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ARCHITECTURE AND PHYSICAL ACTIVITY : A SYSTEMATIC REVIEW

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Malaysia is facing obesity epidemic like the other developing country for the last decade, obesity is one of the major cause to the Non-Communicable Disease and was found that NDC causes the increase of mortality rate in Malaysia. The advancement of technology, humans are relying a lot on technology and resulted in sedentary lifestyle. Hence, the built environment is an important in promoting physical activity as human spend most of te time in built environment. A systematic search of research paper, journals and articles from the year of 2002 to 2019 are studied to investigate the relationship between built environment and the physical activity. The findings of the review shows that the built environment attributes such as, connectivity of streets, availability of pedestrian walkway, parks, recreational facilities are positively correlates with the physical activities in human daily life. The social environment of perceived safety in the neighbourhood that have positive affect on human physical activity. Built environment can be utilized to encourage and promote physical activity among Malaysians by improvising the walkability and connection in the neighbourhood, parks and playground, and the availability of recreational facilities. Further research and investigation on architecture intervention should be done to achieve the goal of increasing the physical health of Malaysians.

Keywords: Built Environment, Physical activity, Architecture, Obesity

1. INTRODUCTION

The rapid development of urban sprawl might cause the planning of a city to be difficult to walk or cycle between one place and another, which caused the physical inactivity of human (Seliske et al., 2012). Studies show that the built environment, social environment and nature environment of a living community can influence the participation in physical activities of people (Edwards & Tsouros, 2006). Hence, we can design and build an environment that promotes the participation of physical activities. Building and structures that forms a community environment such as buildings, parks, roads, walkways even a structure are linked to human physical and mental health (Mohan, V. & Pradeepa, R., 2007). Many people were confuse by exercise and physical activity, the main difference of exercise and physical activity exercise is a set of repeated motion, where a movement are developing into a skill or to achieve a specific target, in addition, exercise is categorised under physical activity (Sallis et al., 2012).

In contrast, according to World Health Organization (WHO) the definition of physical activity is the movement of the body that uses energy from the body itself (WHO, 2013). The needs to increase the physical activity is that studies have revealed that the physical inactivity have become the one of the major leading risk factor for the global death rate (WHO, 2013). Recently, diseases caused by physical inactivity have become a serious issue globally, the most

lethal disease is obesity. Obesity is a major issue due to obesity leads to Non-communicable Diseases (NCDs), which are chronic diseases such as cardiovascular diseases and diabetes (Jönsson et al., 2005). The proof of architecture can contribute in creating environments to prevent diseases is shown in history. In the late 19th century, architects and the urban planners work together to fight against the infectious disease, for example, the Cholera and Tuberculosis with better buildings' design, parks, and streets (The City of New York, 2010). In recent years, architects and designers become one of the important factors that are able to combat obesity and the related Non-communicable Diseases through design. However, there are insufficient research that proof that the practicality and workability of increasing physical activity through architecture and urban design strategies.

2. PROBLEM STATEMENT

Over recent decades, sedentary lifestyle is becoming more and more common as the trend of the human work changed from dependent on physical performance-based work to knowledge-based work that does not require the physical activity to achieve the goal. Hence, the rate of the physical activity is fluctuating due to the sedentary work style that does not need the physical activity of the person working (Hallal et al., 2012). According to the World Health Organization, the Asian country that have the highest population of obesity and overweight is Malaysia. The male and female population that are either obese or overweight in Malaysia is 64% and 65% respectively.

Obesity has become the leading risk factor to Non-Communicable Diseases such as cardiovascular diseases and diabetes that contributes to the increasing rate of morbidity in Malaysia. Studies shows that Malaysian have the highest population rate of obesity and overweight in Asia is due to the sedentary lifestyle of Malaysian adults. In average, Malaysian adult spent most of their time, which is 40.8% of their time in sitting position in a day. Furthermore, 33.1% of a day's time are in lying down or sleeping position. It has summed up that Malaysian adult spent 73.9% of the time being inactive in physical activity and less than 30% of the time are used for leisure activities like sports, doing chores and also commuting between destinations. (Poh, B. K. et al., 2010).

3. RESEARCH PURPOSED & QUESTION

Built environment are defined by the surroundings that is built by human, such as buildings, parks, schools, recreational facilities, roads and shops (Handy et al., 2002). Furthermore, the built environment have direct and strong association with physical activity (Pineo et al., 2018). This research is conduct to investigate the architecture solutions that can increase the opportunity for physical activities in the built environment. Besides that, the objective is to improve the health of the residents in Malaysia by increasing the physical activity through architecture. Lastly, this research aims to contribute to the theory and practice of the built environment. Which can be a start of developing a guideline to achieve healthier community in Malaysian neighbourhood.

Research Question

To study the relationship between the built environment and physical activity, there are two research questions in this research paper :

i. What are the elements of built environment that are able to enhance the physical activity of human?
ii. How does the built environment can increase the physical activity in the neighbourhood?

4. FINDINGS

The factors and attributes of the neighbourhood built environment were systematically reviewed to investigate the variables that affect the physical activity. Table 1 consist of the 20 literatures that is reviewed in this paper. The factors that affects physical activity in this paper can be categorised into 2 categories, which are the physical built environment attributes and social attributes of the built environment.

4.1 PHYSICAL ATTRIBUTES OF BUILT ENVIRONMENT

Physical attributes of the physical built environments includes land-use, density, connectivity, active transportation and design elements. Mixed-use land were found to be positively associate with the increase of physical activity in the neighbourhood. Mixed-use land that have services and commercial shops near the residential promotes walking in the neighbourhood and reduce the use of vehicle to reach their destinations (Douglas et al., 2007). Density of the residents is one of the factors that affects the physical activity, but there are few inconsistency in the findings. According to Oakes and colleagues, the residential density does not directly correlates with the physical activities of the residents (Oakes et al., 2007).

However, Sallis and associates collected data from 11 different country and shows that there are positive correlation between the residential density and physical activity (Sallis et al., 2009). The studies of Sallis and associates are more reliable as it was conducted in 11 different countries and Oakes and colleagues conducted their studies in the United States only. The availability of land-use varieties, and the residential density are positively associated with the physical activity, the connectivity of the destinations plays an important role in enhancing the result of increasing the physical activity. These connectivity can be in the form of pedestrian infrastructure that supports the walkability of the neighbourhood. Studies have shown that the rate of walking is increased if there are the presence of sidewalks. Besides the presences of sidewalk, the well maintained sidewalks also will directly associate with the increase the use of the pedestrian walkway (Shay et al., 2009).

The destinations in the built environment are recommended to travel by active transportation such as public transport, walking and bicycling to achieve healthy lifestyle (L. D. Frank et al., 2003). Active transport were proven to be positively associated with the increase of physical activity in this literature review. Besides, there are relationship of the active transport, the land-use and the residential density are closely associated with each other. For example, the active transportation can enhance the connectivity and resulted in higher physical activity in the neighbourhood.

The neighbourhood aesthetics includes the natural feature such as tress along the streets, architectural elements, decorative ornaments on buildings. The aesthetics of the built environment have positive correlation with the increase of physical activity (Neckerman et al., 2009). In Malaysia, the aesthetic of the building are proven to one of the factors that affect the physical activity (Abdulah et al., 2016). Recreational facilities including parks, playground and sports court were found to be positively associated with the reduction of the overweight among teenagers (Wolch et al., 2011). In Canada, there are research that recommends the city planner and authorities to increase the availability of recreational facilities to achieve healthier city (Frank et al., 2012). Studies show sufficient numbers and the quality of the recreational facilities and parks are important to promote recreational activity (Soltani & Hoseini, 2014). However, previous study showed that the improvement of recreational facilities could further increase the physical activity (Cohen et al., 2009).

4.2 SOCIAL ATTRIBUTES OF BUILT ENVIRONMENT

Social attributes like the crime and traffic safety perception in the neighbourhood plays an important role in the physical activity in the neighbourhood. The crime safety are found that it was negatively correlates with the physical activity among adults (Sallis et al., 2009). However, there are few studies that found the crime safety have positive correlation with adolescents physical activity (Ding et al., 2012). Hence, the crime safety are found to be no direct correlation with adults physical activity. Traffic safety are positively associate with physical activities as showed in previous studies (Neckerman et al., 2009).

The social attributes are also correlate closely with the physical built environment, as the physical built environment will directly affect the social attributes. For example, good design such as the orientation of the building to have sight of the streets can increase the surveillance in the neighbourhood (Cozens, 2014). Besides that, street elements like the roundabouts, sidewalks, bicycle facilities and signal for crosswalk can be implemented on the street design. Studies have shown that the elements mentioned above are

proved to improve the traffic safety (Knoblauch, 1988)

Table 1: Summary of Systematic Literature Review

No.	Author/Year	Built Environment Variables	Method	Findings
1.	(Rawlings et al., 2019)	• High density • Land use mix • Street network	Cross-sectional study	-high density and mix-use of land encourages walking but not as effective. However, streets that are well connected encourages walking more than those does not connects well.
2.	(Molina-García et al., 2019)	• Active transport • Pedestrian walkway • Street network • Sports facilities	Cross-sectional study	-students PA will increase if the walkability of the neighborhood is high.
3.	(Chiang et al,, 2019)	• Active transport • Pedestrian walkway • Recreational facilities • Aesthetics • Accessibility to services	Cross-sectional research design	-accessibility to services and other parts of the neighbourhood increase PA.
4.	(Stappers et al., 2018)	• Aesthetics • Accessibility to facilities • Walking infrastructure	Cross-sectional study	-aesthetics of building increases the moderate-vigorous-physical-activity. -accessibility to destinations and walking facilities increase MVPA
5.	(McCormack, 2017)	• Active transport • Pedestrian walkway • Street network • Sports facilities	cross-sectional study	-the street network, pedestrian walkway and sports facilities have positive correlation with PA.
6.	(Smith et al., 2017)	• Pedestrian walkway • Bicycle path • Active transport	Systematic literature review	-the availability of the active transport, pedestrian walkway, and bicycle facilities increases PA.
7.	(Wang et al., 2017)	• access to PA facilities	Multilevel path model analysis	-availability of PA facilities, community-based facilities were associated with active participation in PA.
8.	(Liu et al., 2017)	• Park accessibility • Proportion of residential green space • Perceived quality of the nearest park	Questionnaire	-park accessibility were significantly correlated with the residents' PA.
9.	(Abdulah et al., 2016)	• Active transport • Pedestrian walkway • Recreational facilities • Aesthetics • Accessibility to services	cross-sectional study	-accessibility to services and other parts of the neighbourhood increase PA. -connectivity and the availability of the walkway are positively associate with PA.

10.	(Wong et al., 2016)	• Accessibility of facilities • Availability of sports facilities • Attractive natural sights • Local destinations • Road density • Street intersection	Objective measure, Questionnaire	-aesthetics of the neighbourhood increase PA level.
11.	(Wineman et al., 2014)	• destination access • street connectivity • dwelling density • land-use mix • streetscape quality	Cross-sectional multilevel regression analyses	-street connectivity and destination accessibility have significant correlation to PA level.
12.	(Ding et al. , 2011)	• Recreation facilities • land-use • street connectivity • walking & biking trail • vegetation	Evidence acquisition, Evidence synthesis	-the environmental attributes studied are consistently related to PA.
13.	(Boone et al., 2010)	• number of links (street segments) • number of nodes (intersections); Intersection density is the number of 3 or more-way intersections/square km	Negative binomial regression models	PA facilities that located within 3km from home, and street intersection within 1km have significant correlation with PA
14.	(Inoue et al., 2009)	• residential density • access to shops • sidewalks & biking tails • access to recreational facilities • aesthetics • traffic safety	Questionnaire	-residential density, access to shops, waking & biking trails are significantly associated with PA. -aesthetics of neighbourhood have positive association with PA.
15.	(Sallis et al., 2009)	• Land-use Mix; many commercial stores around • Residential density • Access to transit • Infrastructure sidewalk /bike lane • Free/ low cost recreational facility • Perceived crime	Cross Sectional Logistic regression analysis	All of the variable are associated with the PA level. Neighbourhood environment have significant association with PA.
16.	(Neckerman et al., 2009)	• Aesthetic in neighbourhood • Safety in streets	Quintile and logistic Regression analysis	-the aesthetic and safety in the neighbourhood have significant association with the increase of PA.
17.	(Strath, Isaacs, & Greenwald, 2007)	• Infrastructure • Land-use • Landscape • Aesthetic	Cross-Sectional Correlation	-infrastructure, land-use, landscape and aesthetic have positive association with PA
18.	(King et al., 2005)	• walking & biking trail • Park •department / hardware stores • shopping center	Cross-sectional	-Presence of post office within walking distance have positive association with physical activity level,

		• post office		-land–use that provide businesses opportunities and facilities may increase physical activity levels .
19.	(Addy et al., 2004)	• Presence of sidewalks • Street lighting in neighbourhood • recreational facilities • Shopping malls • Community parks	Cross-sectional	-presence of side-walks, street lighting, recreational facilities, parks and malls have positive association with the increase in walking and PA.
20.	(Craig et al., 2002)	• Walking routes • Transportation system • Visual interest • Visual aesthetics • Threats from traffic and crime	Cross-sectional	-aesthetics and the visual interest of neighbourhood have positive association with the increase of walking and PA level.

5. CONCLUSION

As a result, the physical and social attributes of built environment have direct and strong association with physical activity. The increased physical activity are mostly measured on walking, hence the walkability in the neighbourhood is playing an important role in helping to shape a healthier community. The land-use and the residential density shows mixed result in association with physical activity, but the connectivity shows strong correlation with physical activity. The connectivity is closely related to the active transport, which is also positively correlates with the physical activity. The active transport includes walking and bicycling, which the presence of the infrastructure that supports the active transport have positive association with physical activity. Hence, the aesthetic of streetscape is positively correlate with physical activity. However, the aesthetic of the building showed mixed result on physical activity.

The social attributes of the built environment are effecting the physical activity, the crime safety does not directly correlate with physical activity, but the traffic safety can be improve with proper design and is proven to correlate positively with physical activity. As the findings of this research have proven that the elements effect the physical activity, the local authorities, architects, city planners and engineers, should work together and develop a set of guidelines in city planning and housing development to fight against the high overweight and obesity in Malaysia. As there are limited research on this field in Malaysia, researchers can study more on the specific elements that directly associate with the rate of physical activities. More studies have to be done before the development of the guideline for combating obesity with design and community intervention in Malaysian context.

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