

A Natural Experiment Reveals the Potential Links Between Perceived Built Environment, Health Status and Suicidal Behaviors: An Explanatory Network Model Analysis

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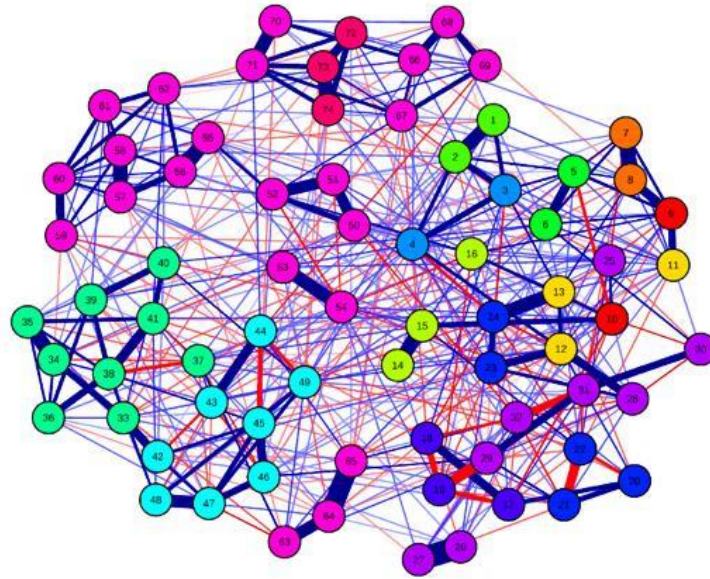
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This study explores the pairwise correlation scores between perceived built environment factors, public housing residents' health status, and suicidal behaviors using a network analysis model, providing empirical evidence for suicide prevention through environmental intervention. Preventing suicide raises global concerns, however built environmental factors might be ignored. Suicidal behaviors as common global health problems were associated with the decreasing of mental health, physical and social health status. While the impact of built environment factors on residents' mental, physical and social health status were demonstrated by previous studies separately. Emerging studies reported the potential links between built environment and suicide rate. As the theoretical and empirical evidence suggested, the protective built environmental factors can help with promoting health status and mitigating the risk of suicide at a low following cost and work in the long term. But few studies have explored the impacts of built environment factors on mental, physical, social health, and suicidal behaviors in a perspective of network in whole. This may lead us to overlook the overall role of certain built environment factors in promoting health and preventing suicidal behavior.

To address these issues, a cross-sectional survey was conducted to collect 3350 valid resident samples from over 224 public housing communities in Hong Kong. The regulations of the public housing authority in Hong Kong constituted a natural experiment with minimal self-selection bias. We collected measures of perceived built environment including distance to the city center, accessibility to public transport, diversity of land use, neighborhood interactions, walkability to green space, walkability to blue space, climatic conditions, housing conditions, and healthy lifestyle support. Measures of health status included mental health status, physical health status, and social health status. Measures of suicidal behaviors included suicidal thoughts, suicide planning, and suicide attempts. We constructed a network analysis of 32 perceived built environment items, 9 mental health measures, 8 physical health measures, 22 social health measures, and 3 suicidal behavior measures using the R bootnet package. We constructed a network analysis of all measures, indicating a network density of 0.183. Using the R bootnet package, we further computed indices of strength centrality for all measures in the network. The results suggested that accessibility to public transport had the highest standardized strength score. The measure of healthy lifestyle support had the second highest strength score, immediately followed by walkability to green space. The network analysis highlights the critical role of accessibility to public transport, healthy lifestyle support, and walkability to green spaces as central factors influencing the interconnectedness between built environment and health outcomes, reflecting their significant impact on mental, physical, and social health, as well as suicidal behaviors.

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Community facilities

- 9: Good community center services and facilities in and around my community.
- 10: Existing facilities and services are not sufficient to meet my needs. *r*

Lack of educational & training spaces

- 7: Good job skills training and counseling.
- 8: Good adult education and training programs.

Little or no presence of nature

- 11: Good medical services and facilities.
- 12: Easily walk to green landscapes (e.g., parks, gardens, meadows, mountains).
- 13: Easily walk to blue landscapes (e.g., oceans, beaches, wetlands, rivers).

Living alone, clustered with low-SES residents

- 14: I feel that a lot of people living alone in my community and neighborhood. *r*
- 15: I feel that many residents who are struggling to make ends meet in my community and neighborhood. *r*
- 16: I feel that residents are willing to socialize and help each other in my community and neighborhood.

Long distance to city center

- 1: Easy access to the city center of Hong Kong
- 2: Easy access to the city center of the district

Low diversity of land uses & destinations

- 5: Enriched by a variety of facilities and services.
- 6: Most of the items and services necessary for daily living are reasonably priced.

Mental health status

- 33: Can you concentrate? (e.g., work, school, daily life activities, etc.)
- 34: Do you find your life meaningful? *!*
- 35: Do you enjoy life?
- 36: Are you comfortable with your appearance? (body shape and appearance)
- 37: Do you often have negative feelings? (e.g., low mood, despair, anxiety, depression *!*)
- 38: Overall, are you satisfied with yourself?
- 39: Do you feel accepted by others? (e.g., become friends with you, or hate or reject you)
- 40: Do you eat what you want easily?
- 41: How would you rate your quality of life?

Physical health status

- 42: Do you have enough energy to go about your daily life?
- 43: To what extent do you feel that pain and discomfort prevent you from doing the things you need to do?
- 44: How much do you rely on medications or medical devices for your quality of life?
- 45: Are you satisfied with your health?
- 46: How satisfied are you with your sleep?
- 47: Are you satisfied with your ability to do the things of daily living?
- 48: Are you satisfied with your ability to work? (including paid work, unpaid work, voluntary social work, full-time study, child care and housekeeping, etc.)
- 49: Are you satisfied with your ability to get around? (e.g., walking or getting on and off transportation alone in the community or at work, etc.)

Poor access to public transportation

- 3: Easy access to the nearest MTR or LRT station from my home.
- 4: Easy access to the nearest bus or minibus stop or ferry pier.

Poor housing condition

- 20: Poor lighting in my residence. *r*
- 21: A lack of privacy in my residence. *r*
- 22: My residence is very cramped and I cannot breathe. *r*
- 23: I have a window view of green landscapes.
- 24: I have a window view of blue landscape.

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- Poor weather/climate conditions**
- 17: I feel uncomfortable in my community and neighborhood on a regular basis (sun exposure, poor ventilation, stuffy and humid). r
 - 18: My community and neighborhood are often affected by weather disasters (typhoons, rainstorms, heat waves). r
 - 19: My community and neighborhood are often affected by environmental pollution (noise, air, light, and water pollution). r
- Promoting health lifestyle**
- 25: Few job opportunities for me in my community and neighborhood. r
 - 26: Many stores that sell alcohol in my community and neighborhood. r
 - 27: Many stores that sell cigarettes in my community and neighborhood. r
 - 28: My neighborhood and the surrounding area are good for walking, jogging, and other physical activities.
 - 29: Where I live seriously affects the quality of my sleep.
 - 30: Very few stores that sell healthy food at a reasonable price.
 - 31: Overall, I feel that my community and neighborhood make it difficult for me to develop a healthy lifestyle.
 - 32: I feel that my community and neighborhood are not safe.
- Social health status**
- 50: Have you asked your relatives for help when you had problems in your life?
 - 51: Have you asked your neighbors for help when you had a problem/issue in your life?
 - 52: When you encountered difficulties/problems in your life, did you ask your friends for help?
 - 53: When you encountered difficulties/problems in your life, did you ask your colleagues for help?
 - 54: When you encountered difficulties/problems in your life, did you seek help from government departments?
 - 55: When you encountered difficulties/problems in your daily life, did you seek help from non-government organizations?
 - 56: When you encountered difficulties/problems in your life, did you seek help from religious organizations?
 - 57: When you encountered difficulties/problems in your life, did you seek help from political organizations?
 - 58: When you encountered difficulties/problems in your life, did you seek help from trade unions?
 - 59: Overall, I think most people in the community are trustworthy.[]
 - 60: Compared to people in other neighborhoods, people in our community are willing to give their time and money to common goals.[]
 - 61: Most people in our community are willing to help me if I need it.[]
 - 62: I don't pay attention to the opinions of others in our community.
 - 63: People in the community usually care about their own interests and not the interests of the community as a whole.
 - 64: I have people who care about what happens to me.
 - 65: I have people who show me love and care.
 - 66: There are opportunities to talk about work or household issues.
 - 67: Opportunities to talk about personal and family issues with people I trust.
 - 68: To talk about exchanging money issues (including your financial income, management, investments, etc.).
 - 69: Helpful advice about important things in life.
 - 70: Being invited to go out and do things with other people (parties, street sweeping, socializing, etc.).
 - 71: I get help when I'm sick and bedridden.
- Suicide ideas**
- 72: Have you ever thought of taking your life, even if you would not really do it?
 - 73: Have you ever reached the point where you seriously considered taking your life, or perhaps made plans how you would go about doing it?
 - 74: Have you ever made an attempt to take your life?

Figure 1. Estimated network structure of 32 perceived built environment items, 9 mental health measures, 8 physical health measures, 22 social health measures, and 3 suicidal behavior measures. The network structure is a Gaussian graphical model.

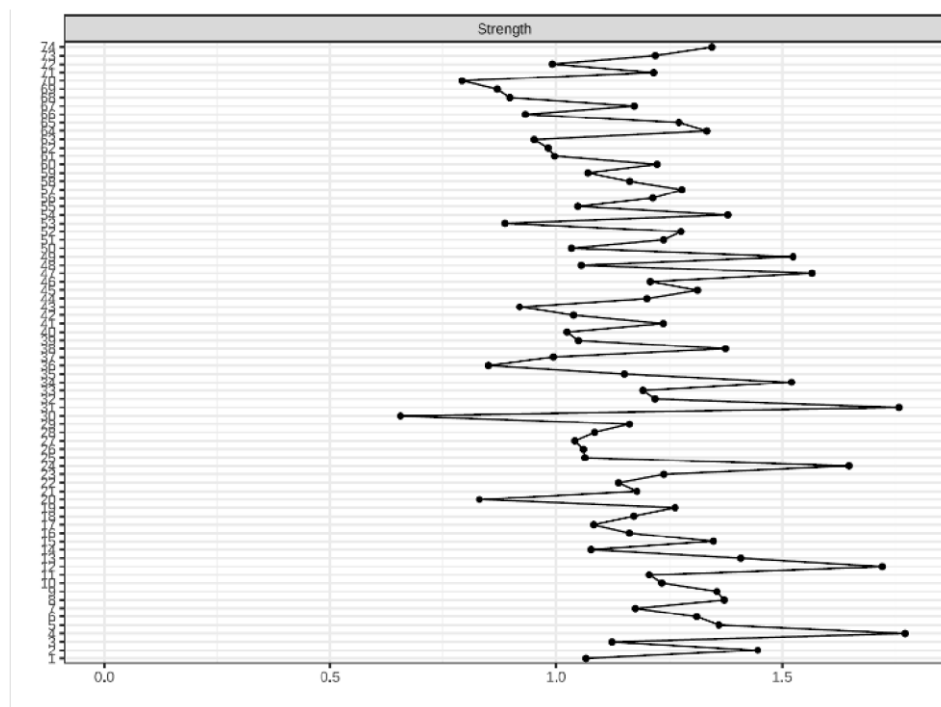


Figure 2. The corresponding centrality indices. Centrality indices are shown as standardized z-scores from minus 1 to 1. The results suggested that accessibility to public transport had the highest standardized strength score (z 1.772). The measure of healthy lifestyle support (z 1.759) had the second to highest strength score, immediately followed by walkability to green space (z 1.722).

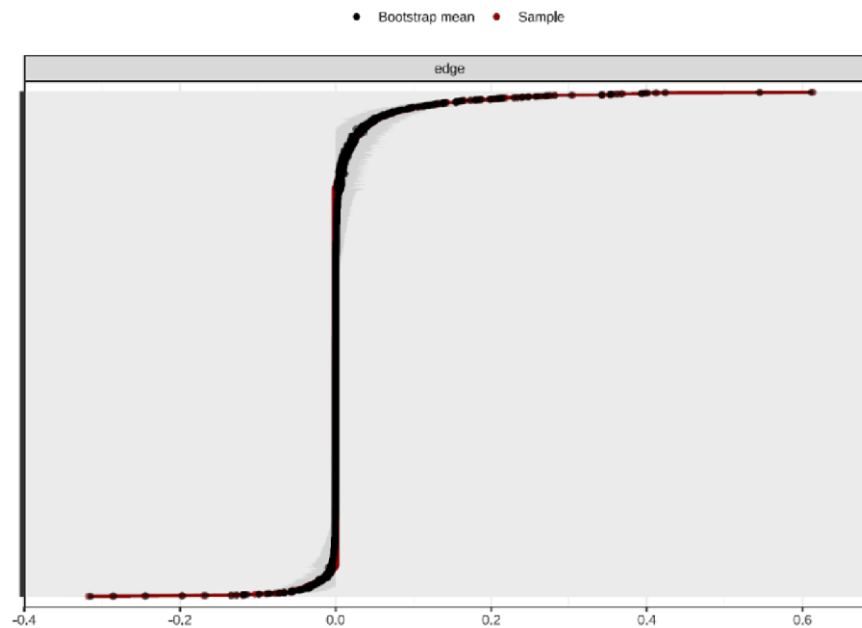


Fig. 3 Bootstrapped confidence intervals of estimated edge-weights for the estimated network of 32 perceived built environment items, 9 mental health measures, 8 physical health measures, 22 social health measures, and 3 suicidal behavior measures. It indicates that many edge-weights likely do not significantly differ from one-another. Each horizontal line represents one edge of the network, ordered from the edge with the highest edge-weight to the edge with the lowest edge-weight.

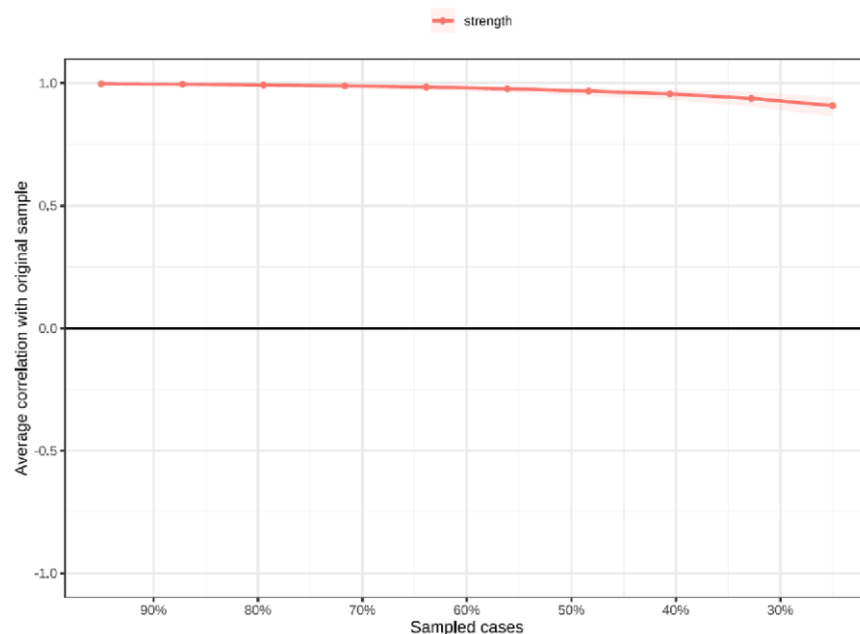


Fig. 4 Average correlations between centrality indices of networks sampled with persons dropped and the original sample. It indicates that both the edge weights of the network and the node strength centrality exhibit a high degree of stability. Even after removing 75% of the data, the correlation remains above 0.7 in 95% of the cases. This suggests that your current network model is highly robust and performs well when handling different data samples.

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