



ASSESSING GREEN ROOF IMPACT ON MENTAL HEALTH IN MALAYSIA VIA QUESTIONNAIRE BASED FREQUENCY ANALYSIS

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Abstract

Green roof implementation around the residence and workplace is beneficial in terms of improving mental health by enhancing mood, productivity and decreasing stress, depression, and anxiety. Various studies have shown the benefits of green roof in improving mental health but there are limited studies that shows the quantitative value of green roof and its attributes efficiency in improving mental health in Malaysia. Thus, the objective of this paper is to identify attributes of green roof that affects mental health and to assess the percentage of efficiency of green roof and its attributes in enhancing mental health among community. Quantitative approach was used via questionnaire survey within green roof residents and visitors to assess green roof capabilities in improving mental health. A total of 385 respondents participated in this survey which resulted in Cronbach's alpha value of 0.985. Then, the results are tabulated, and frequency and descriptive analysis is done to analyse the data. Questionnaire frequency analysis shows that green roof is 67% efficient towards improving mental health, and maintenance attribute recorded the highest percentage of efficiency towards the green roof effectiveness which is 11% followed by accessibility, distance, and size at 10%, and exposure, tree canopy, and facilities at 9%. This paper provides quantitative information and proof that green roof implementation does influence the mental health of the community and the productivity of green roof to provide such social benefits could be enhanced by focusing on the efficiency of the attributes as well.

Keywords: Green Roof, Greenery Exposure, Mental Health, Green Infrastructure.

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INTRODUCTION

Urbanization is increasing throughout the world, and people are moving to urban areas for a better standard of living. In relation to that, people in urban areas tend to face various types of environmental, economic, and social problems, which contribute to mental health issues such as stress, depression, anxiety (Trivedi et al., 2008). In relation with the rising mental health issues, many past researchers have emphasized the advantages of green space which leads to decreased anxiety, depression, and stress feelings (Macintyre et al., 2017). Greenspace is defined as a place that is covered with green plants, trees, and water on an open metropolitan space plant (Taylor and Hochuli, 2012). Green spaces provide numerous environmental, economic, and social benefits (Ab. Azis et al., 2019; Misni & Kamaruddin, 2015)

The introduction of green space in the form of green infrastructure in urban settings is one of the solutions for the mental health issues (Bajirao, 2015). Green infrastructure is a manmade infrastructure that has whole and partial natural structures such as vegetation, plants, and trees which includes green roofs, public parks, green walls, urban tree canopies, community gardens, and urban wetlands. However, looking into the characteristics of urban setting, which is filled with dense building infrastructure and a low supply of land area, the availability of greenery areas is limited. In Malaysia, Kuala Lumpur city is known to be a famous destination for urbanisation which also has high number of mental health issues according to recent surveys (Department of Statistics, 2023; Zaliha Mustafa, 2023). Therefore, introducing green roof as an innovative green infrastructure in urban settings is vital as an appropriate solution to reintroduce greenery areas in urban settings. The green roof implementation for the purpose of recreational and social activities has proven effective in conveying positive mental health for the visitors (Rezaei et al., 2021). However, none of these studies have quantified the quantitative value of green roof efficiency in Malaysia in terms of mental health improvement to the visitors and the attributes of green roof that plays a role in the successful implementation of green roofs.

Hence, this study aims to identify the green roof and its attributes efficiency in improving the mental health of the citizens in Malaysia from the perspectives of green roof residents and green roof visitors in Malaysia. A total of two objectives is derived in this paper to fulfil the aim of the study. The first objective is to identify the green roof attributes that affect the efficiency of green roofs. The second objective is to quantify the green roof and its attributes efficiency in improving mental health of the visitors. This study is designed to understand the hypothesis that green roofs can improve the community's mental health. This study contributes to the body of knowledge regarding the association between green roofs and mental health, which can serve as a reference and guide to the policymakers and developers in Kuala Lumpur, Malaysia. Lastly, this study

also provides information and consciousness to the citizens regarding the benefits of green roof and its attributes in terms of mental health.

LITERATURE REVIEW

Mental Health

According to Galderisi (2015), mental health is a form of human health that is the state of a person's equilibrium emotion that allows them to live daily life with the people around them. According to the World Health Organization (WHO) common mental health symptoms include depression, anxiety, stress, schizophrenia, and bipolar disorder. Most of the person who is undergoing mental health issues tend to isolate themselves from society too, which makes them unable to communicate with anyone, and they would keep procrastinating about it every day, and this leads to the symptoms getting worst by day and in the long run it would affect their physical health too. These mental health issues should be addressed and improved to sustain a healthy community. From the perspective of this research, there should be an effective solution that needs to be implemented to reduce the probability of citizens being affected by these mental health symptoms.

Green Roof

The green roof is a roof fitted in a building that is covered with green vegetations. Green roof is an implementation of a green space wholly or partly on a surface of a building or a property. Green roof systems are fitted to the buildings for their aesthetical values by the developers, but they provide many other benefits in terms of environmental, economic, and social as well (Berndtsson, 2010). Furthermore, there are two types of green roof commonly known as extensive green roof and intensive green roof. The extensive green roof is generally placed on top of the building, which cannot be accessed, and the intensive green roof is placed either in the buildings or on an accessible rooftop. The intensive green roof generally has a higher depth of soil, higher cost of implementation, higher tree heights and eight as well as higher maintenance costs weight when compared to the extensive green roofs (Dunnett and Kingsbury, 2004). In terms of its mental health benefit for the citizens, intensive green roof could perform better due to its accessibility, which allows visitors to get greenery exposure, social interaction and indirectly promotes physical and mental well-being in a dense urban area that has limited green space (Jim, 2011).

Green Roof Benefits on Mental Health

The green roof provides various types of social benefits to the people and ecological benefits to natural habitats such as flora and fauna. There is a growing body of evidence which reports the positive association of green roof with the

physiological stability in humans such as better stress management, improved mood, and better attention to things due to its greenery view, and its appealing aesthetic view (Razaei, 2021). Meanwhile, several theories have emphasised the non-material benefits that could be gained by the citizens in the interaction and exposure to greenery environments such as the Attention Restoration Theory (ART) (Kaplan, 1995) and Stress Reduction Theory (SRT) (Ulrich, 1986). ART explains that citizens whom are in contact with the natural environment tend to have feelings that the environment is very fascination, it is extensive enough for them to feel like they are being very far from their daily stresses and compatible. Meanwhile, SRT explains that stresses in the daily life of citizens can be reduced by exposing and interaction themselves with the natural environment as it has the capability to improves a person's cognitive function which also leads to better clarity and improved mental health. The conceptual framework of this study is shown in Figure 1 below.



Figure 1: Conceptual Framework

RESEARCH METHODOLOGY

The objective of this study is achieved by using quantitative method approach. The first process is to identify the attributes that affect the green roof in improving mental health through the literature review process. As for the green roof and its attribute efficiency, a questionnaire survey is conducted on the green roof residents and visitors using the list of attributes collected from the literature review. The questionnaire survey is collected and analysed using descriptive analysis, which is the frequency analysis.

Study Area

The green roof residents and visitors in Kuala Lumpur are chosen as they have the idea regarding the green roof, and they have experienced the environment of green roof so they would have a better understanding regarding the researched attributes. This research is conducted in Kuala Lumpur, which is the capital city of Malaysia and has the highest frequency of mental health issues in community which is 43% (Institute for Public Health, 2015). The selected green roof buildings that this research will focus on are The Saffron Sentul, Lot 10, Menara Binjai, One Utama Secret Garden, and Riana Green East Kuala Lumpur and The Maple Sentul which can has variation of green roofs and can be accessed for data collection. For the sample size, the number of people in the population is unknown as there is no readily available data regarding the number of population

and number of visitors to the selected study area. Thus, the formula from Cochran (1977) is used to calculate the sample size that is required when the population in the selected study area is unknown or infinite. By determining p value of 0.5 with confidence level of 95%, the required sample size was calculated to be at 385.

Questionnaire Survey

The questionnaire survey aims to identify the percentages (%) of green roof and its attribute efficiency in improving mental health. The scale that is used in the questionnaire survey is the continuous rating scale which ranges from 0-100.0 being least efficient (%) and 100 being very efficient (%) The continuous rating scale, or in the online survey terms it is called as Visual Analogue Scale (VAS) is a method that is used to measure the changes in psychological terms in the body such as mood changes, stress, productivity, and feelings of a person daily and generally continuous rating scale is used on health-related studies. In the context of this questionnaire survey, the influence of the green roof attributes from the improvement and changes in the mental health of a person through green roof visiting is measured so the continuous rating scale which has higher choice of answer 1-100 is a better scale to be used for the respondents to rate the influence of the green and its attributes (Bradlow, 2001). The questionnaire survey was conducted in respect with adherence to research ethics without harming any citizens, by obtaining consents, informing their rights and with integrity and confidentiality (Shamoo & Resnik, 2009).

Data Analysis

In the data analysis phase, a total of two procedures is undergone. The first phase is to test the validity and reliability of the questionnaire survey. Then, frequency analysis will be done to identify the information regarding the demographic profile of the respondents, the percentage of efficiency of green roofs and its attributes. The construct validity is determined by carrying out Exploratory Factor Analysis (EFA) and the reliability test is performed using Cronbach's alpha (Sekaran, 2009). The Statistical Package for Social Science IBM (SPSS) was used as a tool to carry out the analysis. Apart from that, the correlation between the attributes and the green roof benefits were also analysed to understand their relationships.

Every attribute has its percentage of efficiency, which contributes to this study's the overall green roof efficiency. Thus, it is essential to calculate the percentage of efficiency of each attribute that contributes to the overall green roof efficiency that will be analysed. To evaluate that, every attribute's average percentage of efficiency that will be analysed will be calculated using the formula shown below which was adapted from the traditional percentage calculation formula but instead of multiplying the calculating component by 100%, the

percentage of green roof efficiency is used. This step of the calculation is carried out to ensure that all the analysed attributes efficiency is based on the overall green roof efficiency that is derived from the community and not assuming the green roof to be 100% effective in terms improving the mental health of the green roof residents and visitors.

$$\frac{EEa}{SaE} \times GrS$$

Where, EEa = Efficiency of Each Attribute (%); Sae = Sum of Attributes Efficiency (%); Grs = Green Roof Satisfaction (%)

RESULTS

As there is a lack of information regarding green roof attributes, the green space attributes are reviewed and used as an indicator for green roof attributes as well. This is because green roofs are a type of green space like parks, forests and gardens which share the same characteristics. A total of seven attributes were found from the literature that influence the level of efficiency of the green space's exposure, accessibility, distance, tree canopy, size, facilities, and maintenance. The exposure attribute explains the degree of exposure to the green space a person receives in a particular period. If green roofs exist in their residence, workplace and visited shopping malls, there be close to no benefits received from it if the community does not actually get the exposure of it (Feda et al., 2015; Lee and Lee, 2019). The second attribute is the accessibility to green space. Accessibility to green space defines the tendency to easily access or enter a green space environment without any restrictions for public use. Researchers concluded that less accessibility to the green areas tends to result in a higher tendency to experience mental health problems (Guite et al., 2006; Lo, 2003).

Moving on to the third attribute, which is the tree canopy that is defined as the measure of density of greenness on a particular place, whereby when a place has a higher tree canopy, it means that the place has a higher number of vegetation plants and trees. Recent studies portray that when the tree canopy in a particular area is higher in terms of trees, shrubs, grass, and flowers, it leads to the lesser impact on the mental health and could promote a harmony living of people (Astell-Burt & Feng, 2019; Feng, 2022). Furthermore, the size attribute also plays a key role in determining the efficiency of green spaces. Green spaces with larger sizes have greater impacts and influence on the betterment of mental health (Wood et al., 2017). Williams et al. (2019) explained that the benefits in terms of mental health conveyed by green spaces, such as green roof, is very critically affected by the size of the green roof. There are also the facilities attributes, which includes the availability of recreational facilities such as jogging

tracks and places to sit and relax, which encourage social communication between citizens while enhancing their mental health as well (Wood et al., 2017). Citizens who perform their sports activities in an area that is covered with green are reported to have decreased stress, anxiety, and depression when compared to performing sports in a non-green environment (Pope et al., 2018).

Another attribute is the distance attribute, which is the distance of a person from the greenery area. When a person is closer to the green environment, their overall mental health condition seems to improve due to the higher tendency of exposure (James, 2016). Lastly, the maintenance attribute which compromises the security, maintenance, and cleanliness of the green space. The maintenance works that should be done to the green roofs include a good water supply for vegetation and plants in the green roof to ensure the process of evapotranspiration, which promotes and enhances the green roof function in providing ecosystem service benefits, fertilization to promote the growth and ensure the healthiness of the plant and to clean and trim unwanted vegetation and plant leaves and branches (Ismail et al., 2018; Lehmann, 2014). Overall, these are the attributes that has been identified that affects the level of efficiency of green spaces in the urban areas. As this research is focusing on green roof as a green infrastructure which has the same properties to provide green space for the citizens, these attributes are implicated in the context of green roof. There are seven attributes involved in enhancing the efficiency of green space providing green infrastructure such as green roof.

The process of determining the validity of items in the questionnaire is undergone, where a total of five panel experts are chosen to validate the items. The Scale-Content Validity Index Average (S-CVI Ave) value was 0.9, which means that the items met the validity criteria. Table 1 below shows the finalised green roof and its attributes, descriptions, and items that are used in the questionnaire in continuation from the content validation from the panel experts to quantify the percentage of efficiency of green roof and its attributes towards mental health.

Table 1: Green Roof and its Attributes Items

Green Roof	Items	Reference
Mental Health	Item 1: Stress Level Item 2: Anxiety Feeling Item 3: Depression Item 4: Well-Being	Grahn and Stigsdotter (2003); Dannenberg (2003); Macintyre (2017)
Green Roof Attributes	Items	Reference
Exposure	Item 1: Degree of Exposure	Feda et al. (2015); Lee and Lee (2019); Van Dillen et al. (2012)
Accessibility	Item 1: Easy Access Item 2: Free Access	Guite et al. (2006); Lo (2003) ; Feda et al. (2015); Lee and Lee (2019)

Distance	Item 1: Close to Residential Item 2: Close to Work Area	Roe (2013); James (2016); Wood et al. (2017)
Tree Canopy	Item 1: Large Woody Tree Item 2: Shrubs Item 3: Green Grass Item 4: Flowering Plants Item 5: Herbs	Astell-Burt and Feng (2019); Feng (2022); Weeland (2019)
Size	Item 1: Bigger Size	Wood et al. (2017); Williams et al. (2019)
Facilities	Item 1: Playground Item 2: Exercise Equipment Item 3: Jogging Track Item 4: Seat (Bench) Item 5: Roofed Hut Item 6: Swimming Pool Item 7: BBQ Area Item 8: Space for Event Item 9: Small Café Item 10: Vending Machine	Wood et al. (2017); Pope et al. (2018)
Maintenance	Item 1: Secured Item 2: Well-Maintained Item 3: Clean Environment	Ismail et al. (2018); Lehmann (2014)

As for the Exploratory Factor Analysis (EFA), Kaiser-Meyer-Olkin Measure of Sampling Adequacy value was 0.950 which validates that the sample size is enough to conduct EFA which is above the threshold of 0.5. The results were significant where $p < 0.05$. The analysis fruited one component which explained 74.72% of the total variation. As for the reliability test, the Cronbach alpha value for the exposure attribute was 1, accessibility was 0.846, distance was 0.813, tree canopy was 0.980, size was 1 as it has only one item, facilities were 0.964, security was 1 as well and maintenance was at 0.812.

Respondents Characteristics

A total of 385 responses was achieved after cleaning the data where missing data and incomplete responses were eliminated. The data consists of 154 (40%) female and 231 (60%) male respondents. Most of the respondents are green roof visitors in Lot 10 Kuala Lumpur with 92 (24%) respondents, followed by One Utama Secret Garden 85 (22%), Menara Binjai Ampang with 62 (16%) respondents, Riana Green East with 54 (14%) of them and The Maple Sentul and The Saffron Sentul has a frequency of 46 (12%) respondents each. The most common purpose of visit to the green roof is for the aesthetic and greenery environment, where 290 (70%) of the respondents enjoy the green roof for this purpose. Another purpose that gained a high percentage of frequency is recreational activity where 243 (63%) of the respondents visited the green roof for the purpose of carrying out the recreational activity.

Green Roof and Mental Health

The green roof efficiency towards the mental health of green roof residents and visitors is measured from various perspectives such as its efficiency towards stress, anxiety, depression, and well-being. Table 2 below shows the results of the descriptive analysis of the green roof efficiency towards the mental health of the respondents. Every aspect of mental health, which is stress, anxiety, depression, and overall wellbeing was improved where stress level is believed to be reduced by 72% in the presence and visit to the green roof, followed by a reduction in anxiety feelings as much as 67%, not forgetting 61% reduction in depressive feelings and lastly 66% promotion in well-being.

From the results, it can be concluded that green roofs have 67% efficiency in improving the mental health of the community. This explains that in relation to visiting the green roof, the community has 67% of betterment in terms of their mental health in overall. However, the green roof efficiency varies according to its attribute's efficiency as well, and these should also be taken into consideration when evaluating the overall green roof effectiveness in improving the community's mental health.

Table 2: Descriptive Statistics of Green Roof and Mental Health

Green Roof Efficiency	Min (%)	Max (%)	Average (%)	Standard Error Mean (SEM)	Standard Deviation (SD)
Stress	22	100	72	1.029	20.19
Anxiety	21	100	67	1.056	20.72
Depression	25	100	61	1.181	23.17
Well-Being	33	100	66	1.086	21.31
Overall Green Roof Efficiency in Improving Mental Health			67 %		

Green Roof Attributes and Mental Health

A total seven green roof attributes were analysed in this stage according to their items. Table 3 below shows the results of the descriptive analysis of the green roof attributes efficiency. The exposure attribute recorded a 65% efficiency in enhancing the green roof efficiency in improving mental health. Apart from that, accessibility attribute contributes to the enhancement at an average of 68% efficiency. For the distance attribute an average of 69% efficiency is discovered. Moving on to the tree canopy, the items contribute to an average 65% towards the enhancement of mental health by the green roof.

Apart from that, the size of the green roof also mattered to the visitor's in influencing the mental health benefits that are portrayed by the green roof, where bigger size of the green roof contributes to 68% efficiency. Furthermore, the facilities that are available in the green roof area are analysed to understand the importance of these facilities in enhancing the green roof's environment for

the purpose of enhancing mental health. The ten facilities that are listed have efficiency and contribution towards the green roof at an overall average efficiency of 63%. Lastly, the highest contributing attributes is the maintenance attribute with an average percentage of efficiency of 72%. The respondents indicated that these attributes should be considered and should be given priority to ensure a successful green roof implementation for mental health improvement where there are three items listed which is secured (70%), Maintained (83%) and Clean (76%). These findings shows the green roof attributes plays a vital role in enhancing the green roof benefit in proving mental health improvement.

The results from the person's correlation analysis are shown in Table 4 below. Generally, all the attributes have positive correlation on providing mental health benefits but varies in terms of its strength of correlation and all of them are statistically significant too.

Table 3: Descriptive Statistics of Green Roof Attributes and Mental Health

Attributes	Items	Average Items Efficiency (%)	Standard Error Mean (SEM)	Standard Deviation (SD)	Average (%)
Exposure	1: Degree of Exposure	65	1.21	23.81	65
Accessibility	1: Easy Access	68	1.12	21.98	68
	2: Free Access	67	1.31	25.74	
Distance	1: Close to Residential	72	1.02	20.07	69
	2: Close to Work Area	66	1.25	24.44	
Tree Canopy	1: Large Woody Tree	65	1.22	24.00	65
	2: Shrubs	63	1.25	24.49	
	3: Green Grass	67	1.25	24.45	
	4: Flowering Plants	66	1.23	24.17	
	5: Herbs	63	1.29	25.40	
Size	1: Bigger Size	68	1.20	23.44	68
Facilities	1: Children Playground	62	1.23	24.22	63
	2: Exercise Equipment	63	1.27	24.93	
	3: Jogging Track	68	1.29	25.39	
	4: Seat (Bench)	68	1.38	26.98	
	5: Roofed Hut	63	1.06	20.71	
	6:Swimming Pool	53	0.76	14.85	
	7: BBQ Area	64	1.33	26.13	
	8: Space for Event	63	1.43	27.98	
	9: Small Café	67	1.37	26.97	
	10: Vending Machine	60	1.37	26.80	
Maintenance	1: Secured	70	1.26	24.74	75
	2: Maintained	83	0.78	15.23	
	3: Clean	76	1.16	22.76	

Table 4: Correlation Between Green Roof Benefits and Green Roof Attributes

Variable	Pearson Correlation	Sig. (2-tailed)	N
Green Roof Benefits	1.000	—	385
Exposure	.820	.000	385
Accessibility	.825	.000	385
Distance	.854	.000	385
Tree Canopy	.901	.000	385
Size	.768	.000	385
Facility	.817	.000	385
Security	.651	.000	385
Maintenance	.774	.000	385

Green Roof and its Attributes Efficiency

Based on Table 5, every attribute has its percentage of efficiency, which contributes to the overall green roof efficiency, as shown in Table 2. To evaluate that, every attribute average percentage of efficiency is analysed and calculated using the formula shown in sub-section 3.4. Table 4 below shows the average percentage of efficiency of green roof attributes and overall green roof. The validated percentage of efficiency of the attributes is portrayed where the exposure, tree canopy and facilities attribute have a 9% effect on the green roof efficiency towards improving mental health followed by accessibility, distance and size attribute which has a 10% effect on green roof efficiency levels. The maintenance attribute recorded the highest percentage of efficiency towards the green roof effectiveness, which is 11%. Contrary to the conceptual framework of the study, the results shows that green roof together with the availability of all the listed attributes could provide mental health improvement benefits to the citizens.

Table 5: Average Percentage of Green Roof and its Attributes Efficiency

Attribute	Percentage of Efficiency (%)	Average Percentage of Efficiency (%)
Exposure	65	9
Accessibility	68	10
Distance	69	10
Tree Canopy	65	9
Size	68	10
Facilities	63	9
Maintenance	75	11
Overall Green Roof	473	67

DISCUSSION

The findings on the green roof and its attributes efficiency proves that there is a positive association between green roof and mental health improvement. Apart from that, it also aligns with the ART and SRT theory that proves that exposure

to green natural environment has impact on overall mental health and stress levels reduction. These findings also support the previous finding, which shows that the green roof attributes have an impact on the green roof benefits in improving the mental health of a person (James, 2016). Apart from that, the most common purpose of visits to the green roof is for its aesthetic greenery environment and for carrying recreational activities. This shows that green roofs provide great aesthetics to the environment and carrying out recreational activities in the green roof and green spaces is preferred compared to normal environments. These findings also are like previous studies which suggest that green roof also could be a platform for the public to carry out recreational activities in a modern way with supported benefits as the exposure to greenery which can concurrently reduce mental health issues (Rezaei et al., 2021). The overall green roof has been shown to have positive effects on the betterment of mental health symptoms such as stress, anxiety, depression, and overall well-being as well.

As for the green roof attributes, the results shows that every attribute, which has its own characteristics and functions, has an independent role in enhancing the overall green roof effectiveness in improving mental health in the community. Maintenance is reported to be the highest impacting attribute compared to others. This is because, a green roof that is filled with all the necessary attributes and facilities would not perform in its peak productivity if it is not cleaned or maintained after implementation. Poor maintenance also demotivates citizens to visit the green roof and it will subsequently lose its implementation objective. Thus, the results suggest that maintenance should be considered as a priority for the green roof to be at its highest and best use capacity and to achieve the aim of implementation (Ismail et al., 2018). The findings on the green roof and its attributes effectiveness can be a guide and referral for planners, developers and policymakers in promoting and implementing green roof in urban areas concurrently increasing the availability of green spaces.

There are some limitations that is present in this study. Firstly, there is a sampling bias where the study respondents in this study are from the general community that are living in properties with green roof and the green roof visitors, where not all of them were facing mental health issues at the time of the survey or prior to the time of the survey. Secondly, there is a location restriction limitation existed where this study only focused on visitors and residents in six places in Kuala Lumpur due to the unavailability of access to the respondents in other properties that have green roofs. Despite these limitations, this paper provides substantial information that green roof has the ability and performance to the improve mental health condition of the community in Malaysia. There is also a need to research the association of these listed attributes to the already existing green roofs in Malaysia for enhancing its benefits and to understand better the green roof benefits in the mental health improvement aspects and to

understand the latest state of mental health conditions of people living in the urban areas such as Kuala Lumpur.

CONCLUSION

In conclusion, this paper quantified the percentage of efficiency of green roofs together with their attributes efficiency in improving mental health. Generally, green roof is 67% efficient in improving mental health of the citizens. The most notable reduction in mental health symptoms was stress levels, according to the visitors. As for the green roof attributes efficiency, the most important green roof attribute is the maintenance of the green roof and there are also accessibility, distance and size that should be focused in the green roof implementations. This study contributes to the body of green infrastructure knowledge in which it provides a quantitative value of green roof's social benefit in improving mental health. The federal, state government and non-profit making organization bodies such as the Ministry of Finance Malaysia (MOF), Ministry of Economy Malaysia (MOE) and Malaysia Green Building Council (MGBC) can use the information gathered and analysed in this study as a guidance to encourage the implementation of green roof in Malaysia especially in the urban cities which has benefits in improving the mental health of the citizens. Apart from that, the green building policy creation and amendment also could be done by using this study results as the baseline and guidance.

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Zaliha KL has highest number of depressions, anxiety cases, says Dr Zaliha Mustafa.
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