Letter to the Editor

Community Needs Assessment in Relation to Urban Heat Effects: A Study in Greater Kuala Lumpur, Malaysia*

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Urban areas usually experience higher temperatures compared with their rural surroundings; this is characterized as urban heat islands (UHIs), which are the result of environmental overheating due to anthropic activities. Urban areas, which are characterised by massive construction that reduce local vegetation coverage, are subject to the absorption of a large amount of solar radiation, which is only partially released into the atmosphere by radiation in the thermal infrared. In contrast, rural environments generally show a reduced UHI effect, and in particular lower air temperatures, due to evapo-transpiration fluxes[1]. UHIs significantly increase city temperature and are experienced in the majority of large cities worldwide, including Malaysia[2].

Temperature rise in cities impacts a community's health and well being, as well as the productivity of workers due to climate change and heat. Therefore, it is critical to reduce the urban heat impact. A target driven assessment should be conducted to identify areas of need to help design the initiatives to effectively reduce urban heat. Target-driven assessment intended to meet a population's health needs is beneficial and advantageous in terms of health care provision and health policy[3]. In the context of urban heat, target driven assessment is needed to provide insights and strategies that policymakers can use in decision-making to address urban temperature increases in cities. In particular, assessments should focus on measures to counteract the temperature rise in the city. One of the prime factors contributing to temperature rise is excessive influx of the use of private motorcars in cities. Heat emitted from vehicles exacerbates urban heat[4]. Promoting reduction use of private cars by encouraging the use of public transport, or by promoting active transportation, such as cycling and walking are encouraged[5]. Assessing the willingness to walk and cycle in the city and the availability of facilities that promote walking and cycling would be useful to identify gaps and area of improvement in promotion of active transportation. Additionally assessment of the services of public transport such as route and sequence services would be beneficial to improve the quality and promote public transport usage.

Secondly, the need for promotion of green cities is important to mitigate the urban heat effect[6]. The cool cities strategy, which entails the promotion of tree planting to shade buildings to cool the ambient temperature through evapotranspiration of vegetation[6], would be ideal to reduce urban heat. Assessment of the urban park and the provision of indoor vegetation may help in the improvement of green spaces and parks in the city. One of the main contributing factor to urban heat is the material used for building[7]. Various types of construction material may impact interior and exterior surface temperatures, as well as maintain indoor and outdoor thermal comfort. In addition, proper urban building design may combat temperature rise[7]. Proper air paths and breezeways, appropriate building orientation, and sufficient space between buildings are important elements to reduce urban air temperature[7]. Assessment of the sustainability of green city infrastructure is useful for future urban planning and landscape design.

Effective communication strategies to disseminate information related to urban heat and temperature rise are imperative, especially in crisis management[8]. Heat-related health information should be disseminated in a timely manner to the community in the event of heat waves to reduce the impact on the community and particularly to those deemed to be more vulnerable to heat wave events. A such, assessment of city community communication and information needs play a pivotal

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role in all aspects of prevention and mitigation measures.

In view of the lack of sound evidence from the public, and the fact that a needs assessment survey is an effective way of acquiring information from the community, we conducted a target-driven community needs assessment survey related to urban heat in Greater Kuala Lumpur, the capital and commercial heart of Malaysia. The assessment focused on the perceived needs of the above-mentioned areas, namely, 1) active transportation (promotion of cycling and walking) and usage of public transport, 2) green city initiatives, 3) use of appropriate building material and design to reduce urban heat, and 4) communication and information related to urban heat. The rationale for this community needs assessment was to identify accurate local community needs and subsequently provide implementation recommendations for sustainable green city and infrastructure improvements.

Study Respondents and Ssettings The sample was drawn from Greater Kuala Lumpur. In this study, three areas in Greater Kuala Lumpur were randomly selected: (1) Mont Kiara, (2) Jalan Raja Chulan, and (3) Setia Alam. Computer-assisted telephone interviews were conducted between October 2016 and May 2017. Sampling was drawn by random digit dialling of landline phone numbers from all study areas. The selection of respondents within contacted households was accomplished by randomly requesting to speak to adults (18 years of age or older) residing in the household. Interviews were conducted between 5:30 pm and 10:00 pm on weekdays and from 12:00 pm to 7:00 pm on weekends or public holidays to avoid over-representation of unemployed respondents. Unanswered calls were attempted at least two more times on separate days before being regarded as non-responses.

Study Questionnaire An interviewer-assisted questionnaire was developed by a panel of experts. The questions were carefully read aloud to respondents by the interviewers over the telephone. The questions on needs assessment consisted of sections that assess needs in relation to 1) active and public transportation, 2) green city (internal and outer building vegetation), 3) building design and material, and 4) information and communication related to urban heat effects.

The questionnaires were available in three languages: Bahasa Malaysia (the national language of Malaysia), English, and Chinese. Interviews with respondents were conducted by a team of multi-ethnic interviewers. Each interviewer was assigned to interview respondents of a similar ethnic group in their native language. Informed consent was obtained verbally. Respondents were assured that all responses were confidential and were reminded that completing the interview indicated voluntary participation. The study was approved by the University of Malaya Medical Ethics Committee (MECID NO: 2016928-4295).

Data Analyses Data were statistically analysed with SPSS statistics version 19.0 (SPSS Inc., Chicago, IL, USA). Categorical variables were summarized by frequencies and percentages. Respondents were first asked about the availability of 1) active transportation, 2) urban vegetation (internal building and external vegetation), 3) building design and material, and 4) information and communication in relation to urban heat. Possible answers were 'available' and 'not available'. Respondents who answered 'available' were further probed to assess whether the services were 'sufficient' or 'insufficient'. The answer 'not available' was further probed to assess whether the services were 'needed' or 'not needed'.

Multivariable logistic analysis was subsequently carried out to determine factors associated with a higher total needs score. All needs assessment items were totalled, with a maximum value of 30. As the total needs score was not normally distributed, K-means clustering was performed to cluster scores with similar patterns into two clusters[9]. To evaluate the factors associated with a higher total needs score, the Chi-square test was used to examine the association between each of the factors (independent variables) and the clusters for total scores of control measures. Multivariate logistic analysis was subsequently carried out if there were two or more significant associations (P < 0.05). All significant variables in the univariate analysis were entered into multivariate logistic regression analysis using a simultaneous forced entry model (enter method). Odds ratios (*OR*s), 95% confidence intervals (95% *CI*s), and p-values were calculated for each independent variable. The model fit was assessed using the Hosmer–Lemeshow goodness of fit[10].

The socio-demographic characteristics of the respondents are summarized in Table 1. A total of complete 558 responses (Mont Kiara n = 64, Jalan Raja Chulan n = 90, Setia Alam n = 404) were received. Response rate was response rate 57.8%.

A majority of the respondents were female (69.9%) and ranged in age from 26-35 years (36.2%). Most of the respondents were Malays (79.2%). There was a slightly higher proportion of respondents with tertiary education (58.8%) than secondary and below (41.2%). Most respondents worked in professional and managerial services (49.8%). The majority (38.9%) reported a monthly household income greater than MYR 2500 and below MYR 4500.

Active and Public Transportation Over two-thirds of respondents noted the availability of special lanes for cyclists and shaded lanes. Cycling promotion and the availability of special lanes for cyclists were judged as sufficient by 59.5% and 55.0% of the respondents, respectively. A relatively higher proportion reported the availability of special lanes for pedestrians to encourage walking in the city. Shaded lanes were judged as sufficient by 59.7% of respondents. Of those that noted non-availability of special lanes and shaded lanes for cycling and walking, a considerable number noted that they did not require cycling and walking facilities.

Table 1. Socio-demographic Characteristics and Living Conditions (*N* = 558)

Socio-demographic Characteristics	*N* (%)
Gender	
Male	168 (30.1)
Female	390 (69.9)
Age group (years)	
≤ 25	111 (19.9)
26-35	202 (36.2)
36-45	154 (27.6)
> 45	91 (16.3)
Ethnicity	
Malay	442 (79.2)
Chinese	35 (6.3)
Indian	79 (14.2)
Others	2 (0.4)
Highest education level	
Secondary and below	230 (41.2)
Tertiary	328 (58.8)
Occupation	
Professional and managerial	278 (49.8)
General worker	133 (23.8)
Student	61 (10.9)
Housewife	55 (9.9)
Retiree	22 (3.9)
Unemployed	9 (1.6)
Average household monthly income (MYR)	
≤ 2,500	230 (41.2)
2,501-4,499	217 (38.9)
≥ 4,500	111 (19.9)

Overall, nearly a third of respondents noted insufficient public transport facilities encouraging the use of public transportation. The need for facilities to promote the use of public transport was noted by approximately half of the respondents that noted non- availability of facilitators of public transport use.

Urban Vegetation Over 80% of respondents noted the availability of indoor plants and mini-gardens in their house. A relatively lesser degree of outdoor vegetation was available compared to indoor vegetation. Having green roofs or walls were judged as the lowest availability (72.9%). The availability of sport or recreation parks near neighbourhoods was reported as the most highly available (82.6%).

The proportion of needs for outdoor vegetation were higher than indoor vegetation. The highest proportion of respondents warrant the need for vegetation planting along the streets in their neighbourhood (18.5%), followed by green roofs and walls (17.9%), and small gardens in their neighbourhood (17.2%).

Building Design and Material The majority of respondents reported having curtains or blinds in their windows (89.8%) and operating windows or openings for airflow in their house (88.3%). The availability of a light coloured outer wall of their house and neighbourhood building were 84.2% and 83.6%, respectively. An outer wall using solar reflective material was reported to be available by 75.1% of the participants. The highest proportion (20.3%) reported the need for an outer wall that uses solar reflective material to reduce heat absorption into the respondents' house.

Information and Communication A higher proportion of respondents noted the availability of information regarding the causes of urban heat (90.9%) than the availability of information on adverse health impacts (81.9%) and mitigation measures (81.9%). Of those that noted non-availability of information regarding urban heat, an almost equal proportion expressed needs for information regarding causes, adverse health impacts, and mitigation measures. With respect to communication regarding urban heat, the two highest means of communication were through mass media (81.1%) and social media (61.6%). Most of the respondents that noted non-availability of communication through social media and mass media indicated a high level of needs (Table 2).

All needs assessment items were totalled, and the resulting scores ranged from 0 to 30 (mean = 24.24, standard deviation = 8.00). In K-means cluster analysis, two homogeneous groups were clustered, namely groups with a score of 0-20 (n = 160) or 21-30 (n = 398). Univariate analysis revealed that respondents of a higher age group indicated higher total needs compared with the younger age groups (Table 3). Respondents with a tertiary education level and higher income expressed higher needs. Those in the professional, managerial, and manual workers categories expressed a higher level of needs. In the multivariate logistic regression analysis, only age and occupational groups remained as significant factors associated with needs.

Needs assessment in relation to reducing the impact of urban heat has not been previously reported in Malaysia. The findings of this needs assessment has a fundamental role in heat reducing activities and future urban planning in other tropical countries in the world where the weather is hot, humid, and rainy year-round. Shaded lanes and friendly infrastructure is warranted to encourage cycling and walking. Our study implies that shaded lanes are important in tropical countries to increase the use of sustainable active transport among the community as extreme sun and rain may negatively affect public intention to commute via active transportation.

Our results suggest the need to enhance urban vegetation, and in particular, outdoor vegetation. Malaysia, as well as many other tropical countries in the world, has a favourable climate that sustains the growth of a huge variety of outdoor plants. Thus, efforts to promote sustainable land use to conserve tropical biodiversity should be intensified, as it is a feasible and effective way to reduce urban heat. Promotion of indoor plants is equally effective and can be easily implemented. Apart from the cooling effect, indoor vegetation improves indoor air quality and reduces the use of air-conditioning and ultimately reduces environmental urban heat. With respect to building material, study found that most desire thermally reflective building material to reduce heat absorption[7]. Implementing the use of building materials that reduce heat absorption and cool the building interior should be enhanced and would provide long-term benefits of reducing urban heat.

The findings of this study imply the importance of information and communication strategies in preventing the health effects of urban heat. The high proportion expressing insufficient information in this study implies the need for imparting information regarding urban heat and its impact on the temperature rise. It has been suggested that engaging and empowering city communities through knowledge enhancement may create change in practices and accelerate progress towards a sustainable city environment. Communication is of utmost importance in improving public health responses to hot weather. Early childhood education has a major long-term positive impact, and as such, it is vital to establish an early childhood education communication plan related to establishing and maintaining a sustainable green environment.

Lastly, our findings revealed a higher level of needs among respondents who are more educated and of higher socio-economic level, which implies the lack of consciousness among the lower educated community due to lack of awareness. Further investigation will be required in this matter. The following limitations should be considered when interpreting these findings. Cross-sectional telephone survey and self-reported data may limit our ability to generalize our findings. We also acknowledge that our study is further limitted by poor response rate.

In essence, this study indicates the importance of community needs assessment in identifying the issues surrounding the existing vulnerability to urban heat and provides insights into areas of improvement. Our findings are applicable to other cities in tropical climate countries and may serve as a useful guide for future tailored needs assessment.

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Table 2. Needs Assessment (N = 558)

Items	**Available** ***N*** **(%)**		**Non-Available** ***N*** **(%)**	
	Sufficient	Insufficient	Need	Don't need
Active transportation				
Cycling and walking				
Special lanes for cyclists to encourage bicycle usage	332 (59.5)	80 (14.3)	93 (16.7)	53 (9.5)
Shaded lanes for cyclists	309 (55.4)	104 (18.6)	108 (19.4)	37 (6.6)
Special lanes for pedestrians to encourage walking	337 (60.4)	103 (18.5)	89 (15.9)	29 (5.2)
Shaded lanes for pedestrians	333 (59.7)	116 (20.8)	80 (14.3)	29 (5.2)
Public transport				
Bus and rail transport				
Public transport routes that cover all main areas from residential areas to activity centres (workplace, shopping complex, commercial, business centre, etc.)	353 (63.3)	124 (22.2)	57 (10.2)	24 (4.3)
Public transport station within walking distance from residential areas	359 (64.3)	114 (20.4)	63 (11.3)	22 (3.9)
Public transport station within walking distance from workplaces	352 (63.1)	109 (19.5)	74 (13.3)	23 (4.1)
Public transport station within walking distance from activity centres (shopping complex, commercial, business centre, etc.)	367 (65.8)	103 (18.5)	66 (11.8)	22 (3.9)
Short time interval for public transport services (frequent)	356 (63.8)	115 (20.6)	70 (12.5)	17 (3.0)
Green City Initiatives				
Indoor vegetation				
Indoor plants inside your house	369 (66.1)	93 (16.7)	68 (12.2)	28 (5.0)
Nature-based landscapes inside your house	344 (61.6)	81 (14.5)	91 (16.3)	42 (7.5)
Mini-garden outside or on the balcony of your house	372 (66.7)	93 (16.7)	66 (11.8)	27 (4.8)
Outdoor vegetation				
Vegetation around residential buildings	356 (65.4)	87 (15.6)	88 (15.8)	18 (3.2)
Plants on top of the roof (green roof) or crawling plants along the wall (green wall) of your residential building	344 (61.6)	63 (11.3)	100 (17.9)	51 (9.1)
Vegetation around areas where people get together in your neighbourhood	346 (62.0)	100 (17.9)	90 (16.1)	22 (3.9)
Vegetation along the streets in your neighbourhood	347 (62.2)	87 (15.6)	103 (18.5)	21(3.8)
Small garden in your neighbourhood	369 (66.1)	75 (13.4)	96 (17.2)	18 (3.2)
Sport or recreational park near your neighbourhood	356 (63.8)	105 (18.8)	82 (14.7)	15 (2.7)
Building design and materials				
Building design				
Operable windows or openings that allow direct flow of air into your house	423 (75.8)	70 (12.5)	53 (9.5)	12 (2.2)
Curtains or blinds on your house windows	434 (77.8)	67 (12.0)	44 (7.9)	13 (2.3)
Building materials				
Outer wall that use solar (sun's rays) reflective material to reduce heat absorption at your house	339 (60.8)	80 (14.3)	113 (20.3)	26 (4.7)

Continued

Items	Available N (%)		Not-Available N (%)	
	Sufficient	Insufficient	Need	Don't need
Light coloured outer wall of your house	383 (68.6)	87 (15.6)	67 (12.0)	21 (3.8)
Light coloured outer wall of buildings in the neighbourhood	378 (67.7)	89 (15.9)	77 (13.8)	14 (2.5)
Information and communication				
Information				
Information on causes of urban heat islands	356 (63.8)	111 (19.9)	84 (15.1)	7 (1.3)
Information on adverse health impacts of urban heat islands	354 (63.4)	103 (18.5)	90 (16.1)	11 (2.0)
Information on measures to be taken to overcome the risk of urban heat islands	350 (62.7)	107 (19.2)	96 (17.2)	5 (0.9)
Communication				
Communication of urban heat islands through mass media (newspaper, magazine, etc.)	344 (61.6)	109 (19.5)	99 (17.7)	6 (1.1)
Communication of urban heat islands through social media (Facebook, Twitter, Instagram, etc.)	344 (61.6)	110 (19.7)	95 (17.0)	9 (1.6)
Communication of urban heat islands at school to provide early exposure	326 (58.4)	95 (17.0)	131 (23.5)	6 (1.1)
Communication of urban heat islands by visiting or conducting the program in the community (community outreach)	319 (57.2)	88 (15.8)	139 (24.9)	12 (2.2)

Table 3. Factors Associated with Total Health Impact Score (N = 558)

Items	N (%)	Total Needs Assessment Score (0-30)			Multivariable Logistic Regression
		Score of 0-20 (n = 160)	Score of 21-30 (n = 398)	P-value	Score 9-14 *vs.* 0-8 *OR* (95% *CI*)
Socio-demographic characteristics					
Gender					
Male	168 (30.1)	56 (33.3)	112 (66.7)	0.126	
Female	390 (69.9)	104 (26.7)	286 (73.3)		
Age group (years old)					
≤ 25	111 (19.9)	38 (34.2)	73 (65.8)		4.324 (1.762-10.613)**
26-35	202 (36.2)	35 (17.3)	167 (82.7)		4.508 (2.147-9.464)**
36-45	154 (27.6)	25 (16.2)	129 (83.8)	< 0.001	6.421 (3.093-13.329)***
> 45	91 (16.3)	62 (68.1)	29 (31.9)		Reference
Highest education level					
Secondary and below	230 (41.2)	94 (40.9)	136 (59.1)	< 0.001	0.780 (0.458-1.329)
Tertiary	328 (58.8)	66 (20.1)	262 (79.9)		Reference
Occupation					
Professional and managerial	278 (49.8)	46 (16.5)	232 (83.5)		3.579 (0.967-13.239)
Manual worker	133 (23.8)	21 (15.8)	112 (84.2)		5.696 (1.574-20.605)**
Student	61 (10.9)	30 (49.2)	31 (50.8)	< 0.001	1.084 (0.260-4.512)
Housewife	55 (9.9)	38 (69.1)	17 (30.9)		0.931 (0.252-3.441)
Retiree	22 (3.9)	18 (81.8)	4 (18.2)		Reference
Unemployed	9 (1.6)	7 (77.8)	2 (22.2)		-
Average household monthly income (MYR)					
≤ 2,500	230 (41.2)	98 (42.6)	132 (57.4)		0.553 (0.274-1.118)
2,501-4,499	217 (38.9)	42 (19.4)	175 (80.6)	P < 0.001	0.977 (0.504-1.892)
≥ 4,500	111 (19.9)	20 (18.0)	91 (82.0)		Reference

Note. $^{**}P$ < 0.01, $^{***}P$ < 0.001. Hosmer-Lemeshow test; chi square = 21.965, P = 0.05, Nagelkerke R^2 = 0.615.

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