



## Original article

# Impacts of more immediate and less immediate nature experiences on young adults' mental health: The mediating role of nature connectedness in a compact city in China

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## ABSTRACT

Mounting evidence links reinvigorating nature experience with mental health benefits in urban populations. However, studies focusing on populations of compact cities dominated by high-density, high-rise living environments are scarce. This study investigated how more immediate and less immediate nature experiences relate to young adults' mental health in a compact Chinese city, and examined the mediating role of nature connectedness. A sample of 985 young Chinese adults (ages 18–30) completed an anonymous online survey in April–June 2023. More immediate nature experience (e.g., frequency of nature-based recreational activities), less immediate nature experience (e.g., nature views through windows from home), and nature connectedness were self-reported, along with mental health indicators including anxiety, depression and stress symptoms, and happiness. Our findings showed that the frequency of more immediate, but not less immediate, nature experience was associated with greater happiness. Nature connectedness partially mediated the association between more immediate nature experience and happiness, while the interaction effects from greater nature connectedness and more immediate nature experience (independent of their direct effects) was associated with increased mental health symptoms. Still, we argue that policymakers and urban planners should prioritise creating meaningful opportunities for more immediate nature experiences in compact cities, instead of the predominantly visual means of current nature experience. Although young adults in highly urbanised environments may be less proactive in seeking nature, incorporating easily accessible and emotionally-relevant green spaces into daily routines of urban residents, whilst mitigating potential mental health symptoms from eco-anxiety through education or environmental communication remains a crucial strategy to promoting overall mental health.

## 1. Introduction

Urbanisation is now widely regarded as one of the defining public health challenges of the twenty-first century. Life in cities is frequently linked to elevated rates of chronic, noncommunicable, and psychological health problems (Moore et al., 2003; Dye, 2008; Peen et al., 2010). At the same time, growing attention has been directed towards the potential of nature contact to counter these risks, with a growing body of evidence consistently linking it to numerous beneficial health outcomes,

including improved mood, emotional regulation, quality of life, work performance, and reduced anger, aggression, risk of mental and physical illnesses, and mortality rates (Beute et al., 2023; Bratman et al., 2019; Hartig et al., 2014; Yao et al., 2021; Soga & Gaston, 2025). As the evidence base has grown, researchers and policymakers have introduced the concept of a “dose of nature”—the notion that regular engagement with natural environments may function similarly to a health supplement, promoting both physical and psychological well-being (Cox et al., 2017; Frumkin et al., 2017; Shanahan et al., 2016). Two well-established

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psychological frameworks provide theoretical support for these claims: the Attention Restoration Theory (Kaplan, 1995), which posits that natural environments help replenish depleted cognitive resources, and the Stress Reduction Theory (Ulrich et al., 1991), which suggests that nature experiences can evoke positive emotional responses and reduce physiological stress. In response, especially in wealthier countries, there has been a rising interest in programs that actively encourage contact with nature, including initiatives such as “green prescriptions” (Kondo et al., 2020) and nature-based health interventions (Shanahan et al., 2019).

Despite this growing recognition, most of the evidence for the health benefits of nature experiences has been generated in the Global North, while the Global South has received far less attention. This imbalance is problematic, as future urban growth will be concentrated in the latter: by 2050, 68 % of the global population are expected to live in urban areas, which India, China and Nigeria together are estimated to contribute a third of this projected growth (United Nations, 2018). Moreover, the health implications of nature contact may not be the same across regions. In tropical and subtropical contexts, for instance, encounters with unpleasant organisms or exposure to hot and humid conditions may reduce the appeal of more immediate outdoor experiences and complicate their health outcomes (Saw et al., 2015).

To date, both research and policy discussions on providing nature-based health benefits to urban populations have tended to emphasise physically visiting natural environments, such as neighbourhood parks or forests (Maller et al., 2006; White et al., 2019). Yet the ways people encounter nature in cities are far more varied. In compact Asian cities, for example, opportunities to view nature without being physically present—such as through windows or urban vistas—can represent a major form of everyday nature experience (Oh et al., 2021a; Yue et al., 2024). These can be described as ‘less immediate’ nature experiences, in which physical distance or limited sensory involvement contrasts with the ‘more immediate’ experiences of being on-site in parks, green spaces, or the countryside (Soga & Gaston, 2020). This distinction resembles earlier classifications of ‘direct’ and ‘indirect’ nature experiences (Keniger et al., 2013). While the distinction between direct and indirect nature experience creates a useful dynamic in comparing the experience of green spaces with different levels of engagement with our human senses, both types of nature experience may also vary in effectiveness based on the degree of human-mediation or naturalness of the experience, the intentionality and awareness of the experience, and the perceived valence toward the experience (Soga & Gaston, 2020). For example, ‘indirect’ window views of nature can be more naturalistic in Hong Kong due to the abundance of hilly natural landscapes visible from high-rise buildings, which may require less directed attention than street-level urban parks. In contrast, ‘direct’ visits may be limited to more accessible but artificial urban green spaces, resulting in a more human-mediated experience of nature. Independent of the physical activity associated with green space visits, a range of health benefits can be derived from simply viewing nature through windows, including immediate physiological effects such as changes in skin conductive and heart rate, as well as longer term improvements in psychological states (e.g. fewer depressive symptoms), and physical states (e.g. faster post-surgery recovery) (Soga & Gaston, 2025). Nevertheless, both types of experience have been shown to positively impact psychological health (Beute et al., 2023). Understanding the relative importance of these different forms of nature experience in the context of compact cities is crucial for guiding the management of urban green spaces to better support public health.

The psychological benefits of nature exposure may vary depending on an individual’s degree of nature connectedness—a subjective sense of connection to nature (Mayer & Frantz, 2004). This hypothesis has had support from Oh et al. (2021b), suggesting that individuals with stronger nature connectedness experience greater psychological benefits from engaging with natural environments, possibly because of extended durations of nature visits. However, this trait could have much greater

importance in understanding the effects of different nature experiences, whereby individuals with differing levels of nature connectedness may perceive fluctuations in quality of nature experiences through their activeness of sensory engagement when viewing nature through home windows, or willingness to initiate intentional interactions within natural environments (Tang et al., 2015). Simultaneously, nature connectedness may also mitigate the negative psychological effects of strong emotional responses to ecological loss, for example, those related to climate change (Lau et al., 2024). Whilst past studies have supported the mediating role of nature connectedness on more immediate or less immediate nature experience for positive well-being outcomes, such as quality of life, positive emotions, and body positivity (Baceviciene & Jankauskiene, 2022; Chen & Yang, 2024; Martin et al., 2020; Mayer et al., 2009; Swami et al., 2020), fewer studies have examined its role in therapeutic outcomes for nature-based interventions on mental health symptoms (Huang et al., 2022; Liu et al., 2022).

This study focuses on young adults living in Hong Kong, one of the world’s most densely populated compact cities. Despite its small land area (1104 km<sup>2</sup>) and a population of 7.49 million (Census and Statistics Department, 2023), around 78 % of Hong Kong remains protected natural land, with extensive country parks accessible to most residents (Planning Department, 2016). Yet everyday contact with nature is constrained by a fast-paced lifestyle, a high-rise urban development, challenges in providing accessible green spaces (Tian et al., 2012), and the fact that people spend an estimated 86 % of their time indoors (Chau et al., 2002). Hong Kong residents have a strong preference for utilising green spaces within walking distance, and young adults, in particular, are the least frequent users of these local environments (Lai, 2018). Psychological theories such as ART and SRT have also suggested that our urban landscapes impose increasing demands on our cognitive resources (Kaplan, 1995), and may induce mental stress (Ulrich et al., 1991). For lived-in high-density environments such as Hong Kong, the perceived oppressiveness of urban structures at street-level may also be a contributing factor to this mental stress (Luo & Jiang, 2022). Recent surveys have reported concerning levels of mental health problems, including rising rates of depression, anxiety, and suicidal ideation (Lo et al., 2020; Save the Children Hong Kong, 2020). In other Asian countries, a lack of green spaces has been linked to increased self-harming and suicidal behaviours among youth, underscoring the vital role of nature experiences may play in promoting and protecting urban mental health (Jiang et al., 2021; Shen & Lung, 2018).

Hong Kong’s extreme combination of high-density urban living, especially when compared to other compact Asian cities (Lai, 2017), its abundant surrounding natural environment, and rising mental health concerns makes it an ideal context for examining how both more immediate and less immediate nature experiences, along with the understudied mediating role of nature connectedness, relate to psychological well-being and mental health risks. The examination of different types of nature experience effects (i.e. more immediate and less immediate nature experiences), individual senses of nature connectedness, and the self-reported mental health of young adults will form a comprehensive picture of the mental health needs of citizens living in a highly urbanised compact city environment characterised by high-density, high-rise buildings. Our main hypothesis is that both forms of nature experience have a positive association with mental health regardless of immediacy, lowering the symptoms of anxiety, depression, and stress, as well as promoting greater happiness. Following this, our second hypothesis sought to test the potential mediating role of nature connectedness in nature experience-mental health relationships. We expected nature connectedness to play a mediating role in the relationship between nature experience and mental health outcomes, with higher levels of nature connectedness strengthening the positive impact of nature experience on mental health outcomes.

## 2. Materials and methods

### 2.1. Study design and procedures

We obtained the approval from the first author's university's research ethics committee before data collection. Participation was anonymous and voluntary, with all participants providing written informed consent before joining the study. Prior to data collection, a pilot study of the questionnaire was conducted in March 2023 with 20 subjects to ensure its comprehension and readability. The data collection period took place between April and June 2023. The online questionnaire was created on the QuestionPro platform and study link was distributed through a diverse range of established community channels, including district offices, youth community organisations, student associations in universities and colleges, emails and social media platforms (i.e. WhatsApp, Facebook and Instagram). Hong Kong residents at least 18 years old and could read and understand Chinese were eligible for our study. We collected 1655 responses for data cleaning (see Fig. 1), which we excluded cases with speeders ( $n = 493$ ), incomplete questionnaires ( $n = 98$ ), failed lie checks ( $n = 28$ ), and respondents over the ages 31 or above ( $n = 51$ ). Our question had a completion rate of 62.6 % ( $n = 1036$ ), and we retained 59.5 % ( $n = 985$ ) of total cases between the age of 18 and 30. The study was conducted in line with the principles of the Declaration of Helsinki, and the STROBE reporting guideline.

### 2.2. Measures

We collected our participants' demographic information by asking about their age, gender, current housing type, and whether they experienced a mental health condition within the past 12 months. We employed two psychometric scales in order to measure self-reported indicators of mental health, namely the Patient Health Questionnaire-4 (PHQ-4) (Kroenke et al., 2009) to measure of anxiety and depression symptoms in the past two weeks (Cronbach's  $\alpha = 0.896$ ), or individually by Generalised Anxiety Disorder-2 (GAD-2) subscale for anxiety (Cronbach's  $\alpha = 0.807$ ) and Patient Health Questionnaire-2 (PHQ-2) subscale for depression (Cronbach's  $\alpha = 0.871$ ), and the Perceived Stress Scale-4 (PSS-4) (Cohen et al., 1983) to measure stress symptoms in the last month (Cronbach's  $\alpha = 0.657$ ). These scales for assessing mental health symptoms have been employed in previous studies on nature experience (Hazer et al., 2018; Heo et al., 2021; Kanelli et al., 2023). A score of 3 or

higher on the corresponding PHQ-4 subscales indicate probable anxiety or depression. A score of 6 or above indicates high levels of stress (Malik et al., 2020; Goodman et al., 2023). Positive mental health was measured through slider question by asking "Do you feel happy in general?", which respondents would rate their happiness from 1 (poor) to 10 (very good) (Abdel-Khalek, 2006).

The measures of nature experience were asked separately as two sets of indicators for more immediate nature experience and less immediate nature experience. We used the 'immediacy' of the nature experience to distinguish between engaging with local nature while being physically present and from a distance away (Soga & Gaston, 2020), not inclusive of other 'indirect' types of nature such as through media representations or artificial sources of nature views, e.g. indoor plants. For more immediate nature experience, we asked participants "How often are you engaging in nature activities?" providing examples such as hiking, going to parks, country parks, and camping trips, with a scale ranging from never (1), a few times a year (2), at least once a month (3), several times a month (4), to at least once a week of on-site nature experience (5). Past studies have also examined green space use with a single measure of visit frequency (Martin et al., 2020; White et al., 2021). Past studies have also examined green space use using a single measure of visit frequency (Martin et al., 2020; White et al., 2021). Given the generally low usage of urban green space and limited intentions to engage with the natural environment during visits (Lai, 2018), measuring the frequency of more immediate experiences enable us to test its relationship with nature connectedness and its potential role in enhancing psychological benefits from nature visits, without making assumptions about the type of nature experience, such as differences in intentionality or awareness. For less immediate nature experience, we used a count measure of the number of natural feature items observable (0–2) from their home window view from a selection of blue spaces as "Ocean/Rivers" and "Green spaces (Parks/Gardens/Mountains)". An additional measure of a visible "Sky" was included, which should not be regarded as a natural feature but has properties that can enhance the perception of naturalness of nature views, or function as a natural feature when paired with dominantly urban views (Masoudinejad & Hartig, 2020; Sztuka & Kühn, 2024). Views of the sky and tree canopy at street-level had unique mitigating effects on mental stress in Hong Kong (Luo & Jiang, 2022). Lastly, the short version of the Nature Relatedness Scale (NR-6) was employed to measure a one-dimensional sense of nature connectedness in our study, which could mediate the effects of nature experience on mental health (Cronbach's  $\alpha = 0.821$ ) (Nisbet & Zelenski, 2013). Previous studies on nature experience have featured the NR-6 as a validated measure of nature connectedness (Fleming & Schwartz, 2023; Kanelli et al., 2023). Respondents rated their agreement within 6 items assessing their self-identification with nature and appreciation for natural environments, using a scale from 1 (strongly disagree) to 5 (strongly agree). A total score was calculated by averaging the responses across all items, with higher scores indicating a stronger connection to nature. The questionnaire is presented in Appendix 1.

### 2.3. Data analysis

All statistical analyses were performed with IBM SPSS Statistics for Windows, Version 29 (IBM Corp., Armonk, N.Y., USA). Descriptive statistics were represented by their mean and standard deviation, or by count data and percentage of the sample. A  $p$ -value of less than 0.05 was considered statistically significant. Student's  $t$ -tests and chi-squared tests were performed to compare for group differences between participants who did and did not report a mental health condition within 12 months. Multiple linear regression was used to examine the direct effects of nature connectedness, sky views, more immediate and less immediate nature experiences, with the inclusion of interaction effects between the two types of nature experience, nature connectedness with both types of nature experience, and sky views with less immediate nature experience against mental health outcomes of anxiety (Model 1), depression (Model

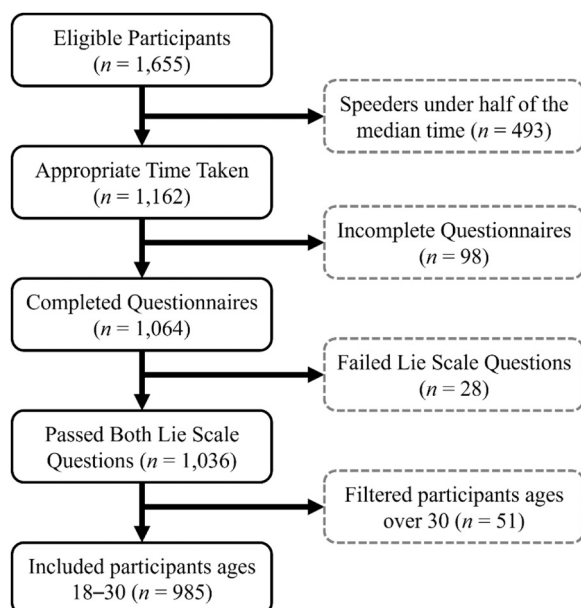


Fig. 1. Flow diagram of data cleaning process.

2), stress symptoms (Model 3), and happiness (Model 4), controlling for age, gender, and housing. Lastly, mediation analysis was performed using Hayes' (2013) PROCESS macro in SPSS to assess whether there was an indirect effect of nature connectedness on the relationship between nature experience and mental health.

### 3. Results

#### 3.1. Sample description

Our sample of 985 young Chinese adult participants had an average age of 21.1 years ( $SD = 2.45$ ) and 66.2 % were female ( $n = 652$ ). 10.6 % of our sample reported experiencing at least one mental health condition within the past 12 months ( $n = 104$ ). 34.2 % of the participants had probable anxiety ( $n = 359$ ) and 34.2 % had probable depression ( $n = 337$ ). High levels of perceived stress were reported in most of our participants (81.2 %,  $n = 800$ ). 55.3 % of respondents reported a scarcity of more immediate nature experience of up to a few times a year ( $n = 545$ ), with 31.0 % reporting once or more monthly, 7.4 % at least once weekly, and 6.3 % with none. 48.6 % of our respondents reported the presence of visible green spaces ( $n = 479$ ), followed by 38.1 % ( $n = 375$ ) who did not have any natural features in home window view, to 35.4 % who could see the sky ( $n = 349$ ) and 13.3 % ( $n = 131$ ) who had a view of the ocean or rivers. Table 1 presents the descriptive statistics of our sample in good mental health compared with experiencing a mental health condition in the past 12 months using  $t$ -tests and chi-squared tests. Demographics and level of nature connectedness did not significantly differ between groups. As expected, participants who experienced a mental health condition in the past 12 months also reported worse mental health outcomes. These participants were less likely to partake in nature activities, but their nature views from their window did not significantly differ, other than in sky views.

#### 3.2. Importance of more immediate and less immediate nature experiences for mental health

We began by testing our first hypothesis that both more immediate and less immediate nature experiences contribute positively to mental health among young adults. Table 2 shows the results of multiple linear regression on anxiety (Model 1), depression (Model 2), stress symptoms (Model 3) and happiness (Model 4). Standardised coefficients ( $\beta$ ) were reported with 95 % confidence intervals (95 % CL). Controlling for demographic factors, we tested the effects of more immediate and less immediate nature experiences, nature connectedness, visible sky views, and their interactions effects. Anxiety scores were greater for female respondents ( $\beta = -0.095$ , 95 % CL =  $[-0.157, -0.032]$ ) and under an interaction effect of more immediate experience and nature connectedness ( $\beta = 0.088$ , 95 % CL =  $[0.024, 0.151]$ ). Depression scores were lower when participants had visible sky views ( $\beta = -0.124$ , 95 % CL =  $[-0.193, -0.055]$ ), but higher under an interaction effect between more immediate nature experiences and nature connectedness ( $\beta = 0.082$   $[0.019, 0.146]$ ). Stress scores were directly correlated with higher nature connectedness ( $\beta = 0.101$ , 95 % CL =  $[0.035, 0.167]$ ), which was positively moderated by more immediate experience ( $\beta = 0.085$ , 95 % CL =  $[0.022, 0.149]$ ) and less immediate experience ( $\beta = 0.066$ , 95 % CL =  $[0.001, 0.131]$ ).

In contrast to negative mental health symptoms, more immediate nature experience ( $\beta = 0.101$ , 95 % CL =  $[0.034, 0.167]$ ) and nature connectedness ( $\beta = 0.106$ , 95 % CL =  $[0.040, 0.171]$ ) was directly associated with higher levels of happiness and explained 4.5 % of the total variance in our respondents ( $R^2 = 0.045$ ). Living in private housing also predicted higher levels of happiness ( $\beta = 0.070$ , 95 % CL =  $[0.007, 0.133]$ ). Less immediate nature experience was not directly associated with mental health indicators in any of our regression models. These results only partially confirmed our expectations that nature experience is associated with better mental health outcomes, due the absence of

**Table 1**

Group differences in descriptive statistics of demographics, mental health scores, nature experience and nature connectedness for participants with and without a mental health condition within 12 months.

| Variable                                | In good mental health for the past 12 months<br>( <i>n</i> = 881) | Mental health condition within past 12 months<br>( <i>n</i> = 104) | $\chi^2$ or <i>t</i> |
|-----------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------------|----------------------|
|                                         | M (SD) or n (%)                                                   | M (SD) or n (%)                                                    |                      |
| <b>Demographics</b>                     |                                                                   |                                                                    |                      |
| Age                                     |                                                                   | 20.93 (2.37)                                                       | <i>t</i> = 0.56      |
|                                         | 21.08 (2.46)                                                      |                                                                    |                      |
| Gender (Female)                         |                                                                   | 70 (67.3 %)                                                        | $\chi^2$ = 0.07      |
|                                         | 582 (66.1 %)                                                      |                                                                    |                      |
| <b>Housing type</b>                     |                                                                   |                                                                    | $\chi^2$ = 3.61      |
| Public housing                          |                                                                   | 56 (53.8 %)                                                        |                      |
|                                         | 498 (56.5 %)                                                      |                                                                    |                      |
| Private housing                         |                                                                   | 45 (43.3 %)                                                        |                      |
|                                         | 342 (38.8 %)                                                      |                                                                    |                      |
| Village-type housing                    |                                                                   | 0 (0.0 %)                                                          |                      |
|                                         | 23 (2.6 %)                                                        |                                                                    |                      |
| Temporary residence (hotel, campus)     |                                                                   | 3 (2.9 %)                                                          |                      |
|                                         | 18 (2.0 %)                                                        |                                                                    |                      |
| <b>Mental health outcomes</b>           |                                                                   |                                                                    |                      |
| <b>Mental distress</b>                  |                                                                   |                                                                    |                      |
| PHQ-4                                   |                                                                   | 6.19 (3.27)                                                        | <i>t</i> = -6.80**   |
|                                         | 4.08 (2.96)                                                       |                                                                    |                      |
| Anxiety subscale                        |                                                                   | 3.19 (1.83)                                                        | <i>t</i> = -6.06**   |
|                                         | 2.03 (1.51)                                                       |                                                                    |                      |
| Depression subscale                     |                                                                   | 3.00 (1.61)                                                        | <i>t</i> = -6.16**   |
|                                         | 2.06 (1.65)                                                       |                                                                    |                      |
| PSS-4                                   |                                                                   | 8.02 (3.30)                                                        | <i>t</i> = -2.28*    |
|                                         | 7.36 (2.72)                                                       |                                                                    |                      |
| <b>Positive mental health</b>           |                                                                   |                                                                    |                      |
| Happiness                               |                                                                   | 3.64 (1.99)                                                        | <i>t</i> = 6.63**    |
|                                         | 5.01 (2.00)                                                       |                                                                    |                      |
| <b>Nature experience</b>                |                                                                   |                                                                    |                      |
| <b>More immediate nature experience</b> |                                                                   |                                                                    |                      |
| (frequency of nature activities)        |                                                                   |                                                                    | $\chi^2$ = 10.26*    |
| Never (1)                               |                                                                   | 13 (12.5 %)                                                        |                      |
|                                         | 49 (5.6 %)                                                        |                                                                    |                      |
| A few times a year (2)                  |                                                                   | 59 (56.7 %)                                                        |                      |
|                                         | 486 (55.2 %)                                                      |                                                                    |                      |
| At least once a month (3)               |                                                                   | 13 (12.5 %)                                                        |                      |
|                                         | 175 (19.9 %)                                                      |                                                                    |                      |
| Several times a month (4)               |                                                                   | 13 (12.5 %)                                                        |                      |
|                                         | 104 (11.8 %)                                                      |                                                                    |                      |
| At least once a week (5)                |                                                                   | 6 (5.8 %)                                                          |                      |
|                                         | 67 (6.7 %)                                                        |                                                                    |                      |
| <b>Less immediate nature experience</b> |                                                                   |                                                                    |                      |
| (no. of nature views from window)       |                                                                   |                                                                    | $\chi^2$ = 2.03      |

(continued on next page)

Table 1 (continued)

| Variable                    | In good mental health for the past 12 months (n = 881)<br>M (SD) or n (%) | Mental health condition within past 12 months (n = 104)<br>M (SD) or n (%) | $\chi^2$ or t        |
|-----------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------|
| 0                           | 402 (45.6 %)                                                              | 55 (52.9 %)                                                                |                      |
| 1                           | 404 (45.9 %)                                                              | 42 (40.4 %)                                                                |                      |
| 2                           | 75 (8.5 %)                                                                | 7 (6.7 %)                                                                  |                      |
| Visible Green Spaces        | 437 (49.6 %)                                                              | 42 (40.4 %)                                                                | $\chi^2 = 3.16$      |
| Visible Ocean/Rivers        | 117 (13.3 %)                                                              | 14 (13.5 %)                                                                | $\chi^2 = 0.00$      |
| Visible Sky                 | 325 (36.9 %)                                                              | 24 (23.1 %)                                                                | $\chi^2 = 7.76^{**}$ |
| <b>Nature connectedness</b> |                                                                           |                                                                            |                      |
| NR-6                        | 3.46 (0.67)                                                               | 3.38 (0.77)                                                                | t = 1.13             |

Note: M = mean, SD = standard deviation;  $\chi^2$  = chi-squared statistic; t = Student's t-test statistic; PHQ-4 = Patient Health Questionnaire; PSS-4 = Perceived Stress Scale; NR-6 = Nature Relatedness Scale; \*p < 0.05, \*\*p < 0.01

direct effects in reducing negative mental health symptoms.

### 3.3. The mediating role of nature connectedness in nature experience-mental health relationships

Next, we tested our second hypothesis concerning the mediating role of nature connectedness in the nature experience-mental health relationship. Table 3 presents the statistical results of mediation analyses for happiness and stress outcomes where the direct effect of nature connectedness was significant. Nature connectedness partially mediated the relationship between more immediate nature experience and happiness (Fig. 2), where the total effect of more immediate nature experience significantly predicted happiness ( $\beta = 0.130$ , 95 % CL = [0.068, 0.192]). The overall mediation model for happiness accounted for 2.9 % of the total variance ( $R^2 = 0.029$ ). Other pathways tested for the mediation effects of nature connectedness between less immediate nature experience and happiness, less immediate and more immediate nature experience on stress did not yield significant direct and total effects. This suggests that nature connectedness fully mediated the effects of less immediate nature experience on happiness, and both types of nature experience on stress. This supports our hypothesis that nature connectedness functions as a key mediator in the relationship between nature experience and mental health.

## 4. Discussion

Our study aimed to discern the potential differences in association between more immediate nature experience (i.e. frequency of nature activities) and less immediate nature experience (i.e. nature views through window views at home) and mental health parameters, including anxiety, depression and stress symptoms and happiness. In addition, we examined whether nature connectedness could affect these

relationships, noting that limited research has explored its mediating role in both more immediate and less immediate nature experiences across positive and negative mental health outcomes (Capaldi et al., 2015; Liu et al., 2022). Furthermore, other studies have highlighted the importance of sampling from more diverse populations and environments to better capture the positive and negative mental health impacts of green space in urban settings (Bowler et al., 2010; McMahan & Estes, 2015). Importantly, we tested these associations in Hong Kong, a highly urbanised and densely populated compact city. We identified a positive association between the frequency of more immediate nature experiences and self-reported happiness but found no such association for the less immediate type. Additionally, our results demonstrated that feeling more connected to nature (compared to those who feel less connected), was important for reaping greater positive well-being benefits from more immediate nature experience, but were also associated with amplified levels of perceived stress when individuals had high levels of more immediate or less immediate nature experiences.

Our sample reflected the trend of less immediate nature experiences—from the windows of homes or other indoor sites such as workplaces—as being the dominant mode of human-nature experiences in urbanised cities (Oh et al., 2021a; Yue et al., 2024). Despite the overwhelmingly undeveloped and natural landscape of Hong Kong, young adults were disincentivised to engage with the surrounding natural landscapes which over half of our sample could see from their home windows. We estimate that at least 80.7 % of our sample are unable to consistently attain a minimal 30 min of nature experience per week from on-site nature experience, which has been linked to improved physical and mental health outcomes (Shanahan et al., 2016). Even so, our findings only supported the merits of nature experience and nature connectedness in improving well-being, while only visible sky views significantly reduced mental health outcomes, specifically depressive symptoms. Our sample exhibited a high risk of mental health disorders, given the high prevalence of probable anxiety (36.4 %) and depression (34.2 %) cases among our sample of young Chinese adults in Hong Kong exceeded past estimates taken in 2019–2021 by almost double the rates (Wong et al., 2023). Moreover, high perceived stress levels were present for 81.2 % of our sample, exceeding the national average scores of Western and European countries, although perceived stress scores were noted to be culturally sensitive between nationalities (Vallejo et al., 2018). Studies on the Australian population similarly found nature connectedness to be associated with psychological distress, which could be the effect of increased eco-anxiety, distinct from sky view effects (Curl et al., 2022; Dean et al., 2018). Our findings did not support a moderating role of nature connections on nature experience and mental health benefits (Oh et al., 2021b). Nature connectedness was unidirectionally associated with greater negative mental health symptoms through direct or interaction effects with greater more immediate and less immediate nature experiences within our study, likely as that climate change is a significant global issue for the future our young adult sample and especially for those who frequently use natural environments (Brophy et al., 2023). The difference in age demographics could explain why our findings deviated from Liu et al. (2022)'s study on a more general, middle-aged population in Guangzhou where nature connectedness positively moderated the reduction in depression risks from more immediate experience, albeit neither of our studies found these interaction effect to be large.

Unlike the effects of more immediate nature experience, we did not find a positive association between less immediate nature experience and mental health, highlighted by previous studies (Beute et al., 2023; Kaplan, 2001; Soga & Gaston, 2025). These findings may have also been influenced by Hong Kong's highly compact, high-rise living environment or our choice of measures. First, our measurement of less immediate nature experience—based on the number of windows with views of natural settings—may not be able to fully capture the nuances of this experience, such as the intentionality, consciousness and affiliated outcomes in its use (Soga & Gaston, 2020). Indeed, factors such as the

**Table 2**

Multiple linear regression models predicting various mental health indices (anxiety, depression, stress symptoms, and happiness) with demographic and nature-related factors.

| Independent variables                                             | PHQ - Anxiety Subscale (Model 1) |                  | PHQ - Depression subscale (Model 2) |                  | PSS-4 (Model 3) |                  | Happiness (Model 4) |                  |
|-------------------------------------------------------------------|----------------------------------|------------------|-------------------------------------|------------------|-----------------|------------------|---------------------|------------------|
|                                                                   | $\beta$                          | 95 % CL [LL, UL] | $\beta$                             | 95 % CL [LL, UL] | $\beta$         | 95 % CL [LL, UL] | $\beta$             | 95 % CL [LL, UL] |
| Demographic factors                                               |                                  |                  |                                     |                  |                 |                  |                     |                  |
| 1. Age                                                            | -0.011                           | [-0.074, 0.053]  | -0.027                              | [-0.090, 0.037]  | -0.015          | [-0.078, 0.049]  | -0.039              | [-0.102, 0.024]  |
| 2. Gender (0 = Female)                                            | -0.095**                         | [-0.157, -0.032] | 0.001                               | [-0.061, 0.064]  | -0.041          | [-0.103, 0.022]  | 0.019               | [-0.043, 0.081]  |
| Type of housing (0 = public housing)                              |                                  |                  |                                     |                  |                 |                  |                     |                  |
| 3. Private housing                                                | -0.003                           | [-0.067, 0.060]  | -0.016                              | [-0.079, 0.048]  | -0.037          | [-0.101, 0.026]  | 0.070*              | [0.007, 0.133]   |
| 4. Village-type housing                                           | -0.008                           | [-0.071, 0.055]  | -0.035                              | [-0.098, 0.028]  | -0.029          | [-0.092, 0.034]  | 0.046               | [-0.016, 0.108]  |
| 5. Temporary residence                                            | 0.030                            | [-0.033, 0.093]  | 0.033                               | [-0.030, 0.097]  | 0.050           | [-0.013, 0.113]  | 0.021               | [-0.041, 0.084]  |
| Nature factors                                                    |                                  |                  |                                     |                  |                 |                  |                     |                  |
| 3. More immediate nature experience                               | -0.027                           | [-0.094, 0.040]  | -0.050                              | [-0.117, 0.017]  | -0.017          | [-0.084, 0.050]  | 0.101**             | [0.034, 0.167]   |
| 4. Less immediate nature experience                               | 0.029                            | [-0.040, 0.098]  | 0.041                               | [-0.028, 0.109]  | -0.018          | [-0.087, 0.050]  | 0.021               | [-0.047, 0.090]  |
| 5. Nature connectedness                                           | 0.056                            | [-0.010, 0.122]  | 0.029                               | [-0.037, 0.095]  | 0.101**         | [0.035, 0.167]   | 0.106**             | [0.040, 0.171]   |
| 6. Visible sky view                                               | -0.068                           | [-0.137, 0.001]  | -0.124**                            | [-0.193, -0.055] | -0.044          | [-0.112, 0.025]  | 0.053               | [-0.015, 0.121]  |
| Interaction effects                                               |                                  |                  |                                     |                  |                 |                  |                     |                  |
| 7. More immediate $\times$ Less immediate nature experience       | -0.024                           | [-0.089, 0.042]  | -0.033                              | [-0.099, 0.032]  | -0.040          | [-0.106, 0.025]  | -0.024              | [-0.089, 0.041]  |
| 8. More immediate nature experience $\times$ Nature connectedness | 0.088**                          | [0.024, 0.151]   | 0.082*                              | [0.019, 0.146]   | 0.085**         | [0.022, 0.149]   | -0.055              | [-0.118, 0.008]  |
| 9. Less immediate nature experience $\times$ Nature connectedness | 0.055                            | [-0.011, 0.120]  | 0.047                               | [-0.018, 0.113]  | 0.066*          | [0.001, 0.131]   | -0.002              | [-0.067, 0.063]  |
| 10. Less immediate nature experience $\times$ Visible sky view    | 0.052                            | [-0.013, 0.117]  | 0.063                               | [-0.002, 0.128]  | 0.041           | [-0.024, 0.106]  | -0.039              | [-0.104, 0.025]  |
| F-value                                                           | 2.25**                           |                  | 2.16**                              |                  | 2.28**          |                  | 3.55**              |                  |
| R <sup>2</sup>                                                    | 0.029                            |                  | 0.028                               |                  | 0.030           |                  | 0.045               |                  |
| Adjusted R <sup>2</sup>                                           | 0.016                            |                  | 0.015                               |                  | 0.017           |                  | 0.033               |                  |
| Total variance explained                                          | 2.9 %                            |                  | 2.8 %                               |                  | 3.0 %           |                  | 4.5 %               |                  |

Note:  $\beta$  = standardised estimate, CI = confidence interval; LL = lower limit; UL = upper limit; PHQ = Patient Health Questionnaire; PSS-4 = Perceived Stress Scale; \* $p < 0.05$ , \*\* $p < 0.01$

**Table 3**

Mediation effect of nature connectedness on the relationship of nature experiences on happiness and stress outcomes.

| Pathway                                | Path a: Nature Connectedness |                  | Path b: Unique effect of Nature Connectedness |                  | Direct Effect (c') |                  | Indirect effect (ab) |                  | Total effect (c) |                  |
|----------------------------------------|------------------------------|------------------|-----------------------------------------------|------------------|--------------------|------------------|----------------------|------------------|------------------|------------------|
|                                        | $\beta$                      | 95 % CL [LL, UL] | $\beta$                                       | 95 % CL [LL, UL] | $\beta$            | 95 % CL [LL, UL] | $\beta$              | 95 % CL [LL, UL] | $\beta$          | 95 % CL [LL, UL] |
| More immediate $\rightarrow$ Happiness | <b>0.294**</b>               | [0.234, 0.354]   | <b>0.116**</b>                                | [0.051, 0.181]   | <b>0.096**</b>     | [0.032, 0.160]   | <b>0.034</b>         | [0.013, 0.057]   | <b>0.130**</b>   | [0.068, 0.192]   |
| F-value                                | 92.70**                      |                  | 14.72**                                       |                  |                    |                  |                      |                  | 16.89**          |                  |
| R <sup>2</sup>                         | 0.086                        |                  | 0.029                                         |                  |                    |                  |                      |                  | 0.017            |                  |
| Less immediate $\rightarrow$ Happiness | <b>0.100**</b>               | [0.037, 0.162]   | <b>0.140**</b>                                | [0.078, 0.202]   | 0.040              | [-0.022, 0.102]  | 0.014                | [0.004, 0.026]   | 0.054            | [-0.009, 0.116]  |
| F-value                                | 9.90**                       |                  | 11.17**                                       |                  |                    |                  |                      |                  | 2.84             |                  |
| R <sup>2</sup>                         | 0.010                        |                  | 0.022                                         |                  |                    |                  |                      |                  | 0.003            |                  |
| More immediate $\rightarrow$ Stress    | <b>0.294**</b>               | [0.234, 0.354]   | <b>0.088**</b>                                | [0.023, 0.154]   | -0.004             | [-0.069, 0.061]  | 0.026                | [0.004, 0.049]   | 0.022            | [-0.041, 0.084]  |
| F-value                                | 92.70**                      |                  | 7.76*                                         |                  |                    |                  |                      |                  | 0.47             |                  |
| R <sup>2</sup>                         | 0.086                        |                  | 0.008                                         |                  |                    |                  |                      |                  | 0.000            |                  |
| Less immediate $\rightarrow$ Stress    | <b>0.100**</b>               | [0.037, 0.162]   | <b>0.090**</b>                                | [0.027, 0.152]   | -0.025             | [-0.088, 0.038]  | 0.009                | [0.002, 0.019]   | -0.016           | [-0.079, 0.047]  |
| F-value                                | 9.90**                       |                  | 4.06*                                         |                  |                    |                  |                      |                  | 0.25             |                  |
| R <sup>2</sup>                         | 0.010                        |                  | 0.008                                         |                  |                    |                  |                      |                  | 0.000            |                  |

Note:  $\beta$  = standardised estimate, 95 % CL = 95 % confidence interval; LL = lower limit; UL = upper limit; \* $p < 0.05$ , \*\* $p < 0.01$ . Significant paths were **Bolded**.

frequency and duration of nature viewing through windows, as well as the composition of natural elements in the view, are known to influence mental health outcomes (Bi et al., 2022; Chang et al., 2020). Second, despite the abundance of natural environments from home window views in Hong Kong, the perceived lack of immediacy of experience may be heightened to an extreme degree within Hong Kong's dominantly high-rise setting, where nature may have become too distal to sufficiently engage with participants' senses to visually notice smaller details of nature, hear the sounds of nature such as bird songs, nor smell natural scents, thus inhibiting potential benefits (Richardson et al., 2021). The

expansive views of nature from high-rise buildings may not only be distal proximally, but also psychologically as the displacement of street-level vegetation for hilly terrain or harbour views may be perceived as physically inaccessible, unfamiliar, and hinder the well-being effects of place attachment (Basu et al., 2020). Third, the effects of less immediate nature experience may generally be more short-lived in comparison to more immediate forms, where it has a more pronounced functionality as a source of psychological restoration (Kaplan, 1995; 2001).

Despite with the misalignment of our findings with the growing

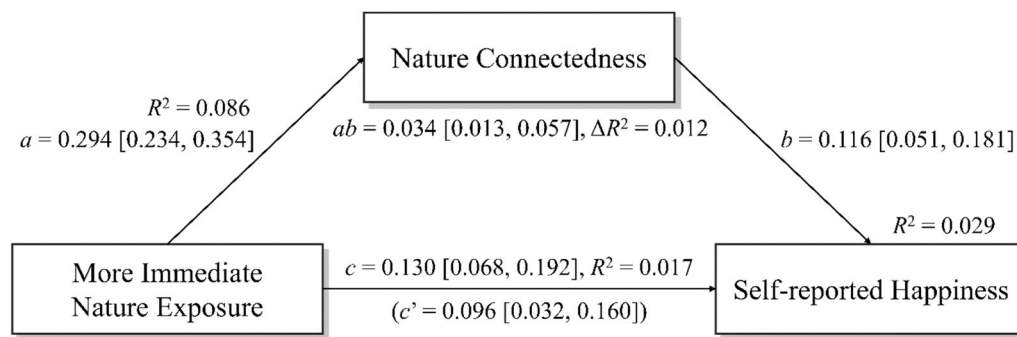


Fig. 2. Partial mediated model of nature connectedness on the relationship between more immediate nature experience and self-reported happiness.

recognition for sources of nature in reinforcing the mental health of urbanised populations, we do implicate the greater importance of more immediate forms of nature experience and general nature connectedness over less immediate nature experiences as determinants of positive mental health (Richardson et al., 2021). Our findings instead suggest that more immediate nature experiences are more effective in promoting positive well-being than in reducing mental health symptoms, where the evidence appears more mixed (Capaldi et al., 2015; McMahan & Estes, 2015; White et al., 2021). Although earlier studies have shown an association between nature connectedness and various indicators of eudaimonic well-being, including autonomy, vitality, meaning and personal growth (Capaldi et al., 2014; Cervinka et al. 2012; Howell et al. 2011; Nisbet & Zelenski, 2013; Pensini et al. 2016). While modern urban lifestyles are highly centralised around spending time indoors and with few motivations to actively seek nature (Cox et al., 2018; Lai, 2018), incorporating nature into the daily routine of young adult citizens in ways that are easily accessible and emotionally relevant (e.g. nature walks in urban parks) would be a crucial strategy to enhance more immediate nature experience and yield mental health benefits (Prévot et al., 2018). Here, we demonstrated that individuals who feel a stronger connection to nature may require more opportunities for nature-related activities in order to maximise effects on their happiness, or because they experience low eudaimonic well-being or lower happiness when displaced from natural environments. Yet, our sample of Hong Kong's young adults exhibited negative mental health outcomes when they felt a stronger connection to nature and had more nature experience, presumably from greater eco-anxiety exacerbating mental health symptoms. Nature-based therapies or green prescriptions may not have the intended effects on mental health without addressing the possible link between eco-anxiety and generalised mental health. This is an important observation that future studies (and, potentially, therapeutic interventions) on highly urbanised compact cities should consider.

## 5. Strengths, limitations and recommendations

The strength of our study lies in its investigation of the understudied mediating role of nature connectedness in the relationship between two distinct pathways of nature experience—more immediate and less immediate—and their respective impacts on positive well-being and negative mental health outcomes, in the extreme case of Hong Kong's densely packed urban population. However, there are several limitations to our findings. First, the cross-sectional study precludes us from elucidating the causal relationships between nature experience and mental health. In addition, since mental health is a multidimensional construct, determining the direct contribution of nature experience to the changes in mental health can be challenging. Retrospective self-reported data may lead to under- or over-reporting nature experiences and mental health outcomes due to social desirability and recall bias. Likewise, our female-skewed sample group could have also impacted this, but minimally as we did not find such demographic group differences between participants that did and did not report experiencing a

mental health symptom within 12 months. As this was a single-city study, caution is warranted when generalising our findings to young adults in other highly urbanised compact cities in China and beyond, particularly regarding the restorative qualities of Hong Kong's urban green spaces, which offer roughly half the area per capita compared to other compact cities, such as Tokyo, Seoul, Shanghai, and Singapore (Lai, 2017). Our regression models only explained a small amount of variance in mental health outcomes, suggesting that unmeasured variables in our study played a larger role. Additional research is required to elucidate the impact of nature experience on positive mental health and mental distress by incorporating multiple mental health indicators, both objective and subjective, and a multi-city, longitudinal study design.

## 6. Conclusions

Our findings provide important practical insights into the design of green spaces and buildings in the compact city of Hong Kong. Our findings contribute to the discussion that more immediate nature experience appears to play a more critical role in harnessing mental health benefits than less immediate experience, emphasising the need for greater attention to the former in urban greening and city planning policies, or improving the accessibility and appeal of country park visits. Additionally, as we propose, enhancing people's nature connectedness would also be important for amplifying the positive well-being benefits of more immediate nature experience, in tandem with more hope-based approaches in education and environmental communication to minimise or fully mitigate the potential causes of negative mental health symptoms from eco-anxiety.

## Ethical approval

This study was approved by the Research Ethics Committee of Hong Kong Baptist University (approval number: REC/21–22/055). Informed consent was obtained from both parents and their participating children before data collection commenced.

## CRediT authorship contribution statement

**Sam SS Lau:** Writing – review & editing, Writing – original draft, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Jason WL Fong:** Writing – original draft, Formal analysis, Data curation. **Andras N Zsido:** Writing – review & editing, Conceptualization. **Masashi Soga:** Writing – review & editing, Conceptualization.

## Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Sam SS Lau reports financial support was provided by Research Grant Council of Hong Kong. If there are other authors, they declare that they

have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.ufug.2025.129160](https://doi.org/10.1016/j.ufug.2025.129160).

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