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Walkable Urban Green Spaces: Health Impact Assessment in Amadora, Portugal

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1 ABSTRACT

Walkable urban green spaces (WUGS) have both direct and indirect effects on health, in the sense that they are associated not only with good health status amongst local residents, but also with improved environment quality. This paper aims to shed light upon the relationship between green spaces, the practice of physical exercise and the impact upon public health, using the Geographical Information System (GIS) and multivariate models.

The results of the study suggest that: 1) the existence of green spaces in the vicinity of residential neighbourhoods encourages the practice of physical exercise, walking and recreational activities, thereby helping to improve the health of people living nearby; 2) there are strong interrelationships between levels of physical activity and health status.

Health Impact Assessment (HIA) explores the relationship between the availability and use of WUGS. Policies are proposed for improving these spaces and creating urban corridors between different parts of the city, with a view to encouraging the pursuit of healthy life styles and promoting health equity.

Further work on this issue is urgently required, a task which clearly requires an interdisciplinary approach. The city of the future should be more than a place to live; it should also aim to further human wellbeing.

2 INTRODUCTION

The relationship between WUGSs and public health is a relatively new area of research. It has emerged due to associations between WUGS and the wellbeing of populations, revealed in recent years by studies that take account of factors such as self-assessed health status and longevity, after the control of individual, demographic and socioeconomic features (Takano *et al.*, 2002; Tanaka *et al.*, 1996; de Vries *et al.*, 2003; Santana *et al.*, 2007a). Other authors have shown that UGSs have an indirect impact on health, improving air quality, and attenuating the effects of pollution and the "island of urban heat" (Whitford *et al.*, 2001; Alcoforado & Andrade, 2007; Vasconcelos & Vieira, 2007).

Finally, the use of WUGSs (facilitated by their proximity to residential areas) improves children's concentration and discipline in day-to-day activities, particularly in the female sex (Taylor *et al.*, 2001), alleviates urban stress (Ulrich, 1984) and fatigue, bringing reductions in levels of aggression and violence (Kuo & Sullivan, 2001), and even influences relationships with neighbours, generating feelings of belonging to the neighbourhood or city (Kim & Kaplan, 2004).

However, given the many different types and forms of WUGSs that exist, the relationship between these spaces, the practice of physical activity and health has not yet been clearly demonstrated (Tzoulas *et al.*, 2007). There is, then, an urgent need to focus attention upon aspects of the constructed urban environment that promote or inhibit physical activity, with direct or indirect consequences upon health.

Amadora (Fig. 1) was chosen as the area of study because it has recently undergone rapid growth in population and housing, attracting a very heterogeneous population; this has affected the health and wellbeing of those living there. In fact, a study into the spatial distribution of certain indicators of wellbeing in the Lisbon Metropolitan Area identified clusters of sociomaterial deprivation (with low educational levels, prevalence of unskilled work or unemployment amongst males, etc), and Amadora presented particularly extreme scores in that respect. This makes it a suitable context for research on the subject of healthy urban planning (Santana *et al.*, 2008: 167).

The results of the study suggest that: 1) the existence of green spaces in the vicinity of residential neighbourhoods encourages physical exercise, walking and recreational activities, thereby helping to

improve residents' health; 2) there are strong interrelationships between levels of physical activity and health status.

3 DATA AND METHODS

The study drew upon information from several sources: i) data published by Amadora City Council (location of facilities, maps, orthophotomaps, reports, etc), and by the National Institute of Statistics (demographic, economic and other figures concerning the statistical subsection 'neighbourhood'); ii) two surveys, one concerned with lifestyle, perception of place and health status, which was administered to residents in the county (1200 questionnaires), and another directed at users (250) of the three biggest parks in Amadora (Central Park, Adventure Park and Delfim Guimarães Park) (Fig. 2).

The Geographical Information System (GIS) was used to assess the size and dimensions of the green spaces in question and their respective distances from the population of potential users. UGS accessibility areas were constructed using the extension *Network Analyst* of the electronic platform *ArcGIS 9.2* (ESRI), and with the function *Service Area*, various accessibility levels were identified (walking at an average speed of 3Km/h) via a network of paths, using analysis intervals of 0-3 minutes, 3-5 minutes, 5-10 minutes and 10-15 minutes. It was also possible, with the *Closest Facility* function, to assess the distance on foot between the centre of each neighbourhood and the nearest UGS (Santana *et al*, 2007b; Santana *et al*, 2009).

4 PROVISION AND USE OF URBAN GREEN SPACES AND HEALTH IN AMADORA

According to Tzoulas *et al*. (2007), the desirable global score for the urban green structure is 40m^2/inhabitant, which is the ratio necessary to maintain the equilibrium of the urban ecosystem and the health of the population (Bernatzky, 1966). In Amadora, this index is 2.3 m^2/inhabitant (according to information provided by the City Council); thus, the city is very deficient in this type of infrastructure (Fig. 2). Indeed, the resident population has only 15% of the amount of green space considered desirable, in accordance with minimum standards established by the Directorate General for Territorial Planning and Urban Development - DGOTPUD (Magalhães, 1992).

Fig. 1. Location of Amadora in the Lisbon Metropolitan Area.

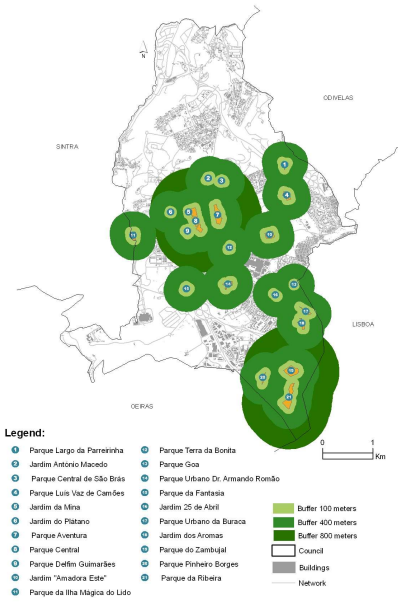

Fig. 2. Location and buffers of the main urban green spaces in Amadora.

Despite this, over half the Amadora population (57%) claim to use an urban green space on a weekly basis. Of those, 74% use the one that is nearest to their place of residence. Urban green spaces near residential areas have indirect impacts on health, by providing environments that encourage physical exercise, including walking. Hence, the questionnaire administered to the resident population of Amadora sought to identify those characteristics that significantly influenced the practice of physical exercise (Santana, *et al*, 2007a). Those characteristics were: gender (men tended to do more physical exercise than women); marital status

(single people were more active physically than married people), and professional status (students recorded the highest levels of physical activity). The last two categories indirectly reflect the age of the individuals concerned, as the practice of physical activity is significantly higher amongst individuals in the lowest age bracket (i.e. between 14 and 24 years).

As regards the factors that influence the use of UGS, the questionnaire directed at users of green spaces revealed that motivation was affected by the physical features of those spaces. It was found, for example, that the use of parks in order to "go for a walk, relax or get some exercise" was directly and significantly correlated with the availability of spaces for informal games (0.234), collective sports (0.234) and walking (0.234), the existence of signposts (0.234) and the absence of vandalism (0.234).

Indeed, signs of vandalism proved to be particularly important, revealing a positive correlation with the use of the green space as "a route between two points" (0.173) and a negative correlation with "go for a walk to relax and get some exercise" (-0.234). Hence, this factor appears to inhibit the use of such spaces for the purposes of sports or walking (and according to the WHO, walking is an important part of a healthy daily routine).

The factors that influenced the use of WUGSs for the purpose of "getting some sun" did not differ substantially from those indicated for "going for a walk to relax or get some exercise". There was, therefore, a positive correlation between the reason "getting some sun" and the good state of conservation of the pathways (0.276), the existence of natural green open spaces (0.276), adequate signposting (indicating activities, restrictions and safety) and also the existence of spaces suitable for walking (0.276) and running (0.290).

Feature of green spaces	**Main reason for using green spaces**						
	Walking the dog	for a walk to relax and get some exercise	Route between two points	Doing sport	Looking at the landscape	Relaxing and picnicking	Getting some sun
Paths in good state of conservation	0.084	0.148	-0.306*	0.093	0.158*	0.000	0.276*
Green spaces for informal games	0.112	0.234*	-0.173*	0.057	0.137	-0.029	0.016
Natural open green space	0.084	0.148	-0.306*	0.093	0.158*	0.000	0.276*
Significant number of trees	-0.038	-0.041	0.280*	-0.083	-0.117	-0.018	-0.338*
Activity signposting	0.038	0.041	-0.280*	0.083	0.117	0.018	0.338*
Restriction signposting	-0.039	-0.112	-0.138	0.037	0.016	0.035	0.290*
Safety signposting	-0.039	-0.112	-0.138	0.037	0.016	0.035	0.290*
Quality of signposting	0.084	0.148	-0.306*	0.093	0.158*	0.000	0.276*
Existence of signposting panels	0.112	0.234*	-0.173*	0.057	0.137	-0.029	0.016
Existence of lighting	0.084	0.148	-0.306*	0.093	0.158*	0.000	0.276*
Suitability for collective sports	0.112	0.234*	-0.173*	0.057	0.137	-0.029	0.016
Suitability for informal sports	0.112	0.234*	-0.173*	0.057	0.137	-0.029	0.016
Suitability for walking	0.084	0.148	-0.306*	0.093	0.158*	0.000	0.276*
Suitability for running	-0.039	-0.112	-0.138	0.037	0.016	0.035	0.290*
Transmits sense of safety	0.038	0.041	-0.280*	0.083	0.117	0.018	0.338*
Maintenance/cleaning of green and grey spaces	-0.039	-0.112	-0.138	0.037	0.016	0.035	0.290*
Signs of vandalism	-0.112	-0.234*	0.173*	-0.057	-0.137	0.029	-0.016
Existence of other (non-natural) attractions	0.110	0.217*	-0.256*	0.081	0.161*	-0.018	0.144

Table 1: Correlations between the features of green spaces and the main reasons for using them.
Note: * significance correlation (p-value <0.05)

The relationship between the use of green spaces and self-assessed health status was analysed in Santana and others (2007b). It was found that individuals that made use of the WUGSs were 40% more likely to present

a positive health assessment to those that did not. Similarly, individuals that sought out green spaces for physical exercise also had a more positive notion of their own health status (Santana *et al*, 2007a).

5 IMPROVING PUBLIC HEALTH BY INTERVENING IN URBAN GREEN SPACES | GREEN SPACES: STAGES IN HEALTH IMPACT ASSESSMENT

The aim of the analysis described below was to clarify the impact of accessibility (understood as the capacity to overcome barriers, such as distance) and the quality of WUGSs on the health of the residents of Amadora (Fig. 3 and 4).

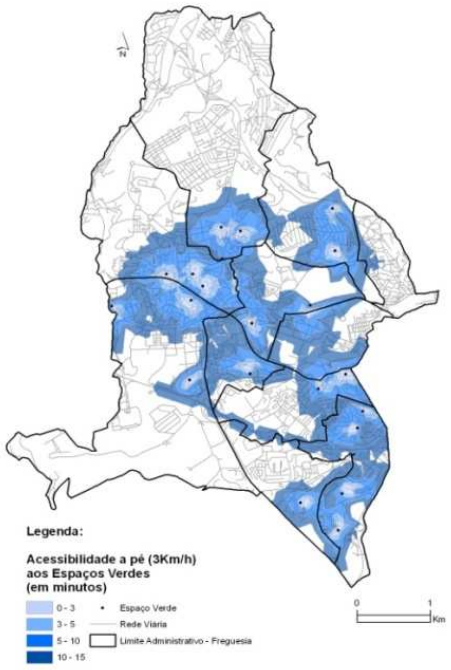

Fig. 3. Acessibility to the urban green spaces of Amadora; journey maximun time: 15 minutes hiking.

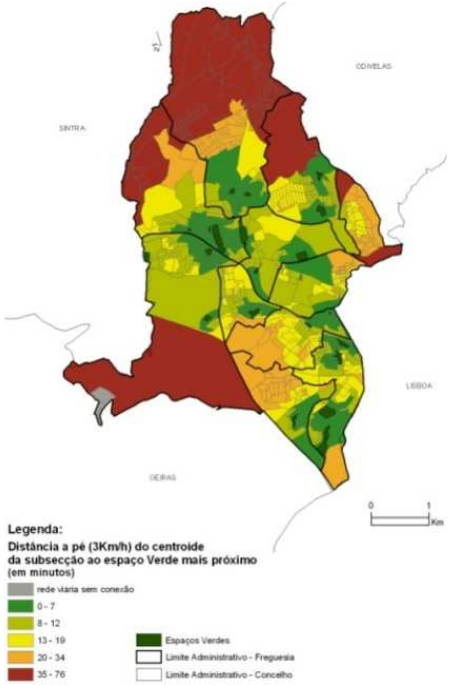

Fig. 4. Distance hiking (in minutes) from the residencial areas to closest urban green space.

The following conclusions were particularly relevant for HIA: i) The provision of UGS in the county of Amadora is not adequate for the size of the population (15% of what would be desirable[1]); ii) 57% used the UGSs on a weekly basis; iii) The use of UGSs is associated to proximity, irrespective of gender, age or socioeconomic factors; iv) health status improves with use of UGSs; v) there is a strong correlation between the use of UGSs and environmental quality (state of conservation and safety), in addition to geographical accessibility.

We proceeded to assess the health impact of restructuring different aspects of WUGSs (geographic accessibility, safety, state of conservation and suitability for walking) on the basis of the evidence derived from the surveys of the resident population and green space users performed in the county. The stages of the HIA are described in Figure 3.

It was found that 74% of Amadora residents questioned used the park nearest to their place of residence. The impact of the frequency of WUGS use upon the health equity of residents was assessed using the most vulnerable cluster (in sociomaterial terms), as this was the group with the worst health results (self-assessed health status, excess weight and obesity, and alterations in emotional state – Santana *et al*. 2007b) and constituted 51% of green space users. Taking this as a premise (frequency of green space use by the population in the most vulnerable cluster), we aimed to assess the impact of this frequency on the health of its residents.

One of the presuppositions included in this model was that the geographic accessibility of a WUGS strongly determines its frequency of use. A logical chain of events was associated to the health status self-assessment model (Santana *et al*. 2007b); it thus became possible to assess or predict the potential effect of improving the conditions of green spaces (increasing accessibility and improving aspects of environmental quality, such

[1] Using DGOTPUD criteria (Magalhães, 1992).

as conservation and safety) upon the health of the residents in the most vulnerable cluster (since 20% of this cluster in less than 15 minutes of one WUGS).

Health impact is predicted by simulating (on the self-assessed health status model) the possibility of all residents in the highest vulnerability cluster start using the WUGSs.

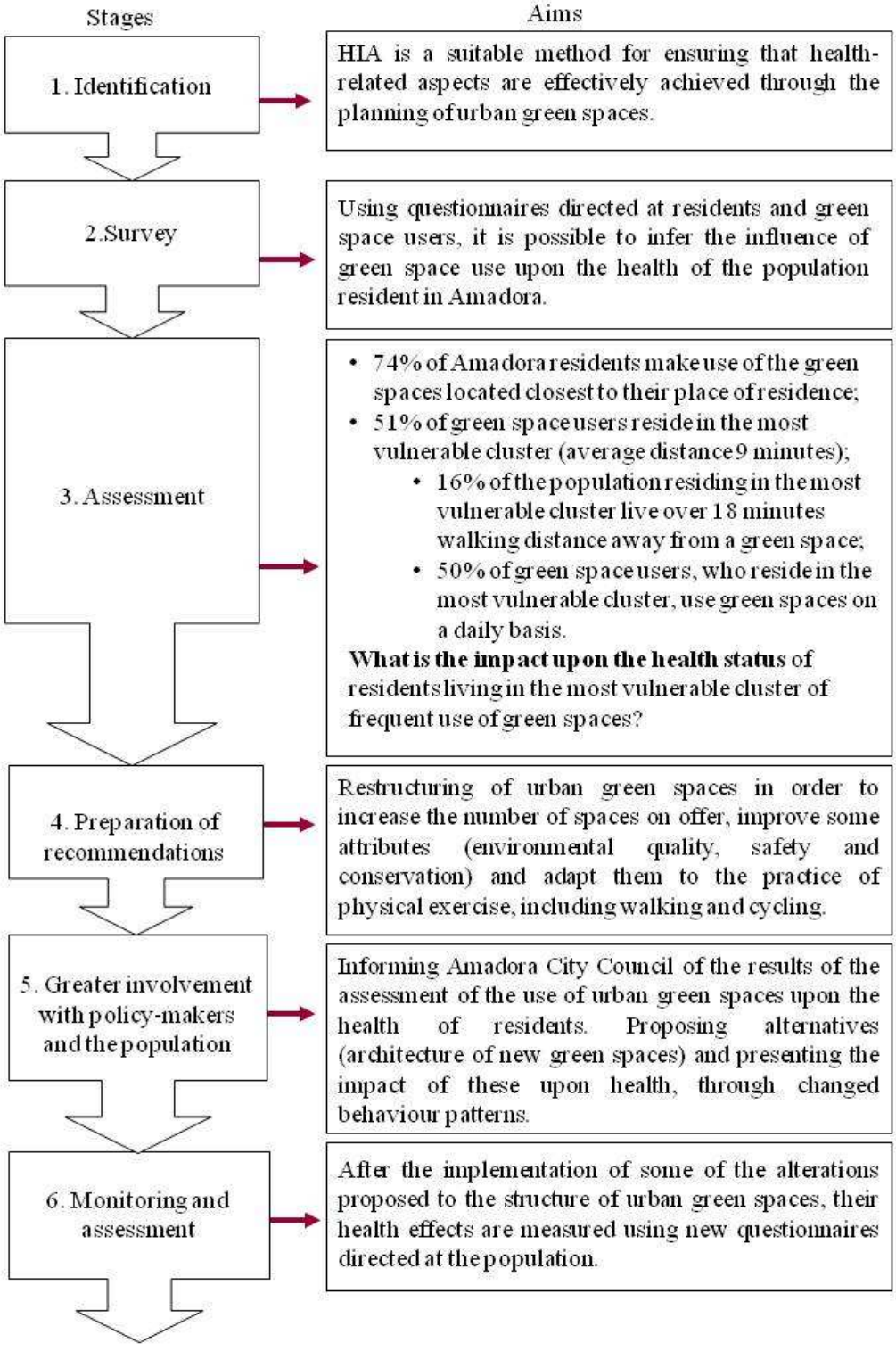

Fig. 3:Environmental Impact Assessment to Walkable Urban Green Spaces in Amadora, Portugal.

This variation is induced by increasing the provision of WUGSs and, potentially, the frequency of use. It was found that this led, *ceteris paribus*, to an improvement in the self-assessed health status for 27% of residents.

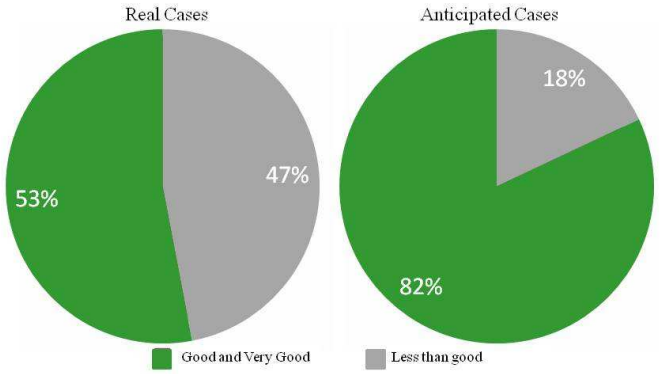

Fig. 6: Variation in self-assessed health status simulating the frequency (potential of 100%) of green spaces on the part of residents in the highest vulnerability cluster.

The following proposals aim to improve the accessibility and quality of WUGSs in the county of Amadora, with direct and indirect implications upon the physical and mental health of the population, and also to attract people to the "centre" of the city.

6 DISCUSSION OF RESULTS AND PROPOSALS FOR IMPROVING GREEN SPACES IN ORDER TO BETTER RESPOND TO THE NEEDS OF THE POPULATION

Like other authors (Takano *et al*., 2002; Tanaka *et al*., 1996; de Vries *et al*., 2003), we found that UGSs have both a direct impact upon health through the association with self-assessed health status, and an indirect impact though the improvement in environment quality. For example, the proximity of UGSs to people's residences has indirect impacts on health, providing a physical environment that encourages physical exercise, including walking. Pikora *et al*. (2003) and Humpel *et al*. (2004) also provide evidence of this association, which remains constant in the face of demographic and socioeconomic factors (sex, age, and education or training), whose role in physical activity has been clearly demonstrated. Other authors have pointed out that the use of UGSs (which is facilitated when they are located near to the place of residence) alleviates urban stress (Ulrich, 1984) and fatigue (Taylor *et al*., 2001) and even influences the capacity to get on with one's neighbours (Kim & Kaplan, 2004), and these observations were also supported by our findings in Amadora.

In this study, it was concluded that the use of WUGSs was determined by geographic accessibility, aesthetic factors, safety, maintenance, and the existence of signposts and lighting. In addition to these, perceptions of safety were also important. The identification of the most relevant aspects as regards to the use of WUGS helps focus interventions with a view to maximising use potential. It also increases our knowledge of the relationship between the provision of UGS, the practice of physical exercise and health, although these associations are not easily demonstrated, as has been pointed out by some authors (Tzoulas *et al*., 2007).

In Amadora, it is possible to improve health by increasing the provision/use of WUGS, and this may be achieved by making use of abandoned agricultural and forestry areas. The proposals concern the restructuring of existing WUGSs and the creation of new ones, including green corridors. Examples of what could be constructed, in response to the previously-identified needs, are: small parks near residential areas; urban allotments; demarcation hedges; small woodland areas; ecological corridors near waterways or inside parks and public gardens, etc. These may be constructed in agricultural and forestry areas which provide real opportunities for the county to overcome its UGS deficit. They may be considered as spaces for recreation and leisure (including the practice of physical exercise) or as walking or cycling routes between different parts of the city (home to work or school / leisure to home). Indeed, walking and cycling, which may and should be practised by individuals of all ages, have a positive cost/benefit ratio for health, and the provision of green spaces for these activities should be increased. However, these should be analysed and prioritised by policy-makers and the public.

Our results are therefore in accordance with those found by other researchers worldwide. Interventions that aim to encourage the practice of physical exercise have not had the hoped-for impact: the type of interventions (spaces barred to the public at large, such as parks and sports facilities) have left much of the population without access to their benefits, bringing fewer long-term positive effects, with consequences upon public health. That is to say, if the intervention is directed only at the infrastructure, without taking

account of surrounding spaces or potential users, the aims of that intervention may not be achieved. However, the effects of green spaces upon the health of the city and health in the city cannot be generalised. For example, deserted or vandalized green spaces may have negative effects upon public wellbeing, increasing anxiety due to the fear of crime (Kuo *et al.*, 1998).

As for Amadora, the size of the county (24 km^2) may prove to be an advantage, provided that there is not too much delay in adapting it to the needs of human life (mobility on foot or by bicycle; interpersonal and intergenerational relations; contact with the green space to release tensions and recover energy, etc). All in all, it is possible to recover the human dimension of the city in Amadora!

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