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Age, gender, and cohort in residential segregation: The case of African immigrants in Spain, 2000–2020

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Abstract

The composition of the immigrant population by gender and age, and characteristics at the moment of arrival plays an influential role in the levels of residential segregation reached, and in their evolution over time. In Spain, the African immigrant population is notable for a marked gender imbalance, where men outnumber women, and for continuous growth in the number of immigrants over the past two decades. It is also one of the groups presenting the highest levels of segregation. Using data from the Continuous Population Register, this study analyses the residential segregation of this group from the triple perspective of age, period, and cohort for the six main Spanish cities. The results reveal a significant differentiation in segregation levels by sex and age, with lower rates in the more recent cohorts. This perspective offers a dynamic view of segregation indicators and enables better understanding of its future evolution.

KEYWORDS
African immigrants, age, cohort, segregation, sex, Spain

1 | INTRODUCTION

Analysis of the spatial distribution of the immigrant population and of residential segregation understood as the different ways in which two or more population groups share and are distributed in the space in which they reside, has a long academic tradition of tracing the levels and evolution of residential distance between different population groups (Massey & Denton, 1988; Musterd et al., 1999). Its interest lies in the fact that this segregation is deemed to be unfavourable inasmuch as it can be an obstacle in the process of integration, hindering social ascent and perpetuating the existence of unequal zones, whether poor (forced segregation) or rich (self-segregation) (Galeano & Sabater, 2016; Massey et al., 1994) which, added to individual preferences regarding ways of sharing urban space, ends up leading to the isolation of population groups (Fortuijin et al., 1998; Musterd, 2003). Nevertheless, in the first stage of arrival, segregation can have positive effects in easing the initial adaptation of the immigrant population (Cutler & Glaeser, 1998; Peach, 2005; Van Kempen & şule Özüekren, 1998), although it can become negatively perceived if the situation is prolonged over time (Sabater et al., 2013).

In origin, segregation is a multidimensional phenomenon, the product of a combination of several factors, which can be economic, social, demographic, or ethnic and, moreover, expressed differently in each city depending on the characteristics of its urban structure and housing market. Furthermore, it has an evolutionary component since its values vary over time.

In the case of Spain, studies on the dynamics of segregation of the immigrant population are recent as they only began to gain relevance over the last two decades, coinciding with the intense migratory boom of the early years of the 20th century (Martori & Apparicio, 2011; Musterd & Fullaondo, 2008; Bayona-i-Carrasco, 2007), which meant heightened demographic and residential complexity and dynamics, and the reshaping of Spanish society as a result of the intense compositional diversification of the population. The availability of an annual population register (Padrón Continuo) enables the study of segregation from an evolutionary perspective that shows declining indicators as the volume of settled immigrants increases, with clear differences among origins (Bayona-i-Carrasco & López-Gay, 2011; Domínguez-Mujica et al., 2010; Martori & Madariaga, 2023).

However, little or no attention has been given to the relationship between the demographic composition of groups and segregation levels, or to the effect of age, even when this was already highlighted as an interpretive element in the segregational processes of the 1960s (Uhlenberg, 2000), or to the effect of the moment of arrival on these processes. These are precisely the main aims of this paper in which analysis of ethnic segregation is approached from the three-dimensional perspective that considers sex and age, the moment of observation, and cohort, which then makes it possible, by means of these three classical standpoints of demographic analysis, to offer a more complete overview of the segregational process.

The study group is the African population (distinguishing between North Africa and sub-Saharan Africa) which, as one of the largest migrant groups in Spain,[1] shows one of the highest levels of segregation, as well as migratory strategies with a marked gender imbalance. It is also one of the groups that is most affected by the economic crisis (Gastón-Guiu et al., 2021). Among the first to settle in Spain (Berriane, 2004; Cohen, 2009), this group faces situations of greater segregation in terms of both employment and housing, not only by comparison with the autochthonous population but also with the other immigrants. Most Africans work in the secondary labour market, with precarious conditions of employment, low wages, and little chance of promotion (Cachón, 2009). As for housing and residential and living conditions, Africans also differ from the native population (Checa et al., 2011). The Moroccan population is that which has the most difficult living conditions (Colectivo IOE, 2005). Since their homes are smaller, overcrowding is worse than it is for other population groups owing to subletting of rooms to reduce costs and the cohabitation of several family nuclei in the same dwelling, while their homes tend to be located in old buildings, which means that, in most cases, they are in a rundown state (Domingo & Bayona, 2007). The usual tenancy regime is renting, while for Spaniards it is ownership. Although it has been shown that, as the years of residence in the host country increase, these situations of residential disadvantage can change (Leal & Alguacil, 2012), improvement is more difficult to achieve for Africans since access to the residential and job markets is conditioned by social images and prejudice in the host society which do not affect all immigrants groups to the same degree. As a result, Africans face more discrimination than European and Latin American immigrants (Cea d'Ancona, 2002).

Hence, we are concerned, first, to find out whether the intensity of residential segregation depends on the demographic characteristics of the group being analysed and whether there is a compositional effect based on gender and age in the levels of segregation. Second, we analyse the period effect on the segregation indicators and whether the year of arrival, defined in terms of the economic period, affects the levels of segregation that are reached. Third and finally, we analyse the existence of a cohort effect, which is to say the impact of initial levels of segregation over time on a fictitious cohort of immigrants defined by sex and age. The interest of this threefold approximation resides in the fact that it offers a better understanding of segregational processes while also providing interpretive elements regarding their future evolution.

2 | LITERATURE REVIEW

2.1 | Residential segregation from a demographic standpoint

As noted above, owing to its multidimensional nature, residential segregation should be observed from several perspectives. Those with the most explanatory potential are the economic standpoint, which relates structure and spatial positioning with the social sphere (Coulter & Clark, 2019; Massey et al., 2009), and the preferential or discriminatory point of view where personal preferences end up determining the location of settlements (Schelling, 1971). With a theoretical model of spatial assimilation, the progressive disappearance of segregation is expected, while with the segmented assimilation model (Portes & Zhou, 1993) segregation is maintained due to the coexistence of different patterns of incorporation in accordance with the segment of society where the immigrants are inserted.

Although there are studies on the influence of demographic dynamics on segregation and its evolution (Finney & Simpson, 2009; Kauppinen & van Ham, 2019), little or no attention has been given to the relationship between segregation levels and the effects of the three classical approaches of demographic analysis. These models tend to be used to ascertain the effect of time on the occurrence of an event (González et al., 2002) and the impact of each variable on the phenomenon which, in this case, is the residential segregation indicator. This analytical tool therefore enables consideration of changes occurring over time, which may be the result of population ageing, the fact of being born in a certain period, or sharing the experience of a particular cohort (Ramalle, 2009).

Nevertheless, some authors consider that, as a result of the close links between variables, it is difficult to obtain the specific weight of each one because of the influence of their multicollinearity (Settersten, 1999). However, the importance of the effort to

[1]In 2022 Africans, numbering 1,371,755 residents, represented 2.9% of the Spanish population. Approximately 77.8% are from North Africa, and 300,000 are from sub-Saharan Africa.

distinguish between the three effects is due to the fact that, although they allude to temporal effects, their influence on the effect being analysed is different (Debiasi, 2018). Age effects are internal to individuals, reflecting biological factors and social processes (Yang & Land, 2013), to which considerable attention is devoted in keeping with the different stages of the life cycle, especially changes occurring during youth as well as in the ageing process. In this way, changes in the tendency of a phenomenon brought about by chronological age are identified.

In fact, traditionally, the age variable, although it has been seen as essential because of its influence in residential choices (McKenzie, 1924; Schelling, 1969), has been given scant attention in segregation analysis (Giele & Elder, 1998; Halli & Rao, 1992; Rhein, 1988). Yet, as Cowgill (1978) states, structural changes are being stimulated by the generalised population increase, causing differentiation and specialisation by age, and leading to residential patterns that transcend those produced by origins (Sabater & Catney, 2019). Another determining factor is the calendar of different life-cycle stages individuals are going through (Sullivan, 2020). All of this makes it more likely that there will be geographic zones occupied by people belonging to the same generation or cohort, and the dissociation or distancing of others, thus obstructing intergenerational contact (Riley & Riley, 2000). This separation can derive from natural, voluntary, or involuntary processes due to social and residential preferences, which are largely conditioned by the different stages of life (Deng & Mao, 2018). However, in the case of the immigrant population, it could also be due to the existence of a range of migratory strategies which differ in accordance with the characteristics of flows depending on origin. For example, in the African case with which we are concerned here, there is a predominance of young men, and this could have an effect on overrepresentation in certain urban areas. For Canada, Okraku (2008), introduced gender as well as age and found the existence of distinctive patterns generated by both variables, with higher segregation rates among older women by comparison with the rest of the population. Recently, Wong and Das Gupta (2023) have shown that non-Whites experienced higher age segregation than Whites, while older adults experienced higher racial segregation than the other age groups.

On the European scale, among the best contributions to the study of segregation by origin and age are those produced by Sabater (2010) and Sabater and Catney (2019) which, from an evolutionary standpoint, analyse the determinant role of age and origin in segregational processes in England and Wales. They find evolutionary variability in the indicators and also the existence of fluctuating results according to age (higher at initial and more mature ages). The rates rose or fell in keeping with the influence of life stages, with the lowest segregation values appearing at the intermediate adult ages (20–44) by comparison with the rest, and also changes in incidence depending on origin.

Then again, period effects are the result of historical events or changes occurring over time and at particular points in time. Any contextual or circumstantial change can affect demographic phenomena (Portrait et al., 2002). The various economic stages experienced with high intensity in Spain in recent years have had a well-known effect on international migrant flows (Prieto et al., 2018) but also on the real-estate market. Hence, the economic situation is reflected in the rental market, easing access to housing in periods of crisis and showing steep increases in times of growth. Finally, cohort effects derive from differences between groups that start from a common initial event, usually, the year of birth, and relate to the macroconditions that are experienced by the different cohorts in the course of life. In the case of the immigrant population, the aim is to ascertain whether the more recent cohorts follow the same residential path as earlier cohorts (Sabater & Catney, 2019).

2.2 | International immigration, residential segregation, and city in Spain

Spain conforms with the segregation patterns and dynamics observed for southern Europe (Arbaci & Malheiros, 2009), with moderate or even low levels of segregation, albeit with poor housing conditions. This means that there is no direct relationship between segregation indicators and social inequality (Arbaci, 2019). In the Spanish case, the settlements of immigrant populations present certain singularities by comparison with the rest of Europe since they were late in occurring, with a relatively short and high-intensity temporal development.[2] Moreover, the volume, origins, and characteristics of flows have been changing and, unlike what is happening in other countries, are notable for their high degree of heterogeneity[3] (Domínguez-Mujica et al., 2010).

In the national scientific literature on residential segregation linked to the immigrant population the conclusions drawn coincide with trends observed for other European countries, with relatively moderate levels tending to gradual reduction at the same time as the numbers of immigrants rise, to fall with the economic crisis, and to stabilise with recovery. Nonetheless, the considerable variability observed in segregation levels by origin should not be overlooked since, while Eastern Europeans and Latin Americans generally present low or very low segregation levels (Vono & Bayona-i-Carrasco, 2010),

[2]The first and not very significant inflows of immigrants date back to the 1970s. A second phase (1985–1995) coincides with a phase of consolidation of Spain as a country of settlement. This period was followed by the well-known period of acceleration (1995–2007) in which immigrant populations grew rapidly, as did the diversity of origins. From one million and 2.7% of the population in 1996, the numbers jumped to six million and 13.1% in 2008. Later, after the onset of the economic crisis, with a smaller volume of arrivals and a greater number of departures, the overall number of immigrants remained stable. After 2014, however, there has been a new upsurge in arrivals, with inflows in 2019 similar to those of the period of greatest growth.

[3]Until the 1990s, most immigrants came from European Economic Community (EEC) member countries. They were joined by the first political exiles from Latin America and, later, because of economic questions, by Ecuadorians, Peruvians, Dominicans, and Colombians. After the 1990s, inflows from Africa also increased, although their numbers had been notable since the 1970s. At present, together with Latin Americans, they constitute the most numerous non-EU contingent. Notable in the case of Africa are inflows from the north (Morocco followed by Algeria) and from sub-Saharan Africa (e.g., Senegal). Eventually, in the early 2000s, there was a steep rise in arrivals from Eastern Europe (mainly Romania and Bulgaria) to the extent of becoming another of the more numerous population groups in certain areas of the country. Likewise, and also more recently, immigrants of other Asian origins (China and Pakistan), have joined the traditional inflows from the Philippines.

the opposite is true for Asians and Africans who show sharp divergence from other population groups, especially in the case of Asians. The effect of the economic crisis, which has an impact on the reduction of segregation, should not be ignored either. A separate case is that of rural areas, especially in the south of Spain, where the demand for labour is high owing to the productive model based on intensive agriculture. In these situations, the segregation levels are much higher than those observed in big cities. And added to these are exclusion from urban areas and peripheral locations in a situation predominantly affecting African immigrants (Checa et al., 2011). Similarly, there are higher levels of segregation in the southern cities of the country, where immigration is quantitatively less substantial and more recent, especially at the metropolitan level (Benassi et al., 2020).

Despite the large increases in the immigrant population and the effects of the economic crisis, segregation levels have remained moderate for most origins. However, hidden behind this fact is a growing concentration in the poorest parts of cities (Benassi & Iglesias-Pascual, 2022; Iglesias-Pascual et al., 2023), and increasing vertical segregation, with a notable concentration of immigrants from low-income countries on lower floors (Leal & Sorando, 2022). Crucial in this distribution is the housing market with its discriminatory practices, especially in renting, which have the effect of perpetuating segregation (Bosch et al., 2015).

3 | DATA AND METHODOLOGY

In this study, we use microdata from the Padrón Continuo de Población (Continuous Population Register), which is produced by the National Statistics Institute (INE) and based on information collected in registers and variables of municipal censuses managed and maintained by each local council. This resource is subject to constant revisions and updates because of changes occasioned by registrations and cancellations arising from births, deaths, and migratory movements. It provides information about the official populations of towns and cities in Spain and includes variables pertaining to the location of residence, gender, age, nationality, and place of birth. The census tract is the smallest unit in which data are collected in Spain and ranges in population size between 1000 and 2500 people (between 72% of the tracts of Madrid and 94.5% of those for Barcelona). The divisions are of similar population weight, so we consider that the comparison of cities is not affected by zoning problems[4] (known as MAUP effects, Wong, 1997). In our case, they vary from 433 in Malaga to 1068 in Barcelona, and 2433 in Madrid. The periodicity of the Continuous Register is annual, dating from January 1. One of the main characteristics of this register is that it considers the entire population, independently of the legal situation in the country, which means a good count of the immigrant population despite the fact that some councils have made it difficult for some groups to register. The data has been available since 1998, and this study analyses figures from the period 2000–2020. In the representation of results, four moments are highlighted, coinciding with the economic phases that Spain has gone through in recent years. In 2002, this would correspond with the period of economic growth and the migratory boom; 2008 and 2014 would refer to the economic crisis (the first phase and final stage, respectively); while 2020 would account for the recent years of incipient economic recovery.

The evolutionary analysis is applied to a selection of specific groups of immigrant population resident in Spain through the variable 'country of birth'. Immigrants of African origin have been selected as the population under study, disaggregated by geographical area into those born in the countries of the north (Morocco, Algeria, Egypt, Tunisia, and Libya) and those in sub-Saharan countries (a group comprising the rest of the African countries), as this is one of the groups with the oldest presence in Spain, and also that presenting the greatest divergence by gender, with a preponderance of young men in the early stages of arrival and subsequent family reunification in which women would be the outstanding group. Furthermore, and in a complementary sense, other groups of immigrants—Latin Americans and Europeans from the former EU-15—are included in the analysis for comparative purposes and to offer an overall view of the segregational phenomenon in Spain. Hence, the comparison is made between the two largest groups of African immigrants with the two groups that are most established in Spain. The indicators are applied to the country's six largest cities, in the following order: Madrid, Barcelona, Valencia, Seville, Zaragoza, and Malaga, with the aim of conducting a double analysis: microspatial and comparative. The cities were chosen because of the size of their populations (from 578,460 inhabitants in Malaga to 3,334,730 in Madrid), as well as the fact that they are the places that have traditionally received the largest volumes of migrant flows, which have had a direct impact on their growth and population structure that is not visible in other, smaller cities.

To measure segregation, an equality indicator is used, namely the Duncan Dissimilarity Index (DI) (Duncan & Duncan, 1955), which compares the distribution of a population group in the geographic space being studied with another population group, usually the majority group, in this case, the autochthonous population born in Spain. The results obtained oscillate between 0 (absence of segregation) and 1 (maximum segregation, when no territory is shared). It is formulated as follows:

$$D = \frac{1}{2}\sum_{i=1}^{n}\left|\frac{x_i}{X} - \frac{y_i}{Y}\right| \quad 0 \le D \le 1,$$

where x_i is the population of the minority group in census tract i; X is the total population of the minority group in the municipality; y_i is the population of the majority group (autochthonous population) in tract i; Y is the total autochthonous population of the municipality; and n is the number of tracts in the municipality.

[4]This problem would only by eliminated by using a Population GRID. However, we have discarded this possibility since those existing in Spain do not have the disaggregation by sex and age required by this study.

The DI is highly sensitive to group size. Hence, changes in segregation patterns should be interpreted with caution since they could be the result of natural population growth or decline instead of strictly segregational causes (Simpson, 2004). This can be appreciated in the varying results according to population size in the evolving study by Napierala and Denton (2017) measuring residential segregation in the United States from 2000 to 2010 through census data. Others like Allen et al. (2015), corroborating the sensitivity of the indicator, apply a series of statistical models and adjustments in their calculations to overcome these limitations. In our case, the correlation between the values obtained for age, sex, and group size has been observed. The results are unequal. While this correlation occurs and is high in Barcelona and Valencia (r^2 = 0.68 and 0.69), it exists but is less intense in Zaragoza and Madrid (r^2 = 0.5 and 0.36) but we cannot say the same about Seville and Malaga where the correlation is very weak (r^2 = 0.19 and 0.14). At the aggregate level, there is no correlation between group size and segregation. To avoid the effect of size on the calculation of the indicator, the DIs have been estimated using a 95% confidence level.[5]

4 | IMMIGRATION IN SPANISH CITIES

The presence of immigrants varies greatly, both in volume and composition, among the country's six largest cities. Hence, they range from maximum values of Barcelona (461,000 immigrants and 27.8% of the population in 2020), Madrid (787,000 and 23.6%), and Valencia (152,000 and 19.1%), all with a percentage of immigrants that exceeds that for Spain as a whole (15.2%), through to 15.1% for Zaragoza (102,000 immigrants), to significantly lower values like 12.7% in Malaga (73,000) and barely 8.5% in Seville (58,000), the latter two being cities in the south of the country. Again, these cities present different patterns in the reception of immigrant flows in terms of their composition by origin. While in Malaga, Zaragoza, and Seville, Africans have a significant presence in their settlements (28.5%, 19.9%, and 17.5% of their immigrant populations respectively in 2020), in Madrid, Barcelona, and Valencia they have a much smaller presence (6.5%, 6.6%, and 9.5% respectively), which is well below their overall presence in Spain (18%). Barcelona, however, is notable for the proportion of Asian immigrants (18% compared with just 7.2% in Spain), and Madrid for that of Latin American immigrants (66.6%, which is well above the 42.3% for the country as a whole) (Table 1). Meanwhile, Zaragoza, Valencia, and Barcelona would be the cities with the largest presence of European Union citizens (22.1%, 18%, and 16.4%), while, in Malaga, the presence of immigrants from elsewhere in Europe (11.6%) is notable.

From a territorial standpoint (Figure 1), immigrants of African origin show clear patterns in 2020 of spatial concentration in the biggest Spanish cities. When the Location Quotient[6] is used as a unit of measurement, the maps show the existence of areas of evident concentration, as is the case of the city of Barcelona, or a marked absence, as occurs in the wealthy neighbourhoods of Barcelona, Madrid, and Zaragoza, where entry is difficult for immigrant populations (Rubiales Pérez, 2020). A shared pattern is found in the six cities where the biggest concentrations of the African population are to be found in areas of lower average income, lower housing costs, and where infrastructure is meagre or in a state of disrepair.

These zones are usually inner-city areas and old working-class neighbourhoods which were originally conceived for and inhabited by families of the rural exodus that occurred in Spain in the mid-20th century, or for specific urban family relocation plans. In Madrid, the greatest concentrations of the African population appear in the city's southern working-class districts[7] (Sorando & Leal, 2019). In Barcelona, besides working-class areas,[8] the highest representation is to be found in the historic centre, in the Ciutat Vella district, a first-arrival area with a high presence of immigrants (58% of the population of the district). In Valencia, their absence in the southern part of the city is perceived as coinciding with districts with the highest per capita incomes, while their presence is high in the working-class neighbourhoods of the old city centre. Seville shows the greatest concentrations in the central districts, once again coinciding with historic or working-class areas.[9] In Zaragoza, by contrast, the largest concentrations are in the old city and the periphery,[10] where living conditions are worse, rents are lower, and infrastructure is more rundown than in other neighbourhoods, while they are not represented in more recently established areas like La Romareda. Finally, in Malaga, the presence of Africans is again detectable in areas of lower family incomes, although they also have a significant incidence in central areas of higher purchasing power.[11]

This distribution presents some differences according to the characteristics of migrants by age. To give an example, in Barcelona, 36% of North Africans aged from 15 to 19 years reside in Ciutat Vella, which is the district of first entry for many immigrants. Yet, this district shows lower values for the remaining age groups, for instance, 11.2% for 10–14 years, and 18.3% for 35–39 years. A similar pattern with a concentration of young people in Ciutat Vella is identified among sub-Saharan Africans. The existence of first-stop places and others of later settlement explains these differences, which justify the hypothesis that

[5]The DI and its confidence intervals have been calculated using the R package 'Segregation' (Elbers, 2021). The confidence intervals can be consulted in the section, Supporting Information, in the online version.

[6]To map the presence of African immigrants in the six Spanish cities the Location Quotient (LQ) has been used. This relates the percentage of a population group in a statistical subunit with the percentage of the same group in the population as a whole (Brown & Chung, 2006). It is formulated as follows:

$$LQ = \frac{X_i/T_i}{X/T}$$

where X_i is the population of a group in spatial unit i; T_i the total population of the same unit; and X and T the population of the group analysed in the total of the area being studied and the total population. Values above 1 represent the existence of territorial concentration and those below 1 express a smaller representation than that for the whole.

[7]Vallecas, Vicálvaro, Villaverde, and San Blas.

[8]The districts of Nou Barris, Sant Martí, and Sants-Montjuïc.

[9]This is the case with the Macarena, Sur, Cerro, and Amate neighbourhoods.

[10]Delicias, Oliver-Valdefierro, and Miralbueno.

[11]The areas with the greatest presence are in or near Bailen-Miraflores, Cruz de Humilladero, Palma-Palmilla, and Carretera de Cádiz.

TABLE 1 Immigrant population by continental group and gender in the largest cities of Spain (2020).

		Total	% Born abroad	Weight of immigrant population	Men	Women	% Women			Total	% Born abroad	Weight of immigrant population	Men	Women	% Women
Barcelona	Africa	30,372	6.6	1.8	18,350	12,022	39.6	Seville	Africa	10,248	17.5	1.5	6004	4244	41.4
	EU	75,716	16.4	4.5	37,602	38,114	50.3		EU	8,066	13.8	1.2	3705	4361	54.1
	Rest of Europe	36,240	7.8	2.2	16,497	19,743	54.5		Rest of Europe	4,411	7.5	0.6	1708	2703	61.3
	America	235,517	51.0	14.2	102,361	133,156	56.5		America	30,476	52.2	4.4	11,890	18,586	61.0
	Asia	83,210	18.0	5.0	48,741	34,469	41.4		Asia	5,137	8.8	0.7	2572	2565	49.9
	Total	**461,960**	100	27.8	223,551	237,504	51.5		**Total**	**58,432**	100	8.5	25,879	32,459	55.6
	Total population	1,664,182							Total population	691,395					
		Total	**% Born abroad**	**Weight of immigrant population**	**Men**	**Women**	**% Women**			**Total**	**% Born abroad**	**Weight of immigrant population**	**Men**	**Women**	**% Women**
Madrid	Africa	51,221	6.5	1.5	28,710	22,511	43.9	Zaragoza	Africa	20,418	19.9	3.0	12,665	7753	38.0
	EU	100,425	12.7	3.0	47,107	53,318	53.1		EU	22,717	22.1	3.3	10,681	12,036	53.0
	Rest of europe	31,527	4.0	0.9	13,696	17,831	56.6		Rest of Europe	3,795	3.7	0.6	1623	2172	57.2
	America	525,378	66.7	15.8	223,158	302,220	57.5		America	48,920	47.7	7.2	19,922	28,998	59.3
	Asia	78,212	9.9	2.3	37,414	40,798	52.2		Asia	6,741	6.6	1.0	3631	3110	46.1
	Total	**787,765**	100	23.6	350,085	436,678	55.5		**Total**	**102,659**	100	15.1	48,522	54,069	52.7
	Total population	3,334,730							Total population	681,877					
		Total	**% Born abroad**	**Weight of immigrant population**	**Men**	**Women**	**% Women**			**Total**	**% Born abroad**	**Weight of immigrant population**	**Men**	**Women**	**% Women**
Valencia	Africa	14,503	9.5	1.8	9041	5462	37.7	Malaga	Africa	20,952	28.5	3.6	11,780	9172	43.8
	EU	27,528	18.0	3.4	13,401	14,255	51.5		EU	11,185	15.2	1.9	5444	5741	51.3
	Rest of Europe	11,801	7.7	1.5	5275	6526	55.3		Rest of Europe	8,527	11.6	1.5	3488	5039	59.1
	America	80,176	52.5	10.0	34,589	45,587	56.9		America	27,911	37.9	4.8	11,595	16,316	58.5
	Asia	18,443	12.1	2.3	10,858	7585	41.1		Asia	4,927	6.7	0.9	2580	2347	47.6
	Total	**152,627**	100.0	19.1	73,164	79,415	52.0		**Total**	**73,591**	100	12.7	33,017	36,355	52.4
	Total population	800,215							Total population	578,460					

Source: Continuous Population Register (INE).

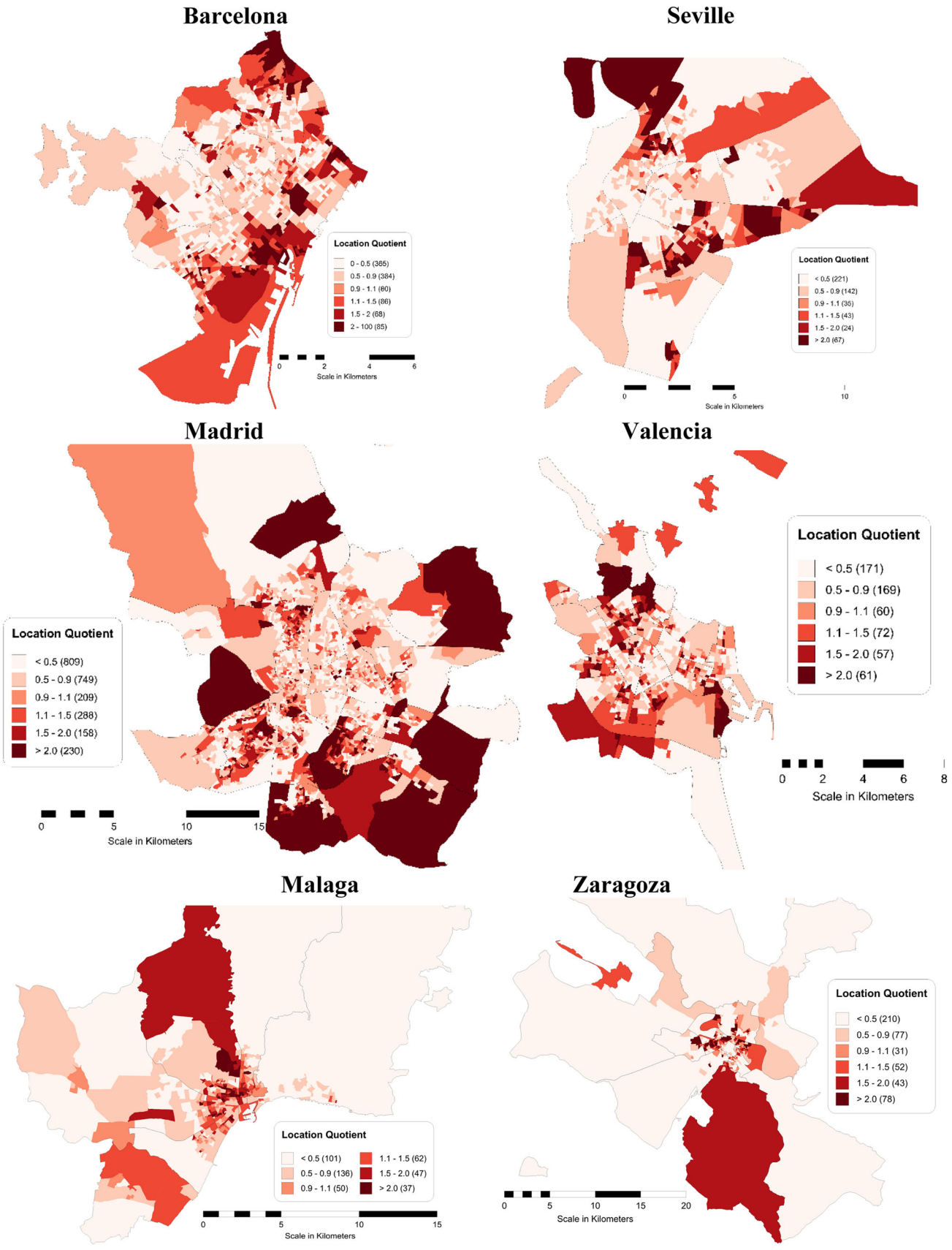

FIGURE 1 Spatial distribution of African immigrants in the main Spanish cities, 2020. *Source*: Continuous Population Register (INE).

there are different segregation patterns among ages and also between the sexes.

5 | RESULTS

5.1 | The temporal evolution of Dissimilarity Index (2000–2020)

Evolutionary analysis of the DIs by population group (Figure 2) confirms that immigrants of African origin show the highest segregation values by comparison with those obtained with Latin American and European (EU-15) immigrants, thus corroborating what has been noted in the scientific literature on immigration in Spain. Nonetheless, among Africans and differentiating in accordance with geographical area of origin in the continent, there are significant differences. Hence, immigrants of sub-Saharan origin show much higher levels and the greatest gaps, these being understood as distance with regard to other origins, a situation that is more notable in the cities of the south of Spain (Seville and Malaga) and less so in Barcelona and Zaragoza. In general, between 2000 and 2020, the levels of residential segregation for sub-Saharan immigrants have fallen, and even markedly in some cases. This occurred in Seville and Malaga in the early years of this century while, in Madrid and Barcelona, the reduction is more continuous. Accordingly, from showing high or very high segregation values (even above 0.45), sub-Saharan immigrants presently have, in the two biggest cities, average segregation values (0.36 and 0.42, respectively, in 2020).

In the case of immigrants from North Africa, however, a tendency toward increased segregation is detected in most of the cities observed. In Valencia, Seville, and Malaga, the evolution is similar to that for Latin Americans and Europeans, although always with slightly higher values. However, in Barcelona and Zaragoza, they do not fit this trend shared with the other origins as their results are comparable with those obtained for sub-Saharan Africans. As a result, and with the exception of Barcelona—where, however, the recent tendency is once again rising—the segregation levels in 2020 are higher in the cities studied than they were in the early 2000s. The negative economic situation partly explains this evolution (Achebak et al., 2017), since, in general, the indicators rose midway through the second decade of the 21st century.

Throughout the evolution one sees maintenance, more or less sustained over time, of most of the values reported, although there are some exceptions. For example, in Barcelona, the falling values of indicators are constant, except those for immigrants from the EU, and the increased rates of segregation for North Africans since 2015. In Madrid, the trend is very steady for all groups with little differentiation in values (hence, at present, they are all between 0.2 and 0.5 points, showing the smallest reported distances). The Madrid situation could be extrapolated to that of Malaga (except for sub-Saharan immigrants, who are highly segregated) and Valencia (with values between 0.2 and 0.4) but with figures for sub-Saharan immigrants that are well above those for other groups. Finally, in Zaragoza, since the economic crisis, all groups have subtly and progressively shown rising results that have kept the same distances by origin from 2000 until 2020, while the lines in other cities have even merged at certain times.

5.2 | The effect of demographic characteristics

To analyse the effects of structure, the DI has been calculated disaggregated by sex and age and only for the last year, with data from 2020. The data for each age and sex group are compared with data from the autochthonous population for the same age and sex. The DI shows a common pattern among North Africans and sub-Saharan Africans, although it is more intense and higher for the latter group and shows more variations in the former group (Figure 3). The trend shown by the line representing the total responds to high values among younger ages (15–24) and falls with the central ages coinciding with the working stage of life but rises once again for mature ages. However, depending on the origin, oscillations in the indicator are more or less pronounced. Among sub-Saharan Africans, the increases and decreases in levels of segregation are considerably more noticeable than they are with other Africans, with rising levels appearing at earlier adult ages and always with indicators moving in the higher figures. Among North Africans, however, growth is more progressive, except in the city of Malaga where the trend with rising age tends to decrease. This particular behaviour can be explained on the basis of two hypotheses: either there is a marked socioeconomic differentiation between older immigrants and present ones (which we do not know as we do not have the census data), or they are Spanish citizens who were born in the old colonies that are now part of Morocco. At some ages, the low number of immigrants observed produces random variations in the dissimilarity indicator. Evolution is marked by an evident size effect: the smaller the group analysed, the greater increase of segregation. But the levels obtained differ according to origin. This explains why segregation for the group as a whole is lower than presented by genders.

As for gender, women generally show higher segregation indexes, with the largest gaps among sub-Saharan women of all age groups and in all cities, although the gap widens with middle age and ends up with an approximation to male values after the age of 60. However, among North Africans, there are no such distances as the lines, which are slightly higher for women, draw similar paths by gender, showing the greatest variations in the cities of Barcelona, Valencia, and Zaragoza after the age of 40, or even earlier. In this case, segregation is comparable with that for men in the initial stages of the migratory process, although the level is higher (about a 10th) in the central ages.

Another distinguishing feature with these two population groups is that, at mature ages, women from the north manage to reduce their indices to below those for men on some occasions while sub-Saharan immigrants only manage to reduce theirs. Malaga is the main exception, with similar and even lower values for women of all ages. Consequently, the results, which coincide with findings in the international literature, suggest that age has a cyclical effect, reducing segregation in the central ages of the life cycle, and affecting the young and the old more severely.

5.3 | Dissimilarity indicators by gender and cohort

Three cohorts have been selected for this final analysis, those born from 1966 to 1970, from 1971 to 1975, and from 1976 to 1980. At

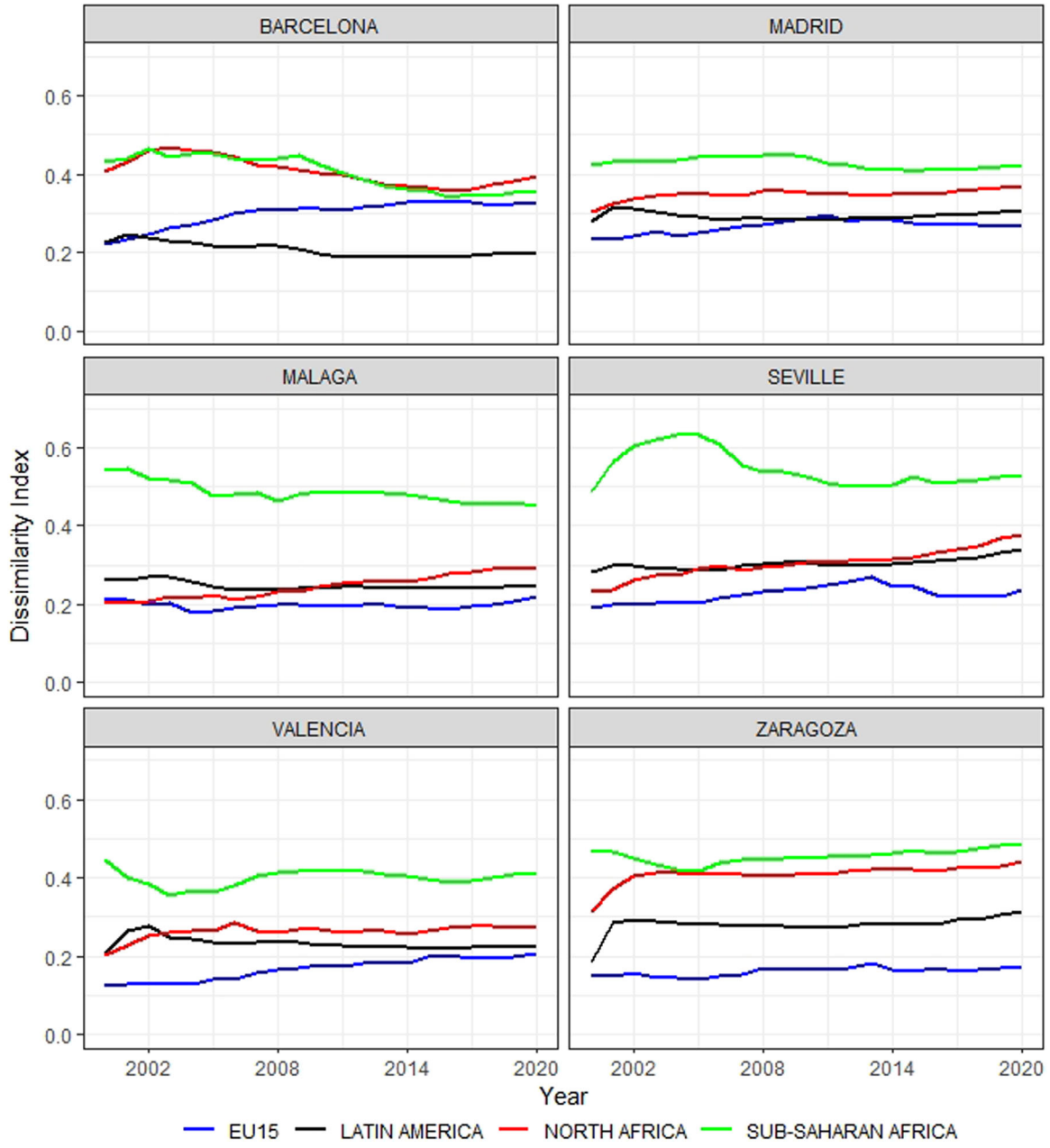

FIGURE 2 Evolution of the Dissimilarity Index (DI) of the main immigrant groups, 2000–2020. *Source*: Continuous Population Register (INE).

the first observation point in 2000, these cohorts were aged 30–34, 25–29, and 20–24, respectively, thus avoiding representation of the group aged from 15 to 19 years where the numbers are smaller and the indices more random. The selected cohorts have been observed for two decades, until 2020 when, now 20 years older, their ages were situated, respectively, at 50–54, 45–49, and 40–44, this giving five moments of observation in the graph.[12] The analysis has been specifically for the two groups of Africans being studied.

Figure 4 shows the trend in the DI from a dual perspective, namely intra-cohort and inter-cohort, which allows a complete comparison. When each generation is taken individually, higher segregation values have been obtained for the younger ages (in the 20–24-year-old group of the 1976–1980 generation) in all cities and for both origins, except for North Africans in Barcelona. It is true that the sub-Saharan members of this age group start out with higher levels (around or above 0.8 points) than those for immigrants from North Africa, and also the distance with regard to the younger members of the other cohorts (25–29 and 30–34) is less significant than it is for North Africans among whom the distances in terms of a declining indicator are more pronounced.

[12]A fictitious cohort model has been constructed, in which it is assumed that follow-up is not carried out with the same individuals since we do not have the information that would allow us to perform such an analysis.

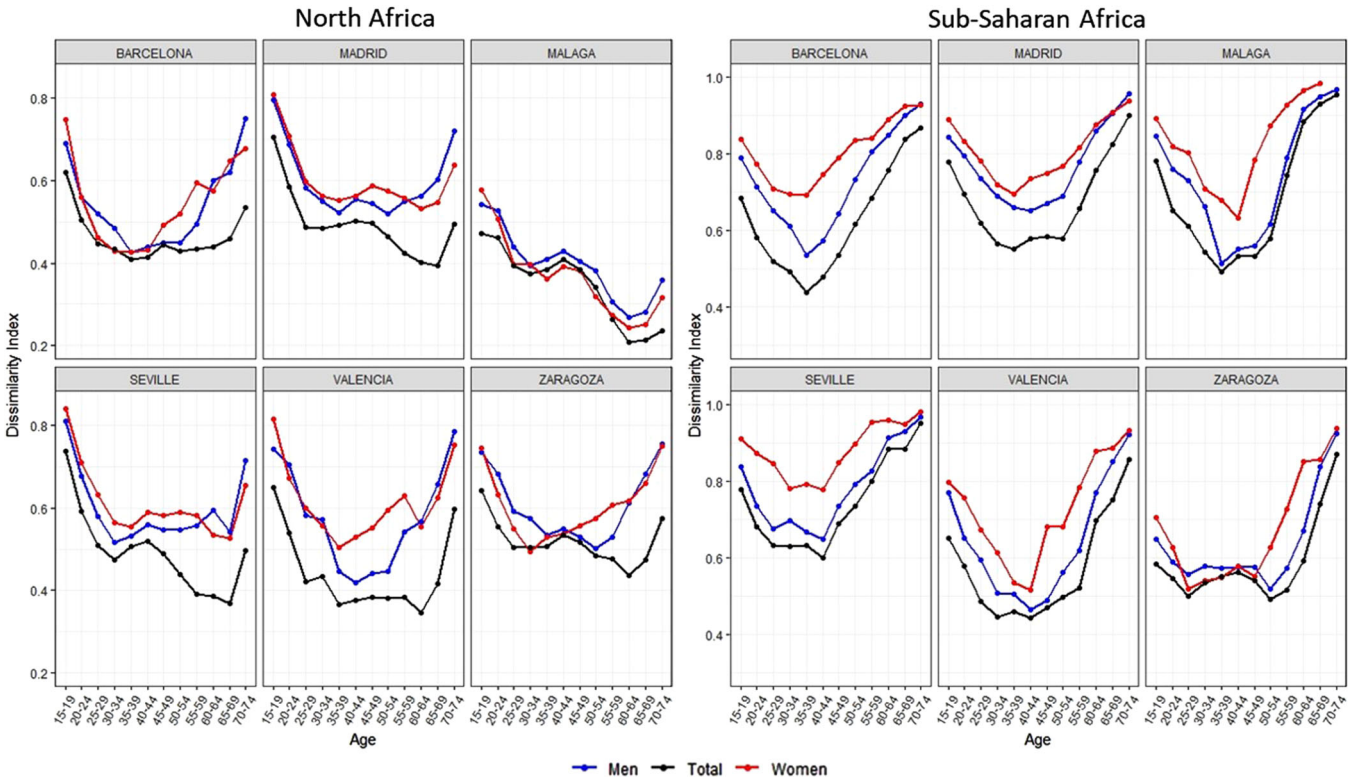

FIGURE 3 Dissimilarity Index (DI) by age, gender, and origin—North and sub-Saharan Africa—in Spain, 2020. *Source*: Continuous Population Register (INE).

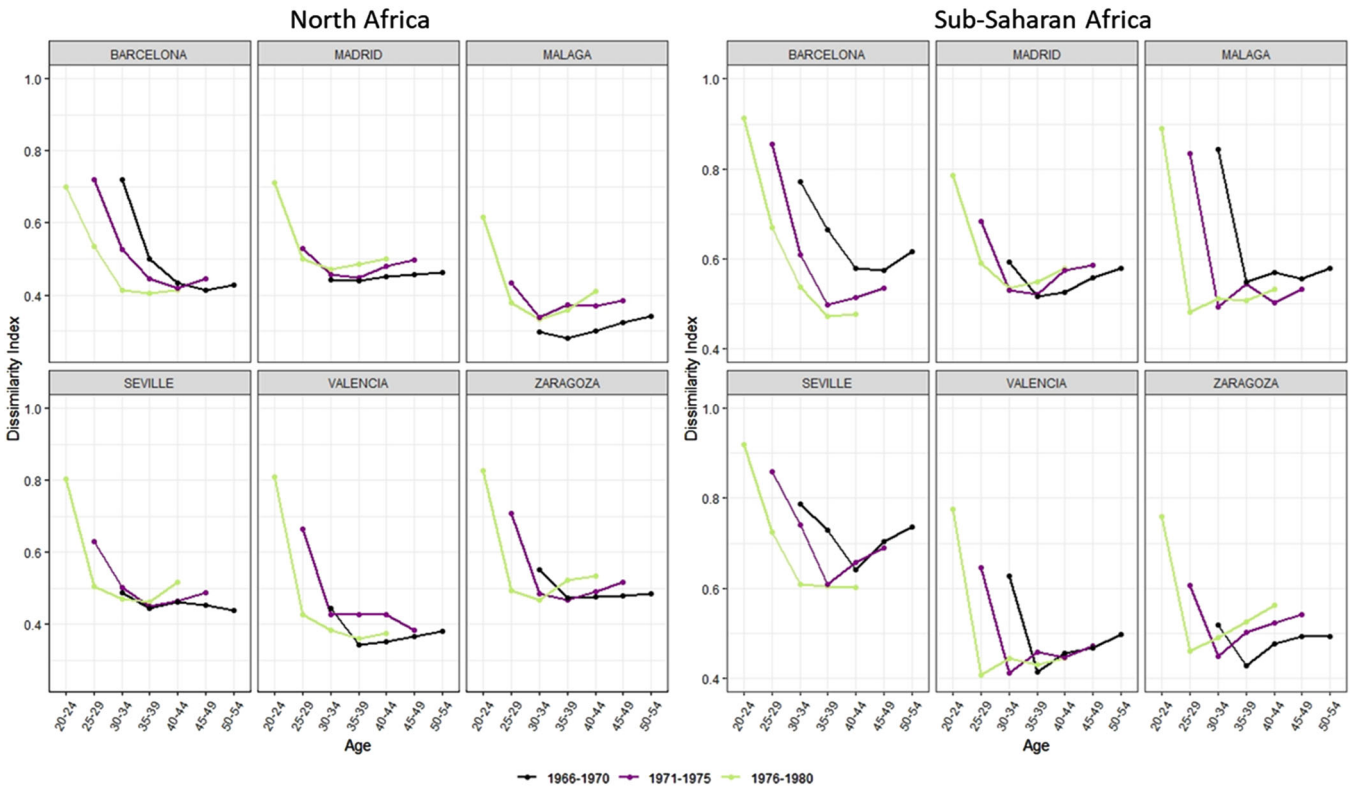

FIGURE 4 Dissimilarity Index (DI) by population group—North Africa and sub-Saharan Africa—and Generation in Spain. *Source*: Continuous Population Register (INE).

One shared feature is decreasing indicators as the generations get older, this being most evident in the case of the youngest cohort since the rest are in the central ages of the life cycle which, as noted above, are associated with lessening segregation. Moreover, in the older generation, there appears a shift, though slight, towards an increase in the values obtained. The two groups analysed follow this pattern, although the sub-Saharan group while showing these falling rates, are always situated above the North Africans. Hence, after beginning with high values, segregation stabilises and even increases with age within the same generation, but the increase is less than what was envisaged from the standpoint of age. The trend of increasing segregation with age is therefore confirmed.

However, if a reading is made of the inter-cohort figures and they are compared with the same age (starting from 30 to 34 years), more recent generations report lower segregation values than those of the other cohorts at the same age. This is especially evident among the sub-Saharan Africans where the largest gaps are to be found between the 1976–1980 and 1966–1970 cohorts at 30–34 years, but it is also the case for North Africans. For both North and sub-Saharan Africans, this falling trend by generation is nuanced by city. For the former group, this very clearly occurs in Barcelona while, in the rest of the cities, instead of a decrease, stabilisation according to age is observed, or even an increase in Madrid and Malaga which, for this group, functions differently from the other cities, as noted above. Hence, the new generations start with lower segregation values than those of older cohorts, a fact that could be due either to greater heterogeneity in demographic profiles among the new cohorts, which would lead to greater dispersion or settling in a city where the volume of compatriots is greater than it was in previous generations.

Finally, this cohort perspective is expanded by adding the gender variable, which is represented in the last two graphs (Figures 5 and 6). Besides reproducing the trends discussed for all immigrants, among the North Africans there is a smoothing of differences between men and women in the youngest generation, while in the more mature generations, the women are more segregated than the men. This could be explained by the particular masculinisation of African migratory flows and a possible opening up of women's migratory projects apart from family reunification processes.

This situation does not occur in the sub-Saharan case, except in the cities of Valencia and Zaragoza, where the results for the younger generation of women is on a par with the male results. However, among the women of older generations, the segregation values are always much higher than those for men. From this point of view, we find that segregation values would therefore be higher among the cohorts that are pioneers of the migratory process, while the new cohorts arriving in a context with a larger presence of immigrants show greater dispersion and, accordingly, less segregation.

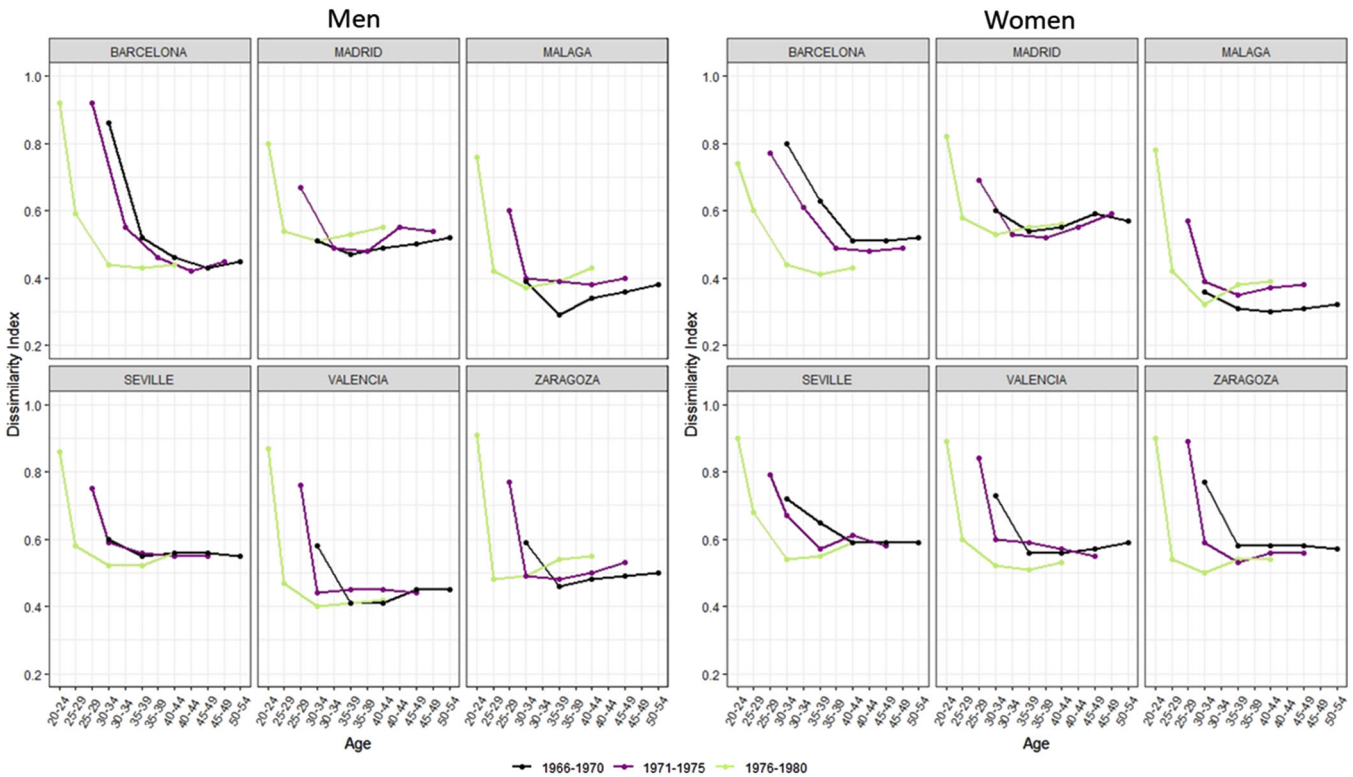

FIGURE 5 Dissimilarity Index (DI) by population group—North Africa—gender and Generation in Spain. *Source*: Continuous Population Register (INE).

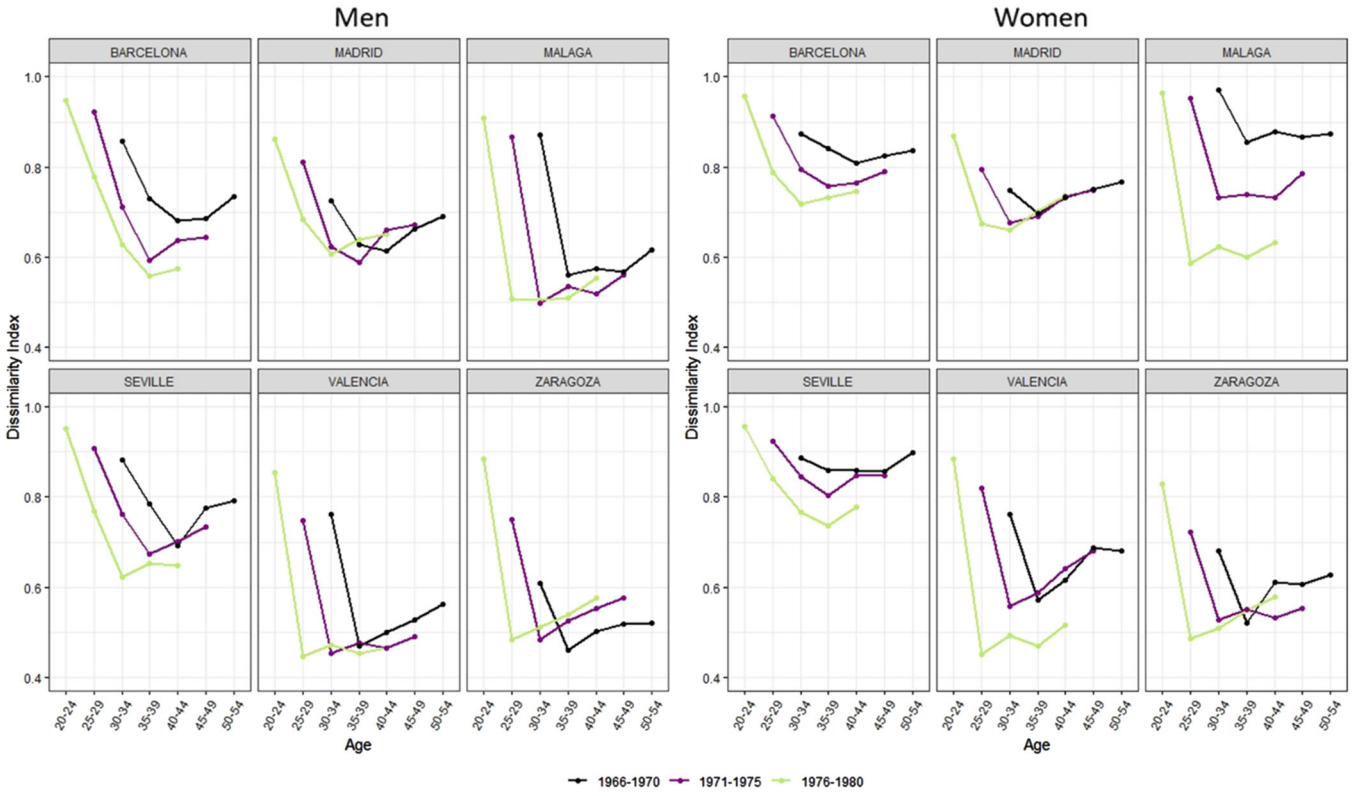

FIGURE 6 Dissimilarity Index (DI) by population group—sub-Saharan Africa—gender and Generation in Spain. *Source*: Continuous Population Register (INE).

6 | DISCUSSION AND CONCLUSIONS

The main conclusions obtained after calculating the segregation indices and reading the results are presented below. This section is organised into three sections that refer to the structure in which the results have been presented.

6.1 | Segregation of Africans (in relation with other origins) and the period effect

Despite the fact that the reception of the immigrant population in Spain occurred late, its peculiarities in terms of high levels of intensity and heterogeneity mean that its study is a far-reaching exercise in terms of both discovering its effects on the Spanish social and population structures and in representing a particular case of considerable interest in the international context. Analysis of residential segregation plays a decisive role here since it makes it possible to study the ways in which individuals coexist and are distributed over geographic space and has taken on great importance following the growth and dynamisation of the Spanish population.

The existing literature on Spain highlights the impact of origin in the greater or lesser incidence of segregation, concluding that Africans constitute one of the most segregated population groups. From the results obtained in the present study, evolutionary analysis of the segregation index indicates that, indeed, this population group is more segregated than other immigrants, and the sub-Saharan Africans are the most affected. Unlike Latin American immigrants, whose patterns are very similar in the six cities, both North and sub-Saharan Africans show significant particularities in the intensity and evolution of segregation, depending on the city in question. Consequently, the characteristics of each city represent an important element in the segregation of Africans, which complicates comparative analysis. Nevertheless, there is a generalised tendency to show higher levels of segregation than those of the other main origins over the 20 years studied. These levels, moreover, have increased in all six cities for North Africans since, in the only case that has shown falling values, Barcelona, segregation has increased again in recent years (coinciding with economic recovery and greater pressure on the real-estate market). The significance of this evolution lies in the fact that this group, one of the oldest and most predominant in Spain, is also subject to more severe stigmatisation of its presence.

As for temporal evolution, the economic crisis represents a change in the evolution of some values of the indicator, as does the incipient recovery. We, therefore, find period effects on the trend of the indicator, although not always in the same direction.

6.2 | Existence of clear patterns of segregation by age and gender differences

With analysis of the impact of demographic characteristics, it is observed that age presents a clear shared pattern with higher segregation at younger and older ages, and lower segregation in the middle years of life. In this case, origin also determines incidence with the highest values for sub-Saharan Africans and evident differences between the cities. The results for the oldest and youngest ages could be magnified by the effect of the group size on the indicator since among the youngest and oldest the numbers of immigrants are lower. However, the persistence of the age patterns confirms this distribution.

In the case of gender, women show higher segregation indices, with the greatest gaps among sub-Saharan Africans. However, at more mature ages, gender differences diminish or even reverse, which is what occurs among North Africans. These differences are not due to an effect of group size and can be explained by household strategies in family reunification.

To sum up, gender and age play a determining role in the greater or lesser intensity of the values associated with segregation. Being a woman implies being more segregated. Age, however, has a cyclical effect that reduces the segregational impact in middle ages, and increases it in the early and later years of life.

6.3 | The generational perspective

In the analysis by cohorts, sub-Saharan Africans are, once again, more segregated than North Africans. This is particularly true among the older generations while the gap narrows slightly among the younger ones. In terms of age profile, North Africans show higher levels of segregation at the youngest and oldest ages in all generations. Here, gender also presents peculiarities where the figures for women are higher, especially at the older ages of each generation. However, this effect could result from the classic masculinisation of African migratory flows and the subsequent processes of family reunification in which women would be predominant. Thus, in a single cohort the values would tend to rise with age, although the increase would be much less than that observed from the age perspective. In spite of this, the trend is confirmed, a fact that can be explained by two hypotheses: either there is a selection effect, where those with more segregated locations continue to be found in the city, or there is a tendency toward concentration in internal mobility, aspects which are beyond the scope of the present research.

Hence, and by way of synthesis, it could be concluded that, at the 'inter-cohort' level, as age increases and birth cohorts grow older, the gender differences become more pronounced, while age attenuates them as they increase within each generation (intra-cohort).

If, however, the graphs are viewed from a comparative perspective, the high degree of stability observed within a single generation, contrasting with divergences found according to age, is significant. The generational perspective suggests that the high differences observed by age could disappear in future, bearing in mind that this is a relatively novel phenomenon with an age structure that is still relatively young.

At the same time, when comparing cohorts, only in some cases, for example, the city of Barcelona, is there a significant decrease in segregation between generations which contrasts with the pattern of stability in other cities. Meanwhile, increased segregation in some cities like Seville is not visible from the generational perspective. For sub-Saharan Africans, the decrease in segregation is much clearer when viewed from the generational perspective. The younger members of this group start with lower segregation values, which will lead to a continued decline of segregation for this group in future.

In light of the results, it can be concluded that the three classical perspectives of demographic analysis offer a richer interpretation of the evolution of segregation. Hence, analysis of segregation should include not only traditional variables like origin but it should also be combined with other demographic variables like age and gender, the moment of observation, and the cohort of belonging, which, as shown above, influence the results. This gives a more complex view and enables a complete understanding of the phenomenon of segregation and, in particular, of the mechanisms that explain the evolution in one direction or another of the values of segregation.

The results achieved can be investigated in greater depth through new lines of research, addressing some of the limitations of the present work. On the one hand, by homogenising the units of analysis through the construction of a Grid, which will facilitate comparison between cities. On the other hand, by using multigroup segregation indicators that take into account the interaction of the group analysed with other immigrant groups, especially in contexts such as Spain's, which is marked by high diversity. Third, by redefining city limits using a metropolitan approach, especially for the cases of Barcelona and Madrid, and finally, with the incorporation of data from the new 2021 Population Census, which will help to differentiate residential patterns based on the characteristics of migrants and territories.

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CONFLICT OF INTEREST STATEMENT

There is no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from Instituto Nacional de Estadística (INE). Restrictions apply to the availability of these data, which were used under license for this

study. Data are available from the author(s) with the permission of Instituto Nacional de Estadística (INE).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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