Impacts of physical environment on elderly health and well-being in high-density cities: Implications on urban planning and design for active ageing

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The Chinese University of Hong Kong

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Conference on “Promoting Intrinsic Capacity in Ageing”
AGEING TREND IN HONG KONG

- 1/3 of the population will be elderly in 2041
- Longer life expectancy and declining birth rate

ENVIRONMENT AND PHYSICAL HEALTH

- Disablement process
- Physical functioning
- Mortality
- Diseases related to environmental quality
ENVIRONMENT AND MENTAL HEALTH

• Quality of housing
• Social interactions
• Sensory stimulations
• Restorative capacity
ENVIRONMENT AND LIFE SATISFACTION

• Quality of life and life satisfaction
• Healthy or successful ageing
• Indirectly related to physical and mental health
• Subjective well-being
• Most of the studies found that life satisfaction is closely related to the quality of living environment
• WHO consider the enhancement of quality of life as a major issue in ageing
OUR BUILT ENVIRONMENT
DENSITY

• Visual and physical access to the outdoors
• High density and mixed land use
  • Increase in pedestrian activity
• Exposure to natural light and ventilation
  • Mood (emotional stress)
  • Comfort (physical stress)
• Balance between development need and the quality of the built environment
STREET DESIGN

• Street pattern
  • Willingness to visit neighbours outside
• Neighbourhood walkability
  • Connectivity and accessibility
  • Environmental quality and safety
• Walkability was proved to be associated with physical health
URBAN GREEN SPACE
• Alleviating urban heat island effect
• Enhancing thermal comfort
• Improving air quality
• Encouraging physical activity
• Aesthetic values and many more…
MR AND MS OS COHORT STUDY

- 4000 subjects recruited from 2001-2003
  - 2000 each for men and women
- Health outcome variables
  - Interview and questionnaire
  - Physical examination and measurements
- Georeferenced based on their residential addresses
  - To obtain an understanding of surrounding living environment

Baseline 2001-2003

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<tbody>
<tr>
<td>1st Follow-up (2YFU)</td>
<td>2000 Male</td>
<td>1745 Male</td>
<td>1566 Male</td>
<td>989 Male</td>
<td>889 Female</td>
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<tr>
<td>2nd Follow-up (4YFU)</td>
<td>2000 Female</td>
<td>1682 Female</td>
<td>1587 Female</td>
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<td>3rd Follow-up (7YFU)</td>
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<td>Current (14YFU)</td>
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BUILT ENVIRONMENT DATA

ROAD NETWORK

LAND USE

GREENERY

BUILDING FORM

Photo Source: LSGI, PolyU
NEIGHBOURHOOD GREEN SPACE AND MORTALITY

- The contributions of neighbouring green space to mortality
- Validated address: 3,544
- 300m buffer was used to represent the neighbourhood characteristics

Normalized Difference Vegetation Index (NDVI)
- Ratio between near-infrared and red (visible) region of spectral reflectance
- To represent the possibility of having live green vegetation

\[
NDVI = \frac{\rho_{nir} - \rho_{red}}{\rho_{nir} + \rho_{red}}
\]
NEIGHBOURHOOD GREEN SPACE AND MORTALITY

- Green space generally has a protective effect to mortality
- Particularly for mortality caused by circulatory diseases (e.g. stroke)
- Effect tends to be stronger in female
  - Greater exposure to green space due to daily activities
- In highly urbanized cities, neighbourhood green space has a great potential in preventive healthcare
MAPPING GERIATRIC DEPRESSION RISK

• Mr/Ms Os baseline data
• Age; Gender; Marital Status; Educational Level; Years of Living in Hong Kong; Living Status
• Geriatric Depression Scale (GDS-15)
  • Cutoff values for depression: GDS ≥ 8
• Variables of built environment
  • % open space; % vegetation; % building coverage; avg building height; and std building height

Article
Spatial Variability of Geriatric Depression Risk in a High-Density City: A Data-Driven Socio-Environmental Vulnerability Mapping Approach

Hung Chak Ho 1,2,*, Kevin Ka-Lun Lau 1,3,4,*, Ruby Yu 4,5, Dan Wang 4, Jean Woo 4,5, Timothy Chi Yui Kwok 4,5,6 and Edward Ng 1,3,7
Generally lower on the Hong Kong Island
• Higher socio-economic conditions

Moderately high in new towns
• Socially deprived
• High-rise buildings
• Better social connections in the community

Higher in the remote areas
• Low socio-economic status
• Low population
• Lack of social cohesion

High in old urban core
• Socially vulnerable
• High S.D. of building height
• Distinctive built environment

\[ \log \left( \frac{\text{Depression}}{\text{Not Depression}} \right) \sim \text{older ages} + \text{male} + \text{not married} + \text{low education} + \text{living alone} + \text{new immigrant} + \text{open space} + \text{vegetation} + \text{building coverage} + \text{avg build height} + \text{std build height} \]

FRAILTY TRANSITION AND GREENSPACE

- Prevalence of frailty among older people in Hong Kong: 5.8%
- Five-item frailty phenotypes
  - Exhaustion
  - Muscle weakness
  - Slow walking speed
  - Weight loss
  - Low physical activity

Baseline 2001-2003
1st Follow-up (2YFU) 2003-2005
2nd Follow-up (4YFU) 2005-2007

- 2000 Male
- 2000 Female
- 1745 Male
- 1682 Female
- 1566 Male
- 1587 Female

# Frailty Transition and Greenspace

<table>
<thead>
<tr>
<th></th>
<th>Deteriorated in frailty status</th>
<th>Stable in frailty status</th>
<th>Improved in frailty status</th>
<th>OR (95% CI)</th>
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<tr>
<td></td>
<td>n=833</td>
<td>n=2130</td>
<td>n=264</td>
<td>Crude</td>
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<td>All participants</td>
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<td>Green space quartile, n (%)</td>
<td></td>
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<td>1.17</td>
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<tr>
<td>Q1 (0.00 - 4.53)</td>
<td>227 (28.5%)</td>
<td>519 (65.0%)</td>
<td>52 (6.5%)</td>
<td>1.18</td>
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<tr>
<td>Q2 (4.54 - 13.20)</td>
<td>204 (25.3%)</td>
<td>540 (67.0%)</td>
<td>62 (7.7%)</td>
<td>1.18</td>
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<tr>
<td>Q3 (13.21 - 34.12)</td>
<td>212 (26.3%)</td>
<td>519 (64.5%)</td>
<td>74 (9.2%)</td>
<td>1.34</td>
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<tr>
<td>Q4 (≥34.13)</td>
<td>190 (23.2%)</td>
<td>552 (67.5%)</td>
<td>76 (9.3%)</td>
<td>1.34</td>
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<tr>
<td>P-trend</td>
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<td>Men</td>
<td>n=346</td>
<td>n=1148</td>
<td>n=149</td>
<td>1.19</td>
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<tr>
<td>Women</td>
<td>n=487</td>
<td>n=982</td>
<td>n=115</td>
<td>1.19</td>
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<td>0.138</td>
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* Model 1: adjusted for age, sex, marital status, socioeconomic status, current smoking status, alcohol intake, diet quality and baseline frailty status.

* Model 2: adjusted for covariates in model 1 and also for no. of diseases, cognitive function, physical activity and depression.
NEIGHBOURHOOD WALKABILITY

• The associations of walkability with walking time, physical activity, subjective wellbeing, and loneliness
• Reduced version of Neighborhood Environment Walkability Scale (NEWS)
• Walkability is positively associated with walking time
  • But the relationship with physical activity is not significant
• Also associated with better life satisfaction, happiness, and less loneliness
  • Environmental mastery and autonomy
• Individual components are also associated with measures of well-being
  • e.g. safety issues are significant in depression and loneliness
FURTHER WORK - WHAT IS “GREEN SPACE” IN HIGH-DENSITY CITIES?

- Perceived qualities and the availability of green space
- Features present in green space and their conditions
- Preference and usage pattern of elderly people
- Associated with physical activity and mental health
- Perception, preference and usage pattern in high-density environment
  - Due to the constraints in land availability
- Relationship with physical and mental health conditions
- How should we design our green space in Hong Kong?
DESIGN ELEMENTS

- Relative importance of different design elements
- How they are preferred?
- Differences between types of green spaces
- Effect of individual factors on perception towards green spaces
PILOT STUDY IN HONG KONG AND TAINAN

VISIT FREQUENCY
• Positively related to the amount of green areas and number of trees
• Amount of sports, recreational facilities, resting areas

HEALTH CONDITIONS
• Self-rated health increases with the number of trees in the neighbourhood
• Less often to feel depressed with higher aesthetics
• Role limitation due to emotional health decreases with increasing area and aesthetic quality of green spaces

PERCEIVED SAFETY
• Role limitation due to physical health is reduced with increasing perceived safety.
• Restriction of physical activity
• Sense of insecurity in the neighbourhood
POLICY IMPLICATIONS

• Promote an age-friendly built environment for “active ageing”, “ageing in place”, “inter-generational support” and community participation for elderly

• Urban planning and design can contribute to a more age-friendly living environment
  • To embrace the characteristics of high-density cities

D. An Inclusive and Supportive City

Catering for the needs of an ageing society

1. Housing for the Elderly
   • Promote more diverse housing choices for the elderly by public and private sectors
   • Promote inter-generational support

2. Universal Design
   • Promote the adoption of universal design in private residential developments
   • Facilitate age friendly public space
   • Continue adopting universal design in public housing

3. Elderly Services
   • Provide land and space for elderly care facilities, preferably on estate basis, complemented by district and community based services
   • Review/formulate planning standards for elderly care facilities

AGEING and HEALTH

WHAT IS NEEDED FOR HEALTHY AGEING

A change in the way we think about ageing and older people

Creation of age-friendly environments

Alignment of health systems to the needs of older people

Development of systems for long-term care

#yearsahead
An age-friendly built environment emphasizes enablement rather than disablement.

- Louise Plouffe and Alexandre Kalache (2010)

Thank you very much