

# Neighboring Green Space and Two-year Transitions between Frailty States among Chinese Older People in Hong Kong

## Introduction

Frailty, as a clinical syndrome resulting from senescence across multiple physiologic systems. There is increasing evidence showing that demographic characteristics, declining physical function, multi-morbidity, and frequent hospitalizations contribute to the onset of frailty, whereas implementing specific exercises and nutritional supplementation are the two important non-pharmacological interventions in treating frailty.

Green space, as an evidenced protective factor against a range of adverse health outcomes via multiple pathways, its effect on dynamic transitions of frailty remain unknown. Using a sample of community-dwelling Chinese older people, we explored the association between neighboring green space and transitions between frailty states.

## Study design & participants

Based on a community-dwelling elderly cohort established at 2001-2003, the current study followed the eligible participants for two years from baseline, to evaluate the effect of green space on two-year transitions between frailty states. The flow chart shows the recruitment of participants in details.

## Green space

Upon reclassifying a 15m NDVI map that was derived from IKONOS multispectral images, a vegetation map of Hong Kong, where each pixel of the map was identified as green (NDVI  $\geq 0.1$ ) or not (NDVI  $< 0.1$ ). For subject A (Fig.1), the % of green space within 300m buffer =  $\frac{\text{counts of green pixels}}{\text{counts of total pixels}}$

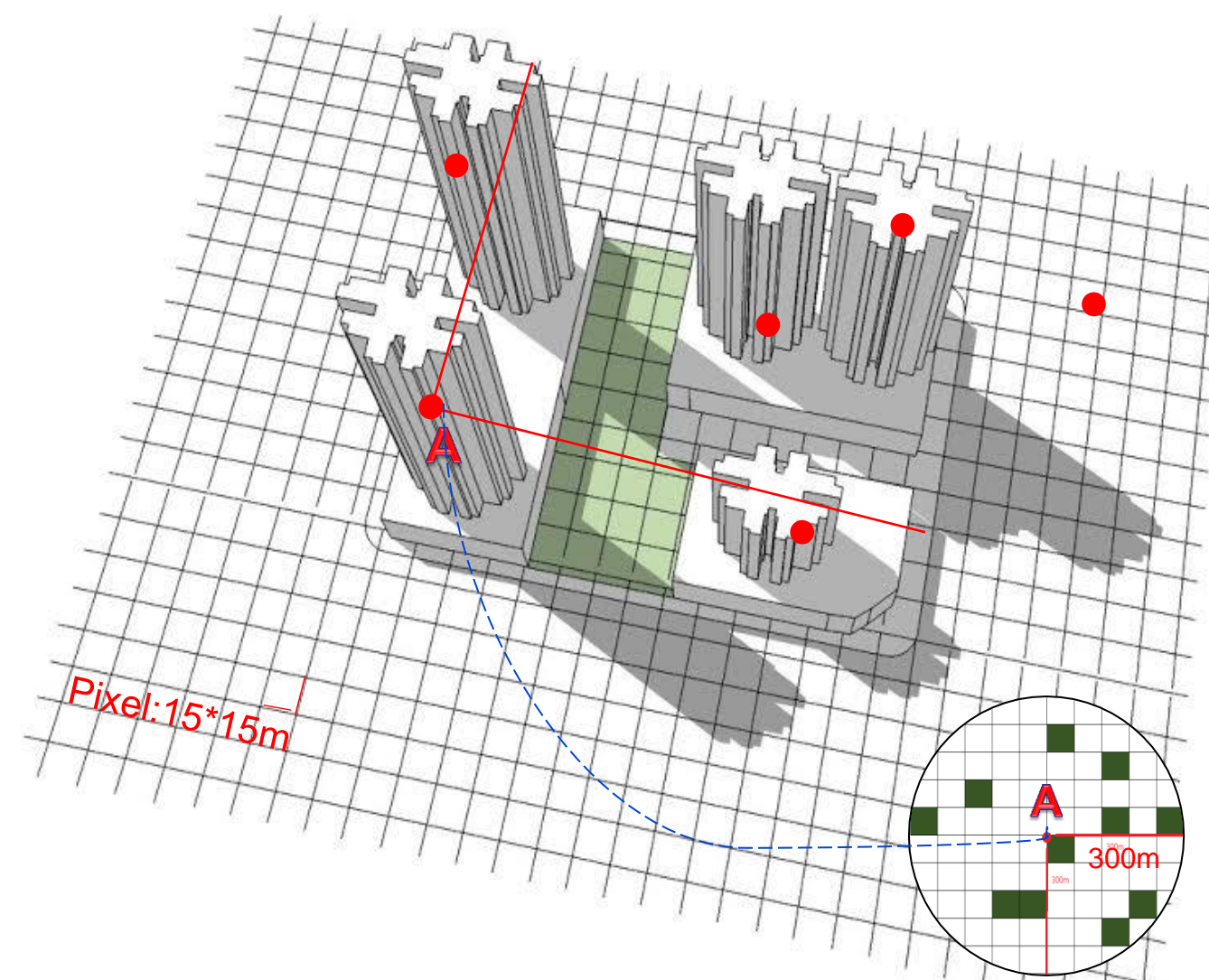


Figure 1. Measurement of neighboring green space within 300m buffer

## Methods

### Baseline(2001-2003)

#### Inclusion criteria

- ✓ Able to approach the study site independently
- ✓ No history of bilateral hip replacement
- ✓ Can competently give informed consent
- ✓ Do not suffer from terminal disease judging by the study physicians

### N = 4,000

- 2000 males, 2000 females
- 33% in each age group: 65-69, 70-74, 75+ years

### Address validation (via HK Geoinfo Map and follow-up)

### Two-year follow-up (2003-2005)

### N = 3,796

#### Exclusion

- ✗ Invalidated address N=56
- ✗ Migrated during the two-year interval N=125
- ✗ The measured coverage of green space=100% N=4
- ✗ Unavailable data for assessment of frailty at baseline N=19

## Frailty transitions

Frailty states were defined by the 5-item Fried Criteria (weight loss, exhaustion, low physical activity, muscle weakness, and slow walking speed): frail (scoring 3-5), pre-frail (1-2), robust (0). By comparing the states of frailty at two rounds, frailty transitions were determined to be improved, stable, or deteriorated. (Fig.2)

## Covariates

Information on age, sex, marital status, years lived in Hong Kong; socioeconomic status; current smoking status, alcohol intake, diet quality; number of diseases, cognitive function; and housing type was collected through questionnaires at baseline.

## Statistical analysis

Binary logistic regression was adopted to evaluate the effect of green space in quartile with odds ratios (OR) and 95% confidential intervals (CI) reported, controlling for demographics, socioeconomic status, lifestyle, health conditions, and housing type. Subgroup analysis was conducted to compare the associations by sex.

## Results

Compared to those living with the lowest quartile of green space, for participants living in the highest quartile of green space, the odds of transitioning into severer frailty status reduced 27% (OR=0.73, 95%CI 0.58, 0.92). A significantly stronger association between green space and two-year frailty transitions was observed for men (OR=0.57, 95%CI 0.41, 0.82), whereas no significant association was observed for women (OR=0.87, 95%CI 0.64, 1.18). (Table 1)

Figure 2. Flow chart of the frailty transitions within two-year follow-up

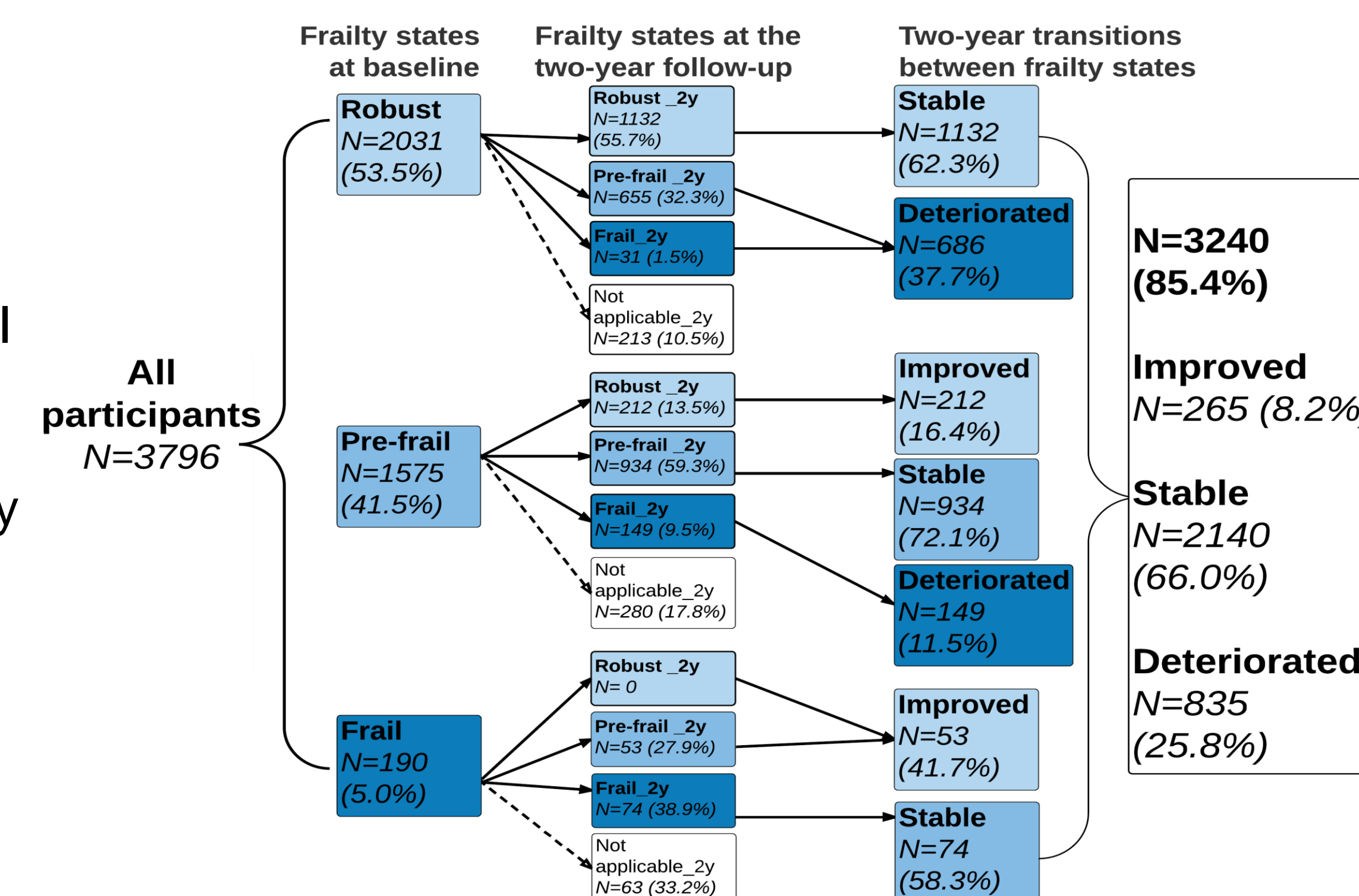


Table 1. Odds ratio(OR) and Confidence Interval(CI) of Two-year Frailty Transitions, for Green Space within 300m by Quartile

Green space quartile (%)	Univariate logistic regression n=3,222			Multivariate-adjusted logistic regression <sup>a</sup>					
	OR (95% CI)	p		All participants n=3,222		Male n=1,641		Female n=1,581	
1 <sup>st</sup> (0.00 - 4.46) (Ref.)	1.00	-		1.00	-	1.00	-	1.00	-
2 <sup>nd</sup> (4.46-13.12)	0.85 (0.68,1.06)	0.16		0.84 (0.67, 1.05)	0.12	0.8 (0.57, 1.11)	0.19	0.87 (0.63, 1.19)	0.37
3 <sup>rd</sup> (13.13-34.19)	0.89 (0.72,1.11)	0.32		0.86 (0.68, 1.07)	0.19	0.9 (0.65, 1.24)	0.53	0.83 (0.60,1.13)	0.23
4 <sup>th</sup> (34.20-99.99)	<b>0.77 (0.61,0.96)</b>	<b>0.02</b>		<b>0.73 (0.58, 0.92)</b>	<b>0.01</b>	<b>0.57 (0.41, 0.82)</b>	<b>0.01</b>	0.87 (0.64 1.18)	0.36

<sup>a</sup> Multivariate-adjusted logistic regression has controlled for age, sex, marital status, years lived in Hong Kong; socioeconomic status; current smoking status, alcohol intake, diet quality; number of diseases, cognitive function; and housing type.

## Conclusions

In addition to the provision of pharmacotherapy and nutritional supplementation, increasing neighboring coverage of green space might be an alternative intervention impeding or remediating the process of frailty with little underlying side effects.

