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Original Article

Analyzing the Impact of Green Roof Functions on the Citizens' Mental Health in Metropolitan Cities

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Abstract

Background: The fast-growing trend of urbanizations and the dwellers' stressful lifestyle in megacities has led to several drawbacks from the mental health perspective. Provided that there is a significant association between the green environment and mental health, we investigated different functions of a green roof from two perspectives of well-being and environment.

Methods: After investigating on different functions of the green roof and classifying them into two sections, a self questionnaire survey was conducted in May 2020 on 100 citizens of the Seoul metropolitan area after, South Korea visiting the green roof. They were asked to clarify their perception of the different functions of green roof gardens. The statistical analysis was performed to show the differences in perception and how each variable can contribute to such differences.

Results: The results illustrated a high satisfaction rate among the visitors of green roofs. The perception of the well-being functions was higher than those of environmental functions. However, age group can alter the perception significantly, as the senior citizens significantly perceived the well-being functions. In contrast, the awareness of the environmental functions was higher among the younger participants.

Conclusion: Providing practical information about the ideal functions of green roofs, this study offered helpful insight for the planners who focus on society's general health and work in two different sections: developing the city landscape and mental health improvement.

Keywords: Green roof; Metropolitan cities; Mental health; Green environment; Well-being; Sustainability

Introduction

Due to the fast-growing urbanisation trend, urban dwellers have faced a new dilemma in their daily lifestyle. It has been mainly in terms of their well-being and quality of life. Nowadays, around 55% of the world population lives in urban areas (1). It is anticipated that the trend of urbanization will significantly increase by 2050. However, urbanization is not limited to the population, but also it affects the 'city health' and 'social atmosphere' of the city that comes with it (2). For instance, urbanization caused a lack of green spaces and consequently decreased citizens' health (physical and mental) living with high levels of environmental stress and tension (3, 4). Such a negative impact of urbanization is believed to be managed by increasing and improving green spaces' quality in urban areas (4). People living in areas with no green space may be

more vulnerable to the negative impacts of stressful life in big cities due to the lack of opportunities for nature-based coping strategies (5). Therefore, governments and authorities must establish and develop a healthy-oriented environment that provides liveable cities and improves health outcomes (6). Greenary, a term for an effective green environment in cities, can even foster recovery for patients and tolerate the pain level during staying in hospitals with a 'healing environment' such as a green balcony. But the main issue for a successful implementation is to design the detailed strategies in a functional way to address the variety of requirements.

According to the 'Healthy city' theory, green spaces can perform as an urban environment that can lead to a sustainable city. The benefits that green spaces can offer to the town have become more noticeable globally (7) because of the positive effect on citizen satisfaction, spiritual and physical health, and sustainability as well. Besides, social cohesion will increase when the greenary is available in a higher percentage in neighbourhoods, leading to less aggression and violence. Quality of life and wellbeing have been practically shown to have a significant association with access to green spaces (8,9), and these factors are crucial for sustainable development targets in cities (10). Though, there are some mediator criteria in the impact of green areas on the mental health benefits, including the access, quantity and types of the green spaces (11). Nevertheless, establishing a healthy urban environment that can lead to citizens' quality of life has become a significant challenge for the planners.

There is a well-designed approach on how urban environments affect citizens' health which includes: water management and sanitation, construction and indoor health, transportation, urban shape and the urban heat island effect, and the development of urban green spaces (12). As a unique type of green area in cities, green roof can positively control urban heat island, improve the urban form, lead to better water management, and promote green spaces (13). Green roofs can also moderate the effect of urban heat island and filter chemical air pollutants and increase the thermal insulation of buildings that can reduce heat and air cost (14). Therefore, to achieve sustainable development goals, green roofs have enough potential to improve the citizens' lifestyle. Such a green-oriented solution has several environmental benefits (15), social and health advantages (16-18), leading to improved cities performance.

In South Korea, Seoul, as a capital city, experienced rapid economic development in the late 1960s, but an unbalanced growth strategy was adopted between urban and rural development, which caused a rapid transformation in both area and several socio-economic, environmental, and mental health problems (19). During that period population of Seoul increased explosively, from approximately 2,000,000 in the 1960s to approximately 9,895,000 in the 2000s (20). Radical changes in the short term in Seoul, after all, caused several problems in terms of the city's infrastructure. Therefore, the Seoul authorities designed various policies and programs based on sustainable development to offer better surroundings (21) for their better lives and health. The main problem, like other metropolitans, was the lack of enough land to implement such mental-health-oriented projects. Hence, the government started to support the green roof projects as efficient ways to improve both the city environment and the citizens' satisfaction. Accordingly, citizens could access more green areas, which potentially ensured better physical and mental health for them (14). It is believed that green roof gardens can lead to an overall healthy experience of well-being for the city dwellers. (22,23). However, none of the studies yet investigated the functions of the green roof that can potentially contribute to visitors' mental health. Such detailed information is required in order to ensure the practical effectiveness of the developmental plan.

The main limitation is the lack of information on the ideal green roof, which is consistent with environmental standards and addresses citizens' preferences. To address this shortage, this study

aimed to investigate the main functions of the green roofs in regards to the mental health positive outcomes. To be more specific, we aimed to investigate the citizen's preferences to find which function of the green roof can contribute to their satisfaction and indirectly to society's mental health. Searching for the ideal green roof would lead to helpful insights for the planners to design the eco-friendly environment and healthy cities.

Methods

Study design

In order to reach the best-classified variables for our investigation, we searched through the previous studies, and mainly projects were about the urban green roofs. Having a list of all the previously mentioned functions of the green roofs, we tried to exclude those factors that were irrelevant to the main concepts of this study. The inclusion criteria were to have potential relevant with either the environment or health-related issues (well-being). Having the confirmation from two experts in this area, we ensured the final list's validity, including eight functions of the urban green roofs, classified in two categories. Accordingly, the questionnaire was designed to clarify the visitors' perception of the green roof's selected functions.

This study was conducted in five different green roof gardens in Seoul metropolitan, Korea in May 2020. The ethical consideration was approved by Konkuk University and the local authorities. The participants (the visitors of those roof gardens) were invited to fill in a questionnaire, and 100 visitors accepted to participate. The first section of the questionnaire provided information about the mental health consequence of urban greenery. To ensure consistency of understanding between participants, we explained the greenery to the participants and what was meant by 'mental health'. We clarified definitions of health vs wellbeing with participants following to McGregorTan Research (24). We defined wellbeing as mental health and overall feeling relating to the 'mind, body, spirit, emotional state and the level of peace'.

The second section deals with their perception of the selected functions of the green roof. The respondents were asked to self-estimate their perception through a 5-point Likert scale (from 'very satisfied' 5, to 'very dissatisfied' 1).

Analyses

Data from the questionnaire responses were analyzed with SPSS version 18. The analysis was calculated to evaluate whether there is a contribution of visiting green roof to enhance the visitors' mood; besides, further analysis was undertaken to test the potential relationships between the age and the perception of each function of the green roof.

Results

This study involved 100 participants, 59% of them were male, and 41% were female. The majority of the participants, more than 60 percent, aged between 21-60, while the participants older than 60 or younger than 20 had the lowest percentage of participation in this research (Table 1). Prior to investigating on the perceived functions of the green roof, the level of general satisfaction was examined. Figure 1 indicates that that totally 76% of visitors were satisfied after visiting the green roof, with the percentages of 39% of satisfied participants and 37% very satisfied. In comparison, dissatisfaction after visiting was reported only by 2% of the visitors.

Table 1: Demographic characteristics of green roof visitors (N=100)

Variable	*N*	*%*
Gender		
Male	59	59.0
Female	41	41.0
Age(yr)		
<20	11	11.0
21-40	31	31.0
41-60	35	35.0
>61	23	23.0
Total	100	

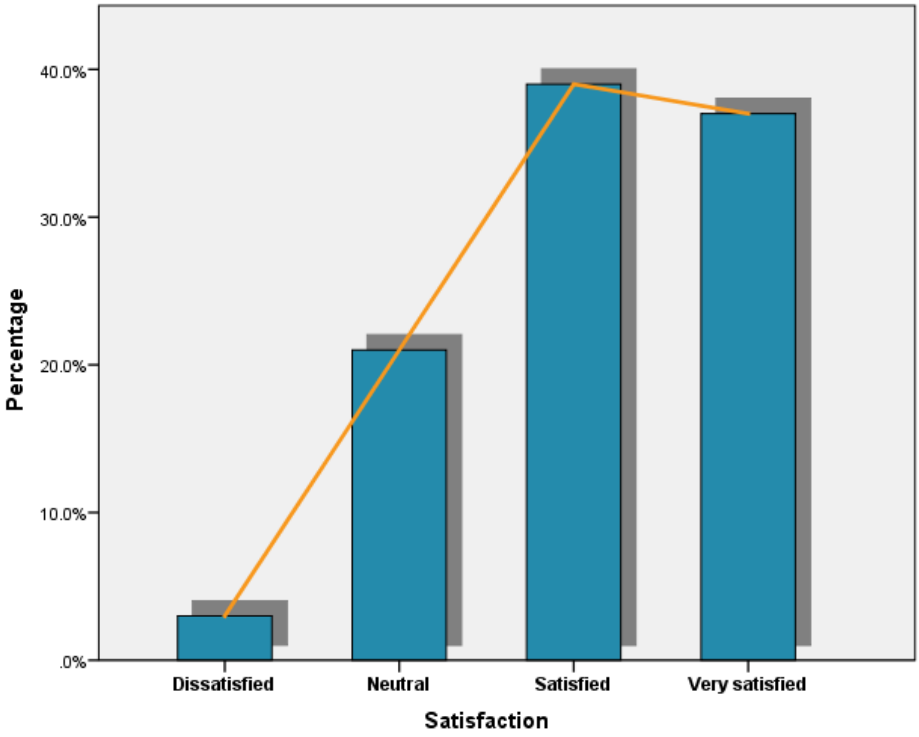

Fig. 1: The perceived level of satisfaction after visiting green roof

Further, the respondents were asked to clarify their perception of the green roof functions. The functions were categorised into two different sets of well-being functions and environmental functions. As shown in Fig. 2, the perception of the well-being functions (blue charts) was higher than those for the environmental functions (green charts). Among all the mentioned functions, the participants were interested in the green roof because of the opportunity to have social interaction, besides being in such a place to release their tension. While the participants were well informed about the green roof function on reducing air and noise pollution, it seems that water management is not among their highest perception of the functions.

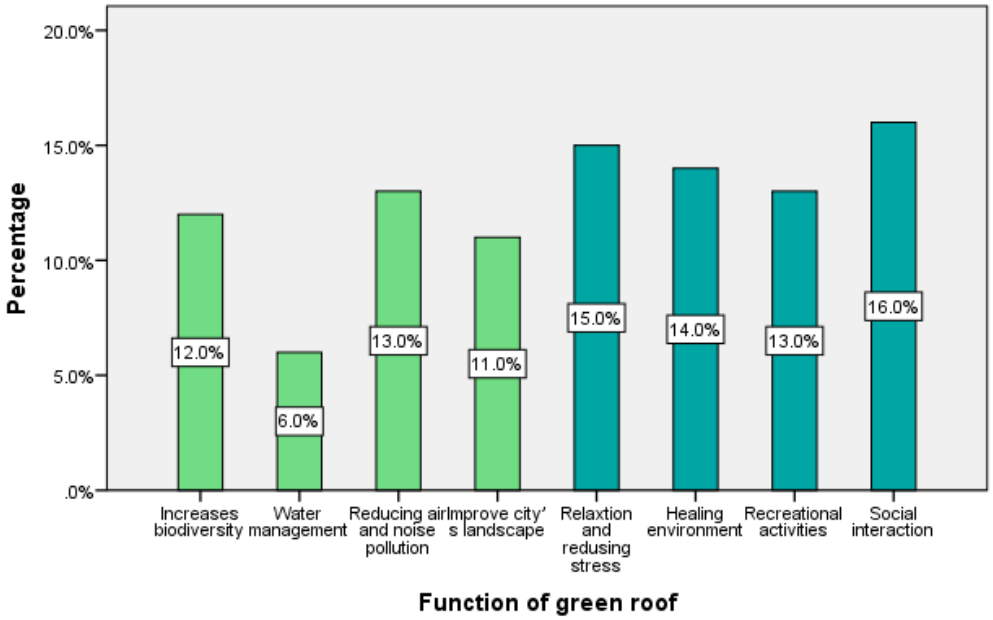

Fig. 2: The perception of the functions of green roof
Green: environmental function, Blue: well-being functions

Finally, we tested whether the perception of the green roof functions will differ based on the factor of age. As shown in Fig. 3, the well-being functions were perceived by senior people with a higher percentage in comparison to the environmental functions.

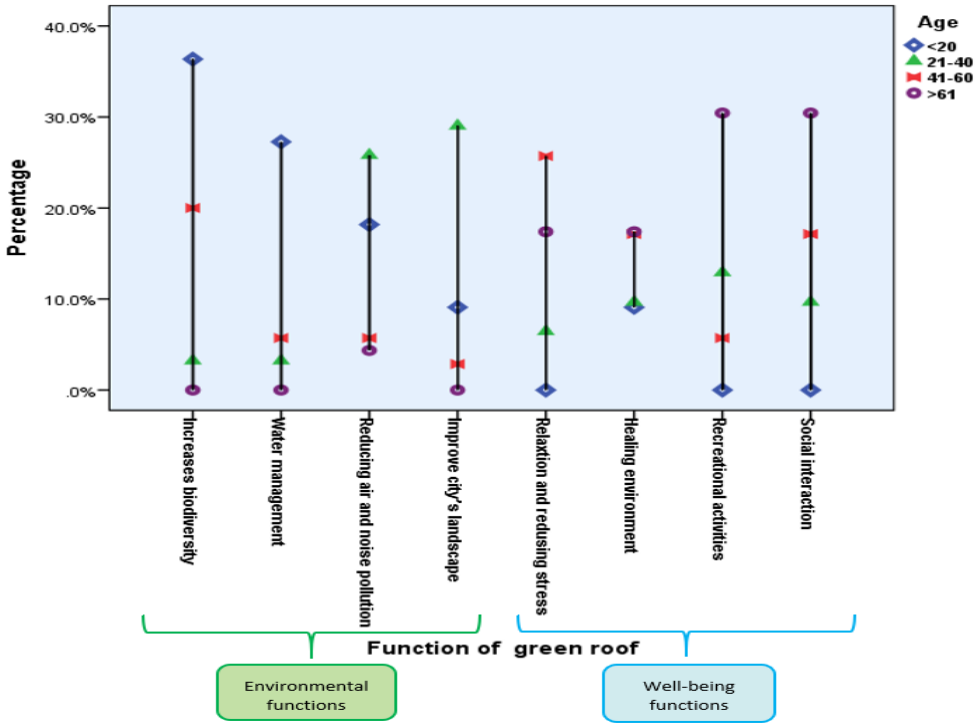

Fig. 3: The prefered green roof types

Visiting a green roof for them is mainly for having social interactions and recreational activities. In contrast, for younger participants, the perception of well-being functions was in a lower percentage. Increasing biodiversity, improving city landscape, relaxation and reducing stress were the most perceived function among the age group of below 20, 21-40, and 41-60, respectively.

Discussion

This paper studied different functions of green roof gardens from two perspectives of well-being and environment. Besides, the primary investigation was conducted on how such functions might contribute to the visitors' satisfaction and indirectly to their mental health. The result of the investigation revealed that the perception of the well-being function was higher than the perception of environmental functions. Moreover, the satisfaction with regard to the well-being outcomes of the green roof visit was high for most visitors. These results are similar to those identified in other similar (25-27) in which the high satisfaction was reported in the area with a high level of greenery.

Having a self-reported perception of the green roof, we found several interesting patterns in the data. Analyzing the visitors' satisfaction level revealed that they mostly feel pleased to be in such an environment. Yet, some improvements are required to enhance the satisfaction at the highest level for all the visitors. It has been proved practically that stress level is associated with the feeling of the loss of green space and the lack of social interaction for most of the citizens in megacities (14, 28). Due to the current stressful lifestyle of the citizens in megacities, roof garden on top of the living area or even the working places can provide the greenery experience. It is critical to establish and develop such spaces based on the citizens' preferences if the goal is mental health efficiency.

Investigating the perception of visitors on the functions of the green roof showed that they are mostly well informed about the well-being functions, while the general awareness of the environmental functions was at a lower level. This result is consistent with the theory, which claims that the immediate social or physical environment can influence the personal perception of something (29). It leads to two different implications for the planners; from the perspective of the greenery marketing in which considering the personal preferences of the visitors in establishing and developing the green spaces would attract more people to use the green roof as a preferred leisure activity (30); and secondly from the educational perspective in which some strategies are required to raise the awareness among the citizens about the environmental benefits of green roofs. It has been recommended to include three mechanisms in the planning process of such green spaces: to design the environment in a way to be 'attractive enough to recover from demanding situations of urban lifestyle' (31), providing the opportunity for social contact which can positively impact the mood and stress level, and finally to focus on the contact type to the environment (32).

The results of testing the effect of age indicated significant differences in perception among the different age group. Senior people were highly interested and well-informed about the well-being functions, and for them, the green roof is a place to have social interaction and have recreational activities. For participants in the age group of 21-40, the city landscape and the pollution issues matters, and it seems that the area is not that interesting for them to spend their quality time and have recreational activities, while it is likely that people below 20 are well informed about the main environmental functions of the green roofs. However, such awareness was not high among the senior people. The most attempt to attract people and increase the awareness can be made for people in the age group of 40-60, since this group of participants were neither shown a high perception of the environmental function, nor the well-being functions. However, this group can be engaged since they perceived the function

of relaxation and reduced stress with a high percentage. Regardless of age, it has been recommended to design the leisure activities to be challenging and ensure positive development and personal growth through engaging their efforts and skills (24).

Accordingly, planners of the green roof need to ensure that the local visitors' personal preferences are involved in the process of implementation and development. Green roof can make a considerable change in the city and building landscape, and the landscape has the potential to promote the mental, physical, and social wellbeing of the citizens (33). Therefore, to lead the process for such a contribution, it would be beneficial and essential to consult psychologists and planners in social science.

Conclusion

The green roof can potentially foster citizens' quality of life and indirectly lead to public health improvement. Hence, focusing on such environment-friendly initiatives can result in a better mood for citizens and will be beneficial for society. The planners and authorities' insights are to consider citizens' perception in developmental strategies. It will contribute not only to improving the quality of life in metropolitan areas but also to citizens satisfaction and indirectly their mental health improvement. The results add to a growing body of knowledge on the impact of green spaces on mental health.

Ethical considerations

The authors have entirely observed ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.).

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Conflicts of interest

The authors declare that there is no conflict of interest.

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