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Sri Lankans' residential segregation and spatial inequalities in Southern Italy: an empirical analysis using fine-scale data on regular lattice geographies

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Abstract
Sri Lankans constitute one of Italy's oldest foreign communities. A comparative geographic study of Sri Lankans' settlement patterns in three main municipalities of South Italy (Naples, Palermo, and Catania) is performed in the present work. The uniqueness of the analysis relies on the fact that, to the authors' knowledge, no other existing studies comparatively examine the spatial segregation of Sri Lankan communities in different southern European municipalities. Moreover, implementing a single geographic reference grid allowed the homogenisation of different areal unit arrangements and the comparison between urban contexts. Original results have emerged from the empirical analysis, detecting peculiar and similar residential behaviour in Sri Lankans' settlement patterns across the three municipalities analysed, jointly influenced by work specialisation and variations in the local cost of living. In particular, the high levels of Sri Lankan concentration detected in the wealthiest neighbourhoods revealed complex dynamics underlying the urban spatial segregation, beyond the mere centre-periphery dichotomy.

Keywords South Europe · Italy · Sri Lankans · Segregation · Local-scale analysis · Divided cities

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1 Introduction

Nowadays, urban socioeconomic segregation and inequality are processes of international concern (van Ham 2021). Migrations play a fundamental role in these dynamics, shaping socio-spatial structures of contemporary urban and metropolitan contexts, configuring urban spaces, and influencing demographic structure in host societies (Benassi et al. 2020a; Portes 2000; Strozza et al. 2016). The increase of immigration flows across Europe in the last three decades, and especially in its southern side, together with rising social and economic inequalities, boosted by the 2008 economic crisis and the actual pandemic one, have consolidated social, economic, and residential segregation in European cities (Allen et al. 2004; Musterd et al. 2017; Tammaru et al. 2016). Such dynamics have greater incidence in Italian metropolitan areas (i.e., regions consisting of a densely populated urban core and its less-populated surrounding territories), where demographic changes and real estate speculation fuel gentrification and speed up suburbanisation of poverty and class segregation at large (Hochstenbach and Musterd 2018). The topic of spatial inequalities and segregation is so relevant that the Organization for Economic Cooperation and Development (OECD) recently published an in-depth study about the s.c. 'Divided cities' (OECD 2018a). The idea is that cities are places of opportunity and, as well known, the engine of economic development (Glaeser 2011). Unfortunately, not all cities have been able to grow inclusively, maintaining exclusive spaces and places where poverty is concentrated. These inequalities undermine the quality of life by exacerbating existing social inequalities (OECD 2018a).

Inequalities, primarily spatial heterogeneity in socioeconomic conditions at the suburban scale, are strongly associated with migrant populations and their territorial integration. This is because migrants tend to be attracted to big cities and metropolitan areas, at least in the initial steps of their journey (Vaughan and Arbaci 2011; Williamson 1988; Yap 1977). Due to several factors, such as challenges of being accepted by host communities, religious beliefs, and language barriers, migrant populations can be considered the most socio-economically vulnerable segment of urban societies and, therefore, the most exposed to the perpetuation of inequalities and marginalisation already affecting urban areas and big cities more than other spatial contexts (Dangschat 2009). At least for Europe, there is evidence of an inverse relationship between the level of residential segregation and economic conditions (i.e., labour market, wealth, productivity): in particular, the comparatively weaker economy in Europe's southern shores is paired with high residential segregation (e.g. Benassi et al. 2020a, b).

These processes are at the basis of the "vicious circles of segregation" framework, according to which social and ethnic inequalities and segregation tend to reproduce across multiple life domains (i.e., homes, workplaces, schools, etc.) and transmit from one generation to another (van Ham et al. 2018, 2021). These "vicious circles" can be reduced (or even stopped) by fostering spatial integration of migrants and, therefore, more inclusive societies. In fact, several studies evidenced the negative impact that residential segregation has on the social cohesion of the host society (Amin 2002; Peterson 2017; Sturgis et al. 2014), producing, at the macro level, a set of negative effects on contemporary social systems (Thomas et al. 2018; Williams and Collins 2001).

Social cohesion is one of the pillars of social sustainability (Vallace et al. 2001), a matter gaining particular relevance in urban contexts (James 2015). It comes straight that producing information about residential segregation and spatial inequalities in local contexts serves as means to address disparities, marginalities, and social disruptions. In particular,

framing the urban geographic arrangement of social groups is crucial (i.e., migrant populations) to cope with intra-urban inequalities (OECD 2018b).

Studies on residential segregation and spatial inequalities in Southern Europe already exist (Arbaci 2008; Benassi et al. 2020a; Tammaru et al. 2017). They have underlined, especially in the last years, an increase in the levels of residential segregation and inequalities that has drastically reduced the gap between Europe's northern and southern shores (Panori et al. 2019), together with an increase in the level of poverty and social vulnerability (Arapoglou 2012). This is partly a novelty compared to the past when levels of residential segregation in Southern Europe were on average lower; for instance, Casacchia et al. (2015), employing individual-level census data, found that segregation decreased between 1991, 2001, and 2011 in the city of Rome, and between 1990, 1999, and 2007 in Paris. However, more recent studies (Benassi et al. 2020a, b; Marcińczak et al. 2021) conducted on several European countries and urban areas using comparable data (harmonised to a uniform spatial grid) have underlined how, in 2011, the level of residential segregation was comparatively high in Southern Europe (especially in Spain and Italy). Studies dealing with the Italian context are fewer compared to those related to Northern Europe, but they are increasing very fast due to the growing relevance of the topic (Benassi et al. 2019; Busetta et al. 2015; Mazza and Punzo 2016; Mazza et al. 2018; Petsimeris and Rimoldi 2015; Rimoldi and Terzera 2017). Overall, they show evidence of a spatial dichotomy at the macro level between the northern and southern parts of the country, with Northern Italy being more economically developed and exhibiting a higher proportion of foreigners and lower levels of residential segregation and inequalities. However, studies performing comparative analyses between southern cities are very scarce, and, to the best of our knowledge, none of them deals with single citizenships. This is quite surprising because in Italy do exist foreign communities, like Sri Lankans, that, contrary to most of the other migrants' communities residing in Italy, are concentrated not only in big northern cities but also in the southern part of Italy, and specifically in some big cities (Henayaka-Lochbihler and Lambusta 2004; Strozza et al. 2016). The presence of Sri Lankans in Italy is so relevant that some authors wrote about "The Sri Lankan Diaspora in Italy" underlying the importance of this community in the Italian immigration framework (Henayaka-Lochbihler and Lambusta 2004). This importance is prominent in Sri Lanka as well, where some local places are called 'Little Italy' because of the strong connections, in terms of emigration flows, with Italy (Pathirage and Collyer 2011). The factors related to this phenomenon strictly concern religion: the first wave occurred during the second half of the seventies had mainly Catholic women relocated to Italy to work in elderly households. Over time, Sri Lankans were able to gradually build up very solid social networks at the local level, capable of characterising entire urban areas (Henayaka-Lochbihler and Lambusta 2004; Pathirage and Collyer 2011).

Based on these premises, the paper proposes an entirely original spatial analysis on residential segregation and settlement models of Sri Lankans, referring to the main three southern Italian municipalities (Naples, Palermo, and Catania). The major contributions of the present work rely on different aspects of novelty. The focus on the residential distribution of a single ethnic group in the southern contexts of Italy compensates for a lack in the studies of spatial urban segregation in the Italian South, as mentioned before. Such peculiarity in both contents (ethnic specificity) and context (big municipalities in South Italy) is accompanied by exclusivity in the data at hand. In particular, this is the first attempt to exploit fine-scale census data on Sri Lankans (at census tract level) that the Italian National

Institute of Statistics (Istat) does not generally disclose due to privacy concerns.[1] In addition, similar census data will not be available at the same territorial level anymore, given the sampling approach of the future Italian Censuses (Istat 2014). This situation provides, in our thoughts, a further element of exclusivity in the data. Moreover, the choice to exploit the Italian Revenue Agency data to characterise the economic conditions of the different urban areas is quite uncommon in similar works, despite the quality and free availability of such data. The methodology implemented also presents some remarkable characteristics. On the one end, the harmonisation and spatial processing of the data collected by different sources to a uniform spatial grid of 100 by 100 m cells enable comparative analyses between urban areas. On the other, the high level of spatial resolution allows for local-specific contextualisation. Being enhanced by the originality of the results, the technical peculiarities concerning data and methods prove to be not self-referential. Sri Lankans are highly segregated in all the municipalities considered, both at the municipality and intra-urban level. This ethnic segregation seems to be paired with the socio-economic conditions at the suburban dimension. Sri Lankans concentrate in the wealthiest urban areas of the three main municipalities of South Italy, disregarding the poorest places. The ethnic and economic mixing in the richest neighbours resulting from the Sri Lankans presence poses several questions of public policy and social interest. This result could be partially related to the fact that Sri Lankans could reside within their Italian employers' house where they work as caregivers and similar, accounting for a separate household. According to the data of the 2011 census the percentage of Sri Lankans households that co-reside together with an Italian household on the total Sri Lankans household is about 6.8%. Given the low value of this percentage, we can assume that its effect on the results is negligible.

The analysis is aimed to give a plausible answer to two main research questions. The first one attempts to understand if, and even why, the settlement models and the level of residential segregation of Sri Lankans are similar across the three municipalities. The second aims at detecting possible spatial polarisation of Sri Lankans in specific urban areas and verifying spatial correlation with other key variables that are proxy of spatial inequalities related to human capital and real estate market.

The article is organised as follows: the next section describes the history and the geography of Sri Lankan immigration flow towards Italy; the third section illustrates the available data and the methodology applied; the fourth and fifth sections present and discuss the main findings, respectively; the sixth and last section summarizes and concludes the work.

2 Sri Lankan migration to Italy

Sri Lankan immigration to Italy started in the 1970s but gained numeric relevance in the 1980s; therefore, the Sri Lankan community is one of the oldest foreign communities residing in the country (Henayaka-Lochbihler and Lambusta 2004). The 1991 census counted about 6800 (4700 residents and 2100 non-residents) people holding Sri Lankan citizenship living in Italy (i.e., 0.1 per thousand residents). However, it is known that the census had missed a part of the foreign presence. For instance, according to data on residence permits

[1] The Sri Lankans' data analysed in the present work have been made available within the scope of the *"Caratteristiche, comportamenti e condizioni di vita degli immigrati di prima e di seconda generazione secondo le principali fonti disponibili"* research agreement between the Italian National Institute for Statistics (Istat), the National Research Centre (CNR), and six Italian universities.

Table 1 Sri Lankans residing in Italy, years 2002–2021 (Absolute values, index numbers, and percentages)

Years (January 1st)	Absolute values	Index numbers (2001 = 100)	% of total foreigners	% of females
2002	26,474	100	2.0	45.5
2007	56,745	214	2.1	44.2
2012	71,573	270	1.7	45.3
2017	104,908	396	2.2	46.3
2021	112,018	423	2.2	47.3

Source: own elaboration on Istat data (Demographic Census and Municipal Population Registers)

(a document that non-EU citizens need to be allowed for long-term stay in Italy), more than 12,000 Sri Lankans were legally present in Italy at the end of 1991, 69% of whom were males. It should be noted that, at least in the early 1990s, Sri Lankans accounted for high numbers of illegal presence in Italy, mostly arriving through the Balkan route (Morlicchio 1992). At the 2001 census, Sri Lankan citizens residing in Italy had become more than 26,000. In the period 2002–2019, immigration has reached considerable dimensions: more than 88,000 arrivals (entries in the Population Registers for transfer from abroad) against less than 7000 departures were recorded. At the beginning of 2012, Sri Lankans residing in Italy became more than 70,000, and almost 110,000 according to the most recent figures; respectively, 2.7 times and over four times those residents at the end of 2001 (Table 1). The gender composition of Sri Lankans has experienced some consistent variation through time: the initial female majority in the 1970s and the following strong male presence in the 1990s have found a recent balance. Nonetheless, both females and males generally find employment as domestic workers (Näre 2012). The stratification of subsequent migratory flows and the processes of stabilisation and integration have not altered Sri Lankans' territorial arrangement and, over the last ten years, the dissimilarity index DI[2] (Duncan and Duncan 1955) has been stable at the country level (0.65 in 2012 and 0.64 in 2021).

Sri Lankans' distribution over the Italian territory presents a twofold element of uniqueness, which is worthy of note. Firstly, the Sri Lankan citizens residing in Italy mostly prefer settling in large cities. At the beginning of 2012, the top 10 Italian cities with the highest number of Sri Lankan residents (four in the North, two in the Centre, and four in the South and Islands) together accounted for 57% of all Sri Lankans residing in Italy. Such an extraordinary concentration level becomes more evident considering that about 420 cities need to be gathered together to reach a similar proportion for the other foreign communities. The city hosting the majority of Sri Lankan residents is Milan (over 11,000, equal to 15.5% of the total number living in Italy), followed by Naples (over 7000, 10.1%), Verona, and Rome (respectively just over and just under 5000, about 7%). In 2021, these remained the four cities hosting the highest number of Sri Lankan residents, even though Rome overtakes Verona in the ranking and Naples shows an evident growth in importance, both absolute and relative, bringing it closer to Milan. Messina, Palermo, and Catania, the three main cities of Sicily, follow in the ranking. The focus on the sole Italian South and Isles unfolds the second peculiarity of Sri Lankans settlement pattern: although accounting for a consistently small portion of the total immigrants (Table 1), Sri Lankans present a

[2] The dissimilarity index (DI) is a very common measure in the field of population geography aimed to measure the residential segregation of minority groups. For major details please see Sect. 3.

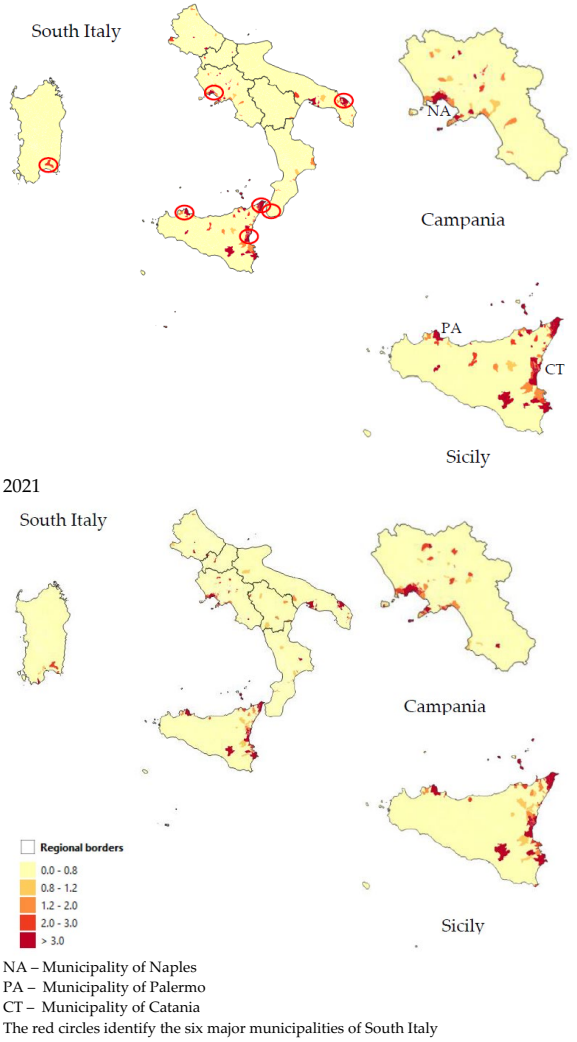


Fig. 1 Location quotients of Sri Lankans (ref. group: Italians). Municipalities, Southern Italy, Campania and Sicily, 2012–2021. *Source*: own elaboration on Istat data (Demographic Census and Municipal Population Registers)

significantly higher concentration in southern cities than that recorded by other foreigners (almost 30% against about 17%), with the exception of Verona in Northeast Italy. Indeed, in the main cities of Southern Italy, the proportion of Sri Lankans to the total number of foreigners has always been remarkably high: over 30% in Messina, between 15% and 30% in Naples and Catania, and over 10% in Palermo.

The strong localisation of Sri Lankans in a few cities, mostly of large demographic size, is evident, with a presence in the South and Islands concentrated essentially in Campania and Sicily (Fig. 1). In both regions, the attraction of large urban areas (Naples, Palermo, Catania, and Messina) is evident.

Despite the strong uniqueness of its settlement pattern and its predominantly urban nature, the Sri Lankan community has been poorly studied so far. Quite surprising, little attention has been paid to the comparative analysis of local settlement patterns in the main southern municipalities to assess similarities and differences and to understand what factors may have affected the strong urban localisation. For these reasons, we focus this analysis on the Sri Lankans' settlement pattern in three main hosting municipalities of South Italy: Naples, Palermo, and Catania.

3 Materials and methods

Population Data on Italian and Sri Lankans come from the 2011 General Population Census, as recorded on October 9th, 2011. The analysis includes all the Sri Lankan citizens holders of a regular residence permit. According to the 2012 Post Enumeration Survey, the 2011 census data are affected by under-coverage problems: 1.07% for the whole population and 11.07% for foreigners at the national level (Istat 2015). For the computation of LQs and bivariate local Moran's I, other geographically referenced variables have been used, such as census tracts data on population and labour dimension from the 2011 General Population Census and data on rent cost per square meter for private residential properties, collected for the different areas of the municipalities by the Italian Revenue Agency (OMI database) during the first semester of 2016. All the elaborations are implemented in the R software environment (R Core Team 2021).

To first assess the degree of global Sri Lankan segregation in the three considered urban areas, we compute the corrected version of the dissimilarity index (DI) proposed by Mazza and Punzo (2015). Then, to uncover possible local unevenness in Sri Lankans' spatial distribution, we map their location quotients (LQs) (Haig 1926). Finally, we employ the bivariate local Moran's I to analyse social and economic implications of Sri Lankans' residential locations, correlating Sri Lankans' LQs with Human Capital Index (HCI)[3] in the labour market dimension and mean rent cost.

Our analyses are based on areal data referring to specific reporting zones, such as census tracts or OMI zones. The arbitrary nature of such reporting zones immediately leads to the difficulties known as the modifiable areal unit problem (Openshaw 1984; Openshaw and Taylor 1979), that is, the dependence of spatial analysis results on both scales and methods used to create areal units. To harmonise and allow for comparison among municipalities, we employ an areal weighted interpolation procedure, one of the most common forms of spatial basis change for socioeconomic data, which transfers data from one set of reporting zones (also termed "source") to a second, independent set (termed "target") (Goodchild et al. 1993). In particular, we redistribute the census tracts and OMI zone based data to a uniform spatial grid with 100 by 100 m cells, as implemented in the *aw_interpolate()* function of the *areal* R package (Prener and Revord 2019).

[3] To capture the level of human capital in the labour market we consider the average between low human capital $LHC = \left(P_{litterate} + P_{illitterate} + P_{PrimaryEdu}\right)/P_{6+} * 100$ and unemployment$U = P_{15+jobseeking}/P_{15+intheworkforce} * 100$, resulting in the Human Poverty Index $HPI = (LHC + U)/2$, rescaled according to the min–max normalisation. The *HPI* is then reversed in its sign by taking its complement to 1 for the applications of this work, obtaining the Human Capital Index (HCI) in the labour market dimension. Hence, *HCI* taking values near to one implies high human capital, whereas *HCI* taking values near to zero implies low levels of human capital.

The choice of a 100 m grid cell, although arbitrary as any other cell size, has emerged as a standard in the recent literature on residential segregation and settlement models of migrants population. Indeed, the D4I Data Challenge on "Integration of Migrants in Cities", promoted by the European Commission Joint Research Centre (JRC), made available to researchers worldwide grids of population distribution in 100 m grid cells for all cities of eight EU Member States.[4] Several works have already taken advantage of the D4I dataset, providing comparable insights on migrant settlement patterns across different urban contexts (Benassi 2020a, b; Marcińczak et al. 2021; Olteanu et al. 2020).

We consider as the areal weight for each intersected feature i, that is the intersection between the source feature (i.e. census tract or OMI zone) and the target feature (i.e. the 100 by 100 m cell), the following:

$$W_i = \frac{A_i}{A_j}, \tag{1}$$

where A_i is the area of the intersected feature i and A_j is the total area of the source feature j. We then estimate the share of the population or OMI data relating to the intersected feature as:

$$E_i = V_j * W_i, \tag{2}$$

where E_i is the estimated value for intersected feature i, V_j is the population (or OMI) value for source feature j, and W_i is the areal weight for intersected feature i. Finally, we summarise the data based on the target feature identification number through summation:

$$G_k = \sum E_{ik} \tag{3}$$

where G_k is the sum of all estimated values for target feature k and E_{ik} are the estimated values from intersected features in i within target feature k.

We apply the corrected version of the classical DI proposed by Mazza and Punzo (2015) to measure global segregation. Although a suite of indices has been used to capture various dimensions of residential segregation (Massey and Denton 1988), we rely on the DI configuration because it's the most commonly employed. The traditional DI index has been used in a broad range of contexts, such as gender segregation in the labour market (Carrington and Troske 1995; Deutsch and Silber 2005; He and Wu 2019; Mavrikiou and Angelovska 2020) and residential segregation (Iceland et al. 2014; Logan 2017; Sydes 2018). The DI reveals how evenly people of different ethnic groups are distributed across areal units, in our case, within an urban area. One formula for the DI is:

$$DI = 0.5 \sum_{k=1}^{N} \left| \frac{x_k}{X} - \frac{y_k}{Y} \right|, \tag{4}$$

[4] The European Commission's Knowledge Centre on Migration and Demography recently released the Data for Integration (D4I) dataset. This dataset has been obtained through a spatial disaggregation of statistics of the 2011 Census, collected from national statistical institutes. The spatial processing of the original data resulted in a uniform grid showing the concentration of migrants in cells of 100 by 100 m in all cities of eight European countries (France, Germany, Ireland, Italy, Netherlands, Portugal, Spain, the United Kingdom)).

where k is used to identify each of the N 100 by 100 m cells, while x and y are Sri Lankans and Italians (at cell level with x_k and y_k, and at urban level with X and Y), respectively. DI varies from 0 (no minority group segregation or geographical spread through areas in the same way as the majority group) to 1 (complete separation) and, specifically, indicates how the distribution of Sri Lankans is different from the one of Italians in terms of evenness. A general rule of thumb suggests that DI taking values less than 0.30 indicates low segregation, 0.30–0.60 indicates moderate segregation, and values over 0.60 indicate high segregation. Of course, this varies between national and local contexts (Massey and Denton 1993).

The observed allocation pattern is one of the possible outcomes of a random process that is characterised by a certain level of "systematic" segregation and by a mix of behaviour-based forces. Systematic segregation refers to economically induced segregation mostly due to urban variations in the price of residential property, in the accessibility of low-cost public infrastructures, and in the availability of certain types of jobs. Conversely, behavioural drivers of segregation pertain to the positive spillovers in settling close to people belonging to the same ethnic group (Mazza and Punzo 2016). Within a multinomial framework based on the assumption that individuals allocate themselves independently and that unit sizes are not fixed, Allen et al. (2009) demonstrate that random allocation generates substantial unevenness, and hence an upward bias, especially when dealing with small units, a small minority proportion (as in our case), and a low level of segregation. To partially mitigate these problems proper to the DI, we resort to the DI bias-corrected estimator introduced by Mazza and Punzo (2015), which outperforms many other resampling-based bias corrections in terms of both bias and mean square errors. The main advantage of the bias-corrected version is that it allows for a better comparison among municipalities, reducing the sensitivity to context-specific allocations as the economically induced segregation, typically due to spatial inhomogeneity in the cost of living and job availability within different parts of the municipality. The computation of the bias-corrected index has been implemented using an analytical formulation based on the folded normal distribution available in the *bcdi* function of the *bcdi* R library (Mazza and Punzo 2014).

To assess the local degree of ethnic residential segregation, we employ LQs. Since their conception (Haig 1926), LQs provided one means of assessing the relative concentration of a particular characteristic within a population. Their popularity has not diminished, and their use is still prevalent: for example, epidemiologists examine the spatial distribution of diseases (Clayton and Hills 1993; Saravanabavanet al. 2019), whereas criminologists often want to understand peculiarities in reported crimes in different neighbourhoods (Block et al. 2012; O'Connor 2017). LQs formulation is given by:

$$LQ_k = \frac{x_k/z_k}{X/Z}, \tag{5}$$

where the numerator represents the proportion of Sri Lankans (x_k) compared to the total resident population (z_k) at the 100 by 100 m cell k, whilst the denominator represents the global proportion of Sri Lankans (X) over total resident population (Z) at the urban level. It follows, for cell k, that if the LQ_k is greater than one, then the cell hosts a greater share of Sri Lankans than the urban average and thus it could be inferred that the ethnic group is more concentrated in that given cell.

Previous studies highlighted the development of ethnic work specialisation in Naples (Mazza et al. 2018), Palermo (Busetta et al. 2015), and Catania (Mazza and Punzo 2016), where Sri Lankans are mainly involved in housework within Italian households. As a consequence, different neighbourhoods of the municipality have different suitabilities for Sri

Table 2 Bias-corrected DI for Sri Lankans and Italians in three main municipalities of South Italy, 2011, computed on 100 by 100 m cell grid

Municipality	Bias-corrected DI
Naples	0.618
Palermo	0.671
Catania	0.513

Source: own elaboration on Istat data (Demographic Census and Municipal Population Registers)

Lankans, with job availability being the most important pull factor. We deem it reasonable to assume that socioeconomic covariates, such as the proximity to the workplace or average rent costs, could play a key role in the spatial arrangement of Sri Lankan households. To reveal the spatial disparity of the relationship between Sri Lankans allocation and local economy and cost of living, we employ the bivariate local Moran's I, proposed by Anselin (2004). The formula of the bivariate LISA statistic can be defined as:

$$I_{kl} = z_k' W^s z_l, \tag{6}$$

where $z_k = \left[a_k - \overline{a}\right]/\sigma_k$ and $z_l = \left[b_l - \overline{b}\right]/\sigma_l$ are, in our case, the standardised LQ at given cell k and the standardised HCI (or mean rent cost) at neighbouring cell l, respectively. W^s is the standardised spatial weights matrix defining the "neighbouring set" for each observation with zero on the diagonal by convention, non-zero elements for neighbours, and zero for the other elements. Neighbouring cells were defined based on a first-order queen contiguity weight matrix. In essence, it captures the relationship between the value for one variable at location k, z_k, and the average of the neighbouring values for another variable, $\sum_l w_{kl} z_l$. The statistic needs to be interpreted with caution since it ignores the in-situ correlation between the two variables. The significance of the bivariate local Moran's I is assessed by means of a randomisation approach which randomly reallocates to locations the observed values for one of the variables and then recomputes the statistic for each such random pattern. The resulting empirical reference distribution provides a way to quantify how extreme the observed statistic is relative to its distribution under spatial randomness. For the present analysis, the pseudo-significance of the bivariate LISA statistic is evaluated at the 5% level based on 999 randomisation permutations. Finally, the identified four types of local association (High–High, Low–Low, Low–High, and High–Low, referring to the level of LQs for Sri Lankans and HCI or mean rent cost) are displayed using a cluster map, together with the not significant statistic. Specifically, a spatial cluster (High–High, Low–Low) occurs when the LQ value registered at a specific location is similar to its neighbours (the spatial lag-weighted average of the neighbouring covariate values) than it would be in case of spatial randomness. Conversely, when the LQ takes on dissimilar values compared to that for the explanatory variable at neighbouring cells, spatial outliers emerge (Low–High, High–Low).

4 Results

4.1 Comparing spatial distributions among three municipalities

Our first research question asks whether there are distinctive patterns of segregation for the three municipalities analysed. This sheds light on the variation in segregation levels within the urban context in South Italy. Table 2 reports 2011 values of the bias-corrected DI for Sri Lankans and Italians in each municipality, computed on a spatial grid with 100 by 100 m cells. The deeper insight into segregation patterns provided through harmonisation to a uniform grid is immediately obvious: similar and high levels of unevenness are observed across urban areas. The greatest unevenness is observable in Palermo and the lowest in Catania.[5]

Given that the global index detects similar levels of residential segregation, we are interested in whether or not Sri Lankans' spatial allocation also shows local similarities across the three municipalities. To examine this, Fig. 2 shows the LQs for Sri Lankans in the considered urban areas. At first glance, the residential pattern for one municipality seems to resemble the other. Sri Lankans appear to be over-represented in specific central areas of the urban fabric. In particular, for all three cases, the neighbourhoods hosting the largest part of Sri Lankans correspond to the old towns and specific areas supposed to present wealthy socio-economic profiles. This point will be better investigated in the next part of the paper.

Indeed, the homogeneity in the residential allocation across municipalities leads us to our second research question about possible socioeconomic spatial covariates which could exert influence on the spatial unevenness within municipalities.

4.2 Is there a specific association between localisations and contextual situations?

As mentioned in Sect. 2, Sri Lankans' work specialisation has been extensively documented in previous studies. With their main activities being housework and caregiving in Italian households, our hypothesis is that the distance from the workplace could affect Sri Lankans' residential positioning, together with other economic factors, such as the average rent cost. To assess our thought's validity and provide a plausible explanation to our second research question, this section focuses on cluster analysis based on bivariate local Moran's statistic.

Figure 3 shows the bivariate LISA index computed between LQs and HCI (Fig. 3a–c) and between LQs and mean rent cost (Fig. 3d–f) in Naples, Palermo, and Catania, respectively. The dark red colour represents cells where the value for the LQs is high and the mean rent cost or HCI in the surrounding cells are also high; the dark blue colour represents cells where both values are low. On the other hand, light blue is for cells with high values for the explanatory variable and low LQs, while light red represents the opposite situation. Considering cross-sectionally the first row of Fig. 3 referred to LQs and HCI, it

[5] Values of the traditional DI were 0.679 in Naples, 0.751 in Palermo, and 0.690 in Catania. The standard DI slightly increases the segregation levels for all the cities and reorders them letting Palermo being the most segregated city (as in the corrected DI version) and Naples the least segregated one. Since this work aims to compare the segregation patterns of different cities, we prefer to rely on the order yielded by the corrected-DI, which can account for a part of the bias due to context-specific allocations of migrants (see Sect. 3).

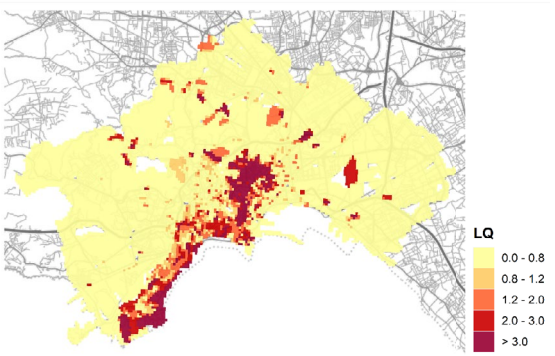
Fig. 2 Location quotients of Sri Lankans (ref. group: total resident population). Main municipalities of South Italy, 2011. Spatial grid with 100 × 100 m cells. *Source*: own elaboration on Istat data (Demographic Census and Municipal Population Registers)

is possible to observe similar configurations for Naples and Catania: the positive spatial correlation between LQs and HCI is clearly registered in the wealthier central neighbourhoods. These areas are surrounded by a belt characterised by low Sri Lankans presence and high HCI. Low-Low clusters are mainly located in peripheral urban parts. Palermo shows a more fragmented situation where Sri Lankans are more concentrated in scattered central pockets of both high or low HCI. On the other hand, the situation emerging in subfigures Fig. 3d–f, reporting the bivariate index between LQs and mean rent, seems homogeneous for all three municipalities: Sri Lankans mostly live in the central areas corresponding to the old towns and the wealthier parts of the municipalities and avoid settling in peripheries. Nevertheless, it is also possible to observe many regions with an inverse relationship between the considered variables: all the three municipalities show a ring of high values for mean rent cost with a low proportion of Sri Lankans (light blue), while few areas reveal the opposite association (light red). Overall, the rings of Low–High cells surrounding the High–High cores could confirm that Sri Lankans mostly reside in proximity to their workplaces, mainly middle-class Italian households concentrated in the wealthier and expensive central neighbourhoods of the municipalities. The existence of several regions where an inverse relation occurs in proximity to the High–High areas reveals the presence of spatial ethnic segregation between High–High clusters and Low–High spatial outlier zones. On the other side, the presence of Sri Lankans in rich areas could imply within-zone segregation, according to which Sri Lankans reside in the old and not renovated buildings located in the historical centres, nearby their richer Italian employers' dwellings.

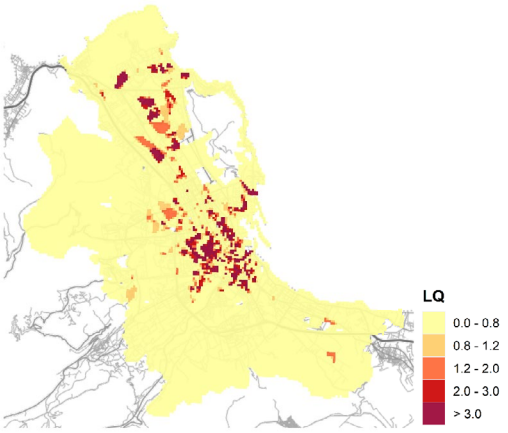
Table 3 reports Sri Lankan and total population counts (in percentage values) for each bivariate local Moran's I cluster type in the three municipalities. Neglecting the non-significant areas, it is clear that the large majority of Sri Lankans are concentrated where HCI and the cost of living are high, discarding the poorest parts of the urban contexts. In particular, the average rent price seems to discriminate the Sri Lankans' allocation among clusters more than the HCI, resulting in about 51%, 36%, and 59% of Sri Lankans residing in the most expensive areas of Naples, Palermo, and Catania, respectively. Moreover, the unevenness in Sri Lankans' distribution among clusters, considering HCI and mean rent cost indifferently, appears more marked than for the total population, revealing a peculiar spatial configuration for the South Asian ethnic group.

5 Discussion

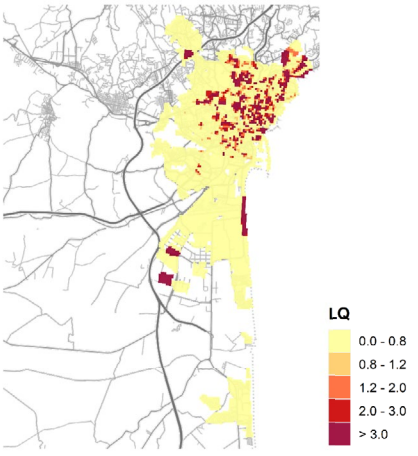
Southern European countries have become destinations for large numbers of international migratory flows only since the second half of the 1970s, having traditionally been labour-exporting countries until then (Collinson 1993; de Haas et al. 2020). Moreover, in Southern Europe, cities are typically more compact than in the North (Kasanko et al. 2006), and the housing context is characterised by very significant shares of owner-occupied houses and by the stronger role of the family and its assets within the housing supply system itself (Arbaci 2019; Leal 2004). These two elements, linked to a more limited foreign presence than in Northern European contexts, have traditionally allowed Southern cities to be characterised by a higher degree of intra-urban spatial heterogeneity (Arbaci 2008; Barbieri



(a) Naples



(b) Palermo



(c) Catania

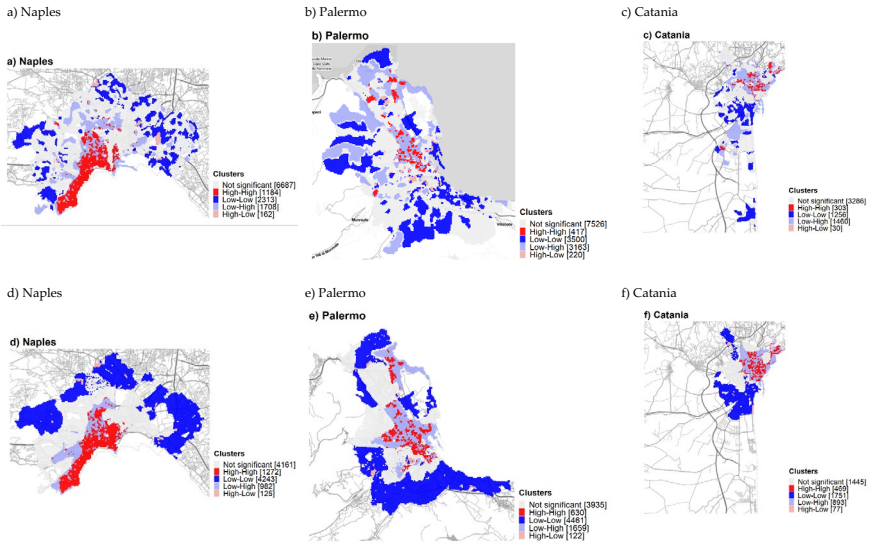


Fig. 3 Bivariate local Moran's I between LQs and HCI (subfig. **a**–**c**) and between LQs and mean rent cost (subfig. **d**-**f**). Reference group: total resident population. Main municipalities of South Italy, 2011. Spatial grid with 100 × 100 m cells. *Source*: own elaboration on Istat data (Demographic Census and Municipal Population Registers) and on OMI data

et al. 2018; Malheiros 2002). As recalled by Arbaci (2019), about 20 years ago Malheiros (2002) identified some fundamental processes underlying the socio-urban development of European metropolises and their ethnic organisation of space. Among these elements, the author pointed out that poor living conditions (thus less inequality between natives and foreigners due to lower average wealth), a very informal real estate market, and a complex geographic population arrangement imply low residential segregation and a high level of suburbanisation. Additionally, at least in the case of Italy, the poorly regulated urban development occurred during the expansive phase of the second post-war period could have increased the urban residential complexity.

The results of our study, although preliminary, allow us to cast a different light on some of the assertions described above that characterise the existing literature on Southern Europe, residential segregation, and socio-economic inequalities. In particular, the use of perfectly comparable geographies referred to a regular grid has allowed us to make comparisons ruling out the effect of different aggregation units. The use of uncommon statistical information at the suburban level, such as the OMI data, which are rarely exploited in Italian studies, has also allowed framing the processes of residential segregation within the broader framework of socio-economic inequalities. From this point of view, in fact, the level of human capital in the labour market and the value of real estate are to be considered as proxies not only for the level of wealth/wealth of the different suburban spaces but also for their potential development. Labour market is in fact a growth factor of primary importance. Moreover, the three main municipalities in Southern Italy considered constitute a spatial context that has been very little investigated and, as far as we know, never studied in comparative terms, even if these cities belong to the same macro geographical area. Finally, the reference to a specific foreign community, studied in three different urban

Table 3 Sri Lankan and total population counts per bivariate local Moran's I cluster in three main municipalities of South Italy, 2011 (percentage values)

Municipality	Cluster	LQs – HCI		LQs—mean rent cost	
		Total population	Sri Lankans	Total population	Sri Lankans
Naples	High–High	14.4	**23.0**	19.5	**51.0**
	Low-Low	13.9	0.1	31.0	0.6
	High-Low	0.5	1.0	0.7	1.0
	Low–High	12.4	2.4	14.4	2.7
	Not significant	58.8	73.5	34.4	44.7
	Total	100.0	100.0	100.0	100.0
Palermo	High–High	7.4	**27.5**	11.9	**36.2**
	Low-Low	14.2	0.5	24.8	0.3
	High-Low	5.7	12.5	2.2	6.4
	Low–High	17.6	0.2	21.1	1.1
	Not significant	55.1	59.3	40.0	56.0
	Total	100.0	100.0	100.0	100.0
Catania	High–High	6.1	**30.8**	13.6	**59.0**
	Low-Low	18.4	2.2	29.8	1.0
	High-Low	1.1	5.3	1.6	5.3
	Low–High	18.0	7.9	18.4	4.9
	Not significant	56.4	53.8	36.6	29.8
	Total	100.0	100.0	100.0	100.0

Source: own elaboration on Istat data (Demographic Census and Municipal Population Registers)
The bold numbers refer to the areas of highest Sri Lankans concentration

contexts in relation to the same meso-level variables, has allowed us to appreciate some peculiar aspects of the relations between residential segregation and inequalities.

The results allowed us to highlight at least three fundamental points:

(1) The levels of low residential segregation that are usually found on average (i.e., when referred to all foreigners) can become very high when referred to specific communities. Our results show that in the three cities analysed, the level of residential segregation, even when corrected, i.e., measured through the bias-corrected DI, is always higher than 0.5. The highest value is recorded in Palermo (0.67). Thus, keeping under control both the distorting effects played by the different geographies, we cannot say that the level of residential segregation of Sri Lankans is low.
(2) In all three municipalities, the highest levels of local concentration of Sri Lankans concern the central areas. This could imply that the past processes of suburbanisation that have characterised the urban and economic development of the Italian cities, especially concerning the middle class, have in fact contributed to the consolidation of a centre-periphery dynamic that only partly, as we shall see in point 3, traces a socio-economic differential.
(3) From a geographical perspective, the concept of socio-economic inequality (here declined according to the level of human capital in the labour market and real estate values) has turned out to be an aspect not univocally defined, at least when linked to

that of residential segregation. As clearly shown by the local bivariate Moran index, in fact, most of the Sri Lankans residing in the three municipalities examined are concentrated in spatial contexts of high levels of human capital in the labour market and high housing cost (23% for Naples, 27.5% for Palermo, and 30.8% for Catania). This concentration is much higher than that of the total population (i.e., of Italians to a large extent) who scarcely reside in these contexts (14.4% for Naples, 7.4% for Palermo, and 6.1% for Catania). From this point of view, the high levels of residential segregation reported in point 1) are also mirrored by the levels of inequality affecting Italians.

In our opinion, these results allow, as mentioned, to expand the existing literature on residential segregation and inequalities by providing a non-biased and partly unprecedented picture. The homogenisation of geographies, the variables exploited, and the spatial measures employed, have contributed to the general understanding of the complexities characterising the contemporary cities of Southern Europe. Several novelties have emerged with respect to what has been known or thought up to now.

6 Conclusions

The study conducted is, to the best of our knowledge, the first attempt to analyse a single ethnic community, namely Sri Lankans, at the suburban level in the Italian South. It is therefore difficult to draw comparative assessments. However, truly original aspects emerge.

The first is related to the similarity of Sri Lankans' settlement patterns in three substantially different urban contexts, even though all belong to Southern Italy. This aspect highlights how macro elements prevail over local dynamics, which probably still characterise the Sri Lankan presence in Italian urban contexts, that is, the work placement and chain migration. Despite the peculiarities of local residential markets make it difficult to prove the existence of general patterns at metropolitan or even regional scale (Panori et al. 2019), the high concentration of Sri Lankans in the central and substantially richest areas of the municipalities confirms that the processes of social polarisation recently detected in other European cities (Haandrikman et al. 2021; Martín-Legendre et al. 2021; Porcel and Antón-Alonso 2021) have an important ethnic and migratory dimension (Boterman et al. 2021; Demireva and Zwysen 2021).

The second aspect is connected to the concept of inequality (here identified through the spatial correlation between the level of Sri Lankans' local urban concentration and context variables related to the human capital of the labour market and housing rent cost) and its local variations. In urban contexts such as those in Italy, where the level of internal heterogeneity and intra-urban inequality is high (Barbieri et al. 2018), it is significant the substantial Sri Lankans' concentration in areas where, on average, the human capital of labour market and the housing cost are high. The question arises whether there is an intra-urban inequality so 'small' in geographical terms that it becomes difficult, in the Italian urban context, to be quantitatively defined. In fact, this second result partially contradicts the typical preference of members of the host societies (i.e., people with Italian citizenship in our case) to share space with people of similar ethnic and cultural characteristics that have been detected in some other studies (Clark 2009; Kaufmann and Harris 2015; Skifter Andersen 2016). The spatial proximity of wealthy Italian households and Sri Lankan ones could suggest the absence of inequality issue for the latter. Conversely, the ethnic mixing

characterising the old towns, where noble ancient buildings and decrepit ones are side by side, could imply a certain level of socioeconomic inequality to be addressed locally. If this is the case as in our thoughts, issues of public interest arise. Being similar multifaceted situations more complex than contexts of complete residential segregation, ad hoc interventions could be required.

These initial results need to be further investigated by extending the comparison of settlement patterns to other Italian urban contexts in the North and Centre of Italy, such as Milan and Rome, and by extending the temporal dimension exploiting the data coming from the last demographic census (2021).

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Data availability General population data analysed in this study were obtained from the Istat online repository and are available at: https://www.istat.it/it/archivio/104317. Data about the mean rent cost were retrieved from the online OMI repository and are available at: https://www1.agenziaentrate.gov.it/servizi/Consultazione/ricerca.htm.

Declarations

Conflict of interest The authors declare no conflict of interest. The opinions expressed by the authors do not represent those of their respective institutions but have to be considered personal.

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