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Article

Greenspaces and Human Well-Being: Perspectives from a Rapidly Urbanising Low-Income Country

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Abstract: Compelling evidence demonstrates links between greenspaces and human well-being. However, the existing evidence has a strong bias towards high-income countries. Rapidly urbanising cities in low- and middle-income countries (LMICs) remain largely unexplored. The rising prevalence of mental disorders in LMICs highlights the need to better understand the role greenspaces can play in mitigating mental ill-health. We carried out a cross-sectional household survey to investigate links between measures of greenspace exposure and human well-being, and tested pathways that could underpin any such interactions in Kathmandu, a rapidly urbanising low-income city in Nepal. While we found no consistent relationship between measures of greenspace exposure and human well-being outcomes, we provide evidence that greenspaces in a rapidly urbanising low-income setting could be important for encouraging physical activity and fostering social cohesion. Further, we revealed that a medium perceived variety of biodiversity attributes of greenspaces was associated with the highest levels of physical activity and social cohesion. Our findings support the view that greenspaces in LMICs may be less likely to provide well-being benefits. Moreover, medium levels of biodiversity may best promote well-being in LMICs. More research is needed to understand how greenspaces can support human well-being in LMICs.

Keywords: nature; greenspace; global south

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1. Introduction

In the past thirty years, mental health conditions have been increasing globally [1]. Common mental disorders including depressive, anxiety and post-traumatic stress disorders account for 13% of the total global burden of disease [2] and for 7.4% of disability adjusted life years (DALYs) [3]. These disorders have been shown to negatively impact a wide range of health, economic and social outcomes [4]. The greatest projected increase in disability due to mental disorders occurs in low- and middle-income countries (LMICs), where the availability of mental health services is most limited [5]. Currently, four out of five people with severe mental illness in LMICs do not receive effective treatment [6], and the prevalence and costs associated with treating poor mental health are expanding worldwide [7].

Urbanisation has reached unprecedented levels, with almost 70% of the global human population predicted to live in cities by 2050, compared to more than half of the population today [8]. Most of the projected growth in the world's urban population will take place in LMICs [9]. Urbanisation in such countries is placing immense pressure on cities to provide good living conditions for their residents [10]. Since cities increasingly shape the context in which people live, it becomes critical to improve our understanding of the determinants of mental health and well-being of urban populations [11].

Although urban living can convey many benefits, such as providing better access to health care, employment and education [12], living in cities can be detrimental to mental

health and well-being outcomes. Poor urban planning and inadequate management of urban expansion can lead to several risk factors for mental ill-health [13], including reduced levels of physical activity [14] and high levels of social stressors such as social isolation, violence and poverty [15,16]. Indeed, levels of mental illnesses are reported to be higher in urban areas compared to rural areas [17]. Risk factors for mental ill-health are particularly high in informal settlements and slums [18], which are a dominant type of settlement in urbanising cities and, as a result, their residents tend to be affected by poorer physical [19] and mental health [18]. Ethnic minorities [20], migrant populations [21] and low-income groups in LMICs carry the highest burden of mental ill-health [22].

While mental health and well-being are determined by a combination of social, economic, psychological, physiological, behavioural, genetic, cultural and environmental factors [23], it is now widely accepted in research, policy and practice that contact with greenspaces can promote mental health and well-being [24]. For instance, neighbourhood greenness is broadly associated with improved quality of life [25], life satisfaction [26] and subjective well-being [27], and reduced prevalence of negative dimensions of mental health such as depression [28] and anxiety [29]. Exposure to greenspaces has also been demonstrated to be protective against risk factors for mental ill-health, such as psychological stress [25,30], and can contribute to attention restoration [31].

However, we still lack a clear understanding of the causal pathways and mechanisms that link greenspaces, mental health and well-being [32]. Existing frameworks (e.g., [32,33]) conceptualise links between greenspaces and human well-being through pathways such as reducing harm (e.g., reducing exposure to air and noise pollution), restoring capacities (e.g., attention restoration and stress reduction), building capacities (facilitating physical activity and fostering social cohesion) and causing harm (exposure to dangerous wildlife, infectious diseases) [32]. Such frameworks are predominantly informed by evidence from high-income countries, and evidence from rapidly urbanising LMICs is rarely incorporated. Studies from high-income countries make universal claims about the links between greenspaces and human well-being, despite disparities in environmental and cultural characteristics, and urban conditions [34]. This is problematic, because environmental and socio-cultural contextual factors can modify links between components of the pathways [32]. Therefore, it cannot be assumed that evidence from high-income countries is representative of such areas [34]. The lack of mechanistic understanding of pathways linking greenspaces to mental health and well-being limits the application of nature-based solutions in public health, and influence on policy in urbanising areas in LMICs [35].

There is increasing consensus that the living components of greenspaces, biodiversity, have a role in determining human well-being [36]. Biodiversity is a complex concept [37] and we still know little about the contribution of the specific biodiversity aspects of greenspaces that promote human well-being in rapidly urbanising cities [34,38]. The available body of evidence has largely treated greenspaces as uniform, comparing broad urban and natural environment categories, or has analysed the amount of or proximity to greenspaces [39]. The few studies that assess biodiversity metrics predominantly examine objective factors such as species richness. However, some research has shown that people are responding to perceived rather than actual biodiversity [39,40]. Indeed, there are many biodiversity attributes that people might be responding to, in positive or negative ways [41]. Besides objective metrics such as species abundance and richness, additional biodiversity attributes such as colours (e.g., yellow bird plumage, green leaves), sounds (e.g., bird song, insects buzzing, wind blowing through leaves on trees) and smells (e.g., pine sap, floral scent) could play a role.

Here, we investigated the links between measures of greenspace exposure, mental health and well-being, and tested pathways that could underpin any such interactions in Nepal, a rapidly urbanising low-income country in South Asia. To understand links between greenspaces and well-being across different sectors of society in Nepal, we sampled households in neighbourhoods that included both formal and informal settlements. To

assess how different exposures to biodiversity affect mental health and well-being outcomes, data were collected in neighbourhoods varying in their provision of greenspace.

2. Materials and Methods

2.1. Setting

Data were collected in Kathmandu, Nepal (Figure 1), a low-income country with the highest annual urban growth rate in South Asia at around 6.5% [42], although the majority (83%) of the population still lives in rural areas [5]. Kathmandu has experienced significant growth and land use and land cover change over the last 30 years. Its population of around one million in 2011 [43] is predicted to double by 2030 [44]. Decades-long political conflicts resulted in rapid migration of villagers into nearby cities [45]. Most of the recently arrived in-migrating populations live in slum settlements located in the core city, primarily on the banks of the Bagmati and Bishnumati rivers [46]. In common with informal settlements and slums globally [18], Kathmandu's slum dwellers live in environmentally hazardous areas.

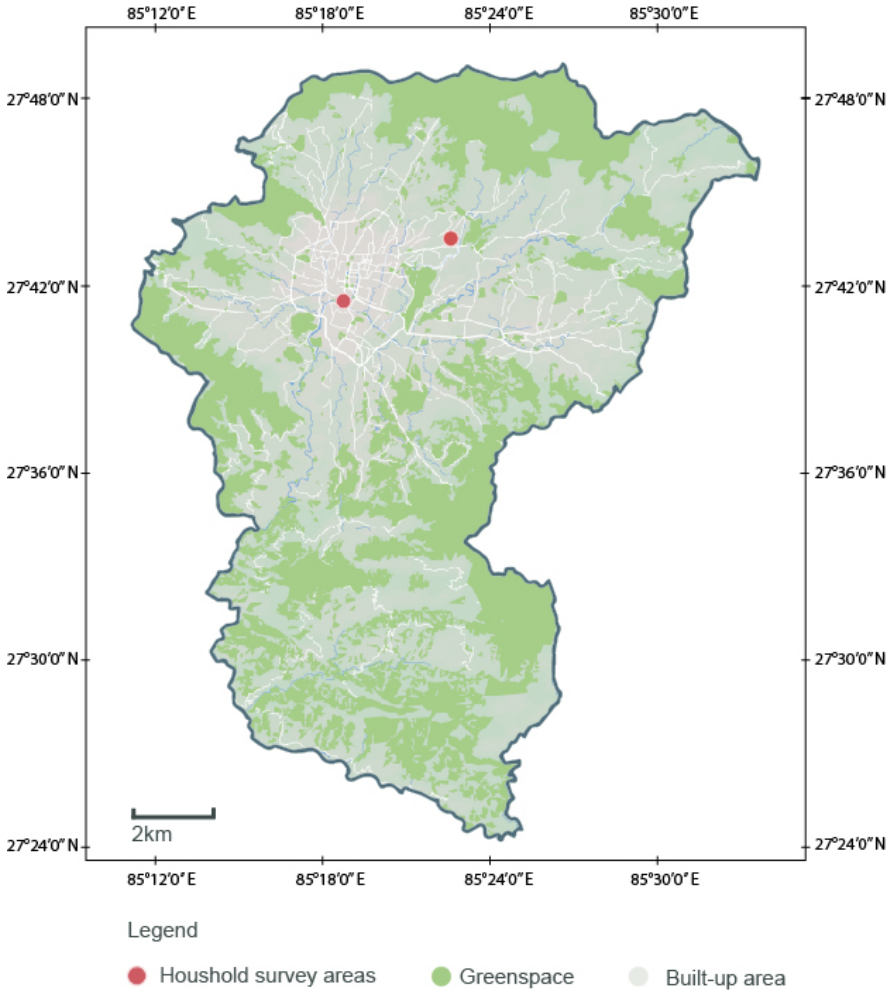

Figure 1. Study sites for household survey areas in Kathmandu, Nepal. The map shows the administrative boundaries of the Kathmandu agglomeration including Kathmandu, Lalitpur and Bhaktapur districts.

Around 81% of the Nepalese population reported their religion as Hindu, while Buddhism and local faiths also play an important role [47]. Independent from the religion people adhere to, all Nepalis are socially defined by the caste system, which is a major determinant of their identity, social status and life chances [47]. The values people in Nepal attach to greenspaces and biodiversity are strongly shaped by religion. Preferences for greenspace types, and different elements of biodiversity, are determined by cultural

and religious norms common in Nepalese society. For instance, tree species such as the Sacred Fig (*Ficus religiosa*) are of great mythological, religious, and medical relevance in Nepal [48]. Nepal and Kathmandu are amongst the most species-diverse parts of the Eastern Himalayas and have been recognised as a biodiversity hotspot [49].

The burden of mental disorders is rising in Kathmandu, affecting the urban poor most severely. Around 23% of Nepal's population is affected by anxiety and around 12% by depression. Prevalence is higher in urban areas [50] and mental disorders disproportionally affect the urban poor in Nepal [51]. Many mental disorders show an upwards trend, for which urbanisation is a key driver [52]. Conceptualisations of mental health and well-being in Nepal differ from those common in Western-world contexts. For instance, in Nepali language, there is no word for depression [53]. In Nepal, similar to other LMICs, mental distress is often described through somatic symptoms [54]. One reason for this may be that mental disorders, conceptualised as 'brain-mind' problems, are highly stigmatised in Nepal [55]. For that reason, individuals may not want to express symptoms of mental distress in psychological terms that could potentially be viewed as mental illness [56]. Stigma is a complex and multifaceted phenomenon that can have multiple detrimental effects on individuals, family members and society [57].

Nepal can be characterised as a collectivistic and interdependent society. In Western-world contexts, human well-being is often conceptualised as eudaimonic, which is associated with a meaningful, fulfilling life [58]. However, in collectivistic cultures such as Nepal, eudaimonia cannot be conceived without integration of a collective, including but not limited to humans [59]. For instance, given the high cultural value assigned to family in Nepal, and the greater extent to which kin are bound to one another to fulfil emotional and instrumental needs, perceived support from family may be highly important [60]. This means that the social domains of well-being may be of particularly high relevance. Moreover, measures of emotions and life satisfaction can be more strongly correlated in individualistic Western-world contexts, as opposed to more collectivistic societies such as Nepal [61]. This could mean that positive emotions elicited by greenspaces may impact people's well-being differently in Nepal.

2.2. Sample Population

We carried out a household survey to investigate links between measures of greenspace exposure and human well-being, and to test pathways that could underpin any such interactions in a Nepalese sample (N = 358; Tables S1–S4) with residents of the neighbourhoods Bansighat and Jorpati in Kathmandu district. Bansighat is a slum settlement in central Kathmandu, and Jorpati is a more affluent area in the north-east of Kathmandu [34]. We selected these neighbourhoods to capture the diversity of Nepalese society, with a particular focus on under-represented sectors (Table S2). These neighbourhoods also vary in their provision of green- and blue space. While Jorpati is adjacent to a large urban forest, Bansighat is located on the bank of the main river traversing Kathmandu. Data were collected in June 2022.

2.3. Survey

2.3.1. Sampling Design

We used the same simple random sampling design to select households in both Bansighat and Jorpati. First, we randomly selected three starting points using GIS software. From the starting points, we then selected three random starting directions by spinning a pen [62]. A single household lying along a line in this direction from the starting point to the border of the sampling area was randomly chosen. We then used proximity selection to choose the next nearest households until the until the desired sample size was reached. No information on household location was collected to ensure anonymity.

Data were collected using tablet computers and the software 1ka. Surveys were carried out by four (three male, one female) field enumerators in Nepali. Enumerators were experienced in conducting surveys and received further training covering our specific

data collection approach and associated ethics standards. Enumerators followed a protocol to ensure that a balance of gender, age, caste and occupation groups were represented (Tables S2 and S3). Respondents were approached in their households and verbal informed consent was obtained prior to data collection.

2.3.2. Measures

We developed a questionnaire (Supplementary Materials Section S4; Nepali version Section S5) that drew on well-established equivalents from high-income countries, which we then tested and adapted for use in Nepal. The selection of questions was guided by existing frameworks [32,33] and by previous qualitative research into the links between greenspaces and human well-being in low-income populations in Kathmandu [34]. To ensure that the questions were appropriate in the cultural context of Nepal, the questionnaire was reviewed by the Nepalese field enumerators who carried out the survey, and we piloted the questionnaire with participants from the target population (N = 21). The pilot revealed that participants may be unfamiliar with Likert-scale question formats. Hence, the enumerators were instructed to take additional care in supporting participants responding to the questions.

To assess greenspace exposure, we asked participants how often, on average in the past 12 months, they visited a nearby greenspace with responses on a six-point scale. Further, we assessed the distance from participants' home to a nearby greenspace, with responses on a 4-point scale. These questions were drawn from a German survey investigating greenspace use [63]. We drew three further questions from UK national surveys investigating use of the outdoors [64]. Two questions explored greenspace use as a child (<13 years old) and as a teenager (13–18 years old). To explore links between measures related to the concept of nature relatedness and well-being outcomes, a third question assessed the importance of spending time in greenspaces. All responses were made on a 5-point scale. Further, we included a single question drawn from the Intentional Nature Exposure Scale [65,66], which asked participants to indicate how much they notice greenspaces in their everyday life on a 5-point scale.

We included three questions to assess links between perceptions and sensory experiences of biodiversity attributes and well-being outcomes. Participants were asked to imagine themselves in a nearby greenspace and to indicate the level of each element they believe that greenspace contains at this time of year. Elements were the variety of sounds, smells and colours, with responses provided on a 3-point scale.

Recent qualitative findings from Kathmandu [34] indicate that the pathway-building capacities (facilitating physical activity and fostering social cohesion) may be of particular importance in the context of Nepal. Hence, we included questions to test for this pathway. We used the International Physical Activity Questionnaire (IPAQ) Short Version [67] to assess physical activity. IPAQ scores were coded into the categories "inactive", "minimally active" and "HEPA active" (health-enhancing physical activity) following standardised scoring protocols [68]. We assessed social cohesion with Buckner's neighbourhood cohesion index [69]. We calculated total scores (range 0–40) and classified responses in the groups low (0–13), moderate (14–26) and high (27–40).

To assess human well-being, we included the EQ-5D-3L health-related quality of life index, which measures the five dimensions mobility, self-care, usual activities, pain/discomfort and anxiety/depression. Following standard protocols, we converted the values for these dimensions into a single utility index and dichotomised scores into the categories 'no problems at all' and 'any problems' [70]. The Patient Health Questionnaire 9 (PHQ-9) was included to assess depressive disorders [5]. The Nepali version of the PHQ-9 also includes a question that asks if respondents have 'heart-mind problems' ('heart-mind problems', 'no problems'). We chose these two scales because they have been validated for use in Nepal [5,71]. We hypothesised that measures of greenspace exposure, and perceptions and sensory experience of biodiversity attributes, would correlate with measures of health-related quality of life, depressive disorders, physical activity and social cohesion. Apart

from the PHQ-9 and the EQ-5D-3L (for which validated translations exist), the initial questionnaire was developed in English and then translated to Nepali by a professional bilingual translator.

2.3.3. Statistical Analyses

All analyses were undertaken in R (Version 1.4.1; R Core Team, Boston, MA, USA, 2020). We used Pearson's chi square tests to examine links between the explanatory categorial measures of greenspace use, distance to nearest greenspace, spending time in greenspaces as children and teenagers, importance of greenspaces, noticing nature, and the response variables of health-related quality of life, depressive disorders, physical activity and social cohesion. We used Bonferroni correction for post hoc comparisons to adjust for multiple comparisons. When expected values fell below the minimum of five, Fisher's exact tests were applied. These methods were used because both explanatory and response variables were categorical.

2.3.4. Ethical Considerations

The study protocol was approved by the University of Leeds Social Sciences, Environment and LUBS Faculty Research Ethics Committee (AREA 21-072) and the Nepal Health Research Council (Reg. Nr. 31—2022).

3. Results

3.1. Sample Characteristics

In total, 358 respondents completed the questionnaire in the neighbourhoods Bansighat and Jorpati, including adults of all age groups. Men were overrepresented (64%). Additional participant characteristics and an outcome summary of explanatory variables are given in Tables S1 and S5, respectively.

Women (two-sided, $p < 0.05$), participants aged 70 and over (two-sided, $p < 0.01$) and Hill Janjati (an indigenous caste group; two-sided, $p < 0.01$) were less likely to visit greenspaces frequently. Most participants reported a full health state (68.95%; that is, no problems in any EQ-5D-3L dimension; Table 1). Participants aged 50–59 were more likely to report health-related quality of life problems (two-sided, $p < 0.001$). Most participants indicated no heart-mind problems (PHQ-9; 85.20%). Seven (1.96%) individuals were positive for a major depressive episode in the past two weeks.

Table 1. EQ5D-3L frequencies by dimension and level (N = 358). Level 1: no problems; level 2: slight problems; level 3: moderate problems. Percentages per level indicated in brackets.

	Mobility	Self-Care	Usual Activities	Pain and Discomfort	Anxiety and Depression
Level 1	347 (98.00)	346 (97.70)	347 (98.00)	285 (80.50)	284 (80.20)
Level 2	7 (2.00)	7 (2.00)	6 (1.70)	68 (19.20)	68 (19.2)
Level 3	0 (0.00)	1 (0.30)	1 (0.30)	1 (0.30)	2 (0.6)

3.2. Links between Measures of Greenspace Exposure and Human Well-Being Outcomes

Greenspace use and distance to nearest greenspace. We provide a summary of associations between explanatory and outcome variables in Table 2. Frequency of greenspace use and distance to nearest greenspace were not linked to measures of health-related quality of life and heart-mind problems/depression. However, our analysis revealed that respondents who reported that they used greenspaces more frequently (3–4 times per month) were more likely to report moderate or high levels of social cohesion (two-sided, $p < 0.001$), and were more likely to report being minimally active or HEPA active (two-sided, $p < 0.001$), compared to those who indicated that they used greenspaces less frequently.

Table 2. Associations between explanatory and outcome variables (N = 358). Differences were assessed using Pearson's chi squared tests for categorical variables. When expected values were below five, we used two-sided Fisher's exact tests. Shaded cells indicate that post hoc pairwise comparisons of each variable category showed significant differences.

	Chi^2 (df)	***p*-Value**	**Fisher's (*p*-Value)**
Greenspace use			
Quality of life	NA	NA	>0.05
Heart-mind problems	NA	NA	>0.05
Depressive disorders	NA	NA	>0.05
Physical activity	NA	NA	$p < 0.001$
Social cohesion	NA	NA	$p < 0.001$
Distance to nearest greenspace			
Quality of life	1.18 (3)	>0.05	NA
Heart-mind problems	NA	NA	>0.05
Depressive disorders	NA	NA	>0.05
Physical activity	NA	NA	>0.05
Social cohesion	NA	NA	>0.05
Greenspace experience as child			
Quality of life	NA	NA	>0.05
Heart-mind problems	NA	NA	>0.05
Depressive disorders	NA	NA	<0.05
Physical activity	NA	NA	<0.01
Social cohesion	NA	NA	<0.001
Greenspace experience as teenager			
Quality of life	NA	NA	>0.05
Heart-mind problems	NA	NA	<0.05
Depressive disorders	NA	NA	>0.05
Physical activity	NA	NA	<0.01
Social cohesion	NA	NA	<0.001
Importance of greenspaces			
Quality of life	NA	NA	>0.05
Heart-mind problems	NA	NA	<0.05
Depressive disorders	NA	NA	>0.05
Physical activity	NA	NA	<0.001
Social cohesion	NA	NA	<0.001
Noticing nature	NA	NA	
Quality of life	NA	NA	<0.001
Heart-mind problems	NA	NA	<0.001
Depressive disorders	NA	NA	<0.05
Physical activity	NA	NA	<0.05
Social cohesion	NA	NA	<0.001
Variety of sounds in nearby greenspace			
Quality of life	13.10 (2)	<0.01	NA
Heart-mind problems	2.30 (2)	>0.05	NA
Depressive disorders	NA	NA	>0.05
Physical activity	41.87 (4)	<0.001	NA
Social cohesion	NA	NA	<0.001
Variety of colours in nearby greenspace			
Quality of life	23.40 (2)	<0.001	NA
Heart-mind problems	4.19 (2)	>0.05	NA
Depressive disorders	NA	NA	>0.05
Physical activity	35.5 (4)	<0.001	NA
Social cohesion	NA	NA	<0.001
Variety of smells in nearby greenspace			
Quality of life	(2) 18.52	<0.001	NA
Heart-mind problems	4.71 (2)	>0.05	NA
Depressive disorders	NA	NA	>0.05
Physical activity	36.72 (4)	<0.001	NA
Social cohesion	NA	NA	<0.001

Table 2. *Cont.*

	Chi^2 (df)	*p*-Value	Fisher's (*p*-Value)
Social cohesion			
Quality of life	NA	NA	<0.05
Heart-mind problems	NA	NA	<0.001
Depressive disorders	NA	NA	>0.05
Physical activity			
Quality of life	8.62 (2)	<0.05	
Heart-mind problems	NA	NA	<0.01
Depressive disorders	NA	NA	>0.05

Greenspace experience as a child and as a teenager. We found no consistent relationships between experiencing greenspaces as a child and a teenager and measures of health-related quality of life and heart-mind problems/depression. However, we showed that respondents who indicated that spending a lot of time in greenspaces as a child and as a teenager was important to them reported higher levels of physical activity (two-sided, $p < 0.01$) and social cohesion (two-sided, $p < 0.001$), compared to those who indicated that greenspace interactions as a child and as a teenager were less important.

Spending time in greenspaces is an important part of life. Importance of spending time in greenspaces was not associated with measures of health-related quality of life and heart-mind problems/depression. In contrast, we revealed that respondents who agreed or strongly agreed that spending time in greenspaces is an important part of their life were more likely to be minimally active or HEPA active (two-sided, $p < 0.001$), and were more likely to report moderate or high levels of social cohesion (two-sided, $p < 0.001$), compared to those who disagreed that spending time in greenspaces is an important part of their life.

Noticing nature. Respondents who indicated that they notice nature in their everyday life a great deal were less likely to report health-related quality of life problems (two-sided, $p < 0.001$), but were more likely to indicate being HEPA active (two-sided, $p < 0.05$) and more likely to report moderate or high levels of social cohesion (two-sided, $p < 0.001$), compared to those who indicated to notice nature less.

Perceptions and sensory experiences of biodiversity attributes. We observed no consistent relationships between health-related quality of life, heart-mind problems/depression, and perceptions and sensory experiences of biodiversity attributes. However, we found that a medium perceived variety of sounds, colours and smells tended to best promote physical activity and social cohesion. Participants who perceived the variety of sounds in their greenspace to be high were more likely to be minimally active and less likely to be HEPA active, and those who perceived a medium variety of sounds were more likely to be HEPA active ($x^2 = 41.87$, df = 4, $p < 0.001$). Conversely, participants perceiving a low variety of sounds were more likely to be inactive. Participants who perceived a medium or high variety of sounds were more likely to report moderate or high levels of social cohesion (two-sided, $p < 0.001$).

Participants who perceived the variety of colours to be low were more likely to be inactive, and those who perceived a medium variety were more likely to be HEPA active (35.52, df = 4, $p < 0.001$). In contrast, participants perceiving a high variety were less likely to be HEPA active, but more likely to be minimally active. Participants perceiving the variety of colours to be high were more likely to have high levels of social cohesion (two-sided, $p < 0.001$). Those who perceived the variety of colours to be medium were more likely to report moderate levels of social cohesion, and less likely to have high levels of social cohesion.

Participants perceiving the variety of smells to be high were less likely to be HEPA active, but more likely to be minimally active ($x^2 = 36.72$, df = 4, $p < 0.001$). Those who perceived the variety of smells to be low were more likely to be inactive, and participants perceiving the variety of smells to be medium were more likely to be HEPA active. Further, those who perceived the variety of smells to be high were more likely to report high levels of social cohesion, and were less likely to report moderate levels of social cohesion (two-

sided, $p < 0.001$). Moreover, those perceiving the variety of smells to be medium were more likely to report moderate levels of social cohesion, and less likely to report high levels of social cohesion.

4. Discussion

Biodiversity loss and the growing prevalence of poor mental health and well-being in LMICs are two key challenges of our time [2,72]. It is therefore important to better understand if and how biodiversity and greenspace might determine mental well-being of urban populations in LMICs. Expanding research beyond high-income countries, and recognising cultural contexts and diversity, are essential for progressing research at the intersection of biodiversity and human well-being [59,73]. Here we provide evidence for the links between urban greenspaces and human well-being in a rapidly urbanising low-income city. While we found no consistent relationship between greenspace exposure and well-being outcomes, we show that greenspaces in these settings may be important for encouraging physical activity and fostering social cohesion.

Contrary to our expectations, frequency of greenspace use, distance to nearest greenspace, experiencing greenspaces as a child and as a teenager and the importance of spending time in greenspaces were not linked to measures of health-related quality of life and heart-mind problems/depression. These findings contrast with the widely accepted consensus that contact with greenspaces can promote human well-being [24]. However, the body of evidence remains globally non-representative [59] as it is strongly biased towards high-income countries [74]. A recent review [74] was supportive of the notion that greenspaces are positively associated with improved mental health and well-being outcomes. Nevertheless some evidence from LMICs has led authors to question whether greenspaces provide the same level of benefits to people's well-being as in high-income countries [33]. For instance, [75] did not find links between greenspaces and obesity in Cairo, Egypt, and [76] provide evidence for negative links between greenspaces and well-being in Dhaka, Bangladesh. Indeed, in a multi-continental analysis, found that greenspaces were negatively associated with human health in a range of low-income cities in LMICs [77]. The findings of this study support the view that greenspaces in low-income countries, and particularly in informal settlements and slums, may not provide well-being benefits. One possible explanation is that greenspaces in rapidly urbanising low-income settings are more likely to be characterised by factors that compromise the quality of greenspaces, such as higher levels of environmental pollution, crime, and risks of infectious diseases [74]. Previous findings from Kathmandu have identified solid waste pollution and a risk of Dengue infectious in greenspaces as factors inhibiting benefits [34]. Therefore, greenspace management policies will need to improve the quality of greenspaces to address such risks and thereby facilitate well-being benefits.

Our findings suggest that greenspaces in a rapidly urbanising low-income setting may still play an important role for encouraging physical activity and fostering social cohesion. This underpins qualitative findings from Kathmandu [34] and suggests that greenspace use may still be protective against physical inactivity and social isolation, which has been shown to be associated with mental disorders [78,79]. The social benefits provided by greenspaces may be of particular relevance in more collectivistic and interdependent societies such as Nepal, where there is a greater importance attached to how people are bound to one another to fulfil emotional and instrumental needs [60]. The rapid urban development currently seen in LMICs and the resulting decrease in the availability of greenspaces may therefore be problematic as it may lead to higher levels of physical inactivity and social isolation.

Individuals who spent a large amount of time in greenspaces as a child and as a teenager reported higher levels of physical activity and social cohesion. This supports evidence from HICs for the benefits of greenspace contact for children's brain development, for which physical activity and social cohesion are major pathways [80]. Greenspace exposure during childhood can influence adult health outcomes, mostly through developing lifelong healthy habits [81,82]. Our findings indicate a similar association between greenspaces and

child development. This underpins the findings from previous research in Kathmandu, which identified that the lack of greenspaces providing opportunities for children to be physically active and to engage socially was perceived by residents as a key concern for the future development of the city [34]. Rapid urbanisation may therefore contribute to increasing levels of sedentary behaviours and reduced levels of physical activity [83], since people are generally becoming less likely to have direct contact with greenspaces [84]. This highlights that continued urban growth and a reduction in the availability of greenspaces in urbanising areas may have potentially far-reaching detrimental consequences for child development in LMICs. Therefore, we suggest that greenspaces in urbanising areas should be designed to be accessible for children, and provide opportunities for children to be physically active and to engage socially.

We observed links between measures related to the concept of nature relatedness, quality of life, heart-mind problems, physical activity and social cohesion. Individuals who indicated that spending time in greenspaces is an important part of their life, and who reported noticing nature more in their everyday life, showed higher levels of physical activity and social cohesion. Moreover, participants who indicated that they noticed nature in their everyday life were less likely to report quality of life problems and heart-mind problems. This suggests that the degree to which individuals feel emotionally connected to the natural world [65] may mediate health and well-being benefits of greenspaces in the context of a rapidly urbanising low-income city. Nature relatedness has previously been shown to be associated with differences in well-being [85,86]. Due to cultural differences in greenspace preferences, it is likely that the construct of nature relatedness will differ across cultures [87]. To date, little attention has been paid to nature relatedness in LMICs, although recent research has confirmed a positive association between nature relatedness and well-being in some non-Western countries [88]. Our findings confirm links between measures related to the concept of nature relatedness and human well-being in Nepal, and suggest that programs to foster nature relatedness in rapidly urbanising cities may be useful public health initiatives.

We anticipated that people would have a positive response to a higher perceived variety of biodiversity attributes [36,39]. However, there was no consistent relationship between health-related quality of life, heart-mind problems/depression, and perceptions and sensory experiences of biodiversity attributes. Indeed, those perceiving the variety of sounds to be low were more likely to report quality of life problems, while those perceiving the variety of colours and smells to be low were less likely to report quality of life problems. Further, we found that a medium perceived variety of sounds, colours and smells in people's nearby greenspace was most conductive for promoting physical activity and fostering social cohesion. One possible interpretation of these findings is that greenspaces with moderate levels of biodiversity may support physical activity and social cohesion in areas that are characterised by high levels of biodiversity such as in Kathmandu. This supports the view that humans generally prefer moderate levels of complexity in greenspaces [89], and that people in biodiverse LMICs may be less likely to prefer biodiverse environments compared to people from high-income countries. For instance, [90] demonstrated that Swiss participants in their study liked species-rich forests more than monocultures, whereas Chinese participants did not show strong preferences for biodiversity-rich forests. Such preferences may be grounded in cultural norms. This indicates that there may be substantial differences in how biodiversity and human well-being are associated in different cultures, which has important implications for the management of greenspaces in biodiverse LMICs.

We asked respondents about their perceptions of greenspace exposure, rather than any objective measures of greenspace quality, biodiversity or exposure. Future studies may wish to use robust ecological methods such as ecological surveys to unpick the various components and traits of greenspaces leading to well-being effects, or validated scales that are able to unpick the contributions of different biodiversity attributes. Future research should also take into account the role cultural norms play, as our findings highlight cultural differences in the perception of biodiversity, which has important implications

for the management of greenspaces in LMICs. Therefore, more context-specific research is needed to better understand the biodiversity preferences of different cultural groups. Future studies may further investigate the factors that can inhibit well-being benefits in low-income settings, and particularly in informal settlements and slums. Lastly, it will be important for future research to improve our understanding of how greenspaces can be used strategically to facilitate physical activity and social cohesion, particularly for children.

5. Conclusions

The fast pace of urbanisation in LMICs and the associated rising burden of mental ill-health highlight the need to better understand the potential of greenspaces for improving the well-being of the growing global urban population. In this study, we found no consistent relationships between greenspace exposure and well-being outcomes. However, we provide evidence that greenspaces in rapidly urbanising low-income settings are associated with facilitating physical activity and fostering social cohesion, and we demonstrate that medium levels of biodiversity may best support these factors. Many of the urban areas in LMICs that will be home to large parts of the global urban population are yet to be built. There is, therefore, a huge potential for urban development interventions that harness greenspaces as nature-based solutions to foster the well-being of urban residents. Our findings provide an important evidence-base for future research in LMICs and indicate the need for more context-specific research that takes into account the preferences of different cultural groups.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/environments9120148/s1. Table S1: Sociodemographic characteristics of participants in the household survey (N = 358); Table S2: Criteria for participant selection; Table S3: Age groups; Table S4: Sample size; Table S5: Outcome summary of explanatory variables (N = 358).

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