URBAN & FORESTRY URBAN GREENING

Landscape planning and stress

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Abstract: Stress and stress-related illnesses, as reflected in medical records, have increased dramatically among adults and children in Western societies. A growing part of the budget for medical service in Sweden is used for individuals suffering from different stress-related illnesses such as burnout syndrome, insomnia and fatigue, depression, feelings of panic, etc. In this paper, we present results from a study in which 953 randomly selected individuals in nine Swedish cities answered a questionnaire about their health and their use of different urban open green spaces in and close to the city.
The results indicate that city landscape planning may affect the health of town-dwellers. Statistically significant relationships were found between the use of urban open green spaces and self-reported experiences of stress – regardless of the informant's age, sex and socio-economic status. The results suggest that the more often a person visits urban open green spaces, the less often he or she will report stress-related illnesses. The same pattern is shown when time spent per week in urban open green spaces is measured.
The distance to public urban open green spaces seems to be of decisive importance, as is access to a garden, in the form of a private garden or a green yard immediately adjacent to, for instance, an apartment building. People do not usually compensate for lack of green environments in their own residential area with more visits to public parks or urban forests.
According to our results, laying out more green areas close to apartment houses, and making these areas more accessible, could make for more restorative environments. Outdoor areas that provide environments free from demands and stress, and that are available as part of everyday life, could have significant positive effects on the health of town-dwellers in Sweden. This may also apply to other Western societies.

Key words: landscape planning, stress, restorative environments, urban open green spaces

Introduction

In the history of humankind, stress has certainly always been a part of life, as it is caused by, for example, death, starvation and plague. During recent decades, however, people have more frequently reported illnesses caused by stress, and they often report experiencing lingering periods in which they cannot control their everyday life. To a greater extent than before, ill-health problems are affecting professionals, who report long periods of sick leave. This is particularly true of Western European countries with generous health insurance systems (Nygren et al. 2002). In Sweden today, the most widespread illnesses among people aged 20 to 60

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 1618-8667/03/02/1-$ 15.00/0

years are related to aches and depression. These illnesses are largely stress-related (Nygren et al. 2002), and are often lingering and slow healing, which leads to high expenditures on sick leave and rehabilitation. The costs for society are now increasing at such a dramatic rate that they are said to constitute a threat to the entire welfare system (Sahlin 2001). For 2001, the costs for the Swedish public sector have been calculated to be at least ten billion Euro, and for burnout-depression syndromes alone, the total costs have been estimated to about 8 billion Euro per year (Sahlin 2001).

Addressing the underlying causes of escalating stress-related illness should be part of town and city planners' work. Although considering public health is not new to these professions, this more recent problem has not been on their agenda. Historically, the widespread diseases fought by society were primarily contagious infections and ill-health caused by confined quarters and general sanitary problems. Today's society also entails different problems, and large sums could be saved by diminishing costs associated with stress-related sick leave and rehabilitation. Apart from the economic aspects, town and city planning in Western societies also involves social responsibility for the health of town-dwellers. During the 20th century, society worked hard to eliminate confined quarters and sanitary problems by raising the general standard of everyday architecture. In Western society, town and city planning once more has the important task of diminishing the problems of today's widespread infectious diseases. However, in addition to concerns about such diseases, the town planner and landscape architect must also focus on stress-related illness.

Humans can generally manage moderate stress levels well and can also manage considerable stress for a limited period of time. There must, however, be opportunities for recovery. Sustained stress over a long period, often several years, in which time for recovery has been scarce or absent, may have severe harmful effects. Stress may be deleterious to, for instance, the cardiovascular system and central parts of the hormonal system, and depression due to exhaustion may occur (Maslach 2001). The question is: Is it possible that environments in the city, such as parks, gardens and green open spaces, could diminish stress and provide opportunities for recovery? Since the beginning of the 1980s, an increasing number of research findings have indicated that nature can bring about quick and strong recovery for stressed individuals (Kaplan & Talbot 1983; Ulrich 1984; 2001; Herzog et al. 1997). This paper focuses on the relationship between the use of outdoor environments and people's stress-related depression and burnout syndromes. Earlier studies of stress and recovery in nature have mostly involved individuals suffering from severe stress, for instance, patients recovering from recent surgery, nursing staff in casualty wards, or individuals working in laboratory environments. This study focused instead on randomly selected town-dwellers. The issue investigated is whether urban open green spaces affected the level of stress in their everyday life.

The primary question underlying the present study has been: "Can the public urban open green spaces of a town or city affect feelings of stress among the inhabitants and thus reduce the number of stress-related reactions due to exhaustion?"

Three secondary questions were formulated:

a) Are there differences regarding the effect of the urban open green space as a restorative environment that can be linked to the sex, age and socio-economic status of the individual?
c) What importance does travel time or distance to the urban open green space have in terms of use of such spaces?
d) Can individuals compensate for a lack of urban open green spaces near their residential area by visiting more remote green areas instead?

Background

Human stress

When speaking of human stress, it is necessary to bear in mind human beings' fundamental biological powers and social faculties (Maslach 2001), which are marked by evolutionary inheritance and cultural conditions, respectively (Rapp 1999; Ulrich 2001). Thus, when discussing stress, it is imperative to take into account the hormones and the nervous system as well as individual preferences of various kinds.

In human beings and animals, the autonomic nervous system is that part of the nervous system that cannot be controlled by will and that regulates fundamental vital processes such as blood circulation and breathing. Regarded in an evolutionary perspective, this is an old part of the nervous system, linked to the older part of the brain – the brainstem and the limbic system (Hansen 1997). Briefly, the autonomic nervous system can be said to adapt an organism's internal environment to its external one. It co-operates constantly with the rest of the nervous system (the cerebrospinal nervous system) to allow information from the surrounding world to be adequately translated into internal autonomic reactions as well as into external behavioral reactions, such as movements and linguistic expressions. The emotional centers of the older part of the brain are directly linked to the autonomic nervous system (Hansen 1997). Feelings of stress, such as the feeling

of being chased, harassed and of not being able to control a situation, have therefore a direct effect on pulse, blood pressure, intestinal functions, and so forth. Various bodily products, such as hormones that are secreted under stress, are broken down and dissipate more rapidly when one takes a walk. If one remains still, on the other hand, increasing amounts of stress hormones are accumulated, affecting the whole body negatively through deleterious effects on, e.g., digestion, blood pressure, pulse and breathing. These lingering stress hormones also make it harder to relax and sleep (Uvnäs-Moberg 1997).

What is the primary driving force underlying human beings' social behavior; what makes them work, play or take an interest at all in the surrounding world? Psychologists have long debated these questions. Today, many maintain that curiosity, the joy of discovery, the will to solve problems and learn constitute one driving force, which has also been called "competence pleasure" (Havnesköld & Risholm Mothander 1995). In order for this force to function, however, human beings must be rewarded in the form of having opportunities to cope or to regularly satisfy their curiosity. They must also have a chance to take a good rest, to recover. If there is a balance between interest, activity, reward and rest, the competence pleasure of the body is cared for, and depression caused by exhaustion is avoided (Maslach 2001).

Today, stress is regarded as one of the most important factors related to ill-health in modern society (Nygren et al. 2002). But stress reactions are basically the same reactions that helped our ancestors survive by heightening their readiness for fight or flight (Klingberg Larson 2001). For our ancestors, muscular strength, quickness, suppleness and the body's own mechanisms of adaptation played a crucial part. Normal stress reactions include increased muscle tension, increased blood pressure, reduced gastrointestinal function, increased sweat-gland production, increased pulse, increased adrenalin production (our "fighting hormone"), increased cortisol production (our "wakefulness hormone"), reduced melatonin production (our "sleep hormone"), and so forth. Originally, all these reactions were functional in that they made us alert to situations requiring fighting or fleeing (Maslach 2001). Yet contemporary everyday life is characterized by another type of stress – an imbalance between what we are able to accomplish and what is demanded of or expected from us, which can lead to a feeling of being unable to control our life. As a consequence, we experience the same fight or flight stress reactions as our ancestors did when facing physical danger. The results are sleep problems, loss of appetite, constipation, stiff muscles, and so forth (Nyström & Nyström 1995).

Stress reactions may be reduced with exercise, which rids the body of some of the fighting and wakefulness hormones. Exposure to daylight may reduce stress reactions by adjusting hormone levels, especially cortisol and melatonin (Küller & Lindsten 1992; Küller & Wetterberg 1996). Moreover, the design of the environment itself may signal danger or safety. Research shows that the body reacts involuntarily to natural elements, whereas artifacts such as houses, streets, etc. do not provoke the same quick and strong reactions (Ulrich 1993). Finally, research findings indicate that nature helps people to concentrate better and to recover from "directed attention fatigue" (Kaplan 1990), because nature contains a wealth of restful information that does not cause tiredness in humans (Kaplan et al. 1998). This means that the body, consciously and unconsciously, integrates a variety of information that supports either stress or recovery. It should, then, be possible to design an environment that contributes to a positive condition of health and well-being. Such an environment should preferably be easy to access, induce recovery and provide the visitor with an opportunity for rest. Hence, we have focused on public urban open green spaces, within or just outside the city limits.

The World Health Organization (WHO) defines health as "a state of complete physical, social and mental well-being, and not merely the absence of disease or infirmity. Health is a resource for everyday life, not the object of living. It is a positive concept emphasising social and personal resources as well as physical capabilities" (World Health Organization 1996). This definition describes health as a positive, almost Utopian state comprising the whole individual, both mind and body, in relation to his or her situation. The relationship between mind and body has long been a controversial issue. According to ancient religious creeds, health is a matter of maintaining a good balance with the world around us; thus health constitutes a spiritual product of mind and body together and in harmony with nature (Romanucci-Ross et al. 1997). Ancient civilizations, from Greece to Rome and throughout the Middle Ages, believed in a unity of or a strong relationship between mind and body (Gatchel et al. 1989). Descartes, however, drew a sharp dividing line between mind and body as well as between logic and emotion. For several centuries, this paradigm was predominant in the scientific tradition and in medicine. Today, however, the correctness of this sharp distinction is being questioned (Antonovsky 1996). Thus, there are research findings showing how emotional experiences can have a directly measurable impact on bodily functions (Hansson 1996). If we assume, then, that the human body is built for a life of movement, exposure to daylight, and that the driving force behind human activity is curiosity, and learning to cope with difficult tasks, what happens when people fail to look after their competence pleasure? Is it possible that we are seeing the answer manifested in many Swedes as stress and stress-related illnesses?

The restorative power of nature

In 1983, an article by Stephen Kaplan and Janet Talbot was published, dealing with the power of nature to give visitors a restful experience (Kaplan & Talbot 1983). This restful experience helped visitors to achieve a fairly quick and strong recovery from fatigue. The authors chose to speak of the power of nature to give rest and recovery as a restorative power. A year later, an article by Roger Ulrich was published in Science; his findings show a positive influence on post-operative recovery of having a view from a hospital window over nature and green open spaces (Ulrich 1984). In these articles, the authors suggested that verdure and nature as such accelerate human beings' recovery from stress. More recently, these earlier results have been followed up and supported by new findings (Hartig et al. 1996; Herzog et al. 1997; Ulrich 1999; 2001).

Many researchers have described humankind's adaptation to nature through evolution, from the time of life on the savannah up to present day (Coss 1991; Ulrich 1993; Appleton 1996; Herzog et al. 1997). To survive and reproduce in the wild, humans must be able to look for food and water, and protect themselves and their offspring from predators and the elements. This means that humans must be able to read the possibilities and obstacles of the natural environment, i.e., to read the "affordances" (Reed & Jones 1982). This requires that individuals grasp the messages of nature, often in a fraction of a second. It may be a matter of finding material to build with, finding food and water, or realizing when danger is imminent. A message of safety means that the whole body can relax and recover from stress. This message may be a matter of a spontaneous and unconscious response to natural stimuli signaling danger or safety. Some researchers have even suggested that a savannah-like landscape with water signals safety (Coss 1991; Ulrich 1993). According to another theory, modern human beings are surrounded by an overload of information that they must sort and assess the importance of (Kaplan & Kaplan 1989; Hartig et al. 1996). The brain has two types of attention: directed attention, which is part of our higher cognitive centers, and soft fascination, which is linked to the old parts of the brain. Nature contains very little information that must be sorted and assessed (Kaplan & Kaplan 1989). Our higher cognitive centers can therefore rest, while the old regions of the brain are stimulated.

Our working hypothesis is that good landscape planning can contribute to creating a less stressful and more restorative everyday environment for inhabitants in towns and cities: interactions with urban green open spaces could help to physically and emotionally restore human beings. The design and the contents of the outdoor environment seem to be of importance for the recovery of a stressed person visiting the environment.

Several studies have explored people's park using habits, in Sweden as well as in, e.g., Denmark, Norway, England, Austria, Germany and the United States, from the 1950s onwards (Grahn & Sorte 1985; Hörnsten 2000; Holm & Jacobsen 2001). In contrast to the above-mentioned studies, we have had the opportunity to compare the respondents' answers with their reported health status. Moreover, we have examined the answers in relation to each respondent's residential situation – access to a garden, to a balcony, and so on.

The main aim of this study was to focus on the town-dwellers' everyday situation, and our goals were to:

- measure the prevalence of stress symptoms among Swedish urban dwellers
- obtain information on the town-dwellers' background, in terms of sex, age and socioeconomic status
- obtain information on their home environment and access to a garden
- obtain information on their habits of visiting urban green open spaces in order to determine whether there were any statistical relationships between the above-mentioned factors.

Method

Selection of cities

We aimed to get a representative picture of the situation of Swedish town-dwellers. Consequently, we chose towns and cities from the geographical areas in which most Swedish people live: close to Stockholm, Gothenburg and Malmö. Approximately 70% of the Swedish population lives in the above-mentioned areas. Moreover, our objective was to choose towns and cities of a size representative of the places where the majority of the Swedish population lives. About 50% of the Swedish population lives in towns and cities with more than 15,000 inhabitants. These towns and cities can be grouped into three categories, all of them equal with respect to the number of Swedish individuals living in each city category: 15,000–30,000, 30,001–50,000 and > 50,000.

The geographical districts chosen are all densely populated. Many of the population centers have no clear boundaries to other areas, which sometimes results in metropolitan areas with blurred boundaries. We were interested in knowing in which part of the city the respondents lived: in the center, close to the center, or in the periphery. To assess this, we needed towns and cities that stood out as clearly delimited. The state-owned company DAFA, which maintains the Swedish personal and address register, assisted us in randomizing the addresses. Finally, we found towns and cities that met all our demands. We chose three towns with

about 25,000 inhabitants, three cities with about 40,000 inhabitants and three cities with about 100,000 inhabitants. The following nine Swedish towns or cities were chosen to take part in the project: Enköping, Halmstad, Kristianstad, Lund, Trelleborg, Trollhättan, Uppsala, Varberg and Västerås.

In this mixture of Swedish cities, some are dominated by universities, others by industry or by commerce and transit. All of them constitute the obvious centers of their geographical surroundings. Some of the cities were granted their town charters in the early Middle Ages, whereas Trollhättan obtained its charter in the 20th century. With the help of DAFA, we were able to identify the different parts of the cities in which the respondents lived, and these were divided into five categories: the old city center, areas built immediately adjacent to the old city center (most often completed by the end of the 1930s), areas built in the 1940s and 1950s, areas built in the 1960s and 1970s, and areas built in the 1980s and later. The first two categories are labeled "inner city areas" in the paper, and the latter three are labeled "suburban areas".

Use of a mailed questionnaire

In order to obtain a representative picture of the situation of Swedish town-dwellers, we used a quantitative survey in the form of a mailed questionnaire with pre-coded questions. Altogether 2,200 questionnaires were sent out to the nine towns, addressed to individuals chosen at random. The questionnaires were sent to persons whose age ranged from three months to 105 years. In accordance with Swedish law, all questionnaires sent to minors were addressed to their parents. Although the register was quite up-to-date, 163 letters were returned; 2,027 correctly delivered questionnaires remained. We received 953 completed or partially completed questionnaires. Thus, the response rate was 47%. The socio-economic grouping we used was the socio-economic index, SEI, used by Statistics Sweden. The SEI takes into account an individual's profession, education and responsibility in the society (Swedish Socio-Economic Classification Reports on Statistical Co-ordination 1995). By definition, all family members in a household belong to the class of the member with the highest-class position. For example, if one person in a family is a high-level civil servant, and none of the other family members are employed, all persons in the family are classified as "official/employee – high-ranking". See Table 1.

Structure of the questionnaire

The questionnaire consisted of three parts. The first part took up the respondent's personal data, for example age, sex, profession, home environment and access to garden. The second part dealt with how many times and for how many minutes and hours people visited the open green spaces of the town. In the third part, the respondents were asked to self-estimate their health status. All questions were pre-coded, often with multiple-choice options; however the respondents had an opportunity to add their own remarks. The answers were analyzed using the statistical software SAS (SAS Statistics 1996).

Table 1. Table showing the socio-demographic distribution in Sweden and among our respondents

	Sex	Age	SEI-classes
Statistics Sweden, SCB	51% W, 49% M	8.9% 0–6 years 13.0% 7–17 years 30.7% 18–39 years 25.0% 40–59 years 22.4% >60 years	23.9% Manual worker 15.2% Professional worker 12.1% Subordinate official/employee 16.3% Official/employee – intermediate position 11.0% Official/employee – high-ranking 7.5% Entrepreneur/self-employed 2.0% Entrepreneur 11.9% Others (students, long-term unemployed)
Our material	54%W, 46% M	9.5% 0–6 years 13.6% 7–17 years 33.0% 18–39 years 26.4% 40–59 years 17.5% >60 years	21.8% Manual worker 12.6% Professional worker 13.9% Subordinate official/employee 20.1% Official/employee – intermediate position 16.5% Official/employee – high-ranking 4.9% Entrepreneur/self-employed 0.4% Entrepreneur 9.8% Others (students, long-term unemployed)
Chi-square	ns	ns	ns

Introduction to the questionnaire

In our definition of the concept of *urban open green spaces*, all types of green outdoor environments in the town or city were included. In these environments, there are varying amounts of vegetation; they may have been designed by landscape architects or by others. The environment may also appear in the form of relatively wild nature. The areas may be inside the city or immediately attached to the outskirts of the city. This concept was conveyed to the respondents by means of an introductory letter. This definition is analogous to the Kaplan's definition of nature in the town (Kaplan & Kaplan 1989).

Estimation of personal health status

In clinical contexts, it is common that people are called upon to estimate their own health status. The questions we formulated regarding the respondents' health status primarily concerned stress complaints. As regards stress and burnout symptoms, there are several different tests (Nyström & Nyström 1995; Maslach 2001) based on knowledge of clear symptoms of stress-triggered illnesses. An important test in this context is SCI-93, a test frequently used in Sweden today, and developed by the physicians Nyström & Nyström (1995). It contains three modules concerning complaints due to stress, where one module deals with mental complaints, another with muscular complaints and a third with autonomic complaints (problems with eating, sleeping, etc.). The questionnaire includes several questions about common symptoms of ache, irritation and fatigue.

The most prominent symptoms of "stress-triggered fatigue reactions" are a general feeling of being chased, harassed and stressed, fatigue, irritability, lack of ability to concentrate, insomnia, muscular tension, body ache, stomach trouble, hypersensitivity to sound and light, itches, dizziness, chest pains, impaired short-term memory and general anxiety and depression (Klingberg Larsson 2001; Maslach 2001). Muscular tension can lead to headache, backache and ache in the back of the head. Apart from the above-mentioned aches, body ache sometimes consists of vague pains or fibrositis (Uvnäs-Moberg 1997; Folkow 1998; Klingberg Larsson 2001). We found that the simplest and clearest questions were those concerning fatigue, headache, ache in the back of the head, backache, irritation and a feeling of being chased, harassed and stressed. We therefore chose to ask questions about these six symptoms. The symptoms included in these questions recurred in all the above-mentioned references. It was considered difficult to ask questions about itching, loose bowels, depression and anxiety, as there is a considerable risk that these would lead to increased non-responsiveness or inaccurate responses. For minors, two of the questions – concerning headache and fatigue – were considered valid (Smedler 1993; Folkow 1998; Ellneby 1999; Barnombudsmannen 2000; 2001). To all questionnaires, we added a question about occurrence of common cold (viral infection), which functioned as a kind of control question, as none of the authors mentioned above specified a common cold as being stress-related. From the responses to the question on common cold, we hoped to obtain an indication of the validity of the responses on the questions on health in general.

Results

On closer examination of the profile of respondents, we found that the distribution of socio-demographic data is representative of the general distribution in Swedish cities. No statistically significant differences were found, with regard to socio-economic status, age or sex, between the individuals who returned the questionnaire and the group of people living in the nine population centers studied.

As the questionnaires began to come in, we got an early indication of the importance of public verdure for town-dwellers' perceived health. In the questionnaire, the respondents answered the question: "What would you recommend a close friend to do if he or she felt stressed and worried?" Table 2 shows the mean values of the respondents' ranking of the answers, on a scale from one to ten. The answers can be divided into five

Table 2. Mean values of the mean preferences and the standard deviation and the standard deviation ranking order in the answers to the question "What would you recommend a close friend to do if he or she felt stressed and worried?"

		Mean Preference	Std Deviation	Rank of Std Deviation	N
1	To take a walk in the forest	1.14	1.78	1	819
2	To listen to restful music	2.64	1.96	2	794
3	To take a good rest in a silent and quiet park	2.92	2.13	4	787
4	To read a book	4.12	2.13	5	785
5	To see a funny film	4.24	2.14	6	774
6	To do sports	4.33	2.66	10	773
7	To sleep	4.39	2.54	9	780
8	To go out dancing	6.04	2.21	7	767
9	To buy a dog	6.26	2.54	8	735
10	To take sedatives	8.21	1.96	3	746

Table 3. Number of occasions per year, on average, that the respondents are afflicted by different illnesses

	Number of occasions per year, on average	Std Deviation	Percent having no symptoms	Percent having symptoms every day	N
Cold	1.26	0.84	15.4%	0%	883
Headache	6.06	17.65	44.6%	2.4%	882
Ache in the back of the head	23.40	78.74	50.3%	4.7%	674
Irritation	28.82	67.59	19.9%	3.1%	679
Fatigue	35.61	86.70	25.5%	5.8%	882
Backache	36.63	97.19	39.9%	7.6%	685
Stress	46.29	91.12	20.1%	6.4%	683

Table 4. Factor analysis, SAS Varimax orthogonal rotation. Rotated Factor Pattern. N = 643 (adults only)

	Factor 1	Factor 2
Stress	0.64	
Irritation	0.58	
Fatigue	0.58	
Cold	0.32	
Headache	0.32	
Backache		0.61
Ache in the back of the head		0.60

groups. The first group mentioned is "To take a walk in the forest". The mean value is as high as 1.14, which shows that many respondents ranked this activity as their first choice. The standard deviation is also low, 1.78. The second group, with mean values of 2.6–2.9, is "to listen to restful music" and "to rest in a silent and quiet park". In both cases sounds are important. A silent park, of course, is never completely silent, there are sounds of the wind, birds, water, etc., but the respondents felt that, just like restful music, it alleviates worries and stress. The third group, with mean values of 4.1–4.4, is "to read a book", "to see a funny film", "to go in for sports" and "to sleep". The activities "to dance" and "to buy a dog" constitute the fourth group, with mean values of 6.0–6.3, while "to take a sedative" ranks the lowest, with a mean value of 8.21. There was a general agreement among the respondents that one should not advise friends to alleviate their stress with medicines and sedatives.

To obtain a picture of the respondents' health status, the questionnaire included questions about the number of occasions per year each individual is afflicted by complaints. For some illnesses, the number of respondents is lower, because the adults could answer seven questions, while parents could only answer three of the questions on behalf of their children. The answers, listed on an eight-step scale from "No, not at all" to "Yes, practically every day", are presented in Table 3, which shows that *stress* is the most frequent complaint, followed by *backache* and *fatigue*.

In Table 3, the figures express the arithmetic mean values of the number of occasions per year the respondents were afflicted by different complaints. This means that, in certain cases, for instance with regard to *headache*, a person may sometimes be confined to bed for a few days, whereas on other occasions, the pain may pass after a few hours. As regards *common cold*, this is a matter of periods of a number of days, in most cases about a week, during which it is sometimes necessary to stay in bed. Concerning *backache*, *ache in the back of the head* and *fatigue*, this may be a matter of long periods when the person in question functions badly, both socially and at work, due to pain or inability to concentrate. With regard to *irritation* and *stress*, this may sometimes be a question of long periods of latent stress nearing a level that is difficult to manage. In other cases, this may be a question of more isolated occasions.

We found that people answered our control question as we had expected, with an average of 1.26 occasions of *common cold* per year and a standard deviation of about 0.84, thus in line with figures for the entire Swedish population (Petersson pers.com.). Table 3 shows that the standard deviation is quite high for, for example fatigue, backache and stress, suggesting considerable spread in the distribution. That is, a wide range of respondents reported suffering from these complaints quite often, whereas others reported never having such complaints.

Relationships between different complaints

Using factor analysis (SAS Varimax, orthogonal rotation), we examined the association between the different complaints (see Table 4). The outcome indicates two clearly distinguishable factors. One factor is formed by *stress*, *irritation* and *fatigue*. *Backache* and *ache in the back of the head* form the second factor,

which will not be dealt with further, as we could not find any significant relationship between this factor and any other variable. *Headache* and *common cold* are not clearly linked to either of these two factors, though they are more closely associated with the first-mentioned one. *Stress, irritation* and *fatigue* all have values over 0.5 and these three variables together point to a strong factor that we interpret as level of stress. *Backache* and *ache in the back of the head* can have many different causes. We found, for instance, that these complaints are more likely to afflict the oldest group in society. This is most apparent among men. *Headache* can also have many different causes, and it cannot be expected that any one factor will explain it.

From the three variables, *stress*, *irritation* and *fatigue*, we constructed a new variable, *level of stress* (LS). To ensure that the three variables *stress*, *irritation* and *fatigue* would be weighed fairly in the new variable LS, their values were multiplied by the principal component value, i.e., the unrotated factor value, PCA (Morrison 1976, Manly 1994). The latter was calculated with the aid of the principal component value of the three individual variables according to the following formula:

$$(PC_{stress} \times stress) + (PC_{irritatation} \times irritation) + (PC_{fatigue} \times fatigue) = LS.$$

That is,

$$(0.58 \times stress) + (0.55 \times irritation) + (0.63 + fatigue) = LS.$$

This relationship between different symptoms is supported in the literature. Stephen Kaplan (1990) described the symptoms less attentive, fatigue and irritation as states of fatigue. This supports the association we have found in factor one between the complaints of *fatigue*, *irritation* and *stress*. Studies of the literature on stress-triggered fatigue reactions (Dinan 1996; Klingberg Larsson 2001) give us further support. A common first sign of being afflicted by stress is a feeling of vague anxiety and stress. One feels chased, harassed and stressed without actually being able to point to a cause. This state is then often followed by fatigue; however, no amount of rest is enough to overcome this fatigue. One often feels exhausted after a good sleep. By this time, the level of stress starts to build, and one overreacts to increased demands from other people by showing irritation at even moderately increased demands. When one reaches such a level of stress, one becomes upset and has fits of crying over minor adversities (Dinan 1996; Klingberg Larson 2001). According to this description, a general feeling of stress is followed by fatigue, which is in turn followed by irritation. In the tables above, we also see that stress is the most common of the three complaints, followed by fatigue, whereas irritation is about half as common as a general feeling of stress. A chi-square analysis also shows that people suffering from irritation are generally suffering from stress ($p < 0.001$). This could be interpreted as indicating that irritation is more common among people who have suffered from stress for a long period. In this article, we will examine how this stress level variable can be related to use of public urban open green spaces.

The use of urban open green spaces and level of stress

How often do people visit urban open green spaces? Table 5 shows that, on average, people visit such spaces at 150 different occasions per year. In total, an estimated average of 220 hours are spent in urban open green spaces per year.

We were interested in examining the differences between the number of visits to urban open green spaces for pre-school children, school children, adults and pensioners. Table 6 shows that there are two distinct groups: the first consists of pre-school children and school children, with about 220 visits per year to urban open green spaces. The second group consists of adults and pensioners, with about 130 visits per year. There seems to be a sharp dividing line between minors and adults/pensioners. However, the adult/pensioner group is quite large. There could still be a possible relation between age and the number of occasions per year on which respondents visit urban open green spaces. Perhaps relationships between the use of urban open green spaces and the factors of sex and socio-economic status, respectively, can be found. Finally, the central issue in this study was to determine whether any relationship between the variable LS and people's use of urban open green spaces could be found.

An analysis of variance between the dependent variable number of occasions per year respondents visited urban open green spaces and the independent variables sex, age and socio-economic index was conducted. However, as can be seen in Table 7, we could not detect any significant relationship between age (adults and pensioners), sex or socio-economic index and the use of urban open green spaces. We performed a corre-

Table 5. Number of occasions per year on which the respondents visited urban open green spaces and the total amount of time they spent in urban open green spaces during a year

	Mean	Std Deviation	N
Number of visits per year to urban open green spaces	151.3	109.1	868
Amount of time spent in urban open green spaces per year in hours	220.1	224.2	840

sponding regression analysis between the number of occasions per year the respondents visited urban open green spaces and the variable LS. This analysis gave a significance level of $p < 0.01$. An identical analysis between LS and the total amount of time per year that respondents spent in the urban open green spaces gave the same significance level, $p < 0.01$ (see Table 8).

We divided the respondents into five equally large categories on the basis of LS. We found that the least stressed individuals (20% of the respondents) reported visiting urban open green spaces on 196 occasions per year, whereas the most stressed individuals (also 20% of the respondents) reported visiting urban open green spaces on 133 occasions per year. The reported time spent in urban open green spaces is 311 hours for the least stressed individuals as compared to 185 hours for the most stressed individuals ($p < 0.0001$). In other words, the results show that the more stressed a person is, the less often that person visits urban open green spaces.

Table 6. Number of occasions per year on which the respondents visited urban open green spaces and the total amount of time they spent in urban open green spaces during a year, by age groups

	0–6 years	7–17 years	Adults	Pensioners >65 years old
Mean number of visits per year to urban open green spaces	225.8 N = 80	215.6 N = 116	132.0 N = 601	130.3 N = 64
Mean amount of time spent in urban open green spaces per year in hours	352.1 N = 80	332.2 N = 111	184.3 N = 586	197.7 N = 56

Table 7. Analysis of variance, SAS GLM Type III sum of squares, between sex, number of occasions per year on which the respondents visited urban open green spaces and the total amount of time they spent in urban open green spaces during a year. This analysis has been repeated to consider age and socio-economic index

	Significance	N
Relationship between sex and number of visits per year to urban open green spaces. Sex independent variable	F 0.45 ns	852
Relationship between sex and total amount of time spent in urban open green spaces per year. Sex independent variable	F 0.02 ns	824
Relationship between age (adults and pensioners) and number of visits per year to urban open green spaces. Age independent variable	F 0.99 ns	628
Relationship between age (adults and pensioners) and total amount of time spent in urban open green spaces per year. Age independent variable	F 1.07 ns	640
Relationship between SEI and number of visits per year to urban open green spaces. SEI independent variable	F 0.35 ns	399
Relationship between SEI and total amount of time spent in urban open green spaces per year. SEI independent variable	F 0.31 ns	389

Table 8. Analysis of regression, SAS GLM Type III sum of squares, between LS, number of occasions per year on which the respondents visited urban open green spaces and the total amount of time they spent in urban open green spaces during a year

	Significance	N
Relationship between LS and number of visits per year to urban open green spaces. LS dependent variable	F 6.26 $p < 0.01$	867
Relationship between LS and total amount of time spent in urban open green spaces per year. LS dependent variable	F 6.39 $p < 0.01$	839

Is it the case that the town-dwellers are content with the frequency of their visits to urban open green spaces? Table 8 shows that a large number of respondents, almost 70%, reported wishing they visited urban open green spaces more often than they do today. When analyzing the variable LS, a clear, significant relationship was found: If a person reports wishing that he/she visited urban open green spaces more often than is currently the case, it is likely that this person feels stressed.

Is it the case that people living in city centers tend to have a kind of lifestyle that makes them more interested in having a stressful life, and at the same time less interested in visiting urban open green spaces? We did not find any evidence to support this assumption: As many as 70% of the inner-city town-dwellers in this study reported wishing to visit urban open green spaces more than they do today, while the corresponding figure for respondents living in suburban areas was 66%.

Table 9. SAS T-TEST, between the respondents' wish to make more visits to urban open green spaces and LS

	N	Mean LS	Significance
Wants to be out more	577	129.93	$p < 0.0000$
Satisfied	292	54.96	

Table 10. SAS T-TEST. The table shows the causes mentioned by the respondents as obstacles to spending time in urban open green spaces to the extent that they wish and LS. The respondents could mention more than one obstacle if they wished

Cause	Number Indicating yes & no	LS mean	Significance
Lack of time	541 yes	111.50	$p < 0.0001$
	341 no	65.23	
Distance	80 yes	150.31	$p < 0.005$
	802 no	87.96	
Unsafe parks	68 yes	111.10	ns
	812 no	92.28	
Family uninterested in more visits	47 yes	97.75	ns
	835 no	93.38	
Informant uninterested in more visits	47 yes	56.78	ns
	835 no	95.59	
Illness/bad health	29 yes	203.43	$p < 0.0005$
	853 no	89.75	
No good open green spaces available	28 yes	137.04	ns
	854 no	92.19	
Too silent and quiet	19 yes	75.72	ns
	862 no	94.22	
Too much life and stir	11 yes	139.91	ns
	870 no	93.13	
Troublesome and unpleasant persons	9 yes	233.11	$p < 0.05$
	869 no	92.49	

Obstacles preventing people from visiting urban open green spaces

Is it possible that people with high stress levels feel that spending time in urban open green spaces would be good for them? If they do feel this way, why are these people not out of doors more often? What stops them from visiting urban open green spaces to the extent they wish?

The respondents were asked to give one or more reasons for not visiting urban open green spaces to the extent they wished (see Table 10). As many as 541 respondents pointed to lack of time as the obstacle. As the second obstacle, the distance to urban open green spaces was mentioned. It is possible, of course, that time and distance are closely related, i.e. that the greatest obstacle preventing people from being out of doors to the extent they wish is that they feel the distance (travel time) from their home to the nearest usable green area is too great. Another obstacle, apart from time and distance, is the insecurity many people experience in parks. Some of the respondents who reported feeling insecure made entries in the questionnaire, stating: "this is particularly true in the evening". This is unfortunate, because in the evening, after work or school, many people actually do have time for a walk outside. A general feeling of insecurity is an important reason for not visiting urban open green spaces (in the evening), whereas only nine persons reported refraining from visiting parks because they are afraid of troublesome and unpleasant persons.

We were interested in looking at how reported LS is related to respondents' answers ("yes" vs. "no") to the questions of whether lack of time and distance are reasons for their not visiting urban open green spaces as much as they wish. Table 10 shows that people who answered "yes" reported a significantly higher LS than did those who answered "no". In other words, there seems to be a relationship between people's feelings of stress and their experiences of time and distance as the main obstacles to visiting open green spaces to the extent they wish. Table 10 also shows a significant relationship between LS and poor health. However, a review of the literature shows that those suffering from poor health often suffer from stress due to illness (Uvnäs-Moberg 1997; Klingberg Larsson 2001; Lundberg 2001).

The present findings indicate that the distance from home to the nearest urban open green space could be a

decisive factor in relation to stress and the use of parks. This prompts us to make a closer analysis of this relationship.

More than half of the respondents stated that they have less than a hundred meters to the nearest urban open green space (see Table 11). The nearest space is not necessarily the one they prefer to visit, but it is nevertheless the case that most people in our study have only a short distance from home to urban open green spaces.

Table 12 may be interpreted as indicating that the shorter the distance to urban open green spaces, the more often people use them and the less often they suffer from stress. Those who live 50 meters or less from the nearest green area generally visit urban open green spaces three to four times a week. If the distance is 300 meters, such spaces are visited 2.7 times a week on average, whereas if the distance is 1000 meters, such spaces are only visited once a week. Use of urban open green spaces can be measured in number of visits, but also in the total amount of time spent there. Distance appears to make green spaces less accessible. Probably, the time budget is restricted for those suffering from most stress: hence, nearness is important. According to our data, LS increases with distance to urban open green spaces. The socio-economic index changes only slightly (and non-significantly), from 3.9 to 4.2 on a seven-step scale, as a function of distance. In this context, this means that education, economy and social status cannot account for the relationship between distance and frequency of visits/time spent in urban open green spaces.

We wished to examine more closely whether socio-demographic variables – such as age, sex and socio-economic index – affect the significant relationship between distance to urban open green spaces and LS. An analysis of variance, type III sum of squares, was performed. The different models included distance combined with age (adults/pensioners), sex and socio-economic index, respectively. In a type III sum of squares analysis (see Table 13), we can see the relationship

Table 11. Distance from respondent's home to the nearest open green space

Reported distance	Percentage	N
0–50 m	38.3	333
51–100 m	19.4	169
101–300 m	17.4	151
301–1 000 m	24.9	216

Table 12. Analysis of variance, SAS GLM, between distance of green spaces from home and LS, number of occasions per year on which the respondents visited urban open green spaces and the total amount of time they spent in urban open green spaces during a year

Distance to open green spaces	50 m	100 m	300 m	1 000 m	Sign
Number of visits per year to urban open green spaces	175.36	166.76	145.81	77.68	$p < 0.0001$
Amount of time	252.03	225.32	219.34	130.29	$p < 0.0001$
LS	80.79	104.90	108.58	122.03	$p < 0.006$
SEI	4.0	4.2	4.1	3.9	ns
N	330	172	149	214	

Table 13. Analysis of regression, SAS GLM

Model 1: Visits to urban open green spaces = distance and age
Model 2: Visits to urban open green spaces = distance and sex, and finally
Model 3: Visits to urban open green spaces = distance and socio-economic index.
The table shows that visits to urban open green spaces are significantly related to distance, and that age, sex and socio-economic index cannot explain the relationship

	Type III Sum of Squares	F value	Significance
Model 1: Distance to urban open green spaces	477307	15.36	$p < 0.0001$
Age> 17 years	7099	0.69	ns
Model 2: Distance to urban open green spaces	659617	19.90	$p < 0.0001$
Sex	7119	0.64	ns
Model 3: Distance to urban open green spaces	2240539	15.91	$p < 0.0001$
SEI	190090	1.35	ns

each independent variable has to the dependent variable, as each independent variable is added last to the total model. Only distance showed a significant relationship to LS, while age, sex and socio-economic index did not.

Visiting nature or living close to nature

Is it then possible to propose a causal relationship between the following conditions: distance to urban open green spaces (use of urban open green spaces (the visitor's LS? Or could there be a more direct relationship between distance to urban open green spaces and stress?

To investigate this, we performed an analysis of variance between the variables distance, amount of time spent in urban open green spaces and the visitor's LS. As can be seen in Table 14 – type III sum of squares – the last variable put into the analysis (distance) has no significant relationship to LS. This indicates that the use of urban open green spaces is the important variable, not the distance from one's dwelling to the closest urban open green space. Hence, there seems to be a causal relationship: The distance to the nearest public open green space turns out to be of great importance to the use of such spaces, and the use of such spaces affects the LS.

Another important question concerns people's choice of lifestyle: Could it be that people living in inner city areas prefer a more stressful lifestyle, and therefore are not particularly interested in visiting urban open green spaces? Above, we presented results showing that as many as 70% of people living in the inner city reported wishing they visited urban open green spaces more than they do today, while the corresponding figure for those living in suburban areas was 66%. This indicates that people living in the inner city do not differ from people living in suburban areas as concerns their interest in, or need for, use of urban open green spaces. Table 15 shows that inner city townd-wellers do have a higher LS than do people living in the suburbs. At the same time, they visit urban open

Table 14. Path analysis. Analysis of variance, SAS GLM. Classes = Distance Model: dependent variable LS = amount of time and distance. The analysis shows a significant relationship between LS and amount of time spent in urban open green spaces. If one adds the distance to urban open green spaces to the model, there are no significant relationships between the distance and LS. N = 798

Dependent variable: LS	Type III Sum of squares	F value	Significance
Amount of time per year spent in urban open green spaces	190469	6.43	$p < 0.01$
Distance to urban open green spaces	92562	0.98	ns

Table 15. Arithmetic mean values of LS, number of visits in urban open green spaces a year, amount of time spent in urban open green spaces a year and distance to the closest urban open green space, divided into inner city and suburb

		N	Mean	Significance
LS	Inner city	254	120.08	$p < 0.05$
	Suburb	501	94.60	
Number of visits per year	Inner city	247	131.99	$p < 0.005$
	Suburb	483	157.29	
Amount of time	Inner city	238	186.14	$p < 0.01$
	Suburb	468	230.57	
SEI	Inner city	112	4.06	ns
	Suburb	237	4.16	
Age	Inner city	251	37.78	ns
	Suburb	497	35.50	
Sex (1 female, 2 male)	Inner city	249	1.45	ns
	Suburb	494	1.48	
Distance to closest urban	Inner city	251	266.63	ns
	Suburb	499	217.03	

green spaces less often. The mean distance to the closest urban open green space is about 50 meters greater in the inner cities compared with suburban areas, although this difference is not significant.

Why do people living in inner city areas suffer from higher levels of stress? Is it because they are living in the inner city or because they use urban open green spaces less often? Table 16 shows that the higher levels of stress have a significant relationship to how often people visit urban open green spaces. However, when the use of urban open green spaces is taken into account, the type III sum of squares analysis shows that the variable LS has no relationship to people's residence category (inner city vs. suburb).

How important, then, is the urban open green space immediately adjacent to a person's home, i.e., a private garden *or* the open green space to which the inhabitants of a residential block have common access?

In Table 17, "having a garden" means that a person has a private garden belonging to his or her home, or access to a green yard immediately adjacent to his or her own apartment building. "Having no garden" means that one has no access to such areas. Access to a yard with little or no vegetation was defined as having no garden. As can be seen from the table, those who do not have a garden reported a higher LS and also reported visiting urban open green spaces less often than did those who have a garden. The distance to the closest urban park is greater for those without a garden, but the difference is non-significant. It seems that those who have no garden do not to compensate for this fact by visiting urban open green spaces.

As can be seen from the table, there are almost no differences in SEI as a function of people's access to a garden. One might expect that having a garden would indicate a high SEI. However, families in Sweden are more inclined now than 20 years ago to live in apartments in the downtown areas of the cities. And this preference concerns people from the higher SEI classes in particular. This has resulted in high apartment prices in the inner cities, and lower prices for large apartments and houses in the outskirts of the city. The results show that gardens immediately adjacent to apartments are found above all in neighborhoods built in the 1960s and 1970s. Thus, "private" gardens are found in all the SEI classes.

Tables 13, 14 and 16 show that the *use* of urban open green spaces is significantly related to the LS, although place of residence is not unimportant. But does having access to a garden, adjacent to one's apartment or house, have any influence on the LS? Table 18 shows that the use of urban open spaces is still related to the LS. However, having access to a garden – private or immediately adjacent to an apartment – is of greater importance.

Discussion

In this paper, our overall aim was to study whether the public urban open green spaces of a town or a city af-

Table 16. Analysis of variance, SAS GLM. Classes = City or suburb. Model: dependent variable LS = Number of visits per year and city/suburb. The analysis shows a significant relationship between LS and amount of time spent in urban open green spaces. If one adds the city/suburb variable to the model, there are no significant relationship between the city/suburb and LS. N = 728

Dependent variable: LS	Type III Sum of squares	F value	Significance
Number of visits per year to urban open green spaces	172464	4.57	$p < 0.05$
City or suburb	56042	1.08	ns

Table 17. Analysis of association between LS and use of urban open green spaces with regard to access to green area at informant's home, SAS T-test.

	Having a garden	Having no garden	Significance
LS	78.31	135.97	$p < 0.0005$
Number of visits per year to urban open green spaces	159.13	128.97	$p < 0.0005$
Amount of time spent in urban open green spaces	231.31	188.16	$p < 0.01$
Distance to urban open spaces	221 m	274 m	ns
SEI	4.09	3.95	ns
Age	36.68	36.78	ns
Sex	1.47	1.42	ns
N	661	230	

Table 18. Analysis of variance, SAS GLM. Classes = Having a garden. Model: dependent variable LS = number of visits to urban open green spaces and access to a garden. N = 865

Dependent variable: LS	Type III Sum of squares	F value	Significance
Number of visits per year to urban open green spaces	129757	3.95	$p < 0.05$
Access to a garden	489941	14.93	$p < 0.0001$

fect feelings of stress among the inhabitants and thus reduce the amount of stress-related reactions due to exhaustion. With regard to this aim, three secondary questions were formulated. We will begin by commenting on these questions:

First: *Are there differences regarding the effect of the urban open green space as a restorative environment that can be linked to the sex, age and socio-economic status of the individual?*

Our findings show that, in Sweden, urban open green spaces are used by all social classes, by both sexes and by people of all ages. We also wish to stress the fact that, in our study, people in the suburb as well as in the inner city reported wishing to visit urban open green spaces to a greater extent than they do today. We presumed that people in the inner city were less interested in visiting urban open green spaces, because of their choice of dwelling. However, people's full freedom of choice as regards place of residence may be a fallacy. Many practical circumstances, such as expenses, proximity to the workplace, et cetera, are likely to direct people's choices. Thus, people's lifestyle, defined by socio-economic status or choice of housing area, seems to play a minor role as concerns using urban open green spaces as significant environments for recreation. Urban open green spaces constitute a resource. All of our examined socio-demographic groups expressed a need for use of such a resource.

Second: *What importance does travel time or distance to the urban open green space have in terms of use of such spaces?*

According to our data, the greatest obstacles to everyday use of urban open green spaces are time and distance. We make this assertion for two reasons: because our respondents reported that the above-mentioned obstacles are the two most important, and because people who live a greater distance from open green spaces also used such spaces less often. Our interpretation is that time and distance are, to a certain extent, interrelated. Research shows that town-dwellers of all ages, i.e. children, adults, and elderly people, are, on average, able to walk 204 meters in five minutes. If the elderly inhabitants are excluded, the rate is 294 meters in five minutes, and if the children are also excluded, the rate for adult town-dwellers is 325 meters in five minutes (The Urban Traffic Network 1975). This shows that, in everyday life, it takes time to get to a recreation area on foot, and this can be crucial when deciding how leisure time should be spent.

Third: *Can individuals compensate for a lack of urban open green spaces near their residential area by visiting more remote green areas instead?*

It would seem natural to assume that people with no access to a garden of their own would instead use public open green spaces, as a kind of compensation – but this is in fact not the case. Our data show that, overall, people with immediate access to a fine and verdant garden or a green yard are also more likely to visit urban parks and nature areas in their spare time. On the other hand, people without a green yard are less likely to visit public open green spaces. Can these circumstances simply be explained by people's different interests in recreation or lifestyles? Earlier studies (Grahn 1988; Ottosson & Grahn 1998) have shown that there seems to be a correspondence between how different organizations, such as medical clinics, schools and daycare centers, use urban parks and other open green spaces and their possession of a garden of their own. The conclusion these authors drew from their findings is that *compensation is a myth*: those with a garden of their own also spent more time in other green open spaces than did those without a garden of their own (Grahn 1988; Ottosson & Grahn 1998). The organizations studied were all run by the local government, thus shared a common philosophy, aim and direction. The only clear difference between them concerned their possession of a garden. This finding suggests that the differences in recreational habits found in the present study should not be interpreted as differences in lifestyle.

We will now focus on the overall question: *Is it possible that the public urban open green spaces of a town or a city can affect feelings of stress among the inhabitants, and thus reduce the amount of stress-related reactions due to exhaustion?*

Through a factor analysis of different illness symptoms, we were able to detect two distinct factors: The

first factor constituted a relationship between fatigue, irritation and a general feeling of being chased, harassed and stressed, and was labeled *level of stress*. The second factor was formed by backache and ache in the back of the head.

Contrary to our expectation, we found no relationship at all between the factor of backache and ache in the back of the head and people's habits concerning outdoor recreation. We presumed that if people took walks in urban open green spaces, they should suffer less from backache or ache in the back of the head. We cannot explain why no such relationship was found, other than to point out that these kinds of ailments do have many causes (SBU 2000). On the other hand, we did find a significant relationship between the new variable *level of stress* and people's use of urban open green spaces. In addition, we found that people who reported wishing to be outdoors in urban open green spaces more often also reported suffering from higher levels of stress. We chose to investigate the relationships between this finding and people's everyday situation.

In the analyses, we began by looking for any significant difference between subgroups, such as men and women. However, the statistically significant relationships found all point to positive effects regarding visits to urban open green spaces and reduction of stress; there were no effects of sex, age or socio-economic status. Nor was there an effect of lifestyle, defined by people's choice of housing area; here we found that inner-city and suburban residents reported the same interest in visiting urban open green spaces.

Next, we were interested in studying the relationships between distance to urban open green spaces and stress. Our findings suggest that the greater the distance between people's dwelling and the closest urban open green space, the less often people are outdoors in urban green areas, and the more often they suffer from stress. One question we had to deal with was whether it was the location of the dwelling that affected the LS or the use of urban open green spaces. The results showed that it was the use of urban open green spaces that affected the levels of stress, not the location as such. The same pattern could be seen when we compared people living in the center of the city with people living in the suburbs. People living in the city center suffer more from stress than do people living in suburbs, but it appears to be the use of urban open green spaces that accounts for the LS, not the location of the dwelling per se. Moreover, we could see that people with access to a garden do not suffer from stress to the same degree as do people without such access. Once again we had to ask the question: Is it access to an open green space or the use of such spaces that influences the LS? In this case, we found that both access and use contribute to lower stress levels.

One can interpret our results as indicating above all that the *visit* per se in urban open green spaces is what may affect the town-dweller's levels of stress, not the site of the dwelling as such. However, a short distance from the residence to the urban open green space allows for more frequent visits.

A special case is when the town-dweller has access to a garden immediately outside his or her doorstep. If people have immediate access to a green environment, they seem to have greater opportunities to recover from stress. Those who have access to a green open space within 50 meters suffer from stress less often than do people who have to walk more than 50 meters to such a space (Table 11). Access to a garden seems to offer the same kind of effect (Table 17). Can this lower stress level be explained by town-dwellers being outdoors more often when they have a very short distance to an urban open green space or when they have access to a garden? How much stress reduction can be due to effects of having a *view* of a green garden outside one's window?

With respect to restorative capacity, the value of having immediate access to green environments can be detected on at least two levels. Roger Ulrich (Ulrich 1984; Ulrich et al. 1991; Ulrich 2001) emphasized the value of having access to a green view, and claimed that such a view can result in lower stress levels. The Kaplans stressed the importance of being outdoors in nature; here urban green areas are part of the concept (Kaplan 1990). Our natural curiosity is softly stimulated by visits in nature, at the same time we do not have to prioritize our tiring demands. According to the Kaplans, this kind of exploring, this "soft fascination", works best if we do not constantly have to shift our "model of the world" (Kaplan 1990) inside our head. When one has immediate access to nature, one is able to shift faster to a model that works in a restorative way. And having a view over green areas immediately adjacent to one's dwelling may also tempt one to spend time in the garden as well as in other urban open green spaces.

Both theories regard nature as restorative, although they focus on different parts of the brain and how the brain handles information from the surrounding world. In this study, we have taken both theories into account. If people visit urban open green spaces, information reaches the brain through visual, auditory and olfactory channels, and it seems likely to us that this information affects both more primitive reflexes as well as higher cognitive centers.

Theories regarding nature as a restorative environment are, of course, of vital importance to explaining our results. However, research findings from different disciplines can also give other explanations concerning the important health benefits of outdoor activities and

environments. By combining these findings and theories, a positive relationship between the use of outdoor environments and reduced stress levels is suggested. For example:

- *Outdoor activities and exercise*. Daily visits outdoors help the body to better endure physical and psychological strains, such as stress (Åstrand 1987; Blair et al. 1989; Jonsson et al. 1993; Paffenberger & Asnes 1994; Küller & Küller 1994; Pate 1995; Perk 1998).
- *Natural daylight* has proved to affect hormones and the biological clock, both of which affect stress levels. Natural daylight decreases depression and anxiety; season-related depressions in particular diminish in extent and strength, and the quality of sleep improves, all of which affect stress levels (Küller & Lindsten 1992, Küller & Wetterberg 1996).
- *Stimulation of the senses;* spending time in nature can stimulate all the senses, which can decrease the amount of stress hormones (Kaplan 1987, Lundberg 2001). Stimulation of the senses applies to taste, scent, touch, balance, temperature, sight, and hearing.
- *Aesthetic experience;* the experience of art, culture and beauty has a positive effect on the experience of stress (Rapp 1999; Dilani 2001).

The list above shows many possible positive effects of outdoor activities. All of the above-mentioned theories together may explain the strong effects of living close to nature. This could be interpreted as follows: Nature and urban open green spaces can offer all of the above-mentioned positive effects, separately and at the same time. Perhaps there are synergy effects so that the above-mentioned effects support one another. Viewed in this way, stress reduction in urban open green spaces becomes more profound – such spaces can be viewed as very useful means for creating stress-free environments that function in the everyday life of all town-dwellers. Moreover, visits to green outdoor environments may, apart from reducing stress, also be good for people's health in many other ways (for example fighting obesity and reducing risks for cardiovascular diseases and non-insulin-dependent diabetes mellitus).

The strength of this study is that it has been carried out on a group of randomly selected respondents, who together provide a representative picture of conditions in Sweden with respect to sex, age and socio-economic status. In general, the respondents filled in the questionnaires well. This indicates that the questions were easy to understand and to answer. The weakness of the material is that the results only give a picture of conditions in a selection of Swedish towns. Internationally speaking, Sweden is a somewhat unusual country: together with Norway, it tops the list of the UN countries with the highest levels of equality with respect to sex and socio-economic conditions (UNDP 2002). It would seem to be important to continue this line of investigation through studies on conditions in other cultures.

If our results were generalizable to other contexts, this would seem to entail a rediscovered view of health and urban open green spaces. Instead of spending all allocated public funds on treatment of stress complaints, part of this money could be invested in preventing stress by laying out gardens, parks and natural environments in cities. Laying out gardens at, e.g., workplaces may prove to be an effective, democratic, comparatively cheap and aesthetic weapon against the new widespread illness called stress. If other studies support these results, this would suggest a more progressive role for architects, landscape architects and city planners.

Conclusion

In modern Western society, stress and stress-related complaints have developed into a new widespread illness afflicting all kinds of people, women and men, young and old, and individuals with various functional disorders. In this article, we present findings indicating that, in Sweden, urban open green spaces may affect the stress levels experienced by town-dwellers in a positive way.

Our findings can be interpreted as indicating that urban open green spaces play an important part in offering town-dwellers a more stress-free environment, irrespective of sex, age or socio-economic background. The results indicate that the more time people spend outdoors in urban open green spaces, the less they are affected by stress.

If our interpretation of the questionnaire results is correct, this should have consequences for the landscape planning and design of nature in the city. We will especially stress the following results:

- Distance – The closer open green spaces are to one's dwelling, the more often one will visit them.
- The visit – Spending time outdoors in urban open green spaces seems to be the most important single factor affecting the levels of stress in this study.
- Accessibility – A dwelling with direct access to a green yard or a garden of its own seems to be the optimal situation.

Acknowledgement. This study was made possible by the financial support of Formas, the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, grant no. 2001-0252.
We would like to thank our statistician, Assistant Professor Dr. Jan-Eric Englund, Swedish University of Agricultural Sciences, Alnarp, for his kind assistance.

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Received:
Accepted:

Landscape planning is a branch of landscape architecture. According to Erv Zube (1931â€“2002) landscape planning is defined as an activity concerned with developing landscaping amongst competing land uses while protecting natural processes and significant cultural and natural resources. Park systems and greenways of the type designed by Frederick Law Olmsted are key examples of landscape planning. Landscape designers tend to work for clients who wish to commission construction work. Landscape planners Other approaches, both to landscape and landscape ecology are common, but in the last decade landscape ecology has become.Â Patterns and processes in a landscape under stress: the study area. Patterns and processes in a landscape under stress: the study area. Claire C. Vos, Jan I. S. Zonneveld. Pages 1-27.Â Methods and Concepts of Landscape Planning. Front Matter. Pages 193-196. PDF. Landscape planning for nature restoration: comparing regional scenarios. Bert Harms, Jan P. Knaapen, Jos G. Rademakers. Pages 197-218. The framework concept and the hydrological landscape structure: a new perspective in the design of multifunctional landscapes. MichaÃ«l van Buuren, Klaas Kerkstra. Pages 219-243.