**The progressive effects of built environments on supporting physical activity diversity in high-density areas: a case study in Shenzhen, China**

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**Calculation method of the physical activity participants’ social class diversity (PAPD)**

The PAPD in this paper was represented by the social class. It was divided into four categories: high-income group, middle-income group, low-income group, and lower-income group.

As PA's VGI data did not contain income information, the equation of Housing Price to Income Ratio (HPIR) was used to derive the income of participants corresponding to PA data in this article. First, the PA data needed to be assigned to housing prices information. The PA route data was overlaid with the geospatial land-use data with residential information on the beginning or end of the routes, then using house prices to determine the social class of participants [1].



Where, *HPIR* is the housing price to income ratio; *m* is the price per square meter of commercial housing; *y* is the residential area; *n* is the annual family income.

The HPIR of Shenzhen 2016 was 27.7 (Ranking List of Housing Price to Income Ratio in 35 Large and Medium Cities in China, 2015). At present, scholars mostly use the housing area of 60m2 to 100m2 as the research standard. Taking Shenzhen as an example, 80m2 can represent the commercial housing transactions on the market, while the size of economically affordable housing is controlled at around 60m2. Therefore, this article used 80m2 as the housing standard for the middle-income and high-income groups and 60m2 as the housing standard for low-income and lower-income groups. The research took the per capita disposable income of Shenzhen residents in 2016 as a reference standard of 7509 USD (2 households per family) (Survey office of the National Bureau of Statistics in Shenzhen, 2015). The high-income class was those whose income is 2.5 times or more than the average level, and the middle-income class were those whose income is between the average level and 2.5 times, and the low-income class was those whose income is 50% of the average level to the average level, and the lower-income class was those whose income is less than 50% of the average level [2]. It can be seen that the annual family income of various social classes in Shenzhen. The per capita income of the high-income class was 37544 USD, and above, and the per capita income of the middle-income class was between 15018 USD and 37544 USD, and the per capita income of the low-income class was between 7509 USD and 15018 USD, and the per capita income of the lower-income class was 7509 USD and below. Reversely, we can see that in 2016, the affordable housing prices of households of various social classes (based on 80m2 for high-income and middle-income households, 60m2 for low-income and lower-income households): High-income families have the ability to purchase commercial houses or villas with a house price of 12953 USD/m2 or more; the highest affordable house price for the middle-income families is 14953 USD/m2; the highest affordable house price for low-income families is 6924 USD/m2; while lower-income families cannot afford to buy houses, and most of them live in urban villages and other affordable housing.

The Shenzhen housing price data used in this article comes from the Home Link database, which is the largest housing trading platform in Shenzhen - using calculated affordable housing price, combined with the real housing prices of the corresponding residential areas in the PA data, to determine the social class of the participants corresponding to each group of PA data.

**Reference**

[1] R. Ewing, R. Cervero, Travel and the built environment: A meta-analysis, Journal of the American planning association 76(3) (2010) 265-294.

[2] P. Li, Y. Zhang, The size of the Chinese middle class, identity and social attitudes, Society 28(2) (2008) 1-19.