Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.
eMethods. Environment exposures, covariates and confounders.

Housing density exposure - Hong Kong Housing Environment Database (HKHED)
We developed the Hong Kong Housing Environment Database (HKHED), a geospatial
database of objectively measured residential density at different scales, namely within
apartment at household level, building block, and neighbourhood level). Spatial data for building
block footprints, housing estate boundaries, street centerline and city-wide housing address
dataset sourced from the Hong Kong Lands Department (spatial database IG1000), as well as
detailed information on housing units within individual blocks, sourced from multiple government
and private agencies including The Hong Kong Housing Authority (HA), Hong Kong Housing
Society (HS), Hong Kong government’s GeoInfo Map, Home Affairs Department and Centraline
Property Agency Limited (CentaMap). We created 3 multi-scalar metrics of crowding and
density:
• residential liveable space, expressed as liveable floor area of the apartment of the cohort
  participant (at the micro-level of household),
• building block density, measured as the number of residential units in building (apartment)
  block of the cohort participant (at a meso-level), and
• neighbourhood housing density at a macro scale, expressed as the number of residential
  (apartment) units within pre-specified street catchments of 402 m (0.25-mile) and 805 m
  (0.5-mile). These radii correspond to distance covered in a 5-10 minute walk from a
  residence in high density Hong Kong, and have been employed elsewhere in studies of
  mental health. We used Hong Kong LANDS Department's street centerline data to create
  street network catchments around geocoded cohort participants' home address and
  residential density (in units per square kilometer) was measured as the number of
  residential units divided by the catchment area.

The full dataset employed to measure participants' neighborhood residential density comprised
2.5 and 2.6 million housing units in the years of the end of baseline and wave 2 respectively.
Our models measured the associations between one interquartile range increment in the
density exposures and depressive sequelae.
Other environment

Among the other environment variables, building age was measured from the first occupation date of each building block and expressed as 1945-80 (old), 1981-95, post-1995 (newly built). Floor level was extracted from the participants’ address data. The floor level data had to be further corrected for participants residing in floors that start with "4" (i.e. 40-49), end with "4" (i.e. 4, 14, 24, 34...) and floor level 58, mostly in private housing blocks constructed after the mid-1990s. These building blocks skipped these floor levels due to auspicious reasons in Hong Kong context and adjustments were accordingly made after thorough checking. Floor level was coded as a four-factor variable (0-5, 6-10, 11-20 and >20). The density of public transport was measured as the number of public transport (bus, green minibus, mass transit railway (MTR), light rail, trams and ferries) stops and stations per square kilometer within 402 m and 805 m residential catchments. Terrain is a measure of physical environment that among other things, increases the friction of travel. It was measured from a 5-metre resolution digital terrain model as mean slope within 402 m and 805 m residential catchments. Building age, floor level, density of public and terrain were assessed both at baseline and wave 2.

The proportion of working population in the neighbourhood, a proxy of neighbourhood-level economic activity, was measured at the level of large street block groups (LSBG) from the 2011 population census. LSBGs are the lower level census aggregates containing a mean population of approximately 4,350 people in Hong Kong. The data was sourced from the Hong Kong Census and Statistics Department on enquiry and subsequently matched with the participants’ geocoded locations.

Covariates and confounders.

In our study, all covariates and confounders (except sex) were measured at two time points, derived from the baseline and wave 2 survey questionnaires. These included socio-demographic covariates (age, sex, marital status, educational qualification, employment status and personal income); lifestyle (number of family members, smoking status, alcohol intake frequency, current religion and neighbourhood cohesion score) and comorbidities (doctor-diagnosed coronary heart disease and high cholesterol) and housing environment attributes (building age, floor level, and public transport density and terrain variability). The cohort participants’ age (in years) was calculated from the dates of birth and examination dates at baseline and wave 2. Sex was assessed at baseline. Marital status was derived from a questionnaire: ‘What is your current marital status?’ and coded as never married; married; and
widowed/divorced/separated. Educational level was coded as a 3-factor coded as primary; secondary; and tertiary or higher degrees. Employment status was coded as employed; homemaker/student/others; and retiree/unemployed. Income was derived from the question: ‘Including all your income sources and MPF contribution, what is your average monthly personal income? (in Hong Kong dollars; 1HK$=0.13$US)’ and coded as a 4-factor variable as <HK$ 5,000; 5,000-9,999; 10,000-14,999; and ≥15,000. Among the lifestyle level variables, the number of family members was coded as a 4-factor variable as one, two, three, ≥four. Smoking status was expressed as non-smoker/past smoker versus current smoker, while alcohol intake frequency was a 3-factor variable coded as non-drinker/former drinker; occasional to 1-3 per month; and 1-3 per week up to daily). Religion was based on the question: ‘What, if any, is your religion currently?’ and coded as None; Christianity; and Buddhism/others. Neighbourhood cohesion score based on a five-item questionnaire on neighbour’s willingness to help, being close-knit, trustworthy, able to get along and sharing similar values was coded as low, medium and high. Self-reported doctor-diagnosed comorbidities (coronary heart disease and high cholesterol) were coded as binary outcomes (Yes versus No).

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2. Hipp J. What is the ‘Neighbourhood’ in Neighbourhood Satisfaction? Comparing the Effects of Structural Characteristics Measured at the Micro-neighbourhood and Tract Levels. Urban Studies. 2010;47(12):2517-2536. doi: https://doi.org/10.1177/004209809359950
## eTable 1. Comparison of the baseline characteristics of the analytic and excluded sample of FAMILY Cohort participants.

| Participant characteristics | Analytic sample (N=16,968) | Excluded sample due to missingness on covariates (N=8,671) | Effect size<sup>abc</sup> | Excluded sample due to loss to follow-up (N=13,637) | Effect size<sup>abd</sup> |
|-----------------------------|-----------------------------|----------------------------------------------------------|--------------------------|-------------------------------------------------|--------------------------|
| **Socio-demographic covariates:** |                             |                                                          |                          |                                                 |                          |
| Age in years (Mean, SD)     | 45.5 (16.7)                 | 52.0 (17.9)                                              | 0.38                     | 45.6 (18.2)                                      | 0.007                    |
| Sex N (%): Female           | 9,328 (55.0)                | 4,955 (57.1)                                             | 0.02                     | 7,165 (52.5)                                     | 0.02                     |
| Male                        | 7,640 (45.0)                | 3,716 (42.9)                                             | 0.10                     | 6,472 (47.5)                                     | 0.06                     |
| Marital status N (%): Never married | 3,965 (23.4)                 | 1,643 (19.0)                                             |                          | 4,117 (30.2)                                     |                          |
| Married                     | 11,714 (69.0)               | 5,823 (67.5)                                             |                          | 8,281 (60.8)                                     |                          |
| Married                      | 1,289 (7.6)                 | 1,167 (13.5)                                             |                          | 1,217 (8.9)                                     |                          |
| Personal income (HK$) N (%): <5 000 | 6,952 (41.0)                | 4,231 (62.3)                                             | 0.20                     | 5,629 (44.8)                                     | 0.06                     |
| 5 000-9 999                 | 3,467 (20.4)                | 1,142 (16.8)                                             |                          | 2,427 (19.3)                                     |                          |
| 10 000-14 999               | 2,660 (15.7)                | 679 (10.0)                                               |                          | 2,179 (17.3)                                     |                          |
| ≥15 000                     | 3,889 (22.9)                | 738 (10.9)                                               |                          | 2,332 (18.6)                                     |                          |
| Educational level N (%): Primary | 3,740 (22.0)                | 3,078 (36.0)                                             | 0.16                     | 3,349 (24.7)                                     | 0.04                     |
| Secondary                   | 8,229 (48.5)                | 3,877 (45.3)                                             |                          | 6,639 (49.0)                                     |                          |
| Tertiary                    | 4,999 (29.5)                | 1,603 (18.7)                                             |                          | 3,563 (26.3)                                     |                          |
| Employment status N (%): Employed | 9,063 (53.4)                | 3,025 (49.6)                                             | 0.06                     | 6,830 (55.6)                                     | 0.02                     |
| Unemployed, home maker, others | 5,469 (32.2)                | 1,874 (30.7)                                             |                          | 3,761 (30.6)                                     |                          |
| Retiree/unemployed           | 2,436 (14.4)                | 1,202 (19.7)                                             |                          | 1,694 (13.8)                                     |                          |
| **Lifestyle and comorbidities** |                       |                                                          |                          |                                                 |                          |
| Number of family members N (%): living alone | 1,999 (11.8)                | 1,790 (20.6)                                             | 0.13                     | 1,894 (13.9)                                     | 0.07                     |
| 2                           | 5,792 (34.1)                | 2,939 (33.9)                                             |                          | 3,817 (28.0)                                     |                          |
| Smoking status N (%) | Nonsmoker/past smoker | Current smoker | Alcohol consumption N (%) | Never/former | 1-3/mo | 1-3/wk to daily | Religion N (%) | None | Christianity/Roman Catholicism | Buddhism/Others | Self-reported coronary heart disease N (%) | No | Yes | Self-reported High cholesterol level N (%) | No | Yes | Other neighbourhood environment |
|----------------------|-----------------------|----------------|--------------------------|--------------|--------|----------------|----------------|-------|-------------------------------|----------------|--------------------------------|-----|-----|--------------------------------|-----|-----|--------------------------------------|
|                      | 4,167 (24.6)          | 2,001 (23.1)   | 3,528 (25.9)             | 14,756 (87.0)| 12,757 (75.2)| 3,060 (18.0)   | 11,965 (70.5) | 2,973 (17.5) | 2,030 (12.0)           | 16,591 (97.8)  | 15,718 (92.6) | 6,223 (36.7) | 3,638 (21.4) | 7,107 (41.9) | 6,223 (36.7) | 37.8 (32.9) | 38.0 (33.2) | 0.04 | 38.1 (34.8) | 0.03 |
| ≥4                   | 5,010 (29.5)          | 1,941 (22.4)   | 4,398 (32.3)             | 11,355 (83.4)| 11,355 (83.4)| 2,301 (17.0)   | 10,076 (73.9) | 2,973 (17.5) | 1,311 (15.1)           | 13,197 (97.4)  | 12,691 (93.7) | 4,588 (33.7) | 7,107 (41.9) | 3,758 (43.4) | 4,588 (33.7) | 37.8 (32.9) | 37.6 (22.9) | 0.07 | 37.2 (24.3) | 0.04 |
| Alcohol consumption N (%) | Never/former | 3,060 (18.0) | 2,030 (12.0) | 16,591 (97.8) | 15,718 (92.6) | 3,060 (18.0) | 11,965 (70.5) | 2,973 (17.5) | 2,030 (12.0) | 16,591 (97.8) | 15,718 (92.6) | 6,223 (36.7) | 3,638 (21.4) | 7,107 (41.9) | 6,223 (36.7) | 37.8 (32.9) | 38.0 (33.2) | 0.04 | 38.1 (34.8) | 0.03 |
| Alcohol consumption N (%) | Never/former | 2,001 (23.1) | 1,941 (22.4) | 7,482 (86.5) | 6,871 (80.7) | 2,001 (23.1) | 11,355 (83.4) | 2,973 (17.5) | 1,165 (13.5) | 7,482 (86.5) | 6,871 (80.7) | 2,301 (17.0) | 2,301 (17.0) | 1,053 (12.4) | 1,053 (12.4) | 0.07 | 0.05 | 0.03 |
| Alcohol consumption N (%) | Never/former | 3,528 (25.9) | 4,398 (32.3) | 3,528 (25.9) | 3,528 (25.9) | 3,060 (18.0) | 11,965 (70.5) | 2,973 (17.5) | 2,030 (12.0) | 3,528 (25.9) | 3,528 (25.9) | 2,301 (17.0) | 2,301 (17.0) | 1,053 (12.4) | 1,053 (12.4) | 0.07 | 0.05 | 0.03 |

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### Housing environment variables

|                             | Analytic Sample Mean (SD) | Excluded Sample Mean (SD) | p-value | Analytic Sample Mean (SD) | Excluded Sample Mean (SD) | p-value |
|-----------------------------|---------------------------|---------------------------|---------|---------------------------|---------------------------|---------|
| **Floor area, m²** (Mean, SD) | 43.2 (14.4)               | 40.9 (15.2)               | <0.001  | 42.9 (15.0)               | 491.2 (315.0)             | 0.08    |
| **Housing units per building block (Mean, SD)**                  | 467.2 (296.7)             | 460.9 (300.2)             | <0.001  | 460.9 (300.2)             | 491.2 (315.0)             | 0.08    |
| **Residential unit density within 402 m (units/Km²)** (Mean, SD) | 38,025.9 (14,570.1)       | 38,465.4 (14,515.8)       | 0.03    | 37,073.7 (14,561.5)       | 28,398.0 (11,173.5)       | <0.001  |
| **Residential unit density within 805 m (units/Km²)** (Mean, SD) | 29,102.9 (11,325.1)       | 29,055.1 (11,139.8)       | <0.001  | 28,398.0 (11,173.5)       | 29,055.1 (11,139.8)       | <0.001  |
| **Floor level N (%)**: 0-5                                      | 3,156 (18.6)              | 1,600 (18.5)              | 0.04    | 2,589 (19.0)              | 2,758 (20.2)              | 0.02    |
|                             | 6-10                      | 3,207 (18.9)              | 1,828 (21.1)              |               | 2,758 (20.2)              |         |
|                             | 11-20                     | 5,100 (30.1)              | 2,763 (31.9)              |               | 4,066 (29.8)              |         |
|                             | 21+                       | 5,505 (32.4)              | 2,480 (28.6)              |               | 4,224 (31.0)              |         |

- **a** Cohen’s \(w\) effect size for categorical variable: 0.1, small; 0.3, medium; 0.5, large.
- **b** Cohen’s \(d\) effect size for continuous variable: 0.2, small; 0.5, medium; 0.8, large.
- **c** Comparison of the baseline characteristics of the analytic and excluded sample due to missingness on covariates.
- **d** Comparison of the baseline characteristics of the analytic and excluded sample due to loss to follow-up.
- **e** HK $1.0 to US $0.13.
eTable 2. Full Multilevel models of longitudinal association between multiple housing environment exposures and depressive sequelae among FAMILY Cohort participants aged 16 years or older across two waves (N = 16 968).

|                        | Probable major depression | Depressive Symptoms |
|------------------------|---------------------------|---------------------|
|                        | OR (95% CI)               | p-value             | OR (95% CI)               | p-value             |
| Residential density    |                           |                     |                           |                     |
| Floor area, m² (per IQR) | 0.84 (0.71,0.98)         | 0.03                | 0.93 (0.86,1.00)         | 0.04                |
| Housing units per building block (per IQR) | 1.13 (0.91,1.40) | 0.28                | 1.07 (0.97,1.19)         | 0.17                |
| Neighbourhood residential density, units/Km² (402 m, per IQR) | 0.94 (0.82,1.09) | 0.45                | 1.00 (0.94,1.07)         | 0.98                |
| Socio-demographic covariates |                   |                     |                           |                     |
| Age in years           | 0.98 (0.97,0.99)         | 0.003               | 0.98 (0.98,0.99)         | <0.001              |
| Sex (Ref: Male)        |                           |                     |                           |                     |
| Female                 | 2.66 (2.01,3.50)         | <0.001              | 1.80 (1.61,2.01)         | <0.001              |
| Marital status (Ref: Never married) |                   |                     |                           |                     |
| Married                | 0.68 (0.48,0.97)         | 0.03                | 0.92 (0.79,1.07)         | 0.29                |
| Widowed/Divorced /separated | 1.12 (0.70,1.81) | 0.63                | 1.53 (1.23,1.91)         | <0.001              |
| Personal income in HK$ (Ref: ≤5 000)³ |                   |                     |                           |                     |
| 5 000-9 999            | 0.77 (0.55,1.09)         | 0.14                | 0.96 (0.82,1.12)         | 0.59                |
| 10 000-14 999          | 0.72 (0.48,1.07)         | 0.10                | 0.89 (0.75,1.06)         | 0.18                |
| ≥15 000                | 0.66 (0.44,0.98)         | 0.04                | 0.78 (0.66,0.94)         | 0.008               |
| Educational qualification (Ref: Primary) |                   |                     |                           |                     |
| Secondary              | 0.90 (0.66,1.23)         | 0.50                | 0.84 (0.73,0.97)         | 0.02                |
| Tertiary or above      | 0.65 (0.43,1.00)         | 0.05                | 0.85 (0.71,1.02)         | 0.08                |
| Employment status (Ref: Employed) |                   |                     |                           |                     |
| Homemaker/student/others | 0.81 (0.59,1.12) | 0.21                | 0.90 (0.78,1.03)         | 0.13                |
| Retiree/unemployed     | 1.51 (1.00,2.26)         | 0.05                | 1.18 (0.97,1.43)         | 0.10                |
| Lifestyle and comorbidities |                   |                     |                           |                     |
| Number in family, Ref: Living alone |                   |                     |                           |                     |
| 2                      | 0.85 (0.60,1.20)         | 0.37                | 0.84 (0.72,0.99)         | 0.04                |
| 3                      | 0.78 (0.54,1.14)         | 0.20                | 0.82 (0.69,0.97)         | 0.02                |
| ≥4                     | 0.93 (0.65,1.35)         | 0.71                | 0.94 (0.79,1.12)         | 0.51                |
| Smoking status (Ref: Non-smoker/past smoker) |                   |                     |                           |                     |
| Smoker                 | 1.76 (1.25,2.47)         | 0.001               | 1.26 (1.08,1.46)         | 0.003               |
| Alcohol intake frequency (Ref: Never/former drinker) |                   |                     |                           |                     |
| Occasional up to 1-3 per month | 2.08 (1.59,2.72) | <0.001              | 1.70 (1.51,1.92)         | <0.001              |
| 1-3 per week up to daily | 1.57 (0.97,2.56) | 0.07                | 1.48 (1.21,1.80)         | <0.001              |

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| Residual environment                      |          |          |          |          |
|------------------------------------------|----------|----------|----------|----------|
| Christianity/Roman Catholicism           | 1.54 (1.16,2.03) | 0.003 | 1.31 (1.15,1.48) | <0.001 |
| Buddhism/Others                          | 1.51 (1.11,2.06) | 0.01  | 1.36 (1.18,1.57) | <0.001 |
| Coronary heart disease (Yes vs. No)      | 2.53 (1.44,4.43) | 0.001 | 1.89 (1.41,2.54) | <0.001 |
| High cholesterol (Yes vs. No)            | 1.63 (1.09,2.43) | 0.02  | 1.67 (1.40,1.99) | <0.001 |
| Residential building age, Ref: Old built (1945-80) |          |          |          |          |
| Medium built (1981-95)                    | 0.92 (0.67,1.27) | 0.62  | 0.99 (0.85,1.16) | 0.92  |
| New built (post-1996)                    | 1.00 (0.71,1.41) | 0.99  | 1.11 (0.94,1.30) | 0.21  |
| Floor level (Ref: level 0-5)             |          |          |          |          |
| level 6-10                                | 0.73 (0.50,1.05) | 0.09  | 1.12 (0.94,1.32) | 0.20  |
| level 11-20                               | 0.96 (0.70,1.32) | 0.81  | 0.99 (0.85,1.16) | 0.94  |
| > level 20                                | 0.84 (0.60,1.16) | 0.29  | 0.99 (0.84,1.16) | 0.88  |
| Density of public transit (402 m), Ref: Q1 |          |          |          |          |
| Q2                                       | 1.09 (0.80,1.49) | 0.59  | 0.97 (0.84,1.12) | 0.65  |
| Q3                                       | 1.13 (0.83,1.55) | 0.44  | 0.87 (0.75,1.01) | 0.07  |
| Q4                                       | 1.02 (0.73,1.44) | 0.89  | 1.06 (0.91,1.23) | 0.47  |
| Terrain (Mean slope)                     | 1.01 (0.99,1.02) | 0.53  | 1.01 (1.00,1.01) | 0.13  |
| Neighbourhood cohesion, Ref: Low         |          |          |          |          |
| Medium                                   | 0.30 (0.22,0.41) | <0.001 | 0.39 (0.33,0.46) | <0.001 |
| High                                     | 0.15 (0.10,0.23) | <0.001 | 0.26 (0.22,0.32) | <0.001 |
| Proportion of working population in Neighbourhood, Ref: Q1 |          |          |          |          |
| Q2                                       | 1.06 (0.79,1.44) | 0.69  | 1.04 (0.89,1.20) | 0.64  |
| Q3                                       | 1.04 (0.73,1.47) | 0.84  | 1.01 (0.86,1.19) | 0.93  |
| Q4                                       | 1.14 (0.80,1.62) | 0.47  | 1.09 (0.92,1.28) | 0.32  |

\(^a\)HK $1.0 to US $0.13.
**eTable 3. Full Multilevel models of longitudinal association between composite housing environment exposures and depressive sequelae using multiple imputation to impute loss to follow-up and missingness across key covariates (N = 39 276).**

| Composite housing environment                                      | Probable major depression | Depressive symptoms      |
|-------------------------------------------------------------------|---------------------------|--------------------------|
|                                                                   | OR (95% CI)               | p-value                  |
|                                                                   | OR (95% CI)               | p-value                  |
| **Model 1**                                                       |                           |                          |
| Floor area, m² (per IQR)                                         | 0.83 (0.74,0.92)          | <0.001                   |
| Housing units per building block (per IQR)                       | 1.15 (1.02,1.30)          | 0.03                     |
| Neighbourhood residential density, units/Km² (402 m, per IQR)   | 0.91 (0.83,1.00)          | 0.05                     |
|                                                                   | 0.98 (0.93,1.02)          | 0.30                     |
| **Model 2**                                                       |                           |                          |
| Floor area, m² (per IQR)                                         | 0.91 (0.82,1.01)          | 0.07                     |
| Housing units per building block (per IQR)                       | 1.08 (0.95,1.23)          | 0.24                     |
| Neighbourhood residential density, units/Km² (402 m, per IQR)   | 0.92 (0.84,1.01)          | 0.07                     |
|                                                                   | 0.98 (0.94,1.03)          | 0.44                     |
| **Model 3**                                                       |                           |                          |
| Floor area, m² (per IQR)                                         | 0.90 (0.81,1.00)          | 0.049                    |
| Housing units per building block (per IQR)                       | 1.07 (0.93,1.23)          | 0.32                     |
| Neighbourhood residential density, units/Km² (402 m, per IQR)   | 0.89 (0.81,0.98)          | 0.01                     |
|                                                                   | 0.96 (0.92,1.01)          | 0.13                     |

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*aModel 1 adjusted for age and sex.*

*bIn addition to age and sex, model 2 was adjusted for other socio-demographic characteristics (marital status, employment status, educational level, income), lifestyle (smoking status, alcohol intake frequency, number of family members and current religion) and comorbidities (cardiac heart disease, high cholesterol level).*
Fully adjusted model 3 comprised the factors in models 1 and 2 plus the residential environment (residential building age, floor level, density of public transport, terrain, neighborhood cohesion and proportion of working population in the neighborhood). The residential environment (neighbourhood residential density, density of public transport and terrain) was measured within 402 m of street catchment of participants’ geocoded residences.
eTable 4. Multilevel negative binomial regression models of longitudinal association between housing environment exposures and PHQ-9 score among FAMILY Cohort participants aged 16 years or older across two waves (N = 16,968).

|                          | Single housing environment models* | Composite model with multiple housing environment** |
|--------------------------|-----------------------------------|---------------------------------------------------|
|                          | IRR (95% CI)                       | p-value               | IRR (95% CI)                     | p-value               |
| **Model 1**a             |                                    |                      |                                    |                      |
| Floor area, m² (per IQR) | 0.96 (0.93, 0.98)                 | <0.001               | 0.97 (0.94, 1.00)                 | 0.03                  |
| Housing units per building block (per IQR) | 1.08 (1.04, 1.12) | <0.001               | 1.06 (1.02, 1.11)                 | 0.002                 |
| Neighbourhood residential density, units/Km² (402 m, per IQR) | 1.01 (0.99, 1.04) | 0.40                  | 1.00 (0.97, 1.02)                 | 0.84                  |
| **Model 2**b             |                                    |                      |                                    |                      |
| Floor area, m² (per IQR) | 0.96 (0.93, 0.99)                 | 0.005                | 0.97 (0.94, 1.00)                 | 0.05                  |
| Housing units per building block (per IQR) | 1.07 (1.03, 1.12) | <0.001               | 1.06 (1.01, 1.10)                 | 0.01                  |
| Neighbourhood residential density, units/Km² (402 m, per IQR) | 1.01 (0.98, 1.04) | 0.48                  | 1.00 (0.97, 1.03)                 | 0.97                  |

*The housing environment variables (floor area, housing units per building block and neighbourhood residential density) were entered into the model separately in the single housing environment models.

**The housing environment variables were simultaneously entered into the model in the composite housing environment model.

aModel 1 adjusted for age and sex.

bModel 2 represents fully-adjusted models accounting for socio-demographics (age, sex, marital status, employment status, educational level, income), lifestyle (smoking status, alcohol intake frequency, number of family members and current religion), comorbidities (cardiac heart disease, high cholesterol level) and residential environment (residential building age, floor level, density of public transport, terrain, neighbourhood cohesion and proportion of working population in the neighbourhood).
The residential environment (neighbourhood residential density, density of public transport and terrain) was measured within 402 m of street catchment of participants’ geocoded residences.
**eTable 5. Multilevel models of longitudinal association between composite housing environment exposures and depressive sequelae among FAMILY Cohort participants aged 16 or older across two waves with residential environment measured within 0.50-mile (805 m) street catchment (N = 16 968).**

| Composite housing environment                                      | Probable major depression | Depressive symptoms |
|-------------------------------------------------------------------|---------------------------|---------------------|
|                                                                   | OR (95% CI)               | p-value             | OR (95% CI)               | p-value             |
| **Model 1**                                                       |                           |                     | **Model 2**               |                     |
| Floor area, m² (per IQR)                                         | 0.79 (0.68,0.92)          | 0.003               | 0.91 (0.84,0.97)          | 0.005               |
| Housing units per building block (per IQR)                       | 1.16 (0.97,1.39)          | 0.10                | 1.10 (1.00,1.20)          | 0.04                |
| Neighbourhood residential density, units/Km² (805 m, per IQR)   | 0.99 (0.86,1.14)          | 0.86                | 0.95 (0.89,1.01)          | 0.09                |
| **Model 2**                                                       |                           |                     | **Model 3**               |                     |
| Floor area, m² (per IQR)                                         | 0.86 (0.74,0.99)          | 0.04                | 0.93 (0.87,1.00)          | 0.05                |
| Housing units per building block (per IQR)                       | 1.11 (0.92,1.33)          | 0.29                | 1.06 (0.97,1.17)          | 0.18                |
| Neighbourhood residential density, units/Km² (805 m, per IQR)   | 0.99 (0.86,1.14)          | 0.91                | 0.95 (0.89,1.01)          | 0.08                |

| Model 3               |                           |                     | Model 3               |                     |
| Floor area, m² (per IQR)                                         | 0.82 (0.70,0.97)          | 0.02                | 0.92 (0.85,0.99)       | 0.02                |
| Housing units per building block (per IQR)                       | 1.04 (0.84,1.30)          | 0.70                | 1.04 (0.94, 1.15)      | 0.47                |
| Neighbourhood residential density, units/Km² (805 m, per IQR)   | 1.03 (0.88,1.19)          | 0.72                | 0.96 (0.90,1.02)       | 0.20                |

*a*Model 1 adjusted for age and sex.  
*b*In addition to age and sex, model 2 was adjusted for other socio-demographic characteristics (marital status, employment status, educational level, income), lifestyle (smoking status, alcohol intake frequency, number of family members and current religion) and comorbidities (cardiac heart disease, high cholesterol level).
Fully adjusted model 3 comprised the factors in models 1 and 2 plus the residential environment (residential building age, floor level, density of public transport, terrain, neighborhood cohesion and proportion of working population in the neighborhood).

The residential environment (neighbourhood residential density, density of public transport and terrain) was measured within 805 m of street catchment of participants’ geocoded residences.
eTable 6. Results of the multinomial logit regression models of association of housing environment exposures and depressive symptoms at wave 2 by depressive symptoms at baseline (N = 16,968).

| Depressive symptomsa | Single housing environment models* | Composite model with multiple housing environment** |
|----------------------|--------------------------------------|---------------------------------------------------|
|                      | RR (95% CI) | p-value | RR (95% CI) | p-value |
| Ref: No depressive symptoms at wave 2 and baseline | | | | |
| Depressive symptoms at wave 2 but not at baseline | | | | |
| Floor area, m² (per IQR) | 0.88 (0.79,0.97) | 0.009 | 0.89 (0.81,0.99) | 0.03 |
| Housing units per building block (per IQR) | 1.16 (1.02,1.32) | 0.02 | 1.12 (0.98,1.28) | 0.10 |
| Neighbourhood residential density, units/Km² (402 m, per IQR) | 1.00 (0.91,1.09) | 0.95 | 0.97 (0.89,1.07) | 0.56 |
| Depressive symptoms at wave 2 and baseline | | | | |
| Floor area, m² (per IQR) | 0.97 (0.86,1.10) | 0.66 | 0.99 (0.87,1.13) | 0.91 |
| Housing units per building block (per IQR) | 1.10 (0.92,1.32) | 0.31 | 1.08 (0.90,1.31) | 0.40 |
| Neighbourhood residential density, units/Km² (402 m, per IQR) | 1.05 (0.93,1.19) | 0.41 | 1.04 (0.92,1.18) | 0.51 |

*The housing environment variables (floor area, housing units per building block and neighbourhood residential density) were entered into the model separately in the single housing environment models.

**The housing environment variables were simultaneously entered into the model in the composite housing environment model.

aFully-adjusted models accounting for socio-demographics (age, sex, marital status, employment status, educational level, income), lifestyle (smoking status, alcohol intake frequency, number of family members and current religion), comorbidities (cardiac heart disease, high cholesterol level) and residential environment (residential building age, floor level, density of public transport, terrain, neighbourhood cohesion and proportion of working population in the neighbourhood). The residential environment (neighbourhood residential density, density of public transport and terrain) were measured within 402 m of street catchment of geocoded participants' residence.
eTable 7. Association of livable floor area with prevalent probable major depression and depressive symptoms by population sub-groups of sex, age and employment status at baseline (N = 16 968).

|                      | n     | Probable major depression \(^a\) | Depressive symptoms \(^a\) |
|----------------------|-------|-------------------------------|--------------------------|
|                      |       | OR (95% CI)                   | p-value                  | OR (95% CI)             | p-value |
| **Sex**              |       |                               |                          |                          |
| Male                 | 7,640 | 0.88 (0.67,1.16)              | 0.36                     | 0.90 (0.81,1.01)        | 0.07    |
| Female               | 9,328 | 0.87 (0.70,1.07)              | 0.18                     | 0.95 (0.86,1.05)        | 0.29    |
| p-interaction        |       |                               | 0.87                     |                          | 0.91    |
| **Age groups**       |       |                               |                          |                          |
| ≤40                  | 6,450 | 0.83 (0.61,1.13)              | 0.24                     | 0.98 (0.86,1.11)        | 0.77    |
| >40-≤60              | 7,201 | 0.70 (0.55,0.90)              | 0.01                     | 0.87 (0.78,0.98)        | 0.02    |
| >60                  | 3,317 | 1.24 (0.96,1.61)              | 0.10                     | 0.94 (0.80,1.09)        | 0.40    |
| p-interaction        |       |                               | 0.44                     |                          | 0.54    |
| **Employment status**|      |                               |                          |                          |
| Employed             | 9,063 | 0.84 (0.65,1.07)              | 0.16                     | 0.87 (0.78,0.96)        | 0.01    |
| Unemployed, home maker, others | 5,469 | 0.86 (0.64,1.15)              | 0.30                     | 1.02 (0.90,1.16)        | 0.72    |
| Retiree/Unemployed   | 2,436 | 1.00 (0.66,1.53)              | 0.99                     | 0.97 (0.83,1.14)        | 0.73    |
| p-interaction        |       |                               | 0.71                     |                          | 0.02    |

\(^a\)Fully-adjusted models accounting for socio-demographics (age, sex, marital status, employment status, educational level, income), lifestyle (smoking status, alcohol intake frequency, number of family members and current religion), comorbidities (cardiac heart disease, high cholesterol level) and residential environment (residential building age, floor level, density of public transport, terrain, neighbourhood cohesion and proportion of working population in the neighbourhood). The residential environment (neighbourhood residential density, density of public transport and terrain) were measured within 402m of street catchment of geocoded participants’ residence.
eTable 8. Multilevel association of housing environment exposures with depressive sequelae among FAMILY Cohort participants aged 16 years or older who did not change residential address over the study period (N = 16407).

| Housing environment                                      | Probable major depression<sup>a</sup> | Depressive symptoms<sup>a</sup> |
|----------------------------------------------------------|---------------------------------------|---------------------------------|
|                                                          | OR (95% CI)                           | OR (95% CI)                     |
|                                                          | p-value                               | p-value                          |
| Floor area, m<sup>2</sup> (per IQR)                       | 0.82 (0.70,0.98)                      | 0.91 (0.84,0.98)                 |
|                                                          | 0.03                                  | 0.02                             |
| Housing units per building block (per IQR)                | 1.12 (0.90,1.39)                      | 1.05 (0.95,1.17)                 |
|                                                          | 0.31                                  | 0.33                             |
| Neighbourhood residential density, units/Km<sup>2</sup> (402 m, per IQR) | 0.96 (0.83,1.11)                      | 0.99 (0.93,1.06)                 |
|                                                          | 0.60                                  | 0.83                             |

<sup>a</sup>Fully-adjusted models accounting for socio-demographics (age, sex, marital status, employment status, educational level, income), lifestyle (smoking status, alcohol intake frequency, number of family members and current religion), comorbidities (cardiac heart disease, high cholesterol level) and residential environment (residential building age, floor level, density of public transport, terrain, neighbourhood cohesion and proportion of working population in the neighbourhood). The residential environment (neighbourhood residential density, density of public transport and terrain) were measured within 402 m of street catchment of geocoded participants' residence. The housing environment variables were simultaneously entered into the model in the composite housing environment model.
eFigure. An illustration showing the attributes of housing exposures of multi-scalar residential space and density in the developed HKHED database; liveable floor area at household level, building units per block at building (meso-) level, and neighbourhood residential density within 402 m (0.25-mile) & 805 m (0.5-mile) residential catchments at macro-level.