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Associations between neighbourhood social cohesion and subjective well-being in two different informal settlement types in Delhi, India: a quantitative cross-sectional study.

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Title Page

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Associations between neighbourhood social cohesion and subjective well-being in two different informal settlement types in Delhi, India: a quantitative cross-sectional study.

Abstract

Objectives To evaluate the relationships between subjective well-being and neighbourhood cohesion in two different informal settlement types.

Design Cross sectional analysis of a community-based survey

Setting Communities in two districts, Sanjay Colony, Okhla Phase II and Bhalswa in Delhi, India

Participants 328 residents in Bhalswa and 311 from Sanjay Colony.

Measurements Neighbourhood social cohesion scale measured on an 18-point scale and the subjective well-being scale made up of four subjective measures – hedonic, eudaemonic, evaluative and freedom of choice. Socio-demographic characteristics, and trust were used as covariates.

Results In both neighbourhood types there was a statistically significant positive correlation between neighbourhood cohesion and subjective well-being (Sanjay: $r=0.145$, $p<0.05$; Bhalswa: $r=0.264$, $p<0.01$). Trust and neighbourhood cohesion were strongly correlated (Sanjay: $r=0.618$, $p<0.01$; Bhalswa: $r=0.533$, $p<0.01$) and the longer the resident had lived in the community the greater the feeling of neighbourhood cohesion (Sanjay: $r=0.157$, $p<0.01$; Bhalswa: $r=0.171$, $p<0.05$). Only in the resettlement colony (Bhalswa) subjective well-being was negatively correlated with length of residency ($r=-0.117$, $p<0.05$). Residents who chose their settlement type (Sanjay residents) were 22.5 percentage points more likely to have a feeling of belonging to their neighbourhood than residents that had been resettled (Bhalswa) (Cohen's d effect size 0.45). Sanjay residents had a greater likelihood to feel more satisfied with life (4.8pp, $p<0.01$) and having greater perceived freedom of choice (4.8pp, $p<0.01$).

Conclusions Our findings contribute to the general knowledge about neighbourhood cohesion and subjective well-being within different informal settlement types in a mega-city such as New Delhi, India. Interventions that promote sense of belonging, satisfaction with life and freedom of choice have the potential to significantly improve people's well-being.

[300 words]

Strengths and limitations of this study

- The study was able to examine multiple dimensions of subjective well-being (evaluative, hedonic, eudaemonic and freedom) with 639 residents in slum areas of Delhi, India.
- To the best of our knowledge this is the first study to evaluate the impact around neighbourhood cohesion and subjective well-being of residents that have been resettled compared with those who chose their informal settlement.
- Cross-sectional design implying that only correlations between neighbourhood social cohesion and subjective well-being were established. Causal associations could not be proven.
- Results were subject to possible selection bias with regards to the colonies participating. Sanjay Colony, Okhla Phase II and Bhalswa resettlement colony were already known to the research team and therefore convenience sampling owing to our long-term relationship.

INTRODUCTION

A neighbourhood is a district of an urban city where neighbours live and come together through social and cultural networks. For some a 'neighbourhood' defines who they are in terms of social position and identity. Neighbourhoods can form boundaries as well as promote rich cultural diversity.[1-3] Social cohesion is defined as the presence of societal features such as trust, networks, support, and societal norms.[4-6] A neighbourhood with strong social cohesion can empower communities to support each other through residential bonds, create coordinated actions, and networks for a collective good.[7,8] Research has shown that neighbourhoods with higher levels of social cohesion can be beneficial to the well-being of their communities.[9-14] Well-being is key to the creation and maintenance of healthy and productive societies.[15,16] High levels of well-being have been shown to result in better health

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and longevity.[17] Low levels of neighbourhood social cohesion and trust are associated with stress, depression, and anxiety.[18,19] Studies suggest that friendship, support and advice are associated with well-being and that social cohesion relates positively to psychological health.[20-26] The length of residency, income, and age of the individual have been shown to be closely associated with a feeling of positive neighbourhood cohesion.[2,27-33] Some studies find no correlations[2,34] and others negative correlations concerning education level.[30,32]

Research from around the world has demonstrated that maintaining well-being is important for those who are living in difficult circumstances.[35,36] Around one-quarter of the world's urban population (over half of whom reside in Asia) live in informal, slum, and squatter settlements, which typically are unauthorised.[37] New Delhi is currently the third largest mega-city in the world and second to Tokyo in Asia, with just over 32 million people living around and in New Delhi.[38,39] With a growth rate of 3% and 800,000 poor rural migrants arriving in the city every year looking for better economic opportunities, forecasts suggest that in the next five years the population could outstrip Tokyo making it Asia's biggest megacity.[40] The Delhi Master Plan divides the city into three categories - planned, special, and unplanned. Due to rapid population growth residents have bought and constructed houses on land which is not zoned in the Master Plan for residential purposes.[41-44] In this paper we investigate similarities and differences in neighbourhood social cohesion and well-being for households living in two different settlement types in Delhi - Sanjay Colony, Okhla Phase II a squatter settlement and Bhalswa a resettlement colony. Squatter settlements are unauthorised occupation of vacant land, mostly public, with minimum access to civic services and amenities. Resettlement colonies are made up of families 'evicted' from their squatter settlement by the Slum Rehabilitation Authority (SRA) to randomly allocated housing. Resettlement colonies, a result of the systematic process of relocating the poor from the city to its periphery through the reclamation of land with a focus of the gentrification of urban spaces, have low levels of amenity provision by public agencies because of the scarcity of funds.[42,45-51] Residents in resettlement colonies have expressed concerns around community cohesion. Studies of resettlement areas in India have found that residents report greater social alienation, their homes being devoid of security of tenure, lacking a socio-economic livelihood base with the resettlement sites being large distances from residents' former settlements.[48,49,52-56] Residents started to live in Bhalswa in 2000, being evicted from 11 different slum locations around and in Delhi including Nizamuddin, Dakshinpuri and Rohini.[57]

We examine the relationships between subjective well-being (SWB) and neighbourhood cohesion, taking into consideration the socioeconomic backgrounds of the households as well as levels of trust in two different informal settlement types. As neighbourhoods are bounded urban areas, they offer the researcher an important opportunity to understand individual's and community's perceptions within a finite region. Different neighbourhoods can be investigated, explored, and compared.[58-61] We consider the association between neighbourhood social cohesion and well-being for residents living in different colony types, one where the residents have chosen to make their home in a squatter colony and the other where squatter colonies have been demolished and the residents uprooted to reside in a resettlement colony. Our findings will inform whether interventions, such as promoting a sense of belonging, respect and inclusion are required in specific neighbourhoods to promote community cohesion and potentially well-being. They will also help in identifying potential policy problems as well as better understand the drivers of subjective well-being.[62]

METHODS

Study design and setting

This is a community based, cross-sectional study carried out with residents in two informal settlements, Sanjay Colony, Okhla Phase II and Bhalswa resettlement colony, in New Delhi, India from 28 March to 9th April 2022 (figure 1 and 2).

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Sample size calculation and sampling techniques

Sanjay Colony and Bhalswa were selected through convenience sampling owing to our long-term relationships with the communities in these areas. Sanjay Colony, Okhla Phase II, has a total population of 66,820 over an area of 1.99km^2 with a population density of 33,659 people per km^2.[63] Bhalswa covers an area of 10.38 km^2 with a population 102,701 and population density of 9,892 people per km^2.[64] Households were selected by multi-stage random sampling, stratified on the population and geographic area. The sample size (n) calculation was performed using $n = {Nx}/{((N-1)E^2 + x)}$ and margin of error $E = \sqrt{{(N-n)x}/{n(N-1)}}$ with $x = Z\left({c}/{100}\right)^2 r(100-r)$ where N is the population size, r is the fraction of responses required and Z(c/100) is the critical value, with the calculation based on the Normal distribution. This calculation gave a target sample size of 311 in Sanjay Colony and 328 in Bhalswa, at the 95% confidence level for 5.1%-5.3% margin of error, with at least 80% power.[65]

Figure 1

Figure 2

Measures

Neighbourhood Cohesion Index (NCI)

The Neighbourhood Cohesion Index (NCI) is used in this research to measure social cohesion with a focus on neighbourhood networks as well as causal interaction with neighbours.[66-67] Higher mean total scores indicating a greater level of neighbourhood social cohesion.[20,68] All items were measured on a 5-point Likert scale with 5 (strongly agree) to 1 (strongly disagree). The total scores for NCI were calculated by taking the average of the eighteen items with 5 and 15 being reverse scored. The NCI measure can be divided into three subscale dimensions: 'sense of community' (SOC), 'neighbouring' (NEI) and 'attraction to neighbourhood' (ATTR).[67,69-71] It has been well validated and used in a range of country settings with various communities.[24,68-70,72,73]

Subjective Well-Being (SWB)

Subjective rather than objective well-being has been used in this study to explore the individual's internal subjective assessment of their own life as a whole, based on cognitive judgments and affective reactions. Diener, one of the leading scholars in subjective well-being (SWB) research, defines SWB as how "a person feels and thinks his or her life is desirable regardless of how others see it" (p.1).[74] This definition highlights the thinking and feeling dimensions of SWB. To gain an understanding of how an individual's perceived subjective well-being is associated with neighbourhood social cohesion four subjective measures of well-being were used. These four subjective measures of well-being are hedonic well-being (feeling of happiness), eudaemonic well-being (sense of purpose), evaluative well-being (life satisfaction) and freedom of choice (life control) (table1).[75-81]

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Table 1 Measures: Neighbourhood Cohesion Index and Subjective Well-Being (NCI and SWB)

Neighbourhood Cohesion Index (NCI)	
Item	***Item description***
NCI1 (ATTR)	Overall, I am very attracted to living in this neighbourhood
NCI2 (ATTR)	I feel like I belong to this neighbourhood
NCI3 (NEI)	I visit with my neighbours in their homes
NCI4 (NEI)	The friendships I have with people in my neighbourhood mean a lot
NCI5 (ATTR)	Given the opportunity, I would like to move out of this neighbourhood (R)
NCI6 (NEI)	If people in my neighbourhood were planning something I'd think of it as something 'we' were doing rather than 'they' were doing
NCI7 (NEI)	If I need advice, I could go to someone in my neighbourhood
NCI8 (SOC)	I agree with most of my neighbourhood about what's important in life
NCI9 (SOC)	I believe my neighbours would help me in an emergency
NCI10 (SOC)	I feel loyal to people in my neighbourhood
NCI11 (NEI)	I borrow things and exchange favours with my neighbours
NCI11 (NEI)	I borrow things and exchange favours with my neighbours
NCI12 (SOC)	I'd be willing to work with others to improve my neighbourhood
NCI13 (ATTR)	I plan to remain a resident of this neighbourhood for a number of years
NCI14 (SOC)	I think of myself as similar to people who live in this neighbourhood
NCI15 (NEI)	I have never invited neighbours over to my house to visit (R)
NCI16 (SOC)	A feeling of fellowship runs deep in this neighbourhood
NCI17 (SOC)	I regularly stop to talk with people in my neighbourhood
NCI18 (SOC)	Living in this neighbourhood gives me a sense of community
Subjective well-being (SWB)	
Item	*Item Description*
Satisfaction	Overall, how satisfied are you with life as a whole these days? (0 not at all satisfied to 10 completely satisfied)
Freedom	How much freedom of choice and control do you feel you have over the way your life turns out? (0 no freedom and control to 10 complete freedom and control)
Happiness	How happy did you feel yesterday? (0 not at all happy to 10 completely happy)
Purpose	Do you feel your life has important purpose or meaning? (0 not at all worthwhile to 10 completely worthwhile)
Trust	
Trust	How much trust do you have in your neighbours? (0 do not trust at all to 4 trust completely)

Covariates

Individual-level characteristics include socio-demographics (age, education, employment status, income, length of residence, ethnicity, religion, and caste). For neighbourhood characteristic we have settlement type.

Patient and public involvement

This research was done with public involvement. This study built on existing long-term relationships with the communities of Sanjay Colony, Okhla Phase II and Bhalswa. Community representatives were informed of the purpose of the study and were consulted on the research instrument. There was no patient involvement.

Informed consent

Verbal informed consent was provided by participants who were willing to take part. Community

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leaders advised that some participants may not be able to sign their names and those who were able may view this with suspicion due to identity protection concerns within the informal settlements. No incentives were provided for participation.

Procedures

The data reported in this article were collected from 311 residents in Sanjay Colony, Okhla Phase II and 328 residents in Bhalswa. These areas were chosen as they represent two different types of informal settlements, Sanjay Colony Okhla II categorised by the Delhi Master Plan as a 'slum' and Bhalswa categorised as a Resettlement Colony. A team of 18 survey administrators under the supervision of a researcher from Newcastle University collected the data. Indus Information Initiatives provided in country support. A systematic household survey was carried out by administrators that were grouped into pairs and had been provided specific training for this project. The head of household was interviewed by the survey administrators in a random sample of households. Where there was a nonresponse, the team moved onto the next 'available' household. To avoid any literacy issues administrators read out the household survey to the participants in their local language.

Data processing and analysis

Data were collected using Qualtrics and exported into Stata 17 for analysis. Initially descriptive statistical analysis was undertaken to obtain means and standard deviations for the data. Statistical tests were then carried out to ascertain if any significant differences existed between the two community's demographic variables. Independent t tests were used for continuous outcomes and Chi-Square tests for dichotomous outcomes. Structural Equation Modelling (SEM) was used to establish the construct validity of the NCI and the SWB measures. The Cronbach alpha was used to measure the internal consistency of the NCI. For the SWB internal reliability was considered through correlations between the NCI and its sub scores. To understand the differences between residents in Sanjay Colony, Okhla Phase II and Bhalswa individual items on both the NCI and SWB measures were analysed using the estimated average marginal components effect (AMCEs). The ACME is the average causal effect of changing the community variable from Bhalswa(=0) to Sanjay Colony(=1) for a given resident while averaging over the other factors is given by,

$$\tau(1,0;\Pr(\boldsymbol{t}_{ij,-l}\boldsymbol{t}_{i,-j})) = \sum_{(\boldsymbol{t}_{ij,-l}\boldsymbol{t}_{i,-j})\epsilon\tau} \mathbb{E}[Y_i(1,\boldsymbol{t}_{ij,-l}\boldsymbol{t}_{i,-j}) - Y_i(0,\boldsymbol{t}_{ij,-l}\boldsymbol{t}_{i,-j})] \times \Pr(\boldsymbol{t}_{ij,-l}\boldsymbol{t}_{i,-j})$$

where $\boldsymbol{t}_{ij,-l}$ is an (L-1) dimensional vector representing levels of all the factors except the factor L of the j th item answered by respondent i, $\boldsymbol{t}_{i,-j}$ denotes the levels of all factors for the remaining other than j, and τ is the choice of $\Pr(\boldsymbol{t}_{ij,-l}\boldsymbol{t}_{i,-j})$. The expectation ($\mathbb{E}$) is over a random sample of the respondents and item responses.[82] A major advantage of this statistical method is that it is fully nonparametric and so does not require any functional choice probability assumptions.

RESULTS

Characteristics of participants

We collected personal information from 328 residents in Bhalswa and 311 from Sanjay Colony, Okhla, Phase II between March-April 2022. The majority in both colonies were Hindu, belonging to the scheduled caste, migrating from Uttar Pradesh (UP). However, there was statistically significant differences between the two colonies with a higher proportion of Muslims in Bhalswa (22.6% Bhalswa vs 5.5% Sanjay), a higher proportion of general and backwards caste in Bhalswa (42.4% Bhalswa vs 31.9% Sanjay) and a higher proportion of migration from UP in Sanjay Colony (71.7% Sanjay vs 63.7% Bhalswa). For the 639 participants the number of years of education (8.78 years) and the age of the main household wage earner (38.62 years) were not statistically significantly different in the two colonies. Almost one third of households in Sanjay Colony reported their main occupation as a self-employed business owner, and in Bhalswa this was true for less than one fifth of households. The average monthly income is Sanjay Colony was statistically significantly less at Rs. 16,681.70/- (£172.82 (£1=Rs.96.52/- conversion rate)) compared with Bhalswa at Rs. 18,935.98/- (£196.18). Monthly income

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was positively correlated with the household owning a refrigerator with a freezer (r=0.280, p<0.01), washing machine (r=0.331, p<0.01) and scooter/motorcycle (r=0.367, p<0.01) in both communities. These wealth indicators show positive associations with monthly income. Those in Sanjay colony were more likely to carry out employment within their own community compared to those in Bhalswa (35.4% Sanjay vs 12% Bhalswa). Where a statistically significant difference was found with regards to the wealth indicators only the ownership of a smartphone was more likely in Sanjay than in Bhalswa. For scooter, bicycle, electricity, refrigerator, and washing machine Bhalswa residents were statistically more likely to own these items than those in Sanjay (table 2).

Table 2 Sociodemographic characteristics of main household wage earner in two settlements

	Sanjay Colony	Bhalswa	p-value	Total
Religion				
Hindu	291 (93.6)	251 (76.5)	0.001***	542 (84.8)
Muslim	17 (5.5)	74 (22.6)	0.001***	91 (14.2)
Other (Christian, Sikh, Buddhist)	3 (0.9)	3 (0.9)		6 (1.0)
Caste				
General caste	54 (17.4)	74 (22.6)	0.114	128 (20.0)
Scheduled caste	216 (69.5)	185 (56.4)	0.001***	401 (62.8)
Backward caste	45 (14.5)	65 (19.8)	0.026*	110 (17.2)
Education				
Mean number of years of education #	9.00 (5.88)	8.57 (5.86)	0.355	8.78 (5.87)
Main household occupation				
Self-employed business owner	94 (30.2)	61 (18.6)	0.001***	155 (24.3)
Regular salary/ wage employee	128 (41.2)	154 (47.0)	0.152	282 (44.1)
Causal worker/ daily paid labourer	89 (28.6)	113 (34.5)	0.126	202 (31.6)
Age of the main household wage earner #	38.87 (11.25)	38.37 (10.89)	0.569	38.62 (11.06)
Mean **length of residence** (years) #	29.05 (12.40)	18.47 (9.44)	0.001***	23.62 (12.18)
Mean **monthly Income** for whole family (Rs) #	16,681.70 (7,575.32)	18,935.98 (10,567.12)	0.001**	17838.82 (9294.46)
Work				
Outside community	167 (53.7)	238 (72.6)	0.001***	405 (63.4)
Work inside and outside	34 (10.9)	50 (15.2)	0.128	84 (13.1)
Inside community	110 (35.4)	40 (12.2)	0.001***	150 (23.5)
State of origin				
Bihar	40 (12.9)	48 (14.6)	0.516	88 (13.8)
Rajasthan	23 (7.4)	30 (9.1)	0.422	53 (8.3)
Uttar Pradesh	223 (71.7)	209 (63.7)	0.031*	432 (67.6)
Other	25 (8.0)	41 (12.5)	0.064	66 (10.3)
Wealth items				
Owns car or jeep	4 (1.3)	8 (2.4)	0.385	12 (1.9)
Scooter/motorcycle	80 (25.7)	116 (35.4)	0.008••	196 (30.7)
Auto/mini-3-wheeler	10 (3.2)	14 (4.3)	0.484	24 (3.8)
Bicycle	60 (19.3)	89 (27.1)	0.019**	149 (23.3)
Smart phone	280 (90.0)	260 (79.3)	0.001***	540 (84.5)
House has electricity	298 (95.8)	324 (98.8)	0.020**	622 (97.3)
Computer	8 (2.6)	11 (3.4)	0.561	19 (3.0)
Refrigerator with a freezer	155 (49.8)	251 (76.5)	0.001***	406 (63.5)
Washing machine	89 (28.6)	127 (38.7)	0.007**	216 (33.8)
TV	237 (76.2)	269 (82.0)	0.071	506 (79.2)

Note # denotes results that are mean (SD), all others are given as number of cases and percentage in parenthesis. Statistical tests: independent t test was used for continuous outcomes and Chi-Square test was used for dichotomous outcomes. Each of the 'other' states each represent individually less than 2% of the population -Delhi, Haryana, Madhya Pradesh, Uttarakhand, Chattisgarh, Himachal, Jharkhand, Nepal, Punjab, Tamil Nadu, and West Bengal.

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Psychometric properties of the NCI and subjective well-being measure

Pilot

To test the cross-cultural transferability of the survey, a pilot was carried out with 150 residents of Hawadigar colony, Bangalore City, Karnataka, India (Delhi being in COVID-19 lockdown in early 2022) to test for reliability. The composite reliability was good (NCI, α = 0.90; SWB, α =0.78). To establish construct validity of the measures Structural Equation Modelling (SEM) was undertaken. In general, good models should have RMSEA < 0.06 and CFI > 0.9. The NCI (RMSEA =0.024, CFI =0.995) and SWB (RMSEA = 0.051, CFI=0.980) measures both show good validity.[83,84]

Current Study

The NCI (α = 0.89) and SWB (α = 0.80) in this present study show good composite reliability. Very good convergent validity of the NCI is seen through correlations with its sub scores of SOC (r=0.947, p<0.01), NEI (r=0.896, p<0.01) and ATTR (r=0.779, p<0.01). For the SWB internal reliability was considered through correlations between the NCI for Sanjay colony (r=0.145, p<0.05) and Bhalswa (r=0.264, p<0.001). Group level construct validity was established with values of CFI > 0.94 and RMSEA < 0.05 for both Sanjay Colony and Bhalswa. Reliability of the measures was also demonstrated by loadings on to each of the factors. Sense of community (0.54 to 0.74), neighbouring (0.30 to 0.77), attraction to neighbourhood (0.30 to 0.79) and well-being (0.33 to 0.82). Factor loadings greater than or equal to 0.3 are said to be salient and relate meaningfully to primary factors.[84-86]

Neighbourhood Cohesion Index (NCI)

Eight statistically significant differences were seen between the responses from residents in Sanjay Colony and Bhalswa on the NCI, four in 'sense of community' (SOC), and two in each of the themes 'neigbouring' (NEI) and 'attraction to neigbourhood' (ATTR) as shown in figure 3 with additional detail in online supplemental table 1.

Figure 3

Regarding the sense of community (SOC), there was an increased likelihood that residents in Sanjay Colony were 9.3 percentage points (pp) more likely to believe their neighbours would help them in an emergency (NCI 9, p<0.001) and 9.5 pp more likely to have a greater willingness to improve their neighbourhood than those residents in Bhalswa (NCI 12, p<0.001). Residents of Sanjay Colony were 10.2 pp more likely to feel a greater sense of community than those residents of Bhalswa (NCI 18, p<0.001). Sanjay Colony residents were 5.48 pp less likely to feel that their neighbours agree with them about what is important in life (NCI 8, p<0.05).

In the subscale 'neighbouring' (NEI) residents in Sanjay Colony were 4.76 pp less likely to invite neighbours to their home (NCI 15, p<0.01) and 9.7 pp less likely to feel that neighbourhood friendships meant a great deal to them (NCI 4, p<0.001).

With regards 'attraction to the neighbourhood' (ATTR) respondents from Sanjay Colony were 7.3 pp less likely to say that they were attracted to living in the neighbourhood (NCI 1, p<0.01). They were 22.5 pp more likely to have a feeling of belonging to the neighbourhood (NCI 2, p<0.001). Given that the base probability is 50 percent, the effect size of this result is the most significant of all these results as it increases the base probability by 45 percent (medium Cohen's d effect size (0.45 =0.225/0.5)).

Subjective well-being (SWB)

There were two statistically significant differences between the responses from residents in Sanjay Colony and Bhalswa on the SWB (figure 4). There was a 4.8 pp increased likelihood that residents in Sanjay Colony had a greater likelihood to feel more satisfied with life (p<0.01) and a 4.8 pp increased

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likelihood of having greater perceived feelings of freedom of choice (p<0.001) than residents in Bhalswa. For additional detail see the online supplemental table 2.

Figure 4

Associations between NCI and SWB

Statistically significant positive correlations demonstrated modest associations between neighbourhood cohesion (NCI) and subjective well-being (SWB) in both Sanjay Colony (r=0.145, p<0.05) and Bhalswa (r=0.264, p<0.01). In both communities there was a strong positive correlation between trust and neighbourhood cohesion (Sanjay r=0.618, p<0.01; Bhalswa r=0.533, p<0.01). However, only in Bhalswa was trust statistically significantly positively related to subjective well-bring (r=0.121, p<0.05).

There was a statistically significant positive modest correlation with regards to the length of residence within the neighbourhood and the NCI in both Sanjay and Bhalswa (Sanjay, r=0.157, p<0.01; Bhalswa, r=0.171, p<0.05). The longer a resident had lived in the community the greater the feeling of neighbourhood cohesion. Well-being was also statically significantly correlated with employment in both communities (Sanjay - income, r=0.119, p<0.5; regular employment, r=0.134, p<0.05: Bhalswa - income, r=0.165, p<0.01; regular employment, r=0.109, p<0.05).

Only in Bhalswa was there shown to be correlations with length of residency, SWB and trust. For subjective wellbeing there was a negative modest correlation between the length of residency (r=-0.117, p<0.05), the longer the resident lived in the community the lower their level of subjective well-being. For the level of trust there was a significant positive modest correlation with length of residency. The longer a resident had lived in Bhalswa the greater the level of trust (r=0.145, p<0.01). Interestingly regarding trust, only in Bhalswa was there a statistically significant correlation between employment and trust (income, r=0.132, p<0.05; regular employment, r=-0.161, p<0.01; working outside the community, r=-0.238, p<0.01).

Neither age nor education were found to be statistically significant correlated with NCI, SWB or trust in Sanjay or Bhalswa (table 3).

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Table 3. Correlations between Neighbourhood Cohesion Index, Subjective Well-Being and socio-demographic covariates

	Total NCI	SWB	Trust	Age	Length of residence	Education	Work out	Income	Daily	Regular
Total NCI		0.145*	0.618**	0.006	0.157**	0.090	0.047	0.072	-0.090	0.083
Subjective well-being (SWB)	0.264**		0.031	-0.036	0.047	0.043	0.108	0.119*	-0.219**	0.134*
Trust	0.533**	0.121*		-0.015	0.020	0.034	0.064	-0.015	0.002	0.045
Age	0.005	0.004	-0.035		0.353**	-0.272**	-0.274**	-0.045	-0.009	-0.210**
Length residence	0.171**	-0.117*	0.145**	0.193**		-0.098	-0.066	0.076	-0.194**	0.083
Education	-0.019	0.095	0.016	-0.332**	-0.093		-0.047	0.196**	-0.090	0.035
Work outside community	-0.160**	0.103	-0.238**	-0.318**	-0.141*	0.118*		-0.155**	0.188**	0.318**
Income	0.123*	0.165**	0.132*	0.030	0.079	0.175**	0.081		-0.280**	-0.025
Daily paid wage earner	-0.032	-0.134*	0.011	0.088	0.047	-0.219**	-0.216**	-0.258**		
Regular employment	-0.035	0.109*	-0.161**	-0.172**	-0.092	0.178**	0.469**	0.101		

Sanjay Colony (above diagonal), Bhalswa (below diagonal)

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DISCUSSION

Key findings

This research considered two different informal settlement types in Delhi, India, where both communities were built on unauthorised land, with one being spontaneously developed by individual families (Sanjay) and the other 'planned' by the government to reallocate slum dwellers away from the city (Bhalswa). We found that in both settlements residents' feelings around community cohesion was associated with their subjective well-being. That is a greater sense of satisfaction, freedom, happiness, and purpose was felt by those residents that had rated more highly their sense of community, attraction to their neighbourhood and neighbourliness. When a community trusted their neighbours there was a greater feeling of cohesion. The longer a resident lived in the community there was a greater sense of cohesion. Those with higher incomes and those that undertook regular employment (employee) enjoyed higher levels of subjective well-being. We found that neither age nor education influenced feelings around trust, neighbourhood cohesion or subjective well-being.

Those living in Sanjay (squatter settlement) were more likely to feel a sense of belonging to a whole community where they would help and be helped by their neighbours in an emergency. However, Sanjay residents were less likely to be neighbourly with fewer friendships, fewer agreements with neighbours and less of an attraction to live in the neighbourhood. In Bhalswa there was a greater feeling of neighbourliness, that is friendships with neighbours and the longer the resident had lived in the community the greater level of trust in neighbours. The longer the resident had lived in Bhalswa the greater the negative effect on subjective well-being.

Our findings are to some extent in line with the existing literature that found associations between greater neighbourhood social cohesion and better subjective well-being.[9-14] Our research showed that a greater sense of community cohesion was associated with trust.[6] As in other literature our research found residents with the highest incomes having better subjective well-being.[27,28,33] Interestingly income was only associated positively with trust and neighbourhood cohesion in Bhalswa.

With regards to neighbourhood cohesion residents in Bhalswa, the resettlement colony, were less likely to have a sense of belonging to their neighbourhood, Williams et al., (2022)[56] agree, stating that resettlement housing projects in India produce ghetto effects, which inhibit feelings of belonging and processes of place-making. As in Mahadevia et al., (2016)[49] we found that residents in the resettlement colony of Bhalswa were less likely to feel a sense of community and the desire to improve their neighbourhood owing to greater heterogeneity of the residents. In contrast to the existing literature, we found that education was not correlated with trust, subjective well-being or neighbourhood cohesion. Blanchflower and Oswald (2004)[87] in their study on well-being over time showed that education played a role independently of income and Patel et al., (2021)[88] found that higher education significantly decreased the odds of low subjective well-being in older adults in India.

Implications

In India, the influx of rural populations arriving in cities causes multiple colony types to emerge that are built on unauthorised residential plots of land. These plots of land and colony types have different access to amenities as well as neighbourhoods that promote a sense of belonging, respect, and inclusivity.

Limitations

The first limitation of our study was its cross-sectional design implying that only correlations between neighbourhood social cohesion and subjective well-being were established. Causal associations could not be proven. Second, the results were subject to possible selection bias with regards to the colonies participating. Sanjay Colony, Okhla Phase II and Bhalswa resettlement colony were already known to the research team and therefore convenience sampling owing to our long-term relationship. We

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endeavoured to overcome this through the multi-stage random sampling of households. Third, self-reported and subjective measurements might cause information bias.

CONCLUSION

This research aimed to contribute to the analyses and debates concerning neighbourhood cohesion and subjective well-being for residents living in different informal settlement types that appear in mega-cities such as New Delhi, India. Gathering better local data allowed for a clearer understanding of the differences between residents of two types of slums, both typically devoid of security of tenure and infrastructure, but one on the periphery of the city with implications around socio-economic livelihood base where residents had not chosen to live but evicted from their original homes. Residents of resettlement colonies were forcefully relocated, uprooted from established social and economic networks typically against their will. Those living in Bhalswa would have experienced this sense of loss and helplessness when they were relocated to the periphery of the city. We found that Bhalswa residents were more likely to feel lower levels of community belonging yet higher levels of neighbourliness. The longer the resident had lived in Bhalswa the lower their subjective well-being, however the longer the residency the more likely they were to trust their neighbours. This seems counterintuitive. One explanation could be that the feelings associated with the trauma of compulsory relocation allowed the development of strong bonds with immediate neighbours coping with the original sense of helplessness. Thus, with longer terms of residency, their trust in neighbours increased independent of their perception of the neighbourhood as a whole. Friendliness and supportiveness among neighbours could have remained independent of any sense of self-esteem or fulfilment within the neighbourhood. Future studies could identify causal mechanisms at play, and strategies and policies that could improve subjective well-being in different neighbourhood settings.

Contributors: PD conceived the idea and conceptualised the study and is responsible for the overall content as guarantor. SH conducted the data analysis with statistical analyses being contributed by AS and BR. BR carried out the data collection, training of data collectors and monitored the data collection in the field. PD, SH and BR interpreted the results. AS and MP provided critical contribution to the discussion of the findings of the study. All authors contributed to the study design and review of the manuscript.

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Figure 1 **Map of Bhalswa Resettlement Colony, Delhi, India** (Google Earth Digital Globe Image, 2022)

Figure 2 **Map of Sanjay Colony, Okhla Phase II, Delhi, India** (Google Earth Digital Globe Image, 2022)

Figure 3 **Neighbourhood Cohesion Index estimated averaged marginal component effects for Sanjay Colony with 95% CIs**. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0). The marginal effect of each independent variable being averaged over the joint distribution of the remaining variables. The independent variables are in the vertical axis. The horizontal axis gives the prediction of change in the independent variable (points), and the associated 95% confidence intervals (bars).

Figure 4 **Well-being estimated averaged marginal component effects for Sanjay Colony with 95% CIs.** The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0). The marginal effect of each independent variable being averaged over the joint distribution of the remaining variables. The independent variables are in the vertical axis. The horizontal axis gives the prediction of change in the independent variable (points), and the associated 95% confidence intervals (bars).

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Figure 1 Map of Bhalswa Resettlement Colony, Delhi, India (Google Earth Digital Globe Image, 2022)

181x226mm (144 x 144 DPI)

Figure 2 Map of Sanjay Colony, Okhla Phase II, Delhi, India (Google Earth Digital Globe Image, 2022)

359x222mm (144 x 144 DPI)

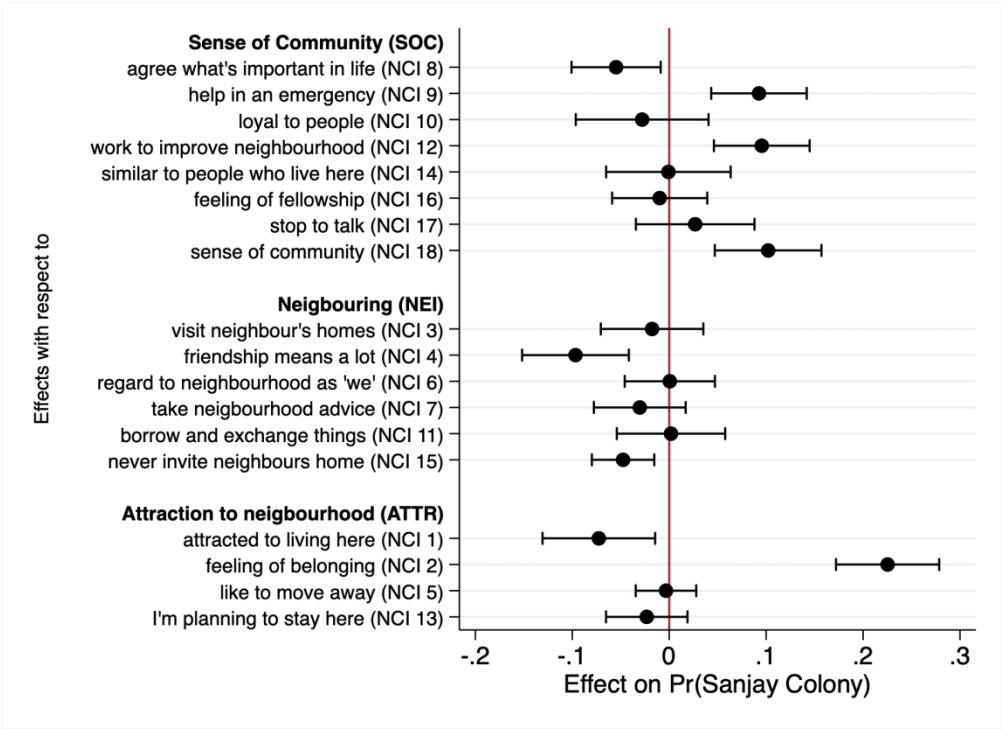

Figure 3 Neighbourhood Cohesion Index estimated averaged marginal component effects for Sanjay Colony with 95% CIs. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0). The marginal effect of each independent variable being averaged over the joint distribution of the remaining variables. The independent variables are in the vertical axis. The horizontal axis gives the prediction of change in the independent variable (points), and the associated 95% confidence intervals (bars).

324x236mm (144 x 144 DPI)

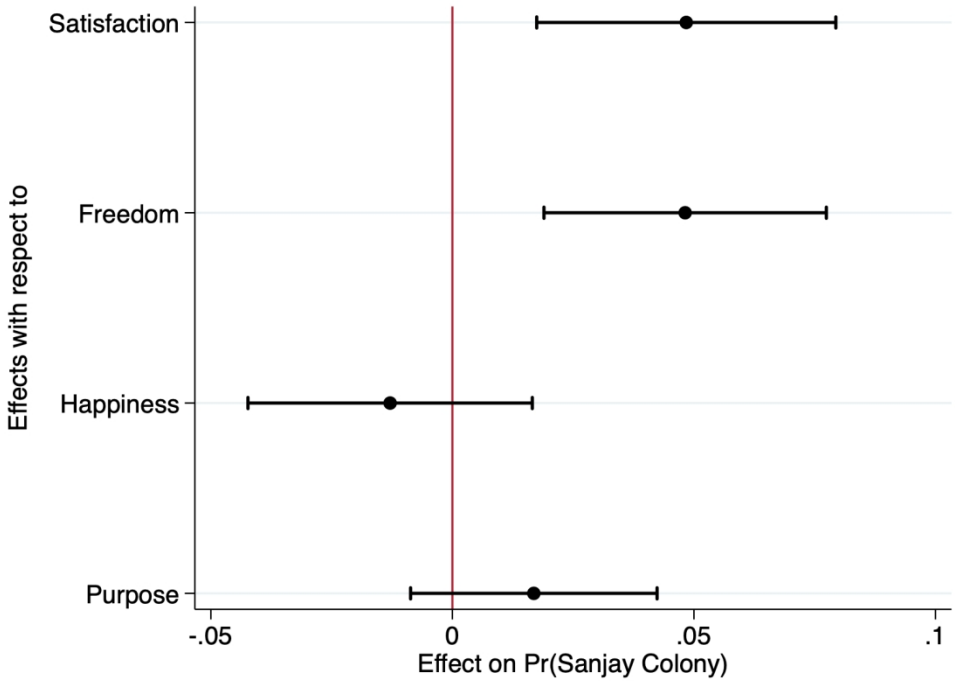

Figure 4 Well-being estimated averaged marginal component effects for Sanjay Colony with 95% CIs. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0). The marginal effect of each independent variable being averaged over the joint distribution of the remaining variables. The independent variables are in the vertical axis. The horizontal axis gives the prediction of change in the independent variable (points), and the associated 95% confidence intervals (bars).

310x225mm (144 x 144 DPI)

Supplemental Material

Coefficient estimates of the average marginal component effects with standard errors in parenthesis for figures 2 and 3 in main article.

Supplemental Table 1 Neighbourhood Cohesion Index estimated averaged marginal component effects for Sanjay Colony with 95% CIs.

Item	***Item description***	Sanjay Colony(=1)
SOC	**Sense of Community**	
NCI8 (SOC)	I agree with most of my neighbourhood about what's important in life	-0.055** (0.023)
NCI9 (SOC)	I believe my neighbours would help me in an emergency	0.093*** (0.025)
NCI10 (SOC)	I feel loyal to people in my neighbourhood	-0.028 (0.035)
NCI12 (SOC)	I'd be willing to work with others to improve my neighbourhood	0.095*** (0.025)
NCI14 (SOC)	I think of myself as similar to people who live in this neighbourhood	-0.001 (0.033)
NCI16 (SOC)	A feeling of fellowship runs deep in this neighbourhood	-0.010 (0.025)
NCI17 (SOC)	I regularly stop to talk with people in my neighbourhood	0.027 (0.031)
NCI18 (SOC)	Living in this neighbourhood gives me a sense of community	0.102*** (0.028)
NEI	**Neighbouring**	
NCI3 (NEI)	I visit with my neighbours in their homes	-0.018 (0.027)
NCI4 (NEI)	The friendships I have with people in my neighbourhood mean a lot	-0.097*** (0.028)
NCI6 (NEI)	If people in my neigbourhood were planning something I'd think of it as something 'we' were doing rather than 'they' were doing	-0.001 (0.024)
NCI7 (NEI)	If I need advice, I could go to someone in my neighbourhood	-0.030 (0.024)
NCI11 (NEI)	I borrow things and exchange favours with my neighbours	0.002 (0.028)
NCI15 (NEI)	I have never invited neighbours over to my house to visit (R)	-0.048** (0.016)
ATTR	**Attraction to neighbourhood**	
NCI1 (ATTR)	Overall, I am very attracted to living in this neighbourhood	-0.073* (0.030)
NCI2 (ATTR)	I feel like I belong to this neighbourhood	0.225*** (0.027)
NCI5 (ATTR)	Given the opportunity, I would like to move out of this neighbourhood (R)	-0.003 (0.015)
NCI13 (ATTR)	I plan to remain a resident of this neighbourhood for a number of years	-0.023 (0.021)
Constant		-0.157 (0.137)
		P[F(18, 620)=16.62] <0.001
		R^2=0.325

Analysis includes 639 observations. Coefficient estimates of the average marginal component effects with standard errors in parenthesis. ***p<0.001, **p<0.01, *p<0.05. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0).

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Supplemental Table 2 Well-being estimated averaged marginal component effects for Sanjay Colony with 95% CIs

Well being		
item	***Item description***	Sanjay Colony(=1)
	Well-being	
Satisfaction	Overall, how satisfied are you with life as a whole these days?	0.048** (0.016)
Freedom	How much freedom of choice and control do you feel you have over the way your life turns out?	0.048*** (0.015)
Happiness	How happy did you feel yesterday?	-0.013 (0.015)
Purpose	Do you feel your life has important purpose or meaning?	0.017 (0.013)
		P[F(4, 634)=14.49] <0.001 R^2=0.084

Analysis includes 639 observations. Coefficient estimates of the average marginal component effects with standard errors in parenthesis. ***p<0.001, **p<0.01, *p<0.05. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0).

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2
Objectives	3	State specific objectives, including any prespecified hypotheses	2
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	3
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*4,5*
Bias	9	Describe any efforts to address potential sources of bias	8
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	2
		(b) Give reasons for non-participation at each stage	6
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6
		(b) Indicate number of participants with missing data for each variable of interest	None
Outcome data	15*	Report numbers of outcome events or summary measures	5-7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9

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		(*b*) Report category boundaries when continuous variables were categorized	8-9
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	6
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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BMJ Open

Associations between neighbourhood social cohesion and subjective well-being in two different informal settlement types in Delhi, India: a quantitative cross-sectional study.

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Title Page

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Associations between neighbourhood social cohesion and subjective well-being in two different informal settlement types in Delhi, India: a quantitative cross-sectional study.

Abstract

Objectives To evaluate the relationships between neighbourhood cohesion and subjective well-being in two different informal settlement types.

Design Cross sectional analysis of a community-based survey

Setting Communities in two districts, Sanjay Colony, Okhla Phase II and Bhalswa in Delhi, India

Participants 328 residents in Bhalswa and 311 from Sanjay Colony.

Measurements Neighbourhood social cohesion scale measured on an 18-point scale and the subjective well-being scale made up of four subjective measures – hedonic, eudaemonic, evaluative and freedom of choice. Socio-demographic characteristics, and trust were used as covariates.

Results In both neighbourhood types there was a statistically significant positive bivariate correlation between neighbourhood cohesion and subjective well-being (Sanjay: $r=0.145$, $p<0.05$; Bhalswa: $r=0.264$, $p<0.01$). Trust and neighbourhood cohesion were strongly correlated (Sanjay: $r=0.618$, $p<0.01$; Bhalswa: $r=0.533$, $p<0.01$) and the longer the resident had lived in the community the greater the feeling of neighbourhood cohesion (Sanjay: $r=0.157$, $p<0.01$; Bhalswa: $r=0.171$, $p<0.05$). Only in the resettlement colony (Bhalswa) was subjective well-being negatively correlated with length of residency ($r=-0.117$, $p<0.05$). Residents who chose their settlement type (Sanjay residents) were 22.5 percentage points more likely to have a feeling of belonging to their neighbourhood than residents that had been resettled (Bhalswa) (Cohen's d effect size 0.45). Sanjay residents had a greater likelihood to feel more satisfied with life (4.8pp, $p<0.01$) and having greater perceived freedom of choice (4.8pp, $p<0.01$).

Conclusions Our findings contribute to the general knowledge about neighbourhood cohesion and subjective well-being within different informal settlement types in a mega-city such as New Delhi, India. Interventions that promote sense of belonging, satisfaction with life and freedom of choice have the potential to significantly improve people's well-being.

[300 words]

Strengths and limitations of this study

- The study was able to examine multiple dimensions of subjective well-being (evaluative, hedonic, eudaemonic and freedom) with 639 residents in slum areas of Delhi, India.
- To the best of our knowledge this is the first study to evaluate the impact around neighbourhood cohesion and subjective well-being of residents that have been resettled compared with those who chose their informal settlement.
- Cross-sectional design implying that only correlations between neighbourhood social cohesion and subjective well-being were established. Causal associations could not be proven.
- Results were subject to possible selection bias with regards to the colonies participating. Sanjay Colony, Okhla Phase II and Bhalswa resettlement colony were already known to the research team and therefore convenience sampling owing to our long-term relationship.

INTRODUCTION

A neighbourhood is a district of an urban city where neighbours live and come together through social and cultural networks. For some a 'neighbourhood' defines who they are in terms of social position and identity. Neighbourhoods can form boundaries as well as promote rich cultural diversity.[1-3] Social cohesion is defined as the presence of societal features such as trust, networks, support, and societal norms.[4-6] A neighbourhood with strong social cohesion can empower individuals within communities to support each other through residential bonds, create coordinated actions, and networks for a collective good.[7,8] Research has shown that neighbourhoods with higher levels of social cohesion can be beneficial to the well-being of their inhabitants.[9-14] Well-being is key to the creation and maintenance of healthy and productive societies.[15,16] High levels of well-being have been shown to

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result in better health and longevity.[17] Low levels of neighbourhood social cohesion and trust are associated with stress, depression, and anxiety.[18,19] Studies suggest that friendship, support and advice are associated with well-being and that social cohesion relates positively to psychological health.[20-26] The length of residency, income, and age of the individual have been shown to be closely associated with a feeling of positive neighbourhood cohesion.[2,27-33] Some studies find no correlations[2,34] and others negative correlations concerning education level.[30,32]

Research from around the world has demonstrated that maintaining well-being is important for those who are living in difficult circumstances.[35,36] Around one-quarter of the world's urban population (over half of whom reside in Asia) live in informal, slum, and squatter settlements, which typically are unauthorised.[37] New Delhi is currently the third largest mega-city in the world and second to Tokyo in Asia, with just over 32 million people living around and in New Delhi.[38,39] With a growth rate of 3% and 800,000 poor rural migrants arriving in the city every year looking for better economic opportunities, forecasts suggest that in the next five years the population could outstrip Tokyo making it Asia's biggest megacity.[40] The Delhi Master Plan divides the city into three categories -planned, special, and unplanned. Due to rapid population growth residents have bought and constructed houses on land which is not zoned in the Master Plan for residential purposes.[41-44] In this paper we investigate similarities and differences in neighbourhood social cohesion and well-being for households living in two different settlement types in Delhi - Sanjay Colony, Okhla Phase II a squatter settlement (unplanned) and Bhalswa a resettlement colony (planned). Squatter settlements are unauthorised occupations of vacant land, mostly public, with minimum access to civic services and amenities. Resettlement colonies are made up of families 'evicted' from their original squatter settlement to plots allotted by the Slum Rehabilitation Authority (SRA). Resettlement colonies, reflect the systematic process of relocating poor residents to the periphery to facilitate the gentrification of urban spaces. Consequently, they experience low levels of amenity provision by public agencies owing to scarcity of funds.[42,45-51] Residents in resettlement colonies have expressed concerns around community cohesion. Studies of resettlement areas in India have found residents reporting greater social alienation, their homes lacking both security of tenure and a socio-economic livelihood base because resettlement sites are large distances from residents' former homes.[48,49,52-56] Residents started to live in Bhalswa in 2000, having been evicted from 11 slum locations in and around Delhi including Nizamuddin, Dakshinpuri and Rohini.[57]

We examine the relationships between subjective well-being (SWB) and neighbourhood cohesion, taking into consideration the socioeconomic backgrounds of the households as well as levels of trust in two different informal settlement types. As neighbourhoods are bounded urban areas, they offer an important opportunity to understand individual's and community's perceptions within a finite region. Different neighbourhoods can be investigated, explored, and compared.[58-61] We consider the association between neighbourhood social cohesion and well-being for residents living in different colony types, one where the residents have chosen to make their home in a squatter colony and the other where squatter colonies have been demolished and the residents uprooted to reside in a resettlement colony. Our findings may inform whether interventions, such as promoting a sense of belonging, respect and inclusion are required in specific neighbourhoods to promote community cohesion and potentially well-being. They may also help in identifying potential policy problems as well as better understand the drivers of subjective well-being.[62]

METHODS

Study design and setting

This is a community based, cross-sectional study carried out with residents in two informal settlements, Sanjay Colony, Okhla Phase II and Bhalswa resettlement colony, in New Delhi, India from 28 March to 9th April 2022 (figure 1 and 2).

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Sample size calculation and sampling techniques

Sanjay Colony and Bhalswa were selected through convenience sampling owing to our long-term relationships with the communities in these areas. Sanjay Colony, Okhla Phase II, has a total population of 66,820 over an area of 1.99km^2 with a population density of 33,659 people per km^2.[63] Bhalswa covers an area of 10.38 km^2 with a population 102,701 and population density of 9,892 people per km^2.[64] Households were selected by multi-stage random sampling, stratified on the population and geographic area. The sample size (n) calculation was performed using $n = {Nx}/{((N-1)E^2 + x)}$ and margin of error $E = \sqrt{{(N-n)x}/{n(N-1)}}$ with $x = Z\left({c}/{100}\right)^2 r(100-r)$ where N is the population size, r is the fraction of responses required and Z(c/100) is the critical value, with the calculation based on the Normal distribution. This calculation gave a target sample size of 311 in Sanjay Colony and 328 in Bhalswa, at the 95% confidence level for 5.1%-5.3% margin of error, with at least 80% power.[65] In order to achieve the power calculation, 660 households were approached. In total 21 households did not agree to participate, with an overall response rate of 97% -94% and 99% in Sanjay Colony and Bhalswa respectively.

Figure 1

Figure 2

Measures

Neighbourhood Cohesion Index (NCI)

The Neighbourhood Cohesion Index (NCI) is used in this research to measure social cohesion with a focus on neighbourhood networks and the degree of neighbourliness; that is the emotional social support within the neighbourhood which includes visiting neighbours and friendships.[66-67] Higher mean total scores indicating a greater level of neighbourhood social cohesion.[20,68] All items were measured on a 5-point Likert scale with 5 (strongly agree) to 1 (strongly disagree). The total scores for NCI were calculated by taking the average of the eighteen items with 5 and 15 being reverse scored. The NCI measure can be divided into three subscale dimensions: 'sense of community' (SOC), 'neighbourliness' (NEI) and 'attraction to neighbourhood' (ATTR).[67,69-71] It has been well validated and used in a range of country settings with various communities.[24,68-70,72,73]

Subjective Well-Being (SWB)

Subjective rather than objective well-being has been used in this study to explore the individual's internal subjective assessment of their own life as a whole, based on cognitive judgments and affective reactions. Diener, one of the leading scholars in subjective well-being (SWB) research, defines SWB as how "a person feels and thinks his or her life is desirable regardless of how others see it" (p.1).[74] This definition highlights the thinking and feeling dimensions of SWB. To gain an understanding of how an individual's perceived subjective well-being is associated with neighbourhood social cohesion four subjective measures of well-being were used. These four subjective measures of well-being are hedonic well-being (feeling of happiness), eudaemonic well-being (sense of purpose), evaluative well-being (life satisfaction) and freedom of choice (life control) (table1).[75-81]

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Table 1 Measures: Neighbourhood Cohesion Index and Subjective Well-Being (NCI and SWB)

Neighbourhood Cohesion Index (NCI)	
Item	***Item description***
NCI1 (ATTR)	Overall, I am very attracted to living in this neighbourhood
NCI2 (ATTR)	I feel like I belong to this neighbourhood
NCI3 (NEI)	I visit with my neighbours in their homes
NCI4 (NEI)	The friendships I have with people in my neighbourhood mean a lot
NCI5 (ATTR)	Given the opportunity, I would like to move out of this neighbourhood (R)
NCI6 (NEI)	If people in my neighbourhood were planning something I'd think of it as something 'we' were doing rather than 'they' were doing
NCI7 (NEI)	If I need advice, I could go to someone in my neighbourhood
NCI8 (SOC)	I agree with most of my neighbourhood about what's important in life
NCI9 (SOC)	I believe my neighbours would help me in an emergency
NCI10 (SOC)	I feel loyal to people in my neighbourhood
NCI11 (NEI)	I borrow things and exchange favours with my neighbours
NCI12 (SOC)	I'd be willing to work with others to improve my neighbourhood
NCI13 (ATTR)	I plan to remain a resident of this neighbourhood for a number of years
NCI14 (SOC)	I think of myself as similar to people who live in this neighbourhood
NCI15 (NEI)	I have never invited neighbours over to my house to visit (R)
NCI16 (SOC)	A feeling of fellowship runs deep in this neighbourhood
NCI17 (SOC)	I regularly stop to talk with people in my neighbourhood
NCI18 (SOC)	Living in this neighbourhood gives me a sense of community
Subjective well-being (SWB)	
Item	*Item Description*
Satisfaction	Overall, how satisfied are you with life as a whole these days? (0 not at all satisfied to 10 completely satisfied)
Freedom	How much freedom of choice and control do you feel you have over the way your life turns out? (0 no freedom and control to 10 complete freedom and control)
Happiness	How happy did you feel yesterday? (0 not at all happy to 10 completely happy)
Purpose	Do you feel your life has important purpose or meaning? (0 not at all worthwhile to 10 completely worthwhile)
Trust	
Trust	How much trust do you have in your neighbours? (0 do not trust at all to 4 trust completely)

Socio-demographic characteristics

Individual-level characteristics include socio-demographics (age, education, employment status, income, length of residence, ethnicity, religion, and caste). For neighbourhood characteristic we have settlement type.

Patient and public involvement

This research was done with public involvement and built on existing long-term relationships with the communities of Sanjay Colony, Okhla Phase II and Bhalswa. Community representatives were informed of the purpose of the study and were consulted on the research instrument. There was no patient involvement.

Informed consent

Verbal informed consent was provided by participants who were willing to take part. All participants were informed before the start of the household survey that participation was voluntary and

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anonymous with no personal identifiable data captured and the results would be kept strictly confidential and for research purposes only. Data were transferred and stored securely at Newcastle University. No incentives were provided for participation.

Procedures

The data reported in this article were collected from 311 residents in Sanjay Colony, Okhla Phase II and 328 residents in Bhalswa. These areas were chosen as they represent two different types of informal settlements, Sanjay Colony Okhla II categorised by the Delhi Master Plan as a 'slum' and Bhalswa categorised as a Resettlement Colony. A team of 18 survey administrators under the supervision of a researcher from Newcastle University collected the data. Indus Information Initiatives provided in country support. A systematic household survey was carried out by administrators that were grouped into pairs and trained specifically for this project. The main household wage earner was interviewed by the survey administrators in a random sample of households. Where there was a nonresponse, the team moved onto the next 'available' household. To avoid any literacy issues administrators read out the household survey to the participants in their local language.

Data processing and analysis

Data were collected by the administrators who inputted, in real time, the responses into Qualtrics during the household survey, which were then exported into Stata 17 for analysis. Initially descriptive statistical analysis was undertaken to obtain means and standard deviations for the data. Statistical tests were then carried out to ascertain if any significant differences existed between the two community's demographic variables. Independent t tests were used for continuous outcomes and Chi-Square tests for dichotomous outcomes. Structural Equation Modelling (SEM) was used to establish the construct validity of the NCI and the SWB measures. The Cronbach alpha was used to measure the internal consistency of the NCI. For the SWB internal reliability was considered through correlations between the NCI and its sub scores. To understand the differences between residents in Sanjay Colony, Okhla Phase II and Bhalswa individual items on both the NCI and SWB measures were analysed using the estimated average marginal components effect (AMCEs). The ACME is the average causal effect of changing the community variable from Bhalswa(=0) to Sanjay Colony(=1) for a given resident while averaging over the other factors is given by,

$$\tau(1,0;\Pr(\boldsymbol{t}_{ij,-l},\boldsymbol{t}_{i,-j})) = \sum_{(\boldsymbol{t}_{ij,-l},\boldsymbol{t}_{i,-j})\epsilon\tau} \mathbb{E}[Y_i(1,\boldsymbol{t}_{ij,-l},\boldsymbol{t}_{i,-j}) - Y_i(0,\boldsymbol{t}_{ij,-l},\boldsymbol{t}_{i,-j})] \times \Pr(\boldsymbol{t}_{ij,-l}\boldsymbol{t}_{i,-j})$$

where $\boldsymbol{t}_{ij,-l}$ is an (L-1) dimensional vector representing levels of all the factors except the factor L of the j th item answered by respondent i, $\boldsymbol{t}_{i,-j}$ denotes the levels of all factors for the remaining other than j, and τ is the choice of $\Pr(\boldsymbol{t}_{ij,-l},\boldsymbol{t}_{i,-j})$. The expectation ($\mathbb{E}$) is over a random sample of the respondents and item responses.[82] A major advantage of this statistical method is that it is fully nonparametric and so does not require any functional choice probability assumptions.

RESULTS

Characteristics of participants

We collected socio-demographic information from 328 residents in Bhalswa and 311 from Sanjay Colony, Okhla, Phase II between March-April 2022. The majority in both colonies were Hindu, belonging to the scheduled caste, migrating from Uttar Pradesh (UP). However, there were statistically significant differences between the two colonies with a higher proportion of Muslims in Bhalswa (22.6% Bhalswa vs 5.5% Sanjay), a higher proportion of general and 'backward' caste in Bhalswa (42.4% Bhalswa vs 31.9% Sanjay) and a higher proportion of migrants from UP in Sanjay Colony (71.7% Sanjay vs 63.7% Bhalswa). For the 639 participants the mean number of years of education (8.78 years) and the age of the main household wage earner (38.62 years) were not statistically significantly different in the two colonies. Almost one third of households in Sanjay Colony reported their main occupation as a self-employed business owner, whereas in Bhalswa this was true for less than one fifth of households. The average monthly income is Sanjay Colony was statistically significantly less at Rs. 16,681.70/- (£172.82

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(£1=Rs.96.52/- conversion rate)) compared with Bhalswa at Rs. 18,935.98/- (£196.18). Monthly income was positively correlated with the household owning a refrigerator with a freezer (r=0.280, p<0.01), washing machine (r=0.331, p<0.01) and scooter/motorcycle (r=0.367, p<0.01) in both communities. These wealth indicators show positive associations with monthly income. Those in Sanjay colony were more likely to carry out employment within their own community compared to those in Bhalswa (35.4% Sanjay vs 12% Bhalswa). Where a statistically significant difference was found regarding wealth indicators only the ownership of a smartphone was more likely in Sanjay than in Bhalswa. For scooter, bicycle, electricity, refrigerator, and washing machine Bhalswa residents were statistically more likely to own these items than those in Sanjay (table 2).

Table 2 Sociodemographic characteristics of main household wage earner in the two settlements

	Sanjay Colony	Bhalswa	p-value	Total
Religion				
Hindu	291 (93.6)	251 (76.5)	0.001***	542 (84.8)
Muslim	17 (5.5)	74 (22.6)	0.001***	91 (14.2)
Other (Christian, Sikh, Buddhist)	3 (0.9)	3 (0.9)		6 (1.0)
Caste[i]				
General caste	54 (17.4)	74 (22.6)	0.114	128 (20.0)
Scheduled caste	216 (69.5)	185 (56.4)	0.001***	401 (62.8)
Backward caste	45 (14.5)	65 (19.8)	0.026*	110 (17.2)
Education				
Mean number of years of education #	9.00 (5.88)	8.57 (5.86)	0.355	8.78 (5.87)
Main household occupation				
Self-employed business owner	94 (30.2)	61 (18.6)	0.001***	155 (24.3)
Regular salary/ wage employee	128 (41.2)	154 (47.0)	0.152	282 (44.1)
Causal worker/ daily paid labourer	89 (28.6)	113 (34.5)	0.126	202 (31.6)
Age of the main household wage earner #	38.87 (11.25)	38.37 (10.89)	0.569	38.62 (11.06)
Mean **length of residence** (years) #	29.05 (12.40)	18.47 (9.44)	0.001***	23.62 (12.18)
Mean **monthly Income** for whole family (Rs) #	16,681.70 (7,575.32)	18,935.98 (10,567.12)	0.001**	17838.82 (9294.46)
Work				
Outside community	167 (53.7)	238 (72.6)	0.001***	405 (63.4)
Work inside and outside	34 (10.9)	50 (15.2)	0.128	84 (13.1)
Inside community	110 (35.4)	40 (12.2)	0.001***	150 (23.5)
State of origin				
Bihar	40 (12.9)	48 (14.6)	0.516	88 (13.8)
Rajasthan	23 (7.4)	30 (9.1)	0.422	53 (8.3)
Uttar Pradesh	223 (71.7)	209 (63.7)	0.031*	432 (67.6)
Other	25 (8.0)	41 (12.5)	0.064	66 (10.3)
Wealth items				
Owns car or jeep	4 (1.3)	8 (2.4)	0.385	12 (1.9)
Scooter/motorcycle	80 (25.7)	116 (35.4)	0.008••	196 (30.7)
Auto/mini-3-wheeler	10 (3.2)	14 (4.3)	0.484	24 (3.8)
Bicycle	60 (19.3)	89 (27.1)	0.019**	149 (23.3)
Smart phone	280 (90.0)	260 (79.3)	0.001***	540 (84.5)
House has electricity	298 (95.8)	324 (98.8)	0.020**	622 (97.3)
Computer	8 (2.6)	11 (3.4)	0.561	19 (3.0)
Refrigerator with a freezer	155 (49.8)	251 (76.5)	0.001***	406 (63.5)
Washing machine	89 (28.6)	127 (38.7)	0.007**	216 (33.8)
TV	237 (76.2)	269 (82.0)	0.071	506 (79.2)

Note # denotes results that are mean (SD), all others are given as number of cases and percentage in parenthesis. Statistical tests: independent t test was used for continuous outcomes and Chi-Square test was used for dichotomous outcomes. Each of the 'other' states each represent individually less than 2% of the population -Delhi, Haryana, Madhya Pradesh, Uttarakhand, Chhattisgarh, Himachal, Jharkhand, Nepal, Punjab, Tamil Nadu, and West Bengal.

i NB These are the caste classification used by the Government of India

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Psychometric properties of the NCI and subjective well-being measure

Pilot

To test the cross-cultural transferability of the survey, a pilot was carried out with 150 residents of Hawadigar Colony, Bangalore City, Karnataka, India (Delhi being in COVID-19 lockdown in early 2022) to test for reliability. The composite reliability was good (NCI, α = 0.90; SWB, α =0.78). To establish construct validity of the measures Structural Equation Modelling (SEM) was undertaken. In general, good models should have RMSEA < 0.06 and CFI > 0.9. The NCI (RMSEA =0.024, CFI =0.995) and SWB (RMSEA = 0.051, CFI=0.980) measures both show good validity.[83,84]

Current Study

The NCI (α = 0.89) and SWB (α = 0.80) in this present study show good composite reliability. Very good convergent validity of the NCI is seen through correlations with its sub scores of SOC (r=0.947, p<0.01), NEI (r=0.896, p<0.01) and ATTR (r=0.779, p<0.01). For the SWB internal reliability was considered through correlations between the NCI for Sanjay Colony (r=0.145, p<0.05) and Bhalswa (r=0.264, p<0.001). Group level construct validity was established with values of CFI > 0.94 and RMSEA < 0.05 for both Sanjay Colony and Bhalswa. Reliability of the measures was also demonstrated by loadings on to each of the factors; sense of community (0.54 to 0.74), neighbourliness (0.30 to 0.77), attraction to neighbourhood (0.30 to 0.79) and well-being (0.33 to 0.82). Factor loadings greater than or equal to 0.3 are said to be salient and relate meaningfully to primary factors.[84-86]

Neighbourhood Cohesion Index (NCI)

Eight statistically significant differences were seen between the responses from residents in Sanjay Colony and Bhalswa on the NCI, four in 'sense of community' (SOC), and two in each of the themes 'neigbourliness' (NEI) and 'attraction to neighbourhood' (ATTR) as shown in figure 3 with additional detail in online supplemental table 1.

Figure 3

Regarding the sense of community (SOC), residents in Sanjay Colony were 9.3 percentage points (pp) more likely to believe their neighbours would help them in an emergency (NCI 9, p<0.001) and 9.5 pp more likely to have a greater willingness to improve their neighbourhood than residents in Bhalswa (NCI 12, p<0.001). Residents of Sanjay Colony were 10.2 pp more likely to feel a greater sense of community than those residents of Bhalswa (NCI 18, p<0.001). Sanjay Colony residents were 5.48 pp less likely to feel that their neighbours agree with them about what is important in life (NCI 8, p<0.05).

In the subscale 'neighbouring' (NEI) residents in Sanjay Colony were 4.76 pp less likely to invite neighbours to their home (NCI 15, p<0.01) and 9.7 pp less likely to feel that neighbourhood friendships meant a great deal to them (NCI 4, p<0.001).

Regarding 'attraction to the neighbourhood' (ATTR) respondents from Sanjay Colony were 7.3 pp less likely to say they were attracted to living in the neighbourhood (NCI 1, p<0.01). They were 22.5 pp more likely to have a feeling of belonging (NCI 2, p<0.001). Given that the base probability is 50 percent, the effect size of this result is the most significant of all these results as it increases the base probability by 45 percent (medium Cohen's d effect size (0.45 =0.225/0.5)).

Subjective well-being (SWB)

There were two statistically significant differences between the responses from residents in Sanjay Colony and Bhalswa on the SWB (figure 4). There was a 4.8 pp increased likelihood that residents in Sanjay Colony had a greater likelihood to feel more satisfied with life (p<0.01) and a 4.8 pp increased

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likelihood of having greater perceived feelings of freedom of choice (p<0.001) than residents in Bhalswa. For additional detail see the online supplemental table 2.

Figure 4

Associations between NCI and SWB

Statistically significant positive correlations demonstrated modest associations between neighbourhood cohesion (NCI) and subjective well-being (SWB) in both Sanjay Colony (r=0.145, p<0.05) and Bhalswa (r=0.264, p<0.01). In both communities there was a strong positive correlation between trust and neighbourhood cohesion (Sanjay r=0.618, p<0.01; Bhalswa r=0.533, p<0.01). However, only in Bhalswa was trust statistically significantly positively related to subjective well-bring (r=0.121, p<0.05).

There was a statistically significant positive modest correlation with regards to the length of residence within the neighbourhood and the NCI in both Sanjay and Bhalswa (Sanjay, r=0.157, p<0.01; Bhalswa, r=0.171, p<0.05). The longer a resident had lived in the community the greater the feeling of neighbourhood cohesion. Well-being was also statically significantly correlated with employment in both communities (Sanjay - income, r=0.119, p<0.5; regular employment, r=0.134, p<0.05: Bhalswa - income, r=0.165, p<0.01; regular employment, r=0.109, p<0.05).

Only in Bhalswa was there shown to be correlations with length of residency, SWB and trust. For subjective wellbeing there was a negative modest correlation between the length of residency (r=-0.117, p<0.05), the longer the resident lived in the community the lower their level of subjective well-being. For the level of trust there was a significant positive modest correlation with length of residency. The longer a resident had lived in Bhalswa the greater the level of trust (r=0.145, p<0.01). Interestingly regarding trust, only in Bhalswa was there a statistically significant correlation between employment and trust (income, r=0.132, p<0.05; regular employment, r=-0.161, p<0.01; working outside the community, r=-0.238, p<0.01).

Neither age nor education were found to be statistically significantly correlated with NCI, SWB or trust in Sanjay or Bhalswa (table 3).

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Table 3. Bivariate Correlations between Neighbourhood Cohesion Index, Subjective Well-Being and socio-demographic covariates

	Total NCI	SWB	Trust	Age	Length of residence	Education	Work out	Income	Daily	Regular
Total NCI		0.145*	0.618**	0.006	0.157**	0.090	0.047	0.072	-0.090	0.083
Subjective well-being (SWB)	0.264**		0.031	-0.036	0.047	0.043	0.108	0.119*	-0.219**	0.134*
Trust	0.533**	0.121*		-0.015	0.020	0.034	0.064	-0.015	0.002	0.045
Age	0.005	0.004	-0.035		0.353**	-0.272**	-0.274**	-0.045	-0.009	-0.210**
Length residence	0.171**	-0.117*	0.145**	0.193**		-0.098	-0.066	0.076	-0.194**	0.083
Education	-0.019	0.095	0.016	-0.332**	-0.093		-0.047	0.196**	-0.090	0.035
Work outside community	-0.160**	0.103	-0.238**	-0.318**	-0.141*	0.118*		-0.155**	0.188**	0.318**
Income	0.123*	0.165**	0.132*	0.030	0.079	0.175**	0.081		-0.280**	-0.025
Daily paid wage earner	-0.032	-0.134*	0.011	0.088	0.047	-0.219**	-0.216**	-0.258**		
Regular employment	-0.035	0.109*	-0.161**	-0.172**	-0.092	0.178**	0.469**	0.101		

Sanjay Colony (above diagonal), Bhalswa (below diagonal)

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DISCUSSION

Key findings

This research considered two different informal settlement types in Delhi, India, where both communities were built on unauthorised land, with one spontaneously developed by individual families (Sanjay) and the other 'planned' by the government to reallocate slum dwellers away from the city (Bhalswa). We found that in both settlements residents' feelings around community cohesion were associated with their subjective well-being. That is a greater sense of satisfaction, freedom, happiness, and purpose was felt by those residents that had rated more highly their sense of community, attraction to their neighbourhood and neighbourliness. When a community trusted their neighbours there was a greater feeling of cohesion. The longer a resident lived in the community there was a greater sense of cohesion. Those with higher incomes and those that undertook regular employment (employee) enjoyed higher levels of subjective well-being. We found that neither age nor education influenced feelings around trust, neighbourhood cohesion or subjective well-being.

Those living in Sanjay (squatter settlement) reported higher subjective well-being and were more likely to feel a sense of belonging to a whole community where they would help and be helped by their neighbours in an emergency. However, Sanjay residents were less likely to be neighbourly with fewer friendships, and less of an attraction to live in the neighbourhood. Part of the reason for this, which we cannot substantiate, may relate to the more cramped living conditions in Sanjay in comparison to those in the 'planned' resettlement community of Bhalswa. That Sanjay residents reported higher subjective well-being than in Bhalswa *despite* such factors may also indicate the independent and over-riding value they place on having chosen were to live and not having been subject to forced relocation – but this needs additional research. In Bhalswa there was a greater feeling of neighbourliness, and the longer the resident had lived in the community the greater level of trust in their neighbours even though residents did not express the sense of community belonging expressed in Sanjay. One explanation for this result could be that the shared feelings associated with the trauma of compulsory relocation allowed the development of strong bonds with immediate neighbours coping with the original sense of helplessness - and with longer terms of residency their trust in neighbours increased independent of their perception of the neighbourhood as a whole. Friendliness and supportiveness among neighbours could have remained independent of any sense of self-esteem or fulfilment within the neighbourhood. Our results showed, however, that the longer the resident had lived in Bhalswa, the greater the negative effect on their subjective well-being. Again, a possible but unsubstantiated explanation for this finding may be the lasting negative impact on sense of belonging and well-being arising from the experience of forced relocation.

Our findings are to some extent in line with the existing literature that reports associations between greater neighbourhood social cohesion and better subjective well-being.[9-14] They show that a greater sense of community cohesion is associated with trust.[6] As in other literature residents with the highest incomes expressed greater subjective well-being.[27,28,33] Interestingly income was only associated positively with trust and neighbourhood cohesion in Bhalswa.

With regards to neighbourhood cohesion residents in Bhalswa, the resettlement colony, were less likely to have a sense of belonging to their neighbourhood, Williams et al., (2022)[56] agree, stating that resettlement housing projects in India produce ghetto effects, which inhibit feelings of belonging and processes of place-making. As in Mahadevia et al., (2016)[49] we found that residents in the resettlement colony of Bhalswa were less likely to feel a sense of community and the desire to improve their neighbourhood owing to greater heterogeneity of the residents. In contrast to the existing literature, we found that education was not correlated with trust, subjective well-being or neighbourhood cohesion. Blanchflower and Oswald (2004)[87] in their study on well-being over time showed that education played a role independently of income and Patel et al., (2021)[88] found that higher education significantly decreased the odds of low subjective well-being in older adults in India.

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Limitations

The first limitation of our study was its cross-sectional design implying that only correlations between neighbourhood social cohesion and subjective well-being were established. Causal associations could not be demonstrated. Second, the results were subject to possible selection bias regarding the participating colonies. Sanjay Colony, Okhla Phase II and Bhalswa resettlement colony were already well known to the research team. We endeavoured to overcome this through the multi-stage random sampling of households. Third, self-reported and subjective measurements might cause information bias. Fourth and perhaps most significant, understanding the impact on subjective well-being that having chosen ones' abode has in comparison to forced relocation, requires a more ethnographic and immersive approach to understand the meanings that people attach to the experience of being subjected to compulsory resettlement.

CONCLUSION

Our analysis in this paper aims to contribute to debates concerning neighbourhood cohesion and subjective well-being for residents living in different informal settlement types in mega-cities. Gathering better local data allowed for a clearer understanding of the differences between residents of two types of slums, both typically devoid of security of tenure and infrastructure, but one on the periphery of the city detached from a socio-economic livelihood base, and where residents had been evicted from their original homes. Residents of resettlement colonies are forcefully relocated, uprooted from established social and economic networks typically against their will. Additional research is required to understand the impact that this forced relocation may have on the sense of subjective well-being and personal agency. This research should take into account issues of selection bias and requires a significant ethnographic component to explore the value that people attach to having chosen where they live.

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Contributors: PD conceived the idea and conceptualised the study and is responsible for the overall content as guarantor. SH conducted the data analysis with statistical analyses being contributed by AS and BR. BR carried out the data collection, training of data collectors and monitored the data collection in the field. PD, SH and BR interpreted the results. AS and MP provided critical contribution to the discussion of the findings of the study. All authors contributed to the study design and review of the manuscript.

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Data availability statement: Technical appendix, statistical code and data set available from the publication date from Newcastle University's open data repository (data.ncl).
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Figure 1 **Map of Bhalswa Resettlement Colony, Delhi, India** (Google Earth Digital Globe Image, 2022)

Figure 2 **Map of Sanjay Colony, Okhla Phase II, Delhi, India** (Google Earth Digital Globe Image, 2022)

Figure 3 **Neighbourhood Cohesion Index estimated averaged marginal component effects for Sanjay Colony with 95% CIs**. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0). The marginal effect of each independent variable being averaged over the joint distribution of the remaining variables. The independent variables are in the vertical axis. The horizontal axis gives the prediction of change in the independent variable (points), and the associated 95% confidence intervals (bars).

Figure 4 **Well-being estimated averaged marginal component effects for Sanjay Colony with 95% CIs.** The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0). The marginal effect of each independent variable being averaged over the joint distribution of the remaining variables. The independent variables are in the vertical axis. The horizontal axis gives the prediction of change in the independent variable (points), and the associated 95% confidence intervals (bars).

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Figure 1 Map of Bhalswa Resettlement Colony, Delhi, India (Google Earth Digital Globe Image, 2022)

181x226mm (144 x 144 DPI)

Figure 2 Map of Sanjay Colony, Okhla Phase II, Delhi, India (Google Earth Digital Globe Image, 2022)

359x222mm (144 x 144 DPI)

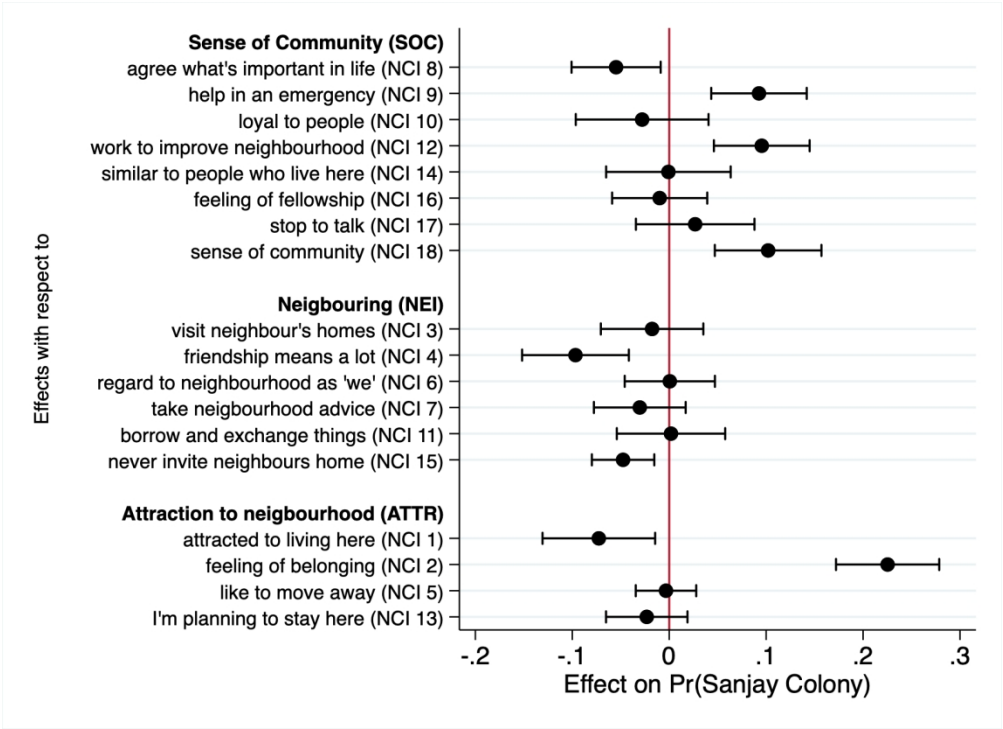

Figure 3 Neighbourhood Cohesion Index estimated averaged marginal component effects for Sanjay Colony with 95% CIs. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0). The marginal effect of each independent variable being averaged over the joint distribution of the remaining variables. The independent variables are in the vertical axis. The horizontal axis gives the prediction of change in the independent variable (points), and the associated 95% confidence intervals (bars).

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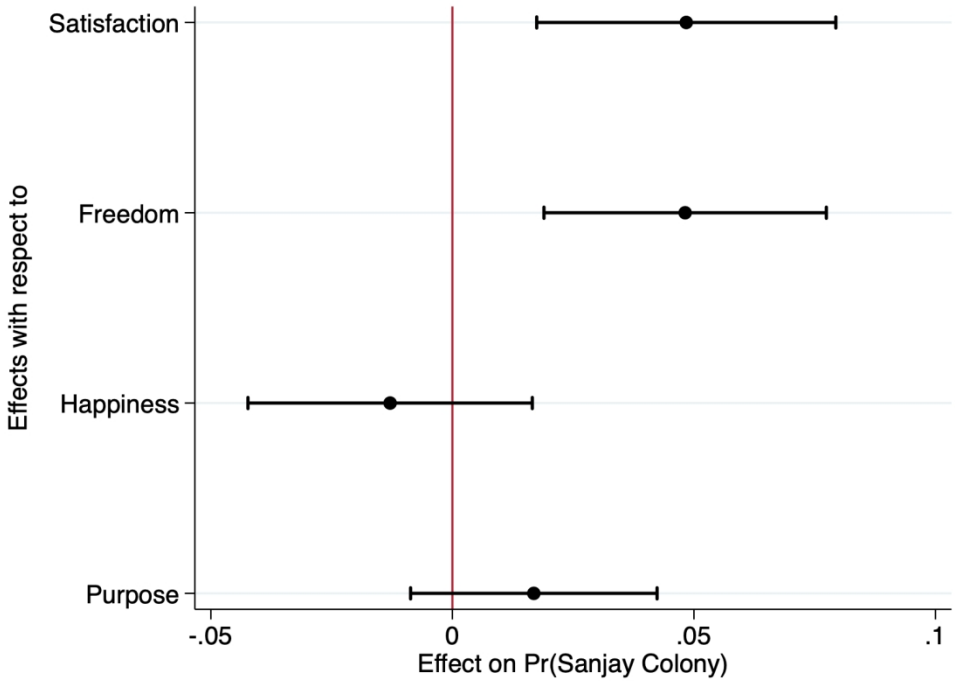

Figure 4 Well-being estimated averaged marginal component effects for Sanjay Colony with 95% CIs. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0). The marginal effect of each independent variable being averaged over the joint distribution of the remaining variables. The independent variables are in the vertical axis. The horizontal axis gives the prediction of change in the independent variable (points), and the associated 95% confidence intervals (bars).

310x225mm (144 x 144 DPI)

Supplemental Material

Coefficient estimates of the average marginal component effects with standard errors in parenthesis for figures 2 and 3 in main article.

Supplemental Table 1 Neighbourhood Cohesion Index estimated averaged marginal component effects for Sanjay Colony with 95% CIs.

Item	***Item description***	Sanjay Colony(=1)
SOC	**Sense of Community**	
NCI8 (SOC)	I agree with most of my neighbourhood about what's important in life	-0.055** (0.023)
NCI9 (SOC)	I believe my neighbours would help me in an emergency	0.093*** (0.025)
NCI10 (SOC)	I feel loyal to people in my neighbourhood	-0.028 (0.035)
NCI12 (SOC)	I'd be willing to work with others to improve my neighbourhood	0.095*** (0.025)
NCI14 (SOC)	I think of myself as similar to people who live in this neighbourhood	-0.001 (0.033)
NCI16 (SOC)	A feeling of fellowship runs deep in this neighbourhood	-0.010 (0.025)
NCI17 (SOC)	I regularly stop to talk with people in my neighbourhood	0.027 (0.031)
NCI18 (SOC)	Living in this neighbourhood gives me a sense of community	0.102*** (0.028)
NEI	**Neighbouring**	
NCI3 (NEI)	I visit with my neighbours in their homes	-0.018 (0.027)
NCI4 (NEI)	The friendships I have with people in my neighbourhood mean a lot	-0.097*** (0.028)
NCI6 (NEI)	If people in my neigbourhood were planning something I'd think of it as something 'we' were doing rather than 'they' were doing	-0.001 (0.024)
NCI7 (NEI)	If I need advice, I could go to someone in my neighbourhood	-0.030 (0.024)
NCI11 (NEI)	I borrow things and exchange favours with my neighbours	0.002 (0.028)
NCI15 (NEI)	I have never invited neighbours over to my house to visit (R)	-0.048** (0.016)
ATTR	**Attraction to neighbourhood**	
NCI1 (ATTR)	Overall, I am very attracted to living in this neighbourhood	-0.073* (0.030)
NCI2 (ATTR)	I feel like I belong to this neighbourhood	0.225*** (0.027)
NCI5 (ATTR)	Given the opportunity, I would like to move out of this neighbourhood (R)	-0.003 (0.015)
NCI13 (ATTR)	I plan to remain a resident of this neighbourhood for a number of years	-0.023 (0.021)
Constant		-0.157 (0.137)
		P[F(18, 620)=16.62] <0.001
		R^2=0.325

Analysis includes 639 observations. Coefficient estimates of the average marginal component effects with standard errors in parenthesis. ***p<0.001, **p<0.01, *p<0.05. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0).

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Supplemental Table 2 Well-being estimated averaged marginal component effects for Sanjay Colony with 95% CIs

Well being		
item	***Item description***	Sanjay Colony(=1)
	Well-being	
Satisfaction	Overall, how satisfied are you with life as a whole these days?	0.048** (0.016)
Freedom	How much freedom of choice and control do you feel you have over the way your life turns out?	0.048*** (0.015)
Happiness	How happy did you feel yesterday?	-0.013 (0.015)
Purpose	Do you feel your life has important purpose or meaning?	0.017 (0.013)
		P[F(4, 634)=14.49] <0.001 R^2=0.084

Analysis includes 639 observations. Coefficient estimates of the average marginal component effects with standard errors in parenthesis. ***p<0.001, **p<0.01, *p<0.05. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0).

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2
Objectives	3	State specific objectives, including any prespecified hypotheses	2
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	3
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*4,5*
Bias	9	Describe any efforts to address potential sources of bias	8
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	2
		(b) Give reasons for non-participation at each stage	6
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6
		(b) Indicate number of participants with missing data for each variable of interest	None
Outcome data	15*	Report numbers of outcome events or summary measures	5-7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9

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		(*b*) Report category boundaries when continuous variables were categorized	8-9
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	6
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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BMJ Open

Associations between neighbourhood social cohesion and subjective well-being in two different informal settlement types in Delhi, India: a quantitative cross-sectional study.

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Title Page

Associations between neighbourhood social cohesion and subjective well-being in two different informal settlement types in Delhi, India: a quantitative cross-sectional study.

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Abstract

Objectives To evaluate the relationships between neighbourhood cohesion and subjective well-being in two different informal settlement types.

Design Cross sectional analysis of a community-based survey

Setting Communities in two districts, Sanjay Colony, Okhla Phase II and Bhalswa in Delhi, India

Participants 328 residents in Bhalswa and 311 from Sanjay Colony.

Measurements Neighbourhood social cohesion scale measured on an 18-point scale and the subjective well-being scale made up of four subjective measures – hedonic, eudaemonic, evaluative and freedom of choice. Socio-demographic characteristics, and trust were used as covariates.

Results In both neighbourhood types there was a statistically significant positive bivariate correlation between neighbourhood cohesion and subjective well-being (Sanjay: $r=0.145$, $p<0.05$; Bhalswa: $r=0.264$, $p<0.01$). Trust and neighbourhood cohesion were strongly correlated (Sanjay: $r=0.618$, $p<0.01$; Bhalswa: $r=0.533$, $p<0.01$) and the longer the resident had lived in the community the greater the feeling of neighbourhood cohesion (Sanjay: $r=0.157$, $p<0.01$; Bhalswa: $r=0.171$, $p<0.05$). Only in the resettlement colony (Bhalswa) was subjective well-being negatively correlated with length of residency ($r=-0.117$, $p<0.05$). Residents who chose their settlement type (Sanjay residents) were 22.5 percentage points more likely to have a feeling of belonging to their neighbourhood than residents that had been resettled (Bhalswa) (Cohen's d effect size 0.45). Sanjay residents had a greater likelihood to feel more satisfied with life (4.8pp, $p<0.01$) and having greater perceived freedom of choice (4.8pp, $p<0.01$).

Conclusions Our findings contribute to the general knowledge about neighbourhood cohesion and subjective well-being within different informal settlement types in a mega-city such as New Delhi, India. Interventions that promote sense of belonging, satisfaction with life and freedom of choice have the potential to significantly improve people's well-being.

Strengths and limitations of this study

- The study was able to examine multiple dimensions of subjective well-being (evaluative, hedonic, eudaemonic and freedom) with 639 residents in slum areas of Delhi, India.
- To the best of our knowledge this is the first study to evaluate the impact around neighbourhood cohesion and subjective well-being of residents that have been resettled compared with those who chose their informal settlement.
- Cross-sectional design implying that only correlations between neighbourhood social cohesion and subjective well-being were established. Causal associations could not be proven.
- Results were subject to possible selection bias with regards to the colonies participating. Sanjay Colony, Okhla Phase II and Bhalswa resettlement colony were already known to the research team and therefore convenience sampling owing to our long-term relationship.

INTRODUCTION

A neighbourhood is a district of an urban city where neighbours live and come together through social and cultural networks. For some a 'neighbourhood' defines who they are in terms of social position and identity. Neighbourhoods can form boundaries as well as promote rich cultural diversity.[1-3] Social cohesion is defined as the presence of societal features such as trust, networks, support, and societal norms.[4-6] A neighbourhood with strong social cohesion can empower individuals within communities to support each other through residential bonds, create coordinated actions, and networks for a collective good.[7,8] Research has shown that neighbourhoods with higher levels of social cohesion can be beneficial to the well-being of their inhabitants.[9-14] Well-being is key to the creation and maintenance of healthy and productive societies.[15,16] High levels of well-being have been shown to result in better health and longevity.[17] Low levels of neighbourhood social cohesion and trust are associated with stress, depression, and anxiety.[18,19] Studies suggest that friendship, support and advice are associated with well-being and that social cohesion relates positively to psychological

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health.[20-26] The length of residency, income, and age of the individual have been shown to be closely associated with a feeling of positive neighbourhood cohesion.[2,27-33] Some studies find no correlations[2,34] and others negative correlations concerning education level.[30,32]

Research from around the world has demonstrated that maintaining well-being is important for those who are living in difficult circumstances.[35,36] Around one-quarter of the world's urban population (over half of whom reside in Asia) live in informal, slum, and squatter settlements, which typically are unauthorised.[37] New Delhi is currently the third largest mega-city in the world and second to Tokyo in Asia, with just over 32 million people living around and in New Delhi.[38,39] With a growth rate of 3% and 800,000 poor rural migrants arriving in the city every year looking for better economic opportunities, forecasts suggest that in the next five years the population could outstrip Tokyo making it Asia's biggest megacity.[40] The Delhi Master Plan divides the city into three categories -planned, special, and unplanned. Due to rapid population growth residents have bought and constructed houses on land which is not zoned in the Master Plan for residential purposes.[41-44] In this paper we investigate similarities and differences in neighbourhood social cohesion and well-being for households living in two different settlement types in Delhi - Sanjay Colony, Okhla Phase II a squatter settlement (unplanned) and Bhalswa a resettlement colony (planned). Squatter settlements are unauthorised occupations of vacant land, mostly public, with minimum access to civic services and amenities. Resettlement colonies are made up of families 'evicted' from their original squatter settlement to plots allotted by the Slum Rehabilitation Authority (SRA). Resettlement colonies, reflect the systematic process of relocating poor residents to the periphery to facilitate the gentrification of urban spaces. Consequently, they experience low levels of amenity provision by public agencies owing to scarcity of funds.[42,45-51] Residents in resettlement colonies have expressed concerns around community cohesion. Studies of resettlement areas in India have found residents reporting greater social alienation, their homes lacking both security of tenure and a socio-economic livelihood base because resettlement sites are large distances from residents' former homes.[48,49,52-56] Residents started to live in Bhalswa in 2000, having been evicted from 11 slum locations in and around Delhi including Nizamuddin, Dakshinpuri and Rohini.[57]

We examine the relationships between subjective well-being (SWB) and neighbourhood cohesion, taking into consideration the socioeconomic backgrounds of the households as well as levels of trust in two different informal settlement types. As neighbourhoods are bounded urban areas, they offer an important opportunity to understand individual's and community's perceptions within a finite region. Different neighbourhoods can be investigated, explored, and compared.[58-61] We consider the association between neighbourhood social cohesion and well-being for residents living in different colony types, one where the residents have chosen to make their home in a squatter colony and the other where squatter colonies have been demolished and the residents uprooted to reside in a resettlement colony. In the present study we evaluate the psychometric properties of the Neighbourhood Cohesion Index (NCI) and the SWB items initially through a pilot in Bangalore, India. Our findings may inform whether interventions, such as promoting a sense of belonging, respect and inclusion are required in specific neighbourhoods to promote community cohesion and potentially well-being. They may also help in identifying potential policy problems as well as better understand the drivers of subjective well-being.[62]

METHODS

Study design and setting

This is a community based, cross-sectional study carried out with residents in two informal settlements, Sanjay Colony, Okhla Phase II and Bhalswa resettlement colony, in New Delhi, India from 28 March to 9th April 2022 (figure 1 and 2).

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Sample size calculation and sampling techniques

Sanjay Colony and Bhalswa were selected through convenience sampling owing to our long-term relationships with the communities in these areas. Sanjay Colony, Okhla Phase II, has a total population of 66,820 over an area of 1.99km² with a population density of 33,659 people per km².[63] Bhalswa covers an area of 10.38 km² with a population 102,701 and population density of 9,892 people per km².[64] Households were selected by multi-stage random sampling, stratified on the population and geographic area. The sample size (n) calculation was performed using $n = {Nx}/{((N-1)E^2 + x)}$ and margin of error $E = \sqrt{{(N-n)x}/{n(N-1)}}$ with $x = Z\left({c}/{100}\right)^2 r(100-r)$ where N is the population size, r is the fraction of responses required and Z(c/100) is the critical value, with the calculation based on the Normal distribution. This calculation gave a target sample size of 311 in Sanjay Colony and 328 in Bhalswa, at the 95% confidence level for 5.1%-5.3% margin of error, with at least 80% power.[65] In order to achieve the power calculation, 660 households were approached. In total 21 households did not agree to participate, with an overall response rate of 97% -94% and 99% in Sanjay Colony and Bhalswa respectively.

Figure 1

Figure 2

Measures

Neighbourhood Cohesion Index (NCI)

The Neighbourhood Cohesion Index (NCI) is used in this research to measure social cohesion with a focus on neighbourhood networks and the degree of neighbourliness; that is the emotional social support within the neighbourhood which includes visiting neighbours and friendships.[66-67] Higher mean total scores indicating a greater level of neighbourhood social cohesion.[20,68] All items were measured on a 5-point Likert scale with 5 (strongly agree) to 1 (strongly disagree). The total scores for NCI were calculated by taking the average of the eighteen items with 5 and 15 being reverse scored. The NCI measure can be divided into three subscale dimensions: 'sense of community' (SOC), 'neighbourliness' (NEI) and 'attraction to neighbourhood' (ATTR).[67,69-71] It has been well validated and used in a range of country settings with various communities.[24,68-70,72,73]

Subjective Well-Being (SWB)

Subjective rather than objective well-being has been used in this study to explore the individual's internal subjective assessment of their own life as a whole, based on cognitive judgments and affective reactions. Diener, one of the leading scholars in subjective well-being (SWB) research, defines SWB as how "a person feels and thinks his or her life is desirable regardless of how others see it" (p.1).[74] This definition highlights the thinking and feeling dimensions of SWB. To gain an understanding of how an individual's perceived subjective well-being is associated with neighbourhood social cohesion four subjective measures of well-being were used. These four subjective measures of well-being are hedonic well-being (feeling of happiness), eudaemonic well-being (sense of purpose), evaluative well-being (life satisfaction) and freedom of choice (life control) (table1).[75-81]

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Table 1 Measures: Neighbourhood Cohesion Index and Subjective Well-Being (NCI and SWB)

Neighbourhood Cohesion Index (NCI)	
Item	***Item description***
NCI1 (ATTR)	Overall, I am very attracted to living in this neighbourhood
NCI2 (ATTR)	I feel like I belong to this neighbourhood
NCI3 (NEI)	I visit with my neighbours in their homes
NCI4 (NEI)	The friendships I have with people in my neighbourhood mean a lot
NCI5 (ATTR)	Given the opportunity, I would like to move out of this neighbourhood (R)
NCI6 (NEI)	If people in my neighbourhood were planning something I'd think of it as something 'we' were doing rather than 'they' were doing
NCI7 (NEI)	If I need advice, I could go to someone in my neighbourhood
NCI8 (SOC)	I agree with most of my neighbourhood about what's important in life
NCI9 (SOC)	I believe my neighbours would help me in an emergency
NCI10 (SOC)	I feel loyal to people in my neighbourhood
NCI11 (NEI)	I borrow things and exchange favours with my neighbours
NCI12 (SOC)	I'd be willing to work with others to improve my neighbourhood
NCI13 (ATTR)	I plan to remain a resident of this neighbourhood for a number of years
NCI14 (SOC)	I think of myself as similar to people who live in this neighbourhood
NCI15 (NEI)	I have never invited neighbours over to my house to visit (R)
NCI16 (SOC)	A feeling of fellowship runs deep in this neighbourhood
NCI17 (SOC)	I regularly stop to talk with people in my neighbourhood
NCI18 (SOC)	Living in this neighbourhood gives me a sense of community
Subjective well-being (SWB)	
Item	*Item Description*
Satisfaction	Overall, how satisfied are you with life as a whole these days? (0 not at all satisfied to 10 completely satisfied)
Freedom	How much freedom of choice and control do you feel you have over the way your life turns out? (0 no freedom and control to 10 complete freedom and control)
Happiness	How happy did you feel yesterday? (0 not at all happy to 10 completely happy)
Purpose	Do you feel your life has important purpose or meaning? (0 not at all worthwhile to 10 completely worthwhile)
Trust	
Trust	How much trust do you have in your neighbours? (0 do not trust at all to 4 trust completely)

Socio-demographic characteristics

Individual-level characteristics include socio-demographics (age, education, employment status, income, length of residence, ethnicity, religion, and caste). For neighbourhood characteristic we have settlement type.

Patient and public involvement

This research was done with public involvement and built on existing long-term relationships with the communities of Sanjay Colony, Okhla Phase II and Bhalswa. Community representatives were informed of the purpose of the study and were consulted on the research instrument. There was no patient involvement.

Informed consent

Verbal informed consent was provided by participants who were willing to take part. All participants were informed before the start of the household survey that participation was voluntary and

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anonymous with no personal identifiable data captured and the results would be kept strictly confidential and for research purposes only. Data were transferred and stored securely at Newcastle University. No incentives were provided for participation.

Procedures

The data reported in this article were collected from 311 residents in Sanjay Colony, Okhla Phase II and 328 residents in Bhalswa. These areas were chosen as they represent two different types of informal settlements, Sanjay Colony Okhla II categorised by the Delhi Master Plan as a 'slum' and Bhalswa categorised as a Resettlement Colony. A team of 18 survey administrators under the supervision of a researcher from Newcastle University collected the data. Indus Information Initiatives provided in country support. A systematic household survey was carried out by administrators that were grouped into pairs and trained specifically for this project. The main household wage earner was interviewed by the survey administrators in a random sample of households. When the main household wage earner was not available a repeat visit was made at a time suitable to the resident. Where there was a nonresponse, the team moved onto the next 'available' household. To avoid any literacy issues administrators read out the household survey to the participants in their local language.

Initially a pilot was carried out with 150 residents in Hawadigar Colony, Karnataka, India (Delhi being in COVID-19 lockdown in early 2022) to test the cross-cultural transferability of the survey. Hawadigar Colony is an unplanned squatter settlement made up of 308 households. Four researchers working in pairs interviewed the main household wage earner in a random sample of households. The psychometric properties of the NCI and SWB are reported in the results section.

Data processing and analysis

Data were collected by the administrators who inputted, in real time, the responses into Qualtrics during the household survey, which were then exported into Stata 17 for analysis. Initially descriptive statistical analysis was undertaken to obtain means and standard deviations for the data. Statistical tests were then carried out to ascertain if any significant differences existed between the two community's demographic variables. Independent t tests were used for continuous outcomes and Chi-Square tests for dichotomous outcomes. Structural Equation Modelling (SEM) was used to establish the construct validity of the NCI and the SWB measures. The Cronbach alpha was used to measure the internal consistency of the NCI. For the SWB internal reliability was considered through correlations between the NCI and its sub scores. To understand the differences between residents in Sanjay Colony, Okhla Phase II and Bhalswa individual items on both the NCI and SWB measures were analysed using the estimated average marginal components effect (AMCEs). The ACME is the average causal effect of changing the community variable from Bhalswa(=0) to Sanjay Colony(=1) for a given resident while averaging over the other factors is given by,

$$\tau(1,0;\Pr(\boldsymbol{t}_{ij,-l},\boldsymbol{t}_{i,-j})) = \sum_{(\boldsymbol{t}_{ij,-l},\boldsymbol{t}_{i,-j})\epsilon\tau} \mathbb{E}[Y_i(1,\boldsymbol{t}_{ij,-l},\boldsymbol{t}_{i,-j}) - Y_i(0,\boldsymbol{t}_{ij,-l},\boldsymbol{t}_{i,-j})] \times \Pr(\boldsymbol{t}_{ij,-l}\boldsymbol{t}_{i,-j})$$

where $\boldsymbol{t}_{ij,-l}$ is an (L-1) dimensional vector representing levels of all the factors except the factor L of the j th item answered by respondent i, $\boldsymbol{t}_{i,-j}$ denotes the levels of all factors for the remaining other than j, and τ is the choice of $\Pr(\boldsymbol{t}_{ij,-l},\boldsymbol{t}_{i,-j})$. The expectation ($\mathbb{E}$) is over a random sample of the respondents and item responses.[82] A major advantage of this statistical method is that it is fully nonparametric and so does not require any functional choice probability assumptions.

RESULTS

Characteristics of participants

We collected socio-demographic information from 328 residents in Bhalswa and 311 from Sanjay Colony, Okhla, Phase II between March-April 2022. The majority in both colonies were Hindu, belonging to the scheduled caste, migrating from Uttar Pradesh (UP). However, there were statistically significant differences between the two colonies with a higher proportion of Muslims in Bhalswa (22.6% Bhalswa

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vs 5.5% Sanjay), a higher proportion of general and 'backward' caste in Bhalswa (42.4% Bhalswa vs 31.9% Sanjay) and a higher proportion of migrants from UP in Sanjay Colony (71.7% Sanjay vs 63.7% Bhalswa). For the 639 participants the mean number of years of education (8.78 years) and the age of the main household wage earner (38.62 years) were not statistically significantly different in the two colonies. Almost one third of households in Sanjay Colony reported their main occupation as a self-employed business owner, whereas in Bhalswa this was true for less than one fifth of households. The average monthly income in Sanjay Colony was statistically significantly less at Rs. 16,681.70/- (£172.82 (£1=Rs.96.52/- conversion rate)) compared with Bhalswa at Rs. 18,935.98/- (£196.18). Monthly income was positively correlated with the household owning a refrigerator with a freezer ($r=0.280$, $p<0.01$), washing machine ($r=0.331$, $p<0.01$) and scooter/motorcycle ($r=0.367$, $p<0.01$) in both communities. These wealth indicators show positive associations with monthly income. Those in Sanjay colony were more likely to carry out employment within their own community compared to those in Bhalswa (35.4% Sanjay vs 12% Bhalswa). Where a statistically significant difference was found regarding wealth indicators only the ownership of a smartphone was more likely in Sanjay than in Bhalswa. For scooter, bicycle, electricity, refrigerator, and washing machine Bhalswa residents were statistically more likely to own these items than those in Sanjay (table 2).

Table 2 Sociodemographic characteristics of main household wage earner in the two settlements

	Sanjay Colony	Bhalswa	p-value	Total
Religion				
Hindu	291 (93.6)	251 (76.5)	0.001***	542 (84.8)
Muslim	17 (5.5)	74 (22.6)	0.001***	91 (14.2)
Other (Christian, Sikh, Buddhist)	3 (0.9)	3 (0.9)		6 (1.0)
Caste[i]				
General caste	54 (17.4)	74 (22.6)	0.114	128 (20.0)
Scheduled caste	216 (69.5)	185 (56.4)	0.001***	401 (62.8)
Backward caste	45 (14.5)	65 (19.8)	0.026*	110 (17.2)
Education				
Mean number of years of education #	9.00 (5.88)	8.57 (5.86)	0.355	8.78 (5.87)
Main household occupation				
Self-employed business owner	94 (30.2)	61 (18.6)	0.001***	155 (24.3)
Regular salary/ wage employee	128 (41.2)	154 (47.0)	0.152	282 (44.1)
Causal worker/ daily paid labourer	89 (28.6)	113 (34.5)	0.126	202 (31.6)
Age of the main household wage earner #	38.87 (11.25)	38.37 (10.89)	0.569	38.62 (11.06)
Mean **length of residence** (years) #	29.05 (12.40)	18.47 (9.44)	0.001***	23.62 (12.18)
Mean **monthly Income** for whole family (Rs) #	16,681.70 (7,575.32)	18,935.98 (10,567.12)	0.001**	17838.82 (9294.46)
Work				
Outside community	167 (53.7)	238 (72.6)	0.001***	405 (63.4)
Work inside and outside	34 (10.9)	50 (15.2)	0.128	84 (13.1)
Inside community	110 (35.4)	40 (12.2)	0.001***	150 (23.5)
State of origin				
Bihar	40 (12.9)	48 (14.6)	0.516	88 (13.8)
Rajasthan	23 (7.4)	30 (9.1)	0.422	53 (8.3)
Uttar Pradesh	223 (71.7)	209 (63.7)	0.031*	432 (67.6)
Other	25 (8.0)	41 (12.5)	0.064	66 (10.3)
Wealth items				
Owns car or jeep	4 (1.3)	8 (2.4)	0.385	12 (1.9)
Scooter/motorcycle	80 (25.7)	116 (35.4)	0.008••	196 (30.7)
Auto/mini-3-wheeler	10 (3.2)	14 (4.3)	0.484	24 (3.8)
Bicycle	60 (19.3)	89 (27.1)	0.019**	149 (23.3)
Smart phone	280 (90.0)	260 (79.3)	0.001***	540 (84.5)
House has electricity	298 (95.8)	324 (98.8)	0.020**	622 (97.3)
Computer	8 (2.6)	11 (3.4)	0.561	19 (3.0)

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Refrigerator with a freezer	155 (49.8)	251 (76.5)	0.001***	406 (63.5)
Washing machine	89 (28.6)	127 (38.7)	0.007**	216 (33.8)
TV	237 (76.2)	269 (82.0)	0.071	506 (79.2)

Note # denotes results that are mean (SD), all others are given as number of cases and percentage in parenthesis. Statistical tests: independent t test was used for continuous outcomes and Chi-Square test was used for dichotomous outcomes. Each of the 'other' states each represent individually less than 2% of the population -Delhi, Haryana, Madhya Pradesh, Uttarakhand, Chhattisgarh, Himachal, Jharkhand, Nepal, Punjab, Tamil Nadu, and West Bengal.
i NB These are the caste classification used by the Government of India

Psychometric properties of the NCI and subjective well-being measure

Pilot

A pilot was carried out with 150 residents of Hawadigar Colony, Bangalore City, Karnataka, India to test for reliability. The composite reliability was good (NCI, α = 0.90; SWB, α =0.78). To establish construct validity of the measures Structural Equation Modelling (SEM) was undertaken. In general, good models should have RMSEA < 0.06 and CFI > 0.9. The NCI (RMSEA =0.024, CFI =0.995) and SWB (RMSEA = 0.051, CFI=0.980) measures both show good validity.[83,84]

Current Study

The NCI (α = 0.89) and SWB (α = 0.80) in this present study show good composite reliability. Very good convergent validity of the NCI is seen through correlations with its sub scores of SOC (r=0.947, p<0.01), NEI (r=0.896, p<0.01) and ATTR (r=0.779, p<0.01). For the SWB internal reliability was considered through correlations between the NCI for Sanjay Colony (r=0.145, p<0.05) and Bhalswa (r=0.264, p<0.001). Group level construct validity was established with values of CFI > 0.94 and RMSEA < 0.05 for both Sanjay Colony and Bhalswa. Reliability of the measures was also demonstrated by loadings on to each of the factors; sense of community (0.54 to 0.74), neighbourliness (0.30 to 0.77), attraction to neighbourhood (0.30 to 0.79) and well-being (0.33 to 0.82). Factor loadings greater than or equal to 0.3 are said to be salient and relate meaningfully to primary factors.[84-86]

Neighbourhood Cohesion Index (NCI)

Eight statistically significant differences were seen between the responses from residents in Sanjay Colony and Bhalswa on the NCI, four in 'sense of community' (SOC), and two in each of the themes 'neigbourliness' (NEI) and 'attraction to neighbourhood' (ATTR) as shown in figure 3 with additional detail in online supplemental table 1.

Figure 3

Regarding the sense of community (SOC), residents in Sanjay Colony were 9.3 percentage points (pp) more likely to believe their neighbours would help them in an emergency (NCI 9, p<0.001) and 9.5 pp more likely to have a greater willingness to improve their neighbourhood than residents in Bhalswa (NCI 12, p<0.001). Residents of Sanjay Colony were 10.2 pp more likely to feel a greater sense of community than those residents of Bhalswa (NCI 18, p<0.001). Sanjay Colony residents were 5.48 pp less likely to feel that their neighbours agree with them about what is important in life (NCI 8, p<0.05).

In the subscale 'neighbouring' (NEI) residents in Sanjay Colony were 4.76 pp less likely to invite neighbours to their home (NCI 15, p<0.01) and 9.7 pp less likely to feel that neighbourhood friendships meant a great deal to them (NCI 4, p<0.001).

Regarding 'attraction to the neighbourhood' (ATTR) respondents from Sanjay Colony were 7.3 pp less likely to say they were attracted to living in the neighbourhood (NCI 1, p<0.01). They were 22.5 pp more likely to have a feeling of belonging (NCI 2, p<0.001). Given that the base probability is 50 percent, the

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effect size of this result is the most significant of all these results as it increases the base probability by 45 percent (medium Cohen's d effect size (0.45 =0.225/0.5)).

Subjective well-being (SWB)

There were two statistically significant differences between the responses from residents in Sanjay Colony and Bhalswa on the SWB (figure 4). There was a 4.8 pp increased likelihood that residents in Sanjay Colony had a greater likelihood to feel more satisfied with life ($p<0.01$) and a 4.8 pp increased likelihood of having greater perceived feelings of freedom of choice ($p<0.001$) than residents in Bhalswa. For additional detail see the online supplemental table 2.

Figure 4

Associations between NCI and SWB

Statistically significant positive correlations demonstrated modest associations between neighbourhood cohesion (NCI) and subjective well-being (SWB) in both Sanjay Colony ($r=0.145$, $p<0.05$) and Bhalswa ($r=0.264$, $p<0.01$). In both communities there was a strong positive correlation between trust and neighbourhood cohesion (Sanjay $r=0.618$, $p<0.01$; Bhalswa $r=0.533$, $p<0.01$). However, only in Bhalswa was trust statistically significantly positively related to subjective well-bring ($r=0.121$, $p<0.05$).

There was a statistically significant positive modest correlation with regards to the length of residence within the neighbourhood and the NCI in both Sanjay and Bhalswa (Sanjay, $r=0.157$, $p<0.01$; Bhalswa, $r=0.171$, $p<0.05$). The longer a resident had lived in the community the greater the feeling of neighbourhood cohesion. Well-being was also statistically significantly correlated with employment in both communities (Sanjay - income, $r=0.119$, $p<0.5$; regular employment, $r=0.134$, $p<0.05$: Bhalswa - income, $r=0.165$, $p<0.01$; regular employment, $r=0.109$, $p<0.05$).

Only in Bhalswa was there shown to be correlations with length of residency, SWB and trust. For subjective wellbeing there was a negative modest correlation between the length of residency ($r=-0.117$, $p<0.05$), the longer the resident lived in the community the lower their level of subjective well-being. For the level of trust there was a significant positive modest correlation with length of residency. The longer a resident had lived in Bhalswa the greater the level of trust ($r=0.145$, $p<0.01$). Interestingly regarding trust, only in Bhalswa was there a statistically significant correlation between employment and trust (income, $r=0.132$, $p<0.05$; regular employment, $r=-0.161$, $p<0.01$; working outside the community, $r=-0.238$, $p<0.01$).

Neither age nor education were found to be statistically significantly correlated with NCI, SWB or trust in Sanjay or Bhalswa. For additional detail see the online supplemental table 3.

DISCUSSION

Key findings

This research considered two different informal settlement types in Delhi, India, where both communities were built on unauthorised land, with one spontaneously developed by individual families (Sanjay) and the other 'planned' by the government to reallocate slum dwellers away from the city (Bhalswa). We found that in both settlements residents' feelings around community cohesion were associated with their subjective well-being. That is a greater sense of satisfaction, freedom, happiness, and purpose was felt by those residents that had rated more highly their sense of community, attraction to their neighbourhood and neighbourliness. When a community trusted their neighbours there was a greater feeling of cohesion. The longer a resident lived in the community there was a greater sense of cohesion. This could imply that residents who feel there is a greater sense of cohesion are more likely to remain in the neighbourhood. Those with higher incomes and those that undertook regular

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employment (employee) enjoyed higher levels of subjective well-being. We found that neither age nor education influenced feelings around trust, neighbourhood cohesion or subjective well-being.

Those living in Sanjay (squatter settlement) reported higher subjective well-being and were more likely to feel a sense of belonging to a whole community where they would help and be helped by their neighbours in an emergency. However, Sanjay residents were less likely to be neighbourly with fewer friendships, and less of an attraction to live in the neighbourhood. Part of the reason for this, which we cannot substantiate, may relate to the more cramped living conditions in Sanjay in comparison to those in the 'planned' resettlement community of Bhalswa. That Sanjay residents reported higher subjective well-being than in Bhalswa *despite* such factors may also indicate the independent and over-riding value they place on having chosen where to live and not having been subject to forced relocation – but this needs additional research. In Bhalswa there was a greater feeling of neighbourliness, and the longer the resident had lived in the community the greater level of trust in their neighbours even though residents did not express the sense of community belonging expressed in Sanjay. One explanation for this result could be that the shared feelings associated with the trauma of compulsory relocation allowed the development of strong bonds with immediate neighbours coping with the original sense of helplessness - and with longer terms of residency their trust in neighbours increased independent of their perception of the neighbourhood as a whole. Friendliness and supportiveness among neighbours could have remained independent of any sense of self-esteem or fulfilment within the neighbourhood. Our results showed, however, that the longer the resident had lived in Bhalswa, the greater the negative effect on their subjective well-being. Residents with poor subjective wellbeing may be those unable to leave owing to lower incomes and employment possibilities. Again, a possible but unsubstantiated explanation for this finding may be the lasting negative impact on sense of belonging and well-being arising from the experience of forced relocation.

Our findings are to some extent in line with the existing literature that reports associations between greater neighbourhood social cohesion and better subjective well-being.[9-14] They show that a greater sense of community cohesion is associated with trust.[6] As in other literature residents with the highest incomes expressed greater subjective well-being.[27,28,33] Interestingly income was only associated positively with trust and neighbourhood cohesion in Bhalswa.

With regards to neighbourhood cohesion residents in Bhalswa, the resettlement colony, were less likely to have a sense of belonging to their neighbourhood, Williams et al., (2022)[56] agree, stating that resettlement housing projects in India produce ghetto effects, which inhibit feelings of belonging and processes of place-making. As in Mahadevia et al., (2016)[49] we found that residents in the resettlement colony of Bhalswa were less likely to feel a sense of community and the desire to improve their neighbourhood owing to greater heterogeneity of the residents. In contrast to the existing literature, we found that education was not correlated with trust, subjective well-being or neighbourhood cohesion. Blanchflower and Oswald (2004)[87] in their study on well-being over time showed that education played a role independently of income and Patel et al., (2021)[88] found that higher education significantly decreased the odds of low subjective well-being in older adults in India.

Limitations

The first limitation of our study was its cross-sectional design implying that only correlations between neighbourhood social cohesion and subjective well-being were established. Causal associations could not be demonstrated. Second, the results were subject to possible selection bias regarding the participating colonies. Sanjay Colony, Okhla Phase II and Bhalswa resettlement colony were already well known to the research team. We endeavoured to overcome this through the multi-stage random sampling of households. Third, self-reported and subjective measurements might cause information bias. Fourth, understanding the impact on subjective well-being that having chosen ones' abode has in

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comparison to forced relocation, requires a more ethnographic and immersive approach to understand the meanings that people attach to the experience of being subjected to compulsory resettlement. Finally, associations between social cohesion and subjective well-being may vary between men and women, one limitation of this study is that data were collected from the main household wage earner, who in the Indian context is typically male.

CONCLUSION

Our analysis in this paper aims to contribute to debates concerning neighbourhood cohesion and subjective well-being for residents living in different informal settlement types in mega-cities. Gathering better local data allowed for a clearer understanding of the differences between residents of two types of slums, both typically devoid of security of tenure and infrastructure, but one on the periphery of the city detached from a socio-economic livelihood base, and where residents had been evicted from their original homes. Residents of resettlement colonies are forcefully relocated, uprooted from established social and economic networks typically against their will. Additional research is required to understand the impact that this forced relocation may have on the sense of subjective well-being and personal agency. This research should take into account issues of selection bias and requires a significant ethnographic component to explore the value that people attach to having chosen where they live.

Contributors: PD conceived the idea and conceptualised the study and is responsible for the overall content as guarantor. SH conducted the data analysis with statistical analyses being contributed by AS and BR. BR carried out the data collection, training of data collectors and monitored the data collection in the field. PD, SH and BR interpreted the results. AS and MP provided critical contribution to the discussion of the findings of the study. All authors contributed to the study design and review of the manuscript.

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Data availability statement: Technical appendix, statistical code and data set available from the publication date from Newcastle University's open data repository (data.ncl).
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Figure 1 **Map of Bhalswa Resettlement Colony, Delhi, India** (Google Earth Digital Globe Image, 2022)

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Figure 2 **Map of Sanjay Colony, Okhla Phase II, Delhi, India** (Google Earth Digital Globe Image, 2022)

Figure 3 **Neighbourhood Cohesion Index estimated averaged marginal component effects for Sanjay Colony with 95% CIs**. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0). The marginal effect of each independent variable being averaged over the joint distribution of the remaining variables. The independent variables are in the vertical axis. The horizontal axis gives the prediction of change in the independent variable (points), and the associated 95% confidence intervals (bars).

Figure 4 **Well-being estimated averaged marginal component effects for Sanjay Colony with 95% CIs.** The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0). The marginal effect of each independent variable being averaged over the joint distribution of the remaining variables. The independent variables are in the vertical axis. The horizontal axis gives the prediction of change in the independent variable (points), and the associated 95% confidence intervals (bars).

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Figure 1 Map of Bhalswa Resettlement Colony, Delhi, India (Google Earth Digital Globe Image, 2022)

181x226mm (144 x 144 DPI)

Figure 2 Map of Sanjay Colony, Okhla Phase II, Delhi, India (Google Earth Digital Globe Image, 2022)

359x222mm (144 x 144 DPI)

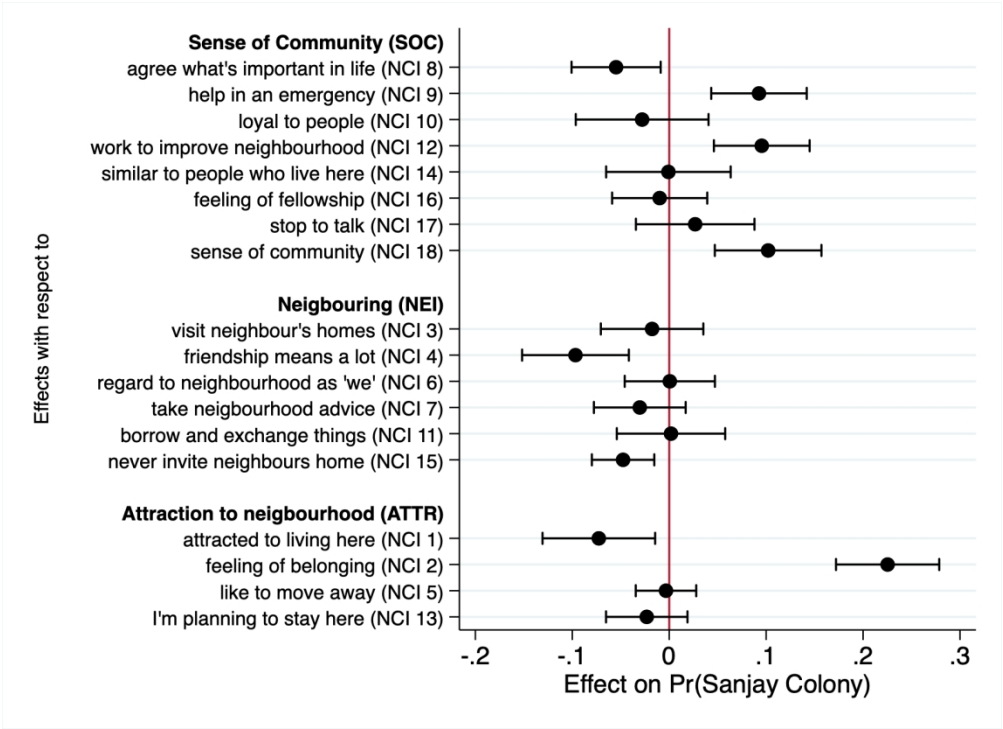

Figure 3 Neighbourhood Cohesion Index estimated averaged marginal component effects for Sanjay Colony with 95% CIs. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0). The marginal effect of each independent variable being averaged over the joint distribution of the remaining variables. The independent variables are in the vertical axis. The horizontal axis gives the prediction of change in the independent variable (points), and the associated 95% confidence intervals (bars).

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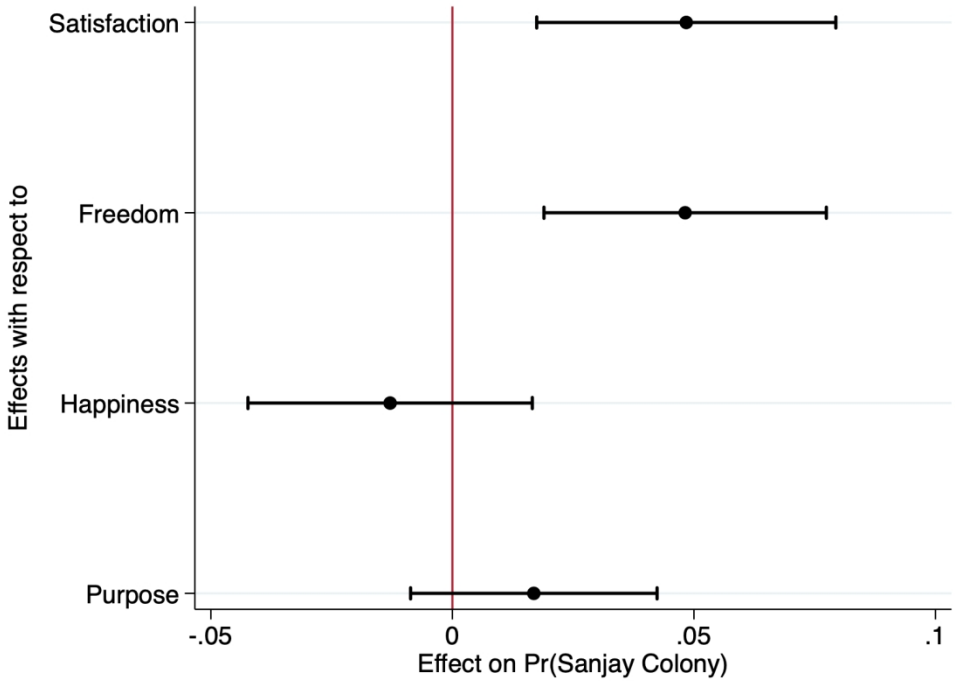

Figure 4 Well-being estimated averaged marginal component effects for Sanjay Colony with 95% CIs. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0). The marginal effect of each independent variable being averaged over the joint distribution of the remaining variables. The independent variables are in the vertical axis. The horizontal axis gives the prediction of change in the independent variable (points), and the associated 95% confidence intervals (bars).

310x225mm (144 x 144 DPI)

Supplemental Material

Supplemental tables 1 and 2 give the coefficient estimates of the average marginal component effects with standard errors in parenthesis for figures 2 and 3 in main article. Supplemental table 3 shows the bivariate correlations between Neighbourhood Cohesion Index, Subjective Well-Being and socio-demographic covariates.

Supplemental Table 1 Neighbourhood Cohesion Index estimated averaged marginal component effects for Sanjay Colony with 95% CIs.

Item	***Item description***	Sanjay Colony(=1)
SOC	**Sense of Community**	
NCI8 (SOC)	I agree with most of my neighbourhood about what's important in life	-0.055** (0.023)
NCI9 (SOC)	I believe my neighbours would help me in an emergency	0.093*** (0.025)
NCI10 (SOC)	I feel loyal to people in my neighbourhood	-0.028 (0.035)
NCI12 (SOC)	I'd be willing to work with others to improve my neighbourhood	0.095*** (0.025)
NCI14 (SOC)	I think of myself as similar to people who live in this neighbourhood	-0.001 (0.033)
NCI16 (SOC)	A feeling of fellowship runs deep in this neighbourhood	-0.010 (0.025)
NCI17 (SOC)	I regularly stop to talk with people in my neighbourhood	0.027 (0.031)
NCI18 (SOC)	Living in this neighbourhood gives me a sense of community	0.102*** (0.028)
NEI	**Neighbouring**	
NCI3 (NEI)	I visit with my neighbours in their homes	-0.018 (0.027)
NCI4 (NEI)	The friendships I have with people in my neighbourhood mean a lot	-0.097*** (0.028)
NCI6 (NEI)	If people in my neigbourhood were planning something I'd think of it as something 'we' were doing rather than 'they' were doing	-0.001 (0.024)
NCI7 (NEI)	If I need advice, I could go to someone in my neighbourhood	-0.030 (0.024)
NCI11 (NEI)	I borrow things and exchange favours with my neighbours	0.002 (0.028)
NCI15 (NEI)	I have never invited neighbours over to my house to visit (R)	-0.048** (0.016)
ATTR	**Attraction to neighbourhood**	
NCI1 (ATTR)	Overall, I am very attracted to living in this neighbourhood	-0.073* (0.030)
NCI2 (ATTR)	I feel like I belong to this neighbourhood	0.225*** (0.027)
NCI5 (ATTR)	Given the opportunity, I would like to move out of this neighbourhood (R)	-0.003 (0.015)
NCI13 (ATTR)	I plan to remain a resident of this neighbourhood for a number of years	-0.023 (0.021)
Constant		-0.157 (0.137)
		P[F(18, 620)=16.62] <0.001
		R^2=0.325

Analysis includes 639 observations. Coefficient estimates of the average marginal component effects with standard errors in parenthesis. ***p<0.001, **p<0.01, *p<0.05. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0).

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Supplemental Table 2 Well-being estimated averaged marginal component effects for Sanjay Colony with 95% CIs

Well being		
item	***Item description***	Sanjay Colony(=1)
	Well-being	
Satisfaction	Overall, how satisfied are you with life as a whole these days?	0.048** (0.016)
Freedom	How much freedom of choice and control do you feel you have over the way your life turns out?	0.048*** (0.015)
Happiness	How happy did you feel yesterday?	-0.013 (0.015)
Purpose	Do you feel your life has important purpose or meaning?	0.017 (0.013)
		P[F(4, 634)=14.49] <0.001 R^2=0.084

Analysis includes 639 observations. Coefficient estimates of the average marginal component effects with standard errors in parenthesis. ***p<0.001, **p<0.01, *p<0.05. The percentage points (pp) estimates for Sanjay Colony (=1) with the base group being Bhalswa (=0).

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Supplemental Table 3. Bivariate Correlations between Neighbourhood Cohesion Index, Subjective Well-Being and socio-demographic covariates

	Total NCI	SWB	Trust	Age	Length of residence	Education	Work out	Income	Daily	Regular
Total NCI		0.145*	0.618**	0.006	0.157**	0.090	0.047	0.072	-0.090	0.083
Subjective well-being (SWB)	0.264**		0.031	-0.036	0.047	0.043	0.108	0.119*	-0.219**	0.134*
Trust	0.533**	0.121*		-0.015	0.020	0.034	0.064	-0.015	0.002	0.045
Age	0.005	0.004	-0.035		0.353**	-0.272**	-0.274**	-0.045	-0.009	-0.210**
Length residence	0.171**	-0.117*	0.145**	0.193**		-0.098	-0.066	0.076	-0.194**	0.083
Education	-0.019	0.095	0.016	-0.332**	-0.093		-0.047	0.196**	-0.090	0.035
Work outside community	-0.160**	0.103	-0.238**	-0.318**	-0.141*	0.118*		-0.155**	0.188**	0.318**
Income	0.123*	0.165**	0.132*	0.030	0.079	0.175**	0.081		-0.280**	-0.025
Daily paid wage earner	-0.032	-0.134*	0.011	0.088	0.047	-0.219**	-0.216**	-0.258**		
Regular employment	-0.035	0.109*	-0.161**	-0.172**	-0.092	0.178**	0.469**	0.101		

Sanjay Colony (above diagonal), Bhalswa (below diagonal)

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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	2
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	2
Objectives	3	State specific objectives, including any prespecified hypotheses	2
Methods			
Study design	4	Present key elements of study design early in the paper	3
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	3
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	3
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	4
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*4,5*
Bias	9	Describe any efforts to address potential sources of bias	8
Study size	10	Explain how the study size was arrived at	4
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	5
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	5
		(*b*) Describe any methods used to examine subgroups and interactions	6
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	6
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	2
		(b) Give reasons for non-participation at each stage	6
		(c) Consider use of a flow diagram	
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	6
		(b) Indicate number of participants with missing data for each variable of interest	None
Outcome data	15*	Report numbers of outcome events or summary measures	5-7
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9

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		(*b*) Report category boundaries when continuous variables were categorized	8-9
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	6
Discussion			
Key results	18	Summarise key results with reference to study objectives	11-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	11
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	11-12
Generalisability	21	Discuss the generalisability (external validity) of the study results	12
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	12

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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