

1 Article

2 **Designing age-friendly communities: Exploring** 3 **qualitative perspectives on urban green spaces and** 4 **ageing in two Indian megacities**

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19 20 **Abstract**

21 The World Health Organization and the United Nations have increasingly
22 acknowledged the importance of urban green space (UGS) for healthy ageing.
23 However, low- and middle-income countries (LMICs) like India with exponential
24 ageing populations have inadequate UGS. This qualitative study examined the
25 relationships between UGS and healthy ageing in two megacities in India.
26 Participants were recruited using snowball sampling in New Delhi and Chennai
27 and semi-structured interviews were conducted with consenting participants
28 (N=60, female=51%; age \geq 60 years; fluent in English, Hindi, or Tamil). Interviews
29 were recorded, transcribed, translated, and analysed using inductive and thematic
30 analysis. Benefits of UGS included community building and social capital,
31 improved health and social resilience, physical activity promotion, reduced
32 exposure to noise, air pollution, and heat. Poorly maintained UGS and lack of safe,
33 age-friendly pedestrian infrastructure were identified as barriers to health
34 promotion in later life. Neighbourhood disorder and crime constrained older
35 adults' use of UGS in low-income neighbourhoods. This study underscores the role
36 of UGS in the design of age-friendly communities in India. Findings highlight the
37 benefits of UGS for older adults, particularly those living in socially disadvantaged
38 or underserved communities, which often have least access to high-quality parks
39 and green areas.

40
41 **Keywords:** urban green spaces; built environment; healthy ageing; older adults;
42 India

46 1. Introduction

47 Population ageing is a dominant global demographic phenomenon of the 21st
48 century and accelerating at a higher rate than in the past. Worldwide, the
49 proportion of older adults (60 years or older) is expected to double by 2050 and
50 more than triple by 2100, rising from 962 million globally in 2017 to 2.1 billion in
51 2050 and 3.1 billion in 2100.¹ Low- and middle-income countries (LMICs) are
52 experiencing exponential growth in ageing populations. In 2009, two-thirds of the
53 world's older persons lived in LMICs, regions that are much less prepared to deal
54 with this shift in population dynamics compared to high-income countries (HICs).²
55 In particular, Southeast Asian countries are currently experiencing an ageing trend
56 that is unprecedented in history. A report by the World Health Organization
57 (WHO) Southeast Asia Regional Framework on Healthy Ageing estimated that 289
58 million people in the region will be aged 60 years or over by 2030.³ At present,
59 India, has the largest population of older adults at 125 million, followed by
60 Indonesia (22 million), Bangladesh (12 million) and Thailand (11 million).¹ The
61 proportion of older adults in India is expected to increase to 20% (315 million) by
62 the year 2050, which would be more than the total population of the United
63 States.^{1,3} The rising costs of health and social care associated with age-related
64 disease and disability makes ageing research a public health priority.

65
66 An ageing population requires additional measures to prevent or reduce the
67 burden of disease and disability, and maintain the functional ability that enables
68 health and wellbeing among older adults, a concept described as 'healthy ageing'
69 by the WHO.^{3,4} Health and wellbeing of older adults is strongly linked to their
70 home neighbourhood, where they are likely to spend more time compared to
71 younger populations due to a range of factors including retirement or limited
72 mobility. Urban areas, in particular, have large numbers of older inhabitants.^{5,6} In
73 India, it is expected that around 42% of the population will live in urban areas by
74 2030.⁷ Across LMICs, an estimated 25% of older adults are expected to be living in
75 cities by 2050, making urban environments important determinants for healthy
76 ageing.^{8,9}

77
78 The built environment exerts an important impact on health, which can either
79 facilitate or hinder participation in activities of daily living and healthy
80 behaviour.^{10,11} Activity-friendly neighbourhoods, with easy access to destinations
81 and services, are known to be positively associated with higher levels of physical
82 activity and walking among older adults.¹² A feature of the built environment that
83 has received increasing attention over the last years is the provision of urban green
84 space (UGS). UGS can come in many forms, including city parks, gardens,
85 playgrounds, pocket parks, large forests, residential greenery, and areas partially
86 or fully covered by vegetation (e.g., street trees, grass, bushes) in the
87 neighbourhood.¹³ Research from HICs has demonstrated that living in
88 neighbourhoods with more UGS is associated with higher levels of physical
89 activity, better mental health, lower levels of stress, and reduced risk of disease.^{14,15}

90 International agencies have identified UGS interventions as a promising strategy
91 for healthy ageing. The United Nations Sustainable Development Goal 11.7 and the
92 WHO recommend that UGSs are key to improving the age-friendliness of
93 neighbourhoods.¹⁶ As older adults are more bound to their home neighbourhood,
94 they may especially benefit from the provision of UGSs in their immediate
95 surroundings. Living in proximity to UGS is linked to more frequent park
96 visitation and better perceived health among older adults.⁶ However, urban living
97 often limits access to nature and can increase exposure to environmental hazards
98 such as air, water, and noise pollution.¹⁷

99 India has been experiencing rapid urbanisation since 1970, with its urban
100 population rising from 109 million in 1971 to 377 million in 2011, a percentage
101 increase from 19.9 to 31.6 in four decades.¹⁸ Currently, there are 46 cities in India
102 with populations of 1 million and above (million-plus cities) including three cities
103 with populations of 10 million and above (megacities).¹⁹ By 2030, India is projected
104 to have six cities with a population of over 10 million, and more than 100 million-
105 plus cities.¹⁹ The availability of UGS is decreasing in most of these cities, with many
106 falling short of the WHO recommended norms of 9 sq. m. UGS per capita. The
107 benefits of UGS have been widely documented, however, a majority of the findings
108 are from HICs.^{6, 20, 21} This limits the generalizability of the evidence to LMICs and
109 there is minimal research exploring the influence of UGS on ageing in India. To our
110 knowledge, this is the first study to fill the knowledge gap in this area. Using
111 qualitative research methods, we investigate the relationships between UGS and
112 healthy ageing in two megacities in India.

113

114 **2. Methods**

115 **2.1. Study context and methods**

116 We focused on two, million-plus (population of 1 million or more), urban
117 agglomerations in India. Between May 2019-January 2020, participants (N=60,
118 female=51%) were recruited from the cities of New Delhi (population=18.6 million)
119 and Chennai (population=10.9 million). A snowball sampling technique with
120 multiple recruitment approaches was adopted to reach out to participants. A
121 gender-and age-sensitive approach was employed to ensure equal representation
122 of men and women above 60 years of age in this study.²² In each city, the lead
123 researcher (DA) commenced with a small population of known individuals and
124 expanded the sample by asking the initial participants to identify others that were
125 interested in participating in the study. The lead researcher was supported by one
126 male and one female bilingual research assistant in each city. Research assistants
127 had prior experience in qualitative research methods and were required to
128 participate in a training session on roles and responsibilities, interview techniques,
129 dealing with sensitive questions, data protection codes of conduct and
130 practicalities of field work. The lead researcher (DA) supervised all research
131 assistants and served as the primary source of contact for all queries related to this
132 study.

133 Recommendations from community gatekeepers such as resident welfare
134 associations, neighbourhood watch groups, and resident associations were used to
135 identify an initial set of eligible participants. Following this, snowball sampling
136 was used to recruit a larger sample. From their social networks, participants
137 recommended other older adults who were willing to participate. Recruitment
138 activities also included canvassing in study neighbourhoods and during social
139 activities hosted by apartment housing blocks and neighbourhood associations.
140 Snowball sampling has been recommended by researchers who have conducted
141 similar studies in LMIC contexts to enable the selection of individuals that are
142 especially knowledgeable about the variables of interest.²³ This approach
143 reinforced the depth of understanding of the lived experiences of older adults in
144 their immediate surroundings.²⁴

145
146 Eligible participants were contacted either in-person or via telephone and invited
147 to participate in the study. Eligibility criteria for this study included: (i) currently
148 residing in the city of New Delhi or Chennai; (ii) residents of the city for at least 6
149 months; (iii) ≥ 60 years of age; (iv) able and willing to communicate in the official
150 languages in the study regions—English, Hindi or Tamil; (v) no visible signs of
151 inappropriate or disruptive behaviour (e.g., insobriety, substance abuse). An
152 international advisory group from the International Physical Activity and
153 Environment Network (IPEN; www.ipenproject.org) was consulted during the
154 study stages to ensure scientific validity and integrity of study protocols and offer
155 triangulation of the results.²⁵ This process was used to resolve any disagreements
156 and reach a consensus for coding and data analysis. We use the COREQ checklist
157 for consolidated reporting of our qualitative research methods and findings.²⁶

158

159 2.2. Data collection

160 Between June 2019 and February 2020, semi-structured interviews were conducted
161 with participants (Chennai n=32, New Delhi n=28) using an interview guide that
162 was developed for this study. The interview guide included open-ended questions
163 that encouraged participants to speak freely about what they felt were relevant and
164 important in terms of their home and family setting, features in the built
165 environment, quality of neighbourhood parks and UGS, work, leisure and travel
166 behaviours, modes of transportation, and social interactions in the community.
167 Among eligible participants that were approached, six participants refused to
168 participate in the study citing illness.

169

170 Information about the study, including interview questions and consent forms,
171 were provided to all participants before the scheduled interview. Participants were
172 able to select their interview location and language preference to ensure their
173 comfort and convenience. Most interviews were conducted in a private room in
174 participants' homes and lasted between 45-60 minutes (mean=52 minutes). A
175 conversational style was adopted by the interviewee and the interview guide was
176 used to navigate the conversation. Researchers made comprehensive field notes

177 during and after the interview detailing the overall setting to provide rich context
178 of the study. Field notes included basic information on the study title, name of the
179 researcher, date of interview, season of data collection and pertinent information
180 about the weather. Field notes also included information on cultural norms, family
181 values, customs, and aspects related to the geographic setting or locations of
182 features relevant to the study topic of interest.

183
184 All interviews were digitally recorded and transcribed verbatim. The transcribed
185 text was anonymized to maintain the privacy and confidentiality of participants.
186 Theoretical saturation of data—a situation where no new information, concepts or
187 themes were emerging from the data—was used to determine the number of
188 participants required for a detailed analysis. There are no fixed sample sizes or
189 standardized tests to estimate the amount of data needed for achieving
190 saturation.²⁷ All study procedures were approved by the Research Ethics
191 Committee at Queen’s University Belfast, UK (approval file number EPS 19_224).

192 193 2.3 Data analysis

194 Interviews conducted in Hindi and Tamil were translated to English by a bilingual
195 person knowledgeable of the common cultural terms and linguistic expressions
196 used in New Delhi and Chennai respectively. To ensure data reliability and rigour,
197 translations were evaluated by two bilingual linguistic experts who were not
198 familiar with the project. Interviews were analysed by a process of inductive and
199 thematic analysis using NVivo 12 (QSR International Pty Ltd., 2018).^{28, 29}

200
201 A nested coding structure was developed by the research team and data was
202 categorised into key themes by identifying and interpreting emerging patterns of
203 meaning or common constructs within the qualitative data. Inductive analysis was
204 conducted in the following phases: a) data familiarisation, b) division of interview
205 text into meaning units, c) grouping of meaning units, d) formulation of
206 descriptive labels and codes, and e) development of categories and themes. Codes
207 and labels were compared and appraised to determine which codes seem to belong
208 together, thereby forming a category or theme.^{30, 31} All interview transcripts were
209 analysed and independently coded by two members of the research team for
210 consistency. The coding structure was validated with the wider research team to
211 refine and agree on codes. Overlapping aspects of coding and categorisation of
212 hard to place data was discussed with the advisory team. A summary report of
213 themes and findings was shared with each participant and they were provided
214 with an opportunity to provide feedback.

215 216 **3. Results**

217 3.1. Sample characteristics

218 Study participants ranged in age between 60 and 78 years (median age=67 years),
219 of which half (n=31, 51.7%) were female. The largest proportion (n=48, 80%) were
220 living with someone, and a fifth of participants (n=12, 20%) were living alone, with

221 66.7% (n=40) retired, and a third (n=20, 33.3%) employed. Sample characteristics
 222 are shown in Table 1.
 223

Table 1. Descriptive characteristics of study participants (N=60)

Age (in years)	Median (SD)
	67 (4.47)
Location	n, %
New Delhi	28 (46.7%)
Chennai	32 (53.3%)
Gender	n, %
Male	29 (48.3%)
Female	31 (51.7%)
Marital status	n, %
Married	38 (63.3%)
Not married /widowed	22 (36.7%)
Living situation	n, %
Living with someone	48 (80.0%)
Living alone	12 (20.0%)
Employment status	n, %
Retired	40 (66.7%)
Employed	20 (33.3%)

224
 225 Key themes on the role of UGS in healthy ageing emerged through the process of
 226 inductive analysis. Participants discussed the benefits of UGS, park quality, and
 227 constraints to active living. Some constraints were unique to the individual and
 228 their immediate neighbourhoods, but a majority were shared by participants in
 229 both cities. Four key themes emerged from the interviews (Table 2): (1) health
 230 benefits of UGS; (2) quality of UGS; (3) community building and social capital; and
 231 (4) benefits for disadvantaged groups.

232

233 3.2. Health benefits of urban green space

234 Findings highlighted the role of UGSs for physical activity promotion. Walking
 235 was reported as the most common behavior and park walkways were the most
 236 commonly used physical activity areas by older adults in both cities. Older adults
 237 with reduced mobility preferred UGSs that were easily accessible and near their
 238 homes. Due to intense urbanisation and rapid growth in motorised traffic, a lack of
 239 safe walking infrastructure emerged as a common barrier in both cities.

240

241 *"I have diabetes and the doctor has asked me to go for a brisk walk for 30 minutes every*
242 *day. I live in a very congested neighbourhood and I do not drive, so this park is my*
243 *only option as it is a five-minute walk from my home."* (Male, Age 62, Chennai)

244

245 *"It is impossible to walk on the footpaths. They are poorly designed. Many uneven*
246 *surfaces and also a high step from the road. The park is nicer and safer. I can walk here*
247 *without worrying about being hit by a car"* (Female, Age 65, New Delhi)

248

249 *"This park has something for everyone. There is a play area and sandpit for children, a*
250 *yoga pavilion, a circular walking pathway, outdoor gym equipment, and some play*
251 *courts. We are lucky to live here; very few neighbourhoods have the luxury of any*
252 *green space anymore."* (Female, Age 65, Chennai)

253

254 Participants reported lower levels of exposure to noise, air pollution, and heat in
255 UGSs. For many older adults, UGSs offered respite and escape from toxic exhaust
256 fumes from motorized vehicles and polluted air in the city.

257

258 *"This park gives me the only chance to breathe clean air. Being here is freedom from the*
259 *dust and pollution in Delhi."* (Male, Age 66, New Delhi)

260

261 *"I am at peace when I am here. It is a break from the exhaust fumes of traffic and*
262 *constant noise of honking vehicles and construction happening near my*
263 *house."*(Female, Age 63, New Delhi)

264

265 3.3. Quality of urban green spaces

266 Participants reported that access routes between home and UGSs were not
267 designed and maintained effectively. In some neighbourhoods, the design of park
268 features, pedestrian infrastructure, and the streetscape did not meet the needs of
269 older adults with mobility difficulties. Lack of safe walking infrastructure (e.g.,
270 unobstructed footpaths, non-slip surfaces, street lighting) and age-friendly facilities
271 (e.g., benches, toilets) in parks were barriers to the use of UGSs.

272

273 *"I like to go to the park at the end of my street, but it is difficult because it does not*
274 *serve my needs. I suffer from joint pain and need to sit down frequently. There are no*
275 *resting spots, benches, or toilets, so I find it difficult when I am there."* (Male, Age 72,
276 New Delhi)

277

278 *"The park in my neighbourhood is very popular with children and younger people*
279 *because it has many facilities for them. There is a badminton court and volleyball net.*
280 *But, for older people like me, there is nothing. Not even proper benches with a backrest*
281 *and arms or non-slip surfaces to walk. When it rains, it is so risky. One of my friends*
282 *slipped and hurt herself."* (Female, Age 65, Chennai)

283

284 *"The footpaths are no longer places where people can walk. They have become parking*
285 *bays for cars. Without the park, I don't know where I would walk safely and go for*
286 *exercise. It is impossible to walk on the streets these days. They are filled with*
287 *motorcycles, cars, autorickshaws leaving no space for us."* (Female, Age 66, Chennai)

288

289 Participants attributed the lack of parks and diminishing street trees to the rapid
290 rates of urbanisation, increased traffic, and congestion on roads. Green space was
291 more important to older adults living in high-rise apartments and multi-occupancy
292 residential dwellings.

293

294 *"The streets in my area used to have these old banyan trees which used to give shade. It*
295 *was a pleasure to walk here. Over the past 50 years, construction and development*
296 *have destroyed them. It is impossible to walk here in the scorching heat. There is no*
297 *sign of nature here now, so I don't go out for walks like I used to."* (Male, Age 66,
298 Chennai)

299

300 *"In the hot summer months, it is impossible to go anywhere. The park is the only green*
301 *space in a jungle of concrete. It is like a place of refuge for many in my building."*
302 (Male, Age 62, New Delhi)

303

304 3.4. Community building and social capital

305 UGSs provided a neutral space for social interactions to occur and where people
306 from different cultures and backgrounds could come together. Participants
307 described new friendly relationships or partnerships developing as a result of
308 impromptu and unplanned interactions in parks. While personal goals or desires
309 were achieved, community building and increased social capital also emerged.
310 Individual and community benefits, improved health, and social resilience were
311 reported as key outcomes.

312

313 *"I have been living alone for the past few years. This park has given me an outlet and a*
314 *chance to meet neighbours during my evening walks. I have made friends here and they*
315 *check on me if they don't seem out for my walk. It gives me comfort knowing that I*
316 *have a community nearby."* (Male, Age 70, New Delhi)

317

318 *"I have a big extended family and bring my grandchildren to this park. The big*
319 *advantage is that there is a play area for kids and a few benches for older people like me*
320 *to sit. I have managed to meet other grandparents and we have a nice community now.*
321 *All our grandchildren play with each other."* (Female, Age 67, Chennai)

322

323 Community gardens created avenues for informal gathering older adults took
324 ownership of the space, collectively grew plants, and developed friendships. Some
325 participants reported working on a community project or common goal with
326 others in the neighbourhood.

327

328 *“There was a neglected corner of the park that was becoming a garbage dump. One of*
329 *my friends decided to clean it up and plant shrubs and flowers. I also joined her, and*
330 *then many others joined us. We now take turns in watering the plants. It has become a*
331 *collective effort.” (Female, Age 66, New Delhi)*

332

333 *“My neighbour and I started a community garden near the park. We grow vegetables,*
334 *herbs, and flowers. We also started a small gardening group where we share tips and*
335 *exchange plants with others. This has now grown to over 75 participants. It has given*
336 *me something to look forward to and keeps me busy.” (Female, Age 60, Chennai)*

337

338 Social and cultural events were often held in parks and gardens, providing
339 opportunities for older adults to interact and develop social bonds.

340 *“There is a shrine in the centre of the park managed by the neighbourhood association.*
341 *Every morning, there is a puja (an act of worship) attended by many park visitors.*
342 *Many people bring flowers and garlands they have made themselves and also make*
343 *rangoli (decorative floor patterns). On auspicious days and festivals like the New Year*
344 *or Diwali, we have a big gathering here and everyone celebrates together.” (Male, Age*
345 *62, Chennai)*

346

347 *“On Children’s Day, a group of us... retired grandparents organise outdoor cultural*
348 *events for children in the park. Last year, we had face painting and many outdoor*
349 *games like hopscotch and tug of war.” (Female, Age 65, New Delhi)*

350

351 3.5. Benefits for socio-economically disadvantaged groups

352 Low-income populations in both cities reported lower access to UGS and parks
353 with lower quality, maintenance, and safety than high-income residents. People
354 living in socio-economically disadvantaged neighbourhoods recognised and
355 appreciated the value of UGSs, but the most convenient spaces were often of poor
356 quality.

357

358 *“I live in public housing in very cramped conditions. There are small streets in a bad*
359 *condition, open drains, poor lighting. The streets are too small to even have trees*
360 *around them. We do not have space inside our homes, so the playground is the only*
361 *space to get a breath of fresh air. I wish the municipality would improve its quality.*
362 *Everything is broken and damaged. Even a few benches for older people to sit will*
363 *help.” (Male, Age 64, New Delhi)*

364

365 *“I used to work as a housekeeper and was very active until I was 60, but then I had a*
366 *stroke and one side of my body was affected. The doctor recommended physiotherapy,*
367 *but I could not afford it long-term. The gym equipment in the nearby park is the only*
368 *free option I have to exercise, but some of it is broken and unusable.” (Female, Age 62,*
369 *Chennai)*

370

371 Neighbourhood disorder (e.g., vandalism, graffiti, litter) constrained older adults’
 372 use of UGS. Older women, in particular, reported feeling unsafe while walking
 373 through UGSs and vulnerable to anti-social behavior. Some older adults avoided
 374 UGSs because of crime, signs of physical disorder, and threats to personal safety.
 375 *“The park is only used by groups of men to drink alcohol. It is not safe for women so I*
 376 *avoid it. They are always loitering around, hanging around at the entrance to the park.*
 377 *I don’t even feel like going there. It is so unpleasant.” (Female, Age 62, New Delhi)*
 378
 379 *“I work as a cleaner all seven days of the week. Sometimes, I walk through the park*
 380 *which is on the way, but there is no proper lighting on the paths. When I leave for work*
 381 *in the mornings, it is still dark and most of the time, the street lights are not working,*
 382 *or someone has broken them. This is the only chance I have to walk in a green space and*
 383 *escape from the traffic and noise, but I don’t feel safe in the park.” (Female, Age 61,*
 384 *Chennai)*
 385

Table 2. Summary table of themes and sample quotes (N=60) highlighting perspectives on urban green spaces and ageing in New Delhi and Chennai, India

Themes	Quotes
Health benefits of urban green space	<p><i>“The roads are busy and pavements are always crowded and chaotic. They are too many hurdles and no continuous flat surface. I have to constantly climb up and down from the footpaths as they end abruptly. The park is the only safe space since it allows me to walk without worrying about falling or motorbikes and traffic hitting me.”</i> –Male, Age 66, Chennai</p> <p><i>“The pollution in Delhi is unbearable. At home, we have air filters, but when I step outside, I usually walk in the neighbourhood park. At least there are some trees and plants there which provide fresh air and shade, otherwise on the streets, I am only breathing the fumes from vehicles and suffering under the hot sun”</i> –Female, Age 69, New Delhi</p>
Quality of urban green space	<p><i>“The park near the signal is the only open space for everyone in this crowded area. It gets very busy in the morning and evening, so I come early to avoid the crowds.”</i> –Male, Age 62, Chennai</p> <p><i>“The park in my neighbourhood and footpaths leading to it are full of garbage and litter. It is unpleasant to walk there and puts me off, so I don’t go there.”</i> –Female, Age 71, New Delhi</p>

	<p><i>“I have arthritis and the doctor has told me to exercise my knees and ankles. But I live in this busy and crowded area where there are many shops. There is no space to walk on the footpaths because they are crowded. Sometimes my son will drive me to the park, but otherwise I stay inside the flat”</i></p> <p style="text-align: right;">—Female, Age 74, New Delhi</p> <p><i>“I cannot walk without support, so I do not like to go outside the house. If someone takes me to the park, then I go, but otherwise, I am worried about falling on the uneven footpaths.”</i></p> <p style="text-align: right;">—Female, Age 76, Chennai</p>
<p>Community building and social capital</p>	<p><i>“I have made new friends here and we meet in the park for yoga every morning. I like doing that because other people are around. Some of us also come here for evening walks. Because I am alone at home all day, I find it is nice to do these in a group.”</i></p> <p style="text-align: right;">—Female, Age 64, New Delhi</p> <p><i>“I have knee pain and have been advised to walk everyday. I started coming to this park every evening and met others who also have health issues. We have formed a walking group and it keeps us motivated.”</i></p> <p style="text-align: right;">—Male, Age 78, Chennai</p> <p><i>“The park provides something for everyone. We have a temple in the park and the regular park visitors have formed a management committee. They take turns in supervising the cleaning, decoration and morning prayer rituals at the temple. There is another committee that oversees the yoga and exercise classes. It has brought the community together.”</i></p> <p style="text-align: right;">—Male, Age 75, Chennai</p>
<p>Benefits for socio-economically disadvantaged groups</p>	<p><i>“I bring my grandchildren here to play. This park is the only free and safe outdoor space near our home where they can run around and play.”</i></p> <p style="text-align: right;">—Female, Age 62, Chennai</p> <p><i>“I drop my grandson to school everyday and we walk through the park to avoid the traffic and pollution. This section of the walk is the only highlight, otherwise the constant noise and fumes from traffic are horrible.”</i></p>

386

387 **4. Discussion**

388 Our study highlights the relevance of UGSs for healthy ageing in rapidly
389 urbanising megacities in India. Predominantly, research investigating the links
390 between UGS and health have been conducted in HICs. Our research draws from
391 the lived experiences of older adults in two high-density cities in India and
392 examines the influence of UGS on behaviours that promote healthy ageing, which
393 is fundamental for the design of age-friendly cities. We explored several pathways
394 through which UGS may promote positive health, social and environmental
395 outcomes, which are consistent with previous research in HICs.^{32,33} UGS may
396 promote mental and physical health in older adults by providing opportunities for
397 psychological relaxation and stress alleviation, supporting physical activity,
398 stimulating social cohesion.^{5,33} UGSs may also reduce exposure to harmful factors
399 which older adults are especially vulnerable to such as toxic air pollutants, noise,
400 and excessive heat.

401

402 Access to UGS provided an incentive for everyday physical activity and improved
403 social interaction, which is especially important for older women. In our study,
404 women reported participating in group-based physical activity programmes and
405 community projects with new friends as a result of increased social interactions in
406 their local UGS. Studies have found that women who frequently exercised in a
407 group developed a sense of familiarity with each other and therefore felt safer.³⁴
408 This is especially important in India, as women over the age of 60 are the fastest-
409 growing age group with insufficient physical activity levels and higher levels of
410 disability compared to men.³⁵

411

412 Neighbourhoods with higher levels of UGS foster social cohesion and reduce
413 feelings of loneliness, which are key predictors of health in the older adults.^{36,37} In
414 our study, participants reported increased communication and non-familial
415 intergenerational interaction between younger and older adults in UGSs.
416 Successful non-familial intergenerational interactions were achieved through
417 shared experiences and meaningful outdoor activities in UGSs. Strong social
418 connections are linked to lower rates of early mortality, less fear of crime, reduced
419 loneliness, and better physical health in older adults.³⁸

420

421 Our study demonstrated the transformation of community liabilities into assets. In
422 both cities, community gardens were established through informal interaction with
423 neighbours and social networks. Studies of the social dynamics of community
424 gardens have illustrated the relationships between urban greening and community
425 building.^{39,40} Grassroots initiatives such as community gardens can transform
426 dilapidated vacant lots into usable UGSs. Once created, these UGSs can continue
427 to strengthen social ties and build a sense of community.

428

429 For UGSs to benefit the health of older adults, the quality and design of the
430 features may need to be adapted. In our study, features such as benches, shaded
431 walking paths with non-slip surfaces and outdoor lighting were especially
432 important. For older adults to move around, walkability, connectivity, and safety
433 of streets around the UGS, and access to public transport are key factors. The
434 quality of UGS is dependent on its integration with neighbourhood planning,
435 design of streetscapes, and pedestrian infrastructure.^{5,6}

436

437 Results from this study underscore that everyone can benefit from UGS, but they
438 can be of particular relevance for older adults living in socially disadvantaged or
439 underserved communities, which often have the least access to high-quality parks
440 and green spaces. Neighbourhoods with high deprivation and crime rates,
441 deficient quality of shelters and housing stock, overcrowding, poor sanitation, and
442 lack of access to healthcare services can exacerbate health and well-being in later
443 life.⁴¹ In such areas, outdoor environments like parks and UGS can play a key role
444 in enhancing physical and mental health, maintaining social networks, and
445 fostering a sense of belonging among older adults.

446

447 4.1. Strengths and limitations

448 The strength of this study was the use of qualitative research methods to
449 investigate the topic of interest and the use of inductive and thematic analysis.
450 Using exploratory techniques with participants sharing narratives of lived
451 experiences and in-built mechanisms to ensure the reliability of data and validity
452 of thematic analysis enabled a richer understanding of the topic. Independent
453 researchers analysed the data and the expertise of the advisory group was used to
454 harmonize discordance and create consensus, ensuring rigor and consistency. This
455 process highlighted the importance and relevance of including qualitative data to
456 understand the mechanisms for a specific population of interest. The sampling and
457 site selection in two megacities cities located in the north and south India captured
458 cultural diversity. To our knowledge, this is the first study on the role of UGS for
459 healthy ageing in India.

460

461 Several limitations of this study must be considered. The modest sample size and
462 the non-probability nature of the sampling strategy may reduce the generalisability
463 of findings. Drawbacks of qualitative interviews include reliance on respondents'
464 accuracy and their intensity in terms of time, expense, and possible emotional
465 strain. The analysis did not account for socio-demographic characteristics of
466 participants and is therefore insufficient to make population-level summaries. This
467 study was conducted in two megacities in India which may restrict environmental
468 variability. Caution should be exerted before generalising findings to populations
469 that are different from the study settings, for example much smaller urban and
470 rural areas in India. Findings are not representative and cannot be extended to
471 wider populations. Delhi and Chennai have dissimilar UGSs, which have
472 diminished over time. The study did not capture information on the availability of

473 UGS per site which could differentially impact the experience of UGS in study
474 participants. This points to the need for care in extrapolating the results beyond the
475 study areas.

476

477 4.2. Implications for research, practice, and policy

478 The introduction of more UGS in urban settings has been widely endorsed as a
479 method to improve both physical and mental health in older adults. Recent
480 research efforts in healthy ageing in LMICs have begun to fill important research
481 gaps. However, the knowledge provided by these studies is limited by study
482 design and data quality. A consideration of contextual, cultural and environmental
483 factors mediating the relationship between UGS and health outcomes is necessary.
484 For example, future research in LMICs should assess cultural norms, traditions,
485 and acceptability of physical activity and recreation in UGS among certain
486 populations, especially women. An understanding of factors such as local climate,
487 heat exposure, environmental pollutants, crime and safety that may be
488 compromising the quality and access to UGS is necessary in LMICs.⁴² Longitudinal
489 studies that use objective indicators of UGS, built environment audits, and health
490 indicators are also warranted.

491

492 Researchers should be included as policy experts in panels of state and central
493 government urban development ministries and urban planning agencies. Creating
494 age-friendly communities will require planners to collaborate with practitioners
495 and researchers from other disciplines and integrate public health theories and
496 practices into planning pedagogy. There is a need for better inclusion of health and
497 equity outcomes in planning UGSs, improved monitoring and management of
498 local UGS in India.

499

500 Understanding how to design, deliver, and manage UGSs effectively is essential
501 for creating age-friendly communities. UGSs seem to be most effective when the
502 physical design of the green space is coupled with community engagement and
503 participation elements. The provision and administration of high-quality UGS
504 intertwine issues of planning, design, management, and governance.^{43,44} Local
505 decision-makers and planners will need to collaborate to address inequities in UGS
506 provision and implement mitigation measures. Examples include protection of
507 environmentally sensitive areas, promotion of urban agriculture, biodiversity
508 enhancement through tree planting and native landscaping, and prioritization of
509 UGS in socio-economically disadvantaged communities.⁴⁵

510

511 5. Conclusion

512 Indian cities are currently facing serious threats due to environmental degradation,
513 increasing carbon emissions, air pollution, and temperature (urban heat island
514 effect).^{46, 45} In dense megacities in India, uncontrolled expansion, poor accessibility
515 and connectivity to neighbourhood parks, diminishing UGS, and biodiversity are
516 pressing challenges to environmental sustainability and health of ageing

517 populations. As health disparities are increasingly understood as a product of
518 social, economic, political, and physical inequalities in places, urban planners will
519 need to play a more active role in understanding and addressing these inequities.
520 Multidisciplinary, cross-sectoral collaborations and community engagement
521 between the fields of urban planning and public health are essential to ensure that
522 UGSs provide functional opportunities for older adults in LMICs.

523

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527 and MC contributed to the writing and editing of the manuscript. All authors
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529

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534

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