Alterra/WUR), ecologists, and landscape architects (Alterra/WUR) will be consulted. The research team is both linked to academic research (Utrecht University and Wageningen University) and research schools (URU, ICS, CaRe, MGS) and to applied research (Alterra and NIVEL). The WUR-department of environmental sciences, of which Alterra is a part, is well known for its integrated research projects ('delta method').

### **10.6 Link between fundamental and applied research within this field**

The project links work at two universities (Wageningen and Utrecht), two applied policy research institutes (NIVEL and Alterra), and the two biggest cities (Municipal health department Rotterdam and Spatial planning service Amsterdam, see also under 10.8). This covers the range from fundamental research to applied research to application. A profound knowledge of the experimental research in this area will be used to guide and inform the more applied research of this programme.

### **10.7 Contribution to the GaMON knowledge infrastructure**

The start of the co-operation between the research groups involved was some four years ago, when an exploratory analysis of the relationships between green space and health started. The current project builds on this and facilitates the integration of health and wellbeing as outcomes in research about nature and landscape. Given the current attention for issues of nature and health, it is expected that our co-operation will be continued. Issues to be explored in future co-operation are longitudinal effects of living in a green environment and policy consequences of the programme. The report of the Health Council and a planned research programming activity by the RMNO will provide a framework and possibly pathways to future funding of the co-operative activities.

### **10.8 Relevance to policy questions (valorisation) and dissemination of results to interested parties**

Urban green space is under strong pressure (De Vries, 2001). Due to increasing urbanisation, combined with a spatial planning policy of densification ('compacte stad beleid'), more people face the prospect of living in less green residential environments. Especially people from low economic strata, without resources to move to greener areas outside the cities, will be affected. This may lead to environmental injustice with regard to the distribution of (access) to public green space. Until now, the possible effects of these developments on public health and wellbeing have not been explicitly incorporated in Dutch policy making (see also the advice of the Council for Rural Areas (RLG, 2004). Policy makers tend to view green space more as a luxury good than as a basic necessity, and appear to overlook the potentially important effects of green space on health, wellbeing, and safety. It is vital that these findings become implemented in urban planning and design. At present, however, there is not sufficient knowledge to translate findings into guidelines for urban planning and design. In particular, little is known about the strength of the relationships, possible social differences, and the spatial conditions that promote beneficial effects of nearby nature. To ensure the practical value of the research, we will closely collaborate with stakeholders from different institutions, such as the spatial planning service of the municipality of Amsterdam (contact: drs. J. van Zoest) and the municipal health department of Rotterdam (contact: dr. F. Woudenberg), throughout the entire project. The interaction with policymakers and other stakeholders will be organized in the *Nature & Health Policy Group* that will meet three times during the project (at the beginning, half way and at the end). In the Nature & Health Policy Group both local policymakers and national policymakers and stakeholders will participate. Apart from the persons mentioned above, representatives of the Ministry of Agriculture and Nature (N. Bosma), the Ministry of Public Health, Wellbeing and Sports (T. Rutten) and Stichting Natuur en Milieu (K. de Feijter) have already indicated their willingness to participate. The results of the projects and the programme as a whole will both submitted to international, peer-reviewed journals and national professional journals.

### **10.9 Links with international programmes; international collaboration**

Professor Groenewegen and dr. van den Berg are members of the Health Council committee on Nature and Health and through this well-informed on activities in this field. Dr. van den Berg is also a member of the scientific committee of the International Conference on the Architecture of Hospitals, to be held in 2004. The central theme of this conference is evidence-based design, i.e. the application of empirical evidence from environmental psychology to architecture (other members of the committee include Prof. dr. Roger Ulrich from Texas A&M University). Dr. de Vries is a member of the Expert Group on Agriculture, Green and Health of Wageningen University and Research Centre, and of the starting COST-E39 action "Forests, Trees and Human Health & Wellbeing", which will, among other things, generate an overview of European studies and activities within this field. Personal contacts exist with several internationally well-known researchers, e.g. Prof. Terry Hartig (Institute for Housing and Urban Research, Uppsala University), Prof. Patrik Grahn (Dept. of Landscape Planning, Health & Recreation, Swedish University of Agricultural Sciences). Dr. Verheij is member of the Health Services Research Section of the

European Public Health Association and is involved in the EU funded network of general practitioners information networks.

#### **10.10 Integrative character; relation between and within the GaMON-themes and between the projects**

The programme is mainly related to policy theme 1: Landscape and nature. The relationship between nature and landscape and health and wellbeing is an under-researched topic. Our own previous work is the first large-scale investigation. Especially the elaboration of explanatory mechanisms and the differentiation according to socio-demographic categories and different kinds of green space are important. The project is also linked to policy theme 2: Housing and living environment. Especially in urban areas, a decreasing amount of green space is seen as problem. The compact city policy has led to building up public green space. Parks and allotments form an urban oasis, both in a physical sense of being part of the green space left within the city boundaries, and in social sense of having a strong social structure that has almost disappeared in the neighbourhoods where the users of the gardens live.

Integration of policy themes 2 and 1 mainly takes place in the macroscopic project by looking, nationwide, at the relationship between the amount and type of green space in the living environment of people and their wellbeing. The relationship between the projects is that they investigate the same problem from a macroscopic to a microscopic view and that they try to test the same group of explanatory mechanisms.

#### **10.11 Management and project organisation**

During the project, co-operation will be structured through monthly meetings of the whole research team. Apart from the Nature & Health Policy Group, the Nature & Health *Research Seminar* will be organised regularly to discuss the programme, its results and implications with other invited researchers in this field. An interactive website will facilitate co-operation.

The first project will be done by the OIO, but s/he will also participate in questionnaire design and data collection for the second project.

The applicant has ample experience in project management, both in NWO-funded projects and in applied contract research. He is head of one of the three research departments of NIVEL, the Netherlands Institute for Health Services Research.

#### **10.12 Relevant literature of the research group**

- Groenewegen PP, Westert GP, Boshuizen HC. Regional differences in healthy life expectancy in the Netherlands. *Public Health* 117:424-429, 2003.
- Groenewegen PP, Leufkens H, Spreeuwenberg P, Worm W. Neighbourhood characteristics and use of benzodiazepines in the Netherlands. *Social Science & Medicine* 48:1701-1711, 1999.
- Van den Berg AE, Koole SL, Van der Wulp NY. Environmental preference and restoration: (How) are they related? *Journal of Environmental Psychology*, 2003; 23, 135-146.
- Van den Berg AE, Van den Berg MMHE. *Van buiten word je beter; een essay over de relatie tussen natuur en gezondheid* (Nature heals; an essay on the relationship between nature and health). Wageningen, Alterra, 2001
- Verheij R.A. *Urban-rural variations in health care*. Utrecht: NIVEL, proefschrift UU, 1999.
- Verheij R.A., Van de Mheen HD, De Bakker DH, Groenewegen PP, Mackenbach JP. Urban-rural variations in health in the Netherlands: does selective migration play a part? *J Epidemiol Community Health* 52:487-493, 1998.
- Vries S de, Verheij RA, Groenewegen PP, Spreeuwenberg P. Natural environments – healthy environments? An exploratory analysis of the relationship between greenspace and health. *Environment & Planning*, 2003; 35: 1717-1731.
- Vries, S. de (2001). Nature and Health; the importance of green space in the urban living environment. Proceedings of the symposium “Open space functions under urban pressure”, 19-21 September 2001, Ghent.
- Vries S de, Verheij RA, Groenewegen PP. Natuur en gezondheid: een verkennend onderzoek naar de relatie tussen volksgezondheid en groen in de leefomgeving. *Mens en Maatschappij* 75:320-339, 2000.

**NWO / GaMON Application Form**  
for project subsidy within the framework of a coherent set of projects

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**PROJECT NUMBER: 1**

**1. Applicant(s)**

*main applicant/ contact person*

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postcode: 3500 BN	town/city: Utrecht	
telephone: 030 2729657	fax: 030 2729729	E-mail: r.verheij@nivel.nl

*other applicants*

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names, titles, university and  
research school:

*Curriculum Vitae of the applicant: appendix 2.*

**2. Title of the research project**

Vitamin G1: Natural Environments - healthy environments. Exploring the mechanisms.

**3. Short summary of the problem definition**

Aim of the project is to gain insight into the relations between aspects of people's living environment, especially the amount and type of green space, and their health, wellbeing and feelings of safety.

Epidemiological research on data from 1988 by our group, has shown a positive relationship between the amount of green space in people's living environment and indicators of self evaluated mental and physical health. Little is known, however, about the *mechanisms* behind this relationship and whether or not the relationship extends to aspects of people's *wellbeing* and *feelings of safety*.

In this project we will further investigate the nature of the relationship by not only investigating the effects on people's health, but also on their wellbeing and feelings of safety. Furthermore, we will investigate the mechanisms involved: social selection, health behaviour, and exposure. Insight into these mechanisms is important for policy making in spatial planning, public health, and social safety.

Three individual-level, geocoded datasets that cover the whole of the country, will be combined with a geographical dataset on land use. The individual level datasets contain information on people's perceived general health and visits to a family doctor in a 12 month period (N= 300.000); a number of more specific perceived health indicators and health behaviour (N=13.000) and feelings of safety (N=90.000). All three datasets contain information on socio-economic and demographic characteristics that will be used as covariates.

**4. Publications,**

in which form will the results of this project be published?

- Dissertation
- Articles in peer reviewed journals
- Article in a professional journal

**5. Duration of requested subsidy**

duration (years): 4

to commence on (date): January 1, 2005

## 6. Research team

name, titles	discipline / university	hours/ week
Prof. dr. P.P. Groenewegen	Sociology, Utrecht University (Department of Sociology, Department of Human Geography), Netherlands Institute of Health Services Research (NIVEL)	2
Dr. R.A. Verheij	Human Geography, Netherlands Institute of Health Services Research (NIVEL)	2
drs. P. Spreeuwenberg	Statistician, Netherlands Institute of Health Services Research (NIVEL)	
OIO	Social, geographic or health scientist, NIVEL/Utrecht University	36 (on the project)

## 7. Research location

organisation: Netherlands Institute for Health Services Research (NIVEL)

institute: Netherlands Institute for Health Services Research (NIVEL)

address: PO box 1568

postcode: 3500 BN

town/city: Utrecht

The project will be part of URU (Utrecht University).

## 8. Has this application been submitted elsewhere?

no

yes, to:

## 9. Other funding for this project (nature, amount and source)

## 10. Description of the research project

### 10.1 Scientific significance

Recent epidemiological research by our team has shown a relationship between a green living environment and perceived health indicators in a large population sample (De Vries et al., 2000, 2003). This was the first study in the general population that showed this relationship not to be exclusive to extreme and controlled settings. People living in greener areas tend to perceive their physical as well as their mental health status as better than their counterparts living in less green areas (controlling for socio-economic and demographic spatial clustering). Whether such a positive relationship will also be found when looking at aspects of people's wellbeing is not known. The same applies to people's feelings of safety, for which it is even very well possible to hypothesize a negative effect of green space in one's living area.

With respect to the mechanisms involved, scientists have so far concentrated mainly on the psychological effects of exposure to nature on people's wellbeing through stress reduction. Very little is known about the positive effects of green space on wellbeing through the other possible mechanisms of higher levels of physical activity and improved social cohesion.

The proposed project takes into account a broader scope on the factors affected; a wider range of settings; a wider range of outcome measures; and a broader perspective of underlying mechanisms than any research in this field has done before. Furthermore, it includes a much larger number of subjects than ever before.

### 10.2 Detailed problem definition

Two main questions will be addressed in this project.

1. How strong is the relationship between the amount of green space in people's living environment and their subjective health and wellbeing, and feelings of safety?
  - a. To what extent is this relationship dependent on the segments of the population involved (e.g. elderly, children, low SES, ethnic minorities, women)?
  - b. To what extent is this relationship dependent on the type of green space involved (e.g. urban green, agricultural green)?

- c. To what extent is this relationship dependent on the type of outcome measure involved (specific health problems, specific aspects of wellbeing and feelings of safety)?
2. How can these relationships be explained by mechanisms of exposure, behaviour and selection?

The relation between people's living environment on the one hand and their health and wellbeing on the other, can theoretically be explained by three general mechanisms: exposure, behaviour and selection.

The *exposure* mechanism will be further developed using, first, psychological theories about stress and restoration. A small but growing body of evidence shows that green environments are particularly effective in providing restoration from stress and mental fatigue (e.g. Van den Berg e.a., 2003). Besides providing relief from stress, an attractive, green neighbourhood may also improve wellbeing by enhancing satisfaction, attachment, and a sense of responsibility. Related to the mechanism of stress reduction there is (American) evidence suggesting that exposure to natural environments may reduce feelings of anger, frustration and aggression (e.g., Kuo & Sullivan, 2001a). In turn, this may enhance feelings of social safety in a neighbourhood, and even reduce the actual rates of aggressive behaviour and criminal activity (Kuo & Sullivan, 2001b). A study on the relationship between the distance to the nearest public green area and stress in relatively small Swedish towns offers encouraging results (Grahm & Stigsdotter, 2003), but nevertheless more research on effects in less extreme situations is clearly needed. The data we use in this project contains information about the incidence of fatigue which is clearly related to stress (Bensing et al., 2003) and includes indicators of 'medically unexplained symptoms'. Second, exposure may affect subjective health and wellbeing through the physiological effect of breathing cleaner air and the absence of pollution (see for example the Rijnmond Health Effect Screening by Slob & Walda, 2003).

The other two mechanisms (selection and behaviour) will be developed, using sociological theories about life style in the Weberian sense of combining structural aspects and opportunities (availability, social integration, selection) and choices people make (behaviour) (Ganzeboom, 1988; Joosten, 1995). For the *behavioural mechanism*, there is abundant evidence that natural environments are perceived as more attractive than built environments. And because of their attractiveness, green areas may stimulate residents to undertake healthy physical activities such as walking or cycling or choose these activities as a mode of transport, and to spend more time on these activities (Taylor e.a., 1998). Attractive green areas in the neighbourhood may serve as a focal point of tacit coordination for positive informal social interaction, strengthening social ties and thereby social cohesion (Kweon e.a., 1998). Social cohesion by itself is thought to have a positive effect on wellbeing.

Social *selection* can be direct, when people's health and wellbeing influence their chances of living in a favourable environment. It can also be indirect, as when people with certain characteristics, such as income, that are related to wellbeing can afford to live in a favourable environment (Verheij, 1999). When analysing the other two (causal) mechanisms, it is important to take into account and control for the possibility of selection effects. However, this mechanism is not only important as a factor to control for: selection effects may point at issues of environmental injustice in terms of limited access to green space for some groups in society.

Previous studies have in common that they focus on possible positive effects of green space on people's health and wellbeing. However, it is very well possible that these positive effects are counterbalanced by a possible tendency of people to feel less safe when walking through a green space such as a park or a quiet country road than in a more crowded built-up area. On the other hand, some of the literature points to lower levels of aggression as a result of being exposed to a green environment, which might lead to increased social safety. The net effect is difficult to predict. Therefore, an important part of the proposed study deals with the effects of living in a green area on people's feelings of safety.

### 10.3 Methodological-technical design

*General outline of the analyses:* Starting point for the analyses is the relationship between green space and people's health that was found by De Vries et al. (2003). In the first step of our analyses we will replicate the analyses of De Vries et al. using larger, more recent, and more comprehensive datasets that are better tuned to each other. The second step entails the theoretical analysis of the mechanisms responsible for the relationship between people's living environment and their health and wellbeing. This will result in a number of hypotheses that will subsequently be tested empirically (see par. 10.2 for examples of possible hypotheses).

The table below lists the datasets involved in the analyses. The analyses on health and wellbeing will be conducted on two datasets that were collected in 2001. The first dataset contains information on perceived

general health of about 300.000 people. This large number of subjects guarantees an enormous power to differentiate between relatively small subgroups in the population. The second dataset contains a much larger set of indicators of health and wellbeing and a much larger set of socio-economic and demographic variables but on a smaller number of people (N=13.000). These two datasets do not contain information on feelings of safety. For this particular part of the project we will use data from the Politiemonitor (N=90.000). The three individual level dataset can be geographically linked to the fourth dataset, containing information on land use in each 25 by 25 meter gridcell in the Netherlands, and thereby providing the ingredients for constructing the core independent variable.

*Table.* The following datasets will be used

	subjects	variables included	geo coding	source
<i>Dataset 1.</i> Health and wellbeing 1	All patients listed in 104 GP practices. N=300.000. Representative for Dutch population.	<ul style="list-style-type: none"> <li>•perceived general health</li> <li>•basic socio-economic and demographic variables, including ethnic background</li> <li>•all diagnose-coded contacts and interventions with general practice during 12 months in 2000/1.</li> </ul>	4-digit postcode	Second National Survey of Morbidity and Interventions in General Practice, 2001 (Schellevis e.a., 2003, Westert e.a., in press)
<i>Dataset 2.</i> Health and wellbeing 2	Random sample of patients listed in 104 GP practices. N= 13.000. Representative for Dutch population. This is a subset of the subjects the first dataset.	as dataset 1, <i>plus</i> : <ul style="list-style-type: none"> <li>•extensive health information</li> <li>•health behaviour (e.g. smoking, nutrition, physical activity)</li> <li>•extensive socio-economic and demographic characteristics</li> <li>•other relevant control variables (e.g. having a private garden, housing conditions)</li> </ul>	4-digit postcode	Second National Survey of Morbidity and Interventions in General Practice, 2001. (Schellevis e.a., 2003, Westert e.a., in press).
<i>Dataset 3.</i> Feelings of safety	Random population sample. N=90.000	<ul style="list-style-type: none"> <li>•feelings of safety</li> <li>•perceived neighbourhood problems</li> <li>•having been victim of crime</li> <li>•socio-economic and demographic characteristics, incl. ethnicity</li> </ul>	4-digit postcode	Politiemonitor Bevolking 2003 (Politiemonitor, 2003)
<i>Dataset 4.</i> Green space	The Netherlands, 25*25 meter grid cells	land use data (type of green, water surface, built-up area).	x- and y-coordinates grid cells	LGN4 data

*Methods.* GIS techniques will be used to link the individual level data to the land use data and construct the core independent variable (for example the total amount of green space in a 1 km radius around one's home). Because spatially clustered data (individuals in their environments) are involved, multilevel research techniques will be used to avoid 'fallacies of the wrong level' (Westert, Verhoeff, 1997; Snijders, Bosker, 1999; Leyland, Groenewegen, 2003).

#### 10.4 Relevance to policy questions (valorisation) and dissemination of results

*Valorisation.* Many people in the Netherlands suffer from health problems, related to stress and/or health behaviour. The presence of green space in people's living environment may diminish stress and stimulate healthy behaviour. At the same time, however, urban green space is under strong pressure (see De Vries, 2001). Due to increasing urbanisation, combined with a spatial planning policy of densification ('compact stad beleid'), more people face the prospect of living in less green residential environments. Dutch policy makers tend to view green space more as a luxury good than as a basic necessity, and appear to overlook the potentially important effects of green space on health, wellbeing, and safety. Especially groups with a low economic status, who do not have the resources to move to greener areas outside the cities, will be affected by these developments. At present, however, there is not sufficient knowledge to translate research findings into guidelines for spatial planning. In particular, little is known about the strength of the relationships, possible group differences, and the spatial conditions that promote beneficial effects of green.

*Dissemination of results* to the scientific field will take place through the publication of articles in peer reviewed journals and a dissertation. To ensure the practical value of the research, the Nature & Health Policy Group will convene three times during the project.

### **10.5 International collaboration**

Dr. Verheij is a member of the European Public Health Association, Health Services Research Section, a network of researchers in the field of health services research ([www.eupha.com](http://www.eupha.com)). Being the central coordinator of the Dutch National Information Network on GP care, dr. Verheij participates in the EU funded network of GP information networks.

### **10.6 Relevant literature of the research group and data sources**

Groenewegen PP, Leufkens H, Spreeuwenberg P, Worm W. Neighbourhood characteristics and use of benzodiazepines in the Netherlands. *Social Science & Medicine* 48:1701-1711, 1999.

Verheij R.A. *Urban-rural variations in health care*. Utrecht: NIVEL, PhD thesis, 1999.

Verheij R, Van de Mheen HD, De Bakker DH, Groenewegen PP, Mackenbach JP. Urban-rural variations in health in the Netherlands: does selective migration play a part? *J Epidemiol Community Health* 52:487-493, 1998.

Vries S de, Verheij RA, Groenewegen PP, Spreeuwenberg P. Natural environments – healthy environments? An exploratory analysis of the relationship between greenspace and health. *Environment & Planning*, 2003; 35: 1717-1731.

Politiemonitor. *Politiemonitor bevolking 2003; landelijke rapportage + tabellenrapport*. Den Haag/Hilversum, B&A Groep Beleidsonderzoek en -Advies / Intomart, 2003

Schellevis F, Westert G, de Bakker D, Groenewegen P, van der Zee J, Bensing J. De tweede Nationale Studie naar ziekten en verrichtingen in de huisartspraktijk: aanleiding en methoden. *Huisarts & Wetenschap* 46:7-12, 2003.

Westert GP, Schellevis FG, de Bakker DH, Groenewegen PP, Bensing JM, van der Zee J. Monitoring health inequalities through General Practice. *European Journal of Public Health*, in press (accepted 28-01-2004).

Datasets:

All datasets to be used in this project are readily available. Their content is described in section 10.3.

### **10.7 Relation to and position in the programme**

Three complementary projects are formulated in the programme. The difference between the three projects is in the scope and level of detail. The first project is described above and focuses on the national level, aiming at generalisable results at this level.

The second project zooms in on the *urban* environment and even on specific neighbourhoods. The urban setting needs special attention because green space is scarcer in urban areas and access to it might be more skewed. This project will mainly use primary data to be collected by a postal survey, and additionally existing data from local surveys of municipal health departments. The same mechanisms that are under investigation in the nation-wide epidemiological project will be studied here, but in more detail. More detailed information on the local green space situation will be available on the perception, evaluation and use of these green elements. Furthermore, more detailed information will be available to explore the possible mechanisms involved. Additionally, data will be analysed for neighbourhoods that went through a large change in the amount of green space. Thus, the second project is complementary to the first in the sense that it zooms in on the urban setting; that it encompasses more detailed information that allows us to go deeper into the question what mechanisms are at work in the relation between green space and health/wellbeing/public safety; and that it includes longitudinal aspects.

The third project focuses on the micro level. This project is also located in an urban environment. It focuses on a specific type of urban green space: allotment gardens. Special attention will be given to testing hypotheses about the role of social integration in explaining the relationship (Armstrong, 2000; Philips, Wielers, 2001).

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**PROJECT NUMBER: 2**

**1. Applicant(s)**

*main applicant/contact person*

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Female

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*other applicants*

names, titles, university and  
research school:

Mw. A.E. van den Berg, dr.  
Wageningen University and  
Research Centre, Mansholt  
Graduate School

*Curriculum Vitae of the applicant: appendix 2.*

**2. Title of the research project**

Vitamin G2: Effects of greenery in urban neighbourhoods on health, wellbeing and social safety

**3. Short summary of the problem definition**

In this project we will focus on health and livability issues in urban neighbourhoods. In particular, we will examine the possible impacts of “local greenery”, such as urban forests, parks, roadside vegetation, and city trees, on health, wellbeing, and social safety. We intend to follow a twofold approach. To start with, we will conduct a longitudinal study, using data of municipal health services (GGD's) on health. We will compare GGD-data collected prior to and after a considerable change in the local green structure of residential areas. We will complement this preliminary investigation with a more thorough cross-sectional study. In this second study, we will select neighbourhoods from several large Dutch cities that differ widely in the amount and type of greenery in the living environment, as well as in the quality of this greenery. We will question inhabitants of these neighbourhoods regarding their knowledge, perceptions, evaluations and use of this greenery. In addition, we will make a detailed inventory of this local supply of green space. The emphasis will be on the mechanisms connecting greenery in the living environment to people's health and wellbeing. These mechanisms relate to stress reduction, health behaviour, social integration, and social selection.

**4. Publications,**

The result of this project will be published in:

- scientific report
- articles in peer reviewed journals
- articles in professional journals

**5. Duration of requested subsidy**

duration (years): 3 years

to commence on (date): 1 January 2005

## 6. Research team

name, titles	discipline /university	to the account of	hours/week
Dr. S. de Vries	Social psychology /WUR (Alterra)	WUR/Alterra	2
Mw. Dr. A.E. van den Berg	Environmental psychology /Wageningen University	WU	2
Postdoc (half-time)	Environmental psychology/human geography	NWO	18

## 7. Research location

organisation: WUR, Environmental Sciences Department  
institute: Alterra  
address: Postbus 47  
postcode: 6700 AA town/city: Wageningen

## 8. Has this application been submitted elsewhere?

no  
 yes, to:

## 9. Other funding for this project (nature, amount and source)

Additional funding is being actively sought in 2004.

### 10.1 Scientific significance

Notions on beneficial effects of greenery in the living environment have only recently been substantiated in controlled scientific research. Several studies have demonstrated positive relationships between the presence of greenery in urban neighbourhoods and residents' health, wellbeing, and social safety (De Vries et al., 2003; Kaplan, 2001; Kuo & Sullivan, 2001; Grahn & Stigsdotter, 2003). These relationships have been explained mostly through the mechanism of stress reduction. Indeed, there is some evidence that exposure to local greenery may reduce stress and mental fatigue. For example, Honeyman (1992) found that stressed participants who viewed images of vegetated urban scenes showed the highest levels of stress reduction, even higher than those viewing countryside, while those viewing the barren urban scenes exhibited an increase in stress levels. However, besides stress reduction, there may be other mechanisms underlying beneficial effects of local greenery. In particular, very little is known about increased and prolonged physical activity, and improved social cohesion as underlying mechanisms.

The proposed project aims to extend previous research by focusing on a broader range of possible mechanisms and their interrelations. Health outcomes of residents of urban neighbourhoods with varying amounts and types of local greenery will be related to possible differences in stress levels, physical activities, and social safety. In addition, the proposed research will also pay special attention to the characteristics of the available local greenery. Relevant questions deal with the consequences of the amount, the type, and the layout of green spaces for the different beneficial effects and underlying mechanisms. Finally, it should be pointed out that most of the previous research in residential areas thus far has been conducted in extremely barren neighbourhoods of mega-cities, such as Chicago and Tokyo. By focusing on less extreme situations, the proposed research will yield more insight into the applicability of the results of prior research to the Dutch situation.

### 10.2 Detailed problem definition

The proposed research will investigate benefits of various aspects of local greenery on a broad range of health and livability outcomes in relation to three underlying mechanisms: stress reduction/attention restoration by looking at natural elements, facilitating physical exercise by offering an attractive setting, building social cohesion by offering an attractive environment for neighbourhood members to meet and interact in a positive way. Although many of these variables have been investigated in previous research, until now they have not been studied in combination. By taking an integrated perspective, the proposed research makes it possible to examine possible interdependencies and interrelations among aspects of

local greenery, health outcomes, and underlying mechanisms. For example, the relative importance of the health outcomes and mechanisms may depend on which aspect of the local green structure is taken into consideration. Viewing a few trees through a window may provide restoration from mental fatigue (Kaplan, 2001), but such a single green spot is not necessarily suited as a place to meet and interact with neighbourhood members. Furthermore, the relative importance of each mechanism may depend on the specific health outcome that is considered e.g., physical health, mental health and wellbeing, or social safety.

In sum, the central questions of this study may be formulated as follows:

1. Do urban neighbourhoods in the Netherlands that differ (changed) in the amount and type of local greenery, also differ (changed) in the health, wellbeing and perceived safety of their inhabitants?
2. If so, which aspects of the local greenery are strongest related to which outcomes, and which mediating factors seem to be of importance?
3. What does this tell us about the (causal) mechanisms behind these relations?

### **10.3 Methodological/technical design**

We will apply a twofold methodology. To start with, we will conduct a longitudinal study, using data of municipal health services (GGD's) on health. We will compare GGD-data collected prior to and after a considerable change in the local green structure of residential areas. We will complement this preliminary with a more in-depth cross-sectional study. In this second study, we will select neighbourhoods from several large Dutch cities that differ widely in the amount and type of greenery in the living environment, as well as in the quality of this greenery.

The selection of neighbourhoods for the longitudinal study will strongly depend upon the availability of GGD-data on health for neighbourhoods that experienced a substantial change in their local greenery situation, prior and after this change. These neighbourhoods are not necessarily the same as the ones selected for the cross-sectional study. The longitudinal analysis will be rather coarse, since only figures at the level of a residential area as a whole will be available. Data on perceptions, evaluations and behaviour of individual residents will not be available. Furthermore, besides the local greenery situation other characteristics may have changed between T1 and T2. The cross-sectional study is more detailed in nature.

Given the need for a detailed inventory of the greenery, the cross-sectional study will be limited to a selected set of urban neighbourhoods. Considering the large number of supply characteristics that may be distinguished (and co-vary), a quasi-experimental design is not deemed feasible. About four large Dutch cities will be selected, having a comparable level of urbanity. Within each of these cities about ten neighbourhoods will be selected with a similar population, to diminish the possibility of strong selection effects and to enable comparison of people with similar social-economic characteristics across local greenery situations. The neighbourhoods will have to differ on the set of local greenery characteristics that are considered relevant. Based on a review of the literature the most important aspects of the local greenery for each of the proposed mechanisms will be identified (e.g. amount, structure, type, design, maintenance). Other environmental characteristics, not dealing with the greenery, should be as similar as possible (housing conditions, ambient noise levels etc.). The inventory will include site visits and contacts with municipalities of the cities at hand (green department, health department, recreation department, police). If possible, GIS-analysis will be used to quantify local greenery characteristics.

By means of a postal self-administered questionnaire data will be collected on the following variables:

- 1) Primary dependent variables:
  - self-reported physical health, mental health and wellbeing
  - perceived social safety
- 2) Variables related to underlying mechanisms
  - levels of stress, mental fatigue
  - use of local green areas: distance from home, frequency of visitation, duration of visits, activities performed during visits, accompanying persons, interactions with other people during visits
  - perceived social cohesion, participation in neighbourhood social activities, social contacts
- 3) Other relevant variables (including possible confounders), such as:

- risky (such as smoking, drinking) and positive health behaviour (e.g. total amount of physical activity)
- knowledge, perception, and evaluation of green elements within the local environment
- possession of durable consumer goods: allotment garden, caravan, sports equipment and their use
- participation in alternative leisure activities: non-green activities and visits to green areas outside the living environment (distance, frequency, duration, activities), holidays and short breaks
- socio-economic background characteristics of the respondent, including housing conditions

The way questions are posed will be coordinated with those in the other two projects as much as possible (same phrasing etc.). In as far as available and feasible, validated measurement scales will be used, e.g. regarding health (see project 1 within this programme). To aid in the identification of green areas, a detailed map will be included in the questionnaire.

Given that the data concern observational units at different levels (individual, neighbourhood), the data will be analysed using multilevel techniques. About 40 observational units at the second level, that of the neighbourhood, are thought to be required to estimate neighbourhood-level effects. Within each neighbourhood about 500 addresses will be randomly selected to participate. Given an expected response rate of 20%, this should result in 100 filled-in questionnaires per neighbourhood.

#### **10.4 Valorisation and dissemination of results**

Cities experience increasing signs of environmental stress, notably in the form of poor air quality, excessive noise, and traffic congestion. Prior research has shown that the enhancement of local greenery has the potential to mitigate the adverse effects of urbanisation by increasing public health and wellbeing. Thus, it seems vital that these findings become implemented in urban planning and design. Unfortunately, until now, the possible positive effects of local greenery on public health and livability have not been explicitly incorporated in Dutch policy making (see also the recent advice of the Council for the Rural Area (RLG, 2004)). At present, there is not sufficient knowledge on these effects to translate the findings into guidelines for urban planning and design. In particular, little is known about the strength of the relationships, possible group differences, and the spatial conditions that enhance beneficial effects of nearby nature. By providing more insight into these issues, the proposed research may promote the implementation of knowledge on health benefits of nature in urban planning and design. The policy relevance of this project is further indicated by the fact that the study anticipates the recommendations of the Advisory council for research on spatial planning, nature and the environment (RMNO) regarding research programming on the topic of Nature & Health. These recommendations have been requested by the ministries of Nature Management (LNV) and Public Health (VWS). In a recent policy document, the latter ministry has also emphasized the importance of studying the role of environmental factors in the amount of physical exercise people take (VWS, 2001, pp. 60-67).

The results of the proposed research can be used to formulate recommendations regarding a number of relevant policy and planning issues, e.g., private gardens versus public green areas, street trees versus parks, small parks versus a large central park, a few well maintained green areas versus more but less well maintained green areas. Many of these issues relate to the more encompassing question of densification versus urban sprawl (green living). Both options may have positive as well as negative effects on public health and livability. For example, it may be argued that urban sprawl yields important health benefits because it provides residents with easy access and prolonged exposure to nearby green space. However, American studies have also suggested that urban sprawl may lead to more car mobility and hence reduced physical activity and health, because shops and other facilities are more likely to be located too far away for walking or cycling (Frumkin, 2002). By systematically comparing more and less densely built urban neighbourhoods, the proposed research may provide more insights into the relative costs and benefits of different options for the spatial lay-out of towns and cities.

To ensure that the results of the proposed research will find their way to policy makers and planners, and fulfil their needs, we will install a policy advisory group that will advise on all three projects of this programme (see the programme description for more information on this advisory group). For the dissemination of the results to the broader audience, co-operation with the 'Groenforum Nederland' and the Stichting Natuur en Milieu' will be sought. The Groenforum is a foundation that aims to convince policy makers, companies, and other organisations to invest more in local greenery. The Stichting Natuur

en Milieu is a foundation that “aims to be the voice of that which has no voice itself”: Vital nature and a healthy environment for this and next generations. This latter foundation has just started a programme “Natuur is gezond” [Nature is healthy].

### 10.5 International Collaboration

Dr. S. de Vries will be a member of the Management Committee of the EU COST-action E39, “Forests, trees and human health and wellbeing”. An explicit purpose of this action, that will start in the second half of 2004, is to exchange knowledge in this field of study. The postdoc could join this action as a working group member. The action also offers the possibility of Short Term Scientific Missions, which may be used to visit other (European) researchers in the field, with material expenses being reimbursed by the COST action. Dr. de Vries is also a member of the WUR knowledge centre for Agriculture, Green space and Health (Landbouw, Groen en Gezondheid) that is being set up. This centre is organising an international conference in 2005. Dr. A.E. van den Berg is a member of the International Scientific Committee preparing an international conference on the Architecture of Hospitals. Finally, on a more personal basis contacts exist with several colleagues working in this area e.g. prof. Stephen Kaplan (Dept. of Psychology, University of Michigan), prof. Terry Hartig (Institute for Housing and Urban Research, Uppsala University), prof. Patrick Grahn (Dept. of Landscape Planning, Health & Recreation, Swedish University of Agricultural Sciences).

### 10.6 Relevant literature of the research group and data sources

- Van den Berg, A.E., Koole, S.L., & Van der Wulp, N.Y. (2003). Environmental preference and restoration: (How) are they related? *Journal of Environmental Psychology*, 23, 135-146.
- Vries, S. de en A.H. de Bruin (1996). Between real constraints and leisure participation; perceived constraints patterns as link between social-structural conditions and outdoor recreational behaviour. *Loisir & Société (Society and Leisure) vol. 19 (1)*: 119-149.
- Vries, S. de (2001). Nature and Health; the importance of green space in the urban living environment. Proceedings symposium “Open space functions under urban pressure”, 19-21 September 2001, Ghent.
- Vries, S. de (2002). “The effect of greenspace in the living environment on recreation (and health)”. In: Barros, S. (Ed.), Proceedings All division 6 IUFRO-meeting “Collaboration and partnership in forestry”, Valdivia (Chile), November 11-17, 2002, pp 192-207.
- Vries, S. de, Verheij, R.A., Groenewegen, P.P. & Spreeuwenberg, P. (2003). Natural environments – healthy environments? An exploratory analysis of the relationship between greenspace and health. *Environment and Planning A*, vol. 35, pp. 1717-1731.

Data sources for the longitudinal part of the project: data on health provided by municipal health services (GGD) and data on land use provided by Statistics Netherlands (‘Bodemstatistiek’).

Data sources for the cross-sectional part: land use data provided by Alterra (LGN4); otherwise not applicable, since primary data will be collected during the project (also on local greenery).

### 10.7 Relation to and position in the programme

Within the programme, this second project deals with the meso level of study, in a geographical sense. Compared to the first project, a nation-wide study, it zooms in on the urban environment, and even on specific neighbourhoods within this environment. Green space is scarcer in urban areas and access to it might be more skewed. The same mechanisms that are under investigation in the nation-wide epidemiological project, will be studied here, but in more detail. More detailed information on the local green space situation will be available, as well as on the perception, evaluation and use of these green elements. Furthermore also more detailed information on the possible health effect will be available (stress, physical exercise, social cohesion, social safety). Also more information on other relevant characteristics of the environment, offering possible alternative explanations, will be made available through the primary data collection. However, the project is still more general than the third project within the programme, which focuses on a specific type of green space within the urban environment: allotment gardens. Information being gathered will be coordinated with information available/being gathered in the other two projects.

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**PROJECT NUMBER: 3**

**1. Applicant(s)**

*main applicant/ contact person*

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*other applicants*

names, titles, university and  
research school:

*Curriculum Vitae of the main applicant: appendix 2*

**2. Title of the research project**

Vitamin G3: Health benefits of allotment gardens

**3. Short summary of the problem definition**

In this project we will study health benefits of allotment gardens. Residents from deprived urban neighbourhoods with a lack of gardens and public green space will be compared to residents from the same neighbourhoods who own an allotment garden with overnight stay permit. The difference in exposure to green space between these groups is assumingly one of the largest that can be found in The Netherlands. In keeping with the other two projects in this programme, the groups will be compared with respect to their health condition, as well more general perceptions of wellbeing and social safety. With respect to the possible mechanism underlying relations between allotment gardens and health, this project will focus on physical activities (cultivation) and opportunities for social contact as mechanisms that have been found relatively important in previous research.

**4. Publications**

The result of this project will be published in:

- articles in peer reviewed journals
- articles in professional journals
- presentations at international conferences
- presentations at the Nature & Health Policy Group and Research Seminars

**5. Duration of requested subsidy**

duration (years): 3 years

to commence on (date): January, 1, 2005

**6. Research team**

name, titles	discipline/university	to the account of	hours/week
Dr. Sjerp de Vries	Social Psychology WUR/Alterra	WUR/Alterra	2
Dr. A.E. van den Berg (PostDoc)	Environmental Psychology/ Wageningen University	NWO	18

**7. Research location**

organisation: Wageningen University  
institute: Socio-spatial Analysis of Land Use (Recreation and Tourism) Group  
address: Gen. Foulkesweg 13  
postcode: 6703 BJ  
town/city : Wageningen

#### **8. Has this application been submitted elsewhere?**

no

yes, to:

#### **9. Other funding for this project (nature, amount and source)**

##### **10.1 Scientific significance**

There is a long history of the use of gardens to improve psychological wellbeing and physical health (Cooper Marcus & Barnes, 1999). However, few studies have systematically investigated the health benefits of gardens in general, and allotment gardens in particular. Most of the evidence on health benefits of gardens comes from laboratory experiments that exposed participants to photographic simulations of various types of natural environments (Van den Berg *et al.*, 2003), or controlled field studies that compared residents with a view of urban greenery to residents without a view of such greenery (Kaplan, 2001). This research has demonstrated that mere exposure to views of nature can improve people's health and wellbeing by providing restoration from stress and mental fatigue. Moreover, this research has shown that views of nature can improve feelings of neighbourhood safety and even lead to decreases in aggression and crime rates (Kuo *et al.*, 2001a, 2001b).

Although stress reduction may be an important mechanism underlying health benefits of allotment gardens, other mechanisms may be equally or more important in this type of setting. In particular, results of qualitative studies suggest that physical activities and opportunities for social contact are two relatively important factors in the health benefits of community gardening (Armstrong, 2000; Milligan *et al.*, in press). Unfortunately, the descriptive character of these studies and the lack of control groups do not allow any firm conclusions concerning a positive relation between allotment gardens and health and wellbeing. Moreover, these studies do not provide insight into the relative importance of stress reduction, physical activities, and social contacts as causal factors underlying this relationship.

The proposed project aims to extend previous research by examining health benefits of allotment gardens, and possible underlying mechanisms, in a quantitative, controlled manner. Tenants of allotment gardens will be compared to control groups that are comparable to the allotment gardeners in all respects, except for the fact that they do not have access to such a garden. The allotment gardeners and the control groups will be questioned on relevant aspects of their perceptions and behaviour using a mixed methodology of quantitative and qualitative methods. In addition, the proposed research will also pay attention to possible influences of the spatial lay-out and organizational aspects of the allotment gardens by including participants from different garden complexes. Relevant questions deal with the consequences of the size and gardening philosophies (productive vs recreational) of the different complexes.

##### **10.2 Detailed problem definition**

Allotment gardens originated at the turn of the 20<sup>th</sup> century and have known revivals during and after the two world wars to increase supplies of fresh foods (Wiltshire & Azuma, 2000). Today, food production is only one of the many functions of allotment gardens. These gardens are now generally assumed to contribute to a wide array of public health and livability issues (Twiss *et al.*, 2003). Beneficial effects of allotment gardens have been attributed to various factors, including enhanced physical activities, reduced levels of stress and mental fatigue, and a better social and cultural integration (Armstrong, 2000).

Several studies have investigated physical activities associated with gardening (Blair *et al.*, 1991; Ford *et al.*, 1991). In one study among elderly men in The Netherlands, participants spent a greater amount of time per week doing gardening than doing other activities such as walking or cycling (Caspersen *et al.*, 1991). Gardening activities have typically been related to specific health benefits such as reduced cholesterol

levels (Pahor *et al.*, 1994). But there is some evidence that activities on allotment gardens may also contribute to health and wellbeing in a more general way (Milligan *et al.*, in press).

When they are asked to describe their reasons for participating in an allotment garden, people often refer to the stress reducing effects of gardening (Milligan *et al.*, in press). Consistent with these anecdotal accounts, numerous studies have shown that contact with a real or simulated natural environment can provide restoration from stress and mental fatigue (Ulrich *et al.*, 1991; Hartig *et al.*, 2003; Van den Berg *et al.*, 2003). However, up to now, such restorative effects have not been demonstrated in the context of allotment gardens.

It has been suggested that in addition to promoting physical activity and reducing stress, allotment gardens may also help to establish a sense of social and cultural integration among gardeners (Schmelzkopf, 1995). Especially for older people, allotment gardens may provide a supportive environment that combats social isolation and contributes to the development of their social networks (Milligan *et al.*, in press). Allotment gardens may also facilitate cultural integration because newly arrived immigrants are often attracted to such gardens (Twiss *et al.*, 2003). Social cohesion has been related to health, wellbeing, and safety (Kweon *et al.*, 1998; Kawachi *et al.*, 2000), but such relationships remain to be demonstrated for allotment gardens.

In sum, there is some evidence that allotment gardens may promote health, wellbeing, and social safety through three mechanisms: Enhanced physical activities, reduced stress, and improved social cohesion. The aim of the proposed research is to further demonstrate the beneficial effect of allotment gardens, and to illuminate the role of various underlying mechanisms. In particular, the following research questions will be addressed:

1. Are urban residents with an allotment garden healthier and happier than residents without an allotment garden? And do they feel safer in the allotment garden than in their own neighbourhood?
2. If so, which mediating factors (physical exercise, stress reduction, social cohesion) seem to be of (more) importance?
3. What is the influence of garden characteristics (size, gardening philosophy) on these relationships?

### **10.3 Methodological/technical design**

This project focuses on individual residents of deprived urban neighbourhoods who spend considerable amounts of time in so-called 'allotment gardens' with overnight stay permit. The allotment gardeners will be questioned with respect to the same health-related perceptions and behaviours that will be studied in the other two projects. In addition, data will be collected on relevant background variables, such as housing condition and leisure activities. Data will be collected using a mixed methodology of semi-structured face-to-face interviews and the completion of standard weekly diaries over a prolonged period of time. Compared to the other two projects, these data collection methods offer the advantage of gaining detailed insight into the emotional, physical, and spiritual experiences of the gardeners and the factors influencing these experiences.

The selection of appropriate control groups is of critical importance in this project. Ideally, the control group should be comparable to the allotment gardeners in every respect, except for the time spent in an allotment garden. Because this is difficult to realize in practice, we will use two different control groups, each with its own advantages and disadvantages. The first control group consists of the next-door neighbours of the allotment gardeners. Because most deprived neighbourhoods in The Netherlands consist of similar row houses or apartments, the members of this control group are likely to be similar to the allotment gardeners with respect to their housing circumstances and other variables. However, self-selection may constitute a problem with this control group, since individuals are more likely to rent allotments when they are in good physical condition. To control for self-selection, we will also compare the allotment gardeners with future allotment gardeners who are on a waiting list for the same gardening complex.

Because of the time-consuming nature of the data collection, this project will include fewer respondents than the other two projects. A feasible design would include 80 gardeners from four different complexes,

systematically varying in size (small vs large) and gardening philosophy (productive vs recreational). Each gardener will be matched on age, gender, ethnic background and major health risks (e.g., smoking, drinking) to either a neighbour, or a person from the waiting list. This design results in a total sample of 160 respondents, divided in three groups (80 allotment gardeners, 40 neighbours, and 40 future gardeners on a waiting list). Assuming that effect sizes will be medium (0,5), this design provides a power of over 90% at an alpha of 0.05 for detecting differences between the gardeners and the control groups if the two control groups can be combined, and a power of 72% at an alpha of 0.05 for detecting differences between the gardeners and each of the two control groups separately.

Each respondent will be interviewed personally by an interviewer at home, using a combination of closed and open ended questions. The formulation of questions will be coordinated with those in the other two projects as much as possible. In as far as possible, validated measurement scales, such as the ZIPERS (affect measurement scale) will be used. In addition, gardeners will also be asked to keep a weekly diary for a month. The diary will ask structured questions concerning the gardeners' health and wellbeing over the previous week, with additional unstructured space in which the respondents are encouraged to discuss events over the week that may have influenced their health, and their thoughts and feelings concerning these events.

#### **10.4 Valorisation and dissemination of results**

Allotment gardens are popular among people from low income groups, who often live in houses without gardens that are located in neighbourhoods with a lack of green space (Van der Reijden *et al.*, 2003). Consequently, allotment gardens may provide a powerful tool for diminishing environmental injustice with respect to urban residents' access to green space. However, around most of the big cities in The Netherlands, the demand for allotment gardens is bigger than the supply, and candidate gardeners have to wait a long time before they gain access to the garden (De Vries & Schöne, in preparation). Due to the spatial policy of densification existing allotment gardening areas are under pressure, while at the same time this densification is likely to increase the demand for allotment gardens, by way of compensation. By shedding more light on the benefits of allotment gardens, the proposed research may support local authorities develop plans and make spatial decisions that reduce environmental injustice. Moreover, the results of the proposed research will provide local authorities with insights on the spatial and organizational conditions that promote beneficial effects of allotment gardens.

To further enhance the applicability of results, this project will be carried out in close collaboration with the municipality of Amsterdam (contact: Johan van Zoest). In this municipality alone, there are more than 35 complexes with allotment gardens. Previously, the municipality of Amsterdam has funded desk research by Alterra on physical and social aspects of allotment gardens in Amsterdam (the main applicant of this project is involved in this research). In carrying out the research, we will also seek cooperation with the Dutch Association of Allotment Garden Associations (AVVN), as well as the local organization of allotment gardeners in Amsterdam.

#### **10.5 International Collaboration**

Dr. S. de Vries is a member of several relevant international committees, including the Management Committee of the EU COST-action E39, "Forests, trees and human health and wellbeing". Dr. A.E. van den Berg is a member of scientific committee of the International Conference of the Architecture of Hospitals, to be held in 2004. She is also a regular participant of symposia on health benefits of nature at the international conferences of IAPS and IAAP. Furthermore, both dr. De Vries and dr. Van den Berg have collaborated with leading researchers working in this area, including prof. dr. Stephen Kellert (Yale University School of Forestry and Environmental Studies), dr. Terry Hartig (Institute for Housing and Urban Research, Uppsala University) and prof. dr. Patrick Grahn (Dept. of Landscape Planning, Health & Recreation, Swedish University of Agricultural Sciences).

#### **10.6 Relevant literature of the research group and data sources**

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### **10.7 Relation to and position in the programme**

Within the programme, this third project deals with the geographical micro level of study. Compared to the other projects, it zooms in on individuals that are more or less exposed to green in their daily living environment. Due to the primary data collection in face-to-face interviews and diaries, more detailed information on the local green space situation will be available, as well as on the perception, evaluation, and use of these green elements. Collection of data will be coordinated with information available/being collected in the other two projects.

## Appendix 1: Other References (not mentioned in paragraphs 10.6 'relevant literature of the research group and data sources')

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