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Beyond the Suburban-Urban Divide: Convergence in Age Structures in Metropolitan Rome, Italy

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Abstract

A comprehensive analysis of local demographic structures by age allows a better understanding of complex processes of population re-distribution across large metropolitan regions. Based on these premises, local population age structures were studied at the spatial scale of urban districts in Rome's metropolitan area (Italy) between 1971 and 2018. Results of this study indicate (i) a rapid suburbanization (1971-1991) consolidating distinct demographic structures in urban and rural areas, (ii) a less rapid disurbanization (1991-2011) with aging of suburban populations and (iii) a subsequent process of slow re-urbanization (2011-2018). Taken together, these phenomena have reduced the structural divide in urban (older) populations and suburban (younger) populations. Residential mobility contributed to a more balanced age structure during suburbanization and an increased urban-rural gap in the subsequent phases (disurbanization and re-urbanization). A refined analysis of long-term population dynamics in metropolitan regions reflects spatial outcomes and latent aspects of demographic transitions, shedding light on the debate over the future development of urban and rural societies in advanced economies.

Keywords

Age pyramid; demographic indicators; city life cycle; multivariate analysis; Mediterranean city

Introduction

Metropolitan agglomerations are growing at considerable speed all over the world to accommodate demographic changes and natural population growth (Fielding, 1982; Champion, 1989; Cross, 1990; Frey, 1990). In advanced economies, urban population growth was the highest between early 1970s and late 1990s (Cohen, 2006). More recently, a spatially complex process of population redistribution across larger regions attracted the attention of many scholars (Angel, Parent, Civco, Blei & Potere, 2011). Population redistribution over expanding metropolitan regions has been studied in different geographical areas and socioeconomic contexts, adopting multiple disciplinary perspectives, technical approaches, indicators, and spatial scales of analysis (Lever, 1993; Mordridge & Parr, 1997; Van Criekingen, 2010). However, few studies have investigated the aforementioned processes comprehensively in terms of the impact of population redistribution on local-scale age structures (Haase et al., 2010; Kabisch & Haase, 2011; Kroll & Kabisch, 2012).

Population structure by age is a powerful factor at the base of socioeconomic transformations in both urban and rural areas. Structural changes at local scale were relatively little investigated despite their (direct and indirect) linkages with metropolitan

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growth, land-use, housing, and other relevant issues dealing with spatial planning (Salvati, Sateriano & Grigoriadis, 2016). Population redistribution along the urban-rural gradient in response to different phases of cities' growth is a particularly interesting phenomenon in south Europe because of a consolidated urban tradition (leading to compact cities with dense settlements and radio-centric expansion) and a rapid transition from high fertility and low mortality to low fertility and high mortality between late 1960s and early 1990s (Kulu, Boyle & Anderson, 2009; Adveev et al., 2011; Lerch, 2014). Since the 1990s, a transition towards spatially complex urban dynamics, featuring peculiar socioeconomic transformations and more heterogeneous demographic processes, was observed in Mediterranean cities (Carlucci, Grigoriadis, Rontos & Salvati, 2017), and a consequent change in demographic dynamics was reflected in local-scale population structures by age (Arapoglou & Sayas, 2009).

Population redistribution over larger regions and demographic transitions were occasionally studied in light of sequential urban cycles (Salvati & Serra, 2016). In this regard, the City Life Cycle (CLC) theory was considered an appropriate framework to exploring the relationship between exurban development and changes in regional and local demographic structures (Salvati et al., 2016). Introduced by Klaassen, Molle and Paelinck (1981) and subsequently adopted by Van den Berg, Drewett, Klaassen, Rossi, and Vijverberg (1982) and several other scholars (Fielding, 1982; Champion, 1989; Cross, 1990; Cheshire, 1995), the CLC was widely used to explain the different stages of urban development (Pacione, 2005), identifying phases during which distinctive demographic dynamics emerge and decline at a given spatial unit (Kontuly & Tammaru, 2006; Munafò, Salvati & Zitti, 2013; Carlucci et al., 2017; Kurek, Wójtowicz, & Gałka, 2017). Expansion of a metropolitan region may therefore, be interpreted through a comparative analysis of population dynamics along urban-rural gradients based on changes in spatial direction and intensity of population growth or decline (Kasanko et al., 2006; Kroll & Kabisch, 2012; Morelli, Rontos, & Salvati, 2014).

The CLC theory identifies four phases (urbanization, suburbanization, disurbanization, and re-urbanization) that form a complete urban cycle. In the first phase, the population of inner cities grow more rapidly than the surrounding area thanks to heavy movement of population (and economic activities) towards urban cores (Fielding, 1982; Cross, 1990; Frey, 1990; see also Carlucci et al., 2017 for some specificities of the Northern Mediterranean region). In the second phase, population in urban rings grow more rapidly than the population at the inner city thanks to medium-high income households that move to the border of central cities which have better environmental quality and improved housing conditions (Klaassen et al., 1981; Bourne, 1996; Arapoglou & Sayas, 2009; Kurek et al., 2017). The third phase is when population loss in urban cores exceeds the population gain in the outer ring, resulting in overall population decline and shrinking economic activities in central cities (Champion, 1989; Frey, 1990; Cheshire, 1995). In the last phase, core cities start re-attracting population while the suburbs still experience demographic decline (Zambon, Benedetti, Ferrara & Salvati, 2018), thanks to extensive programs of regeneration and renewal of central cities (Van Criekingen, 2010), better housing conditions and improved quality of environment in the urban areas (Pacione, 2005).

Although (more or less) recent literature (Roberts, 1991; Novotný, 2016; Carlucci et al., 2017) have criticized the simplified interpretation of intrinsically complex metropolitan dynamics, the CLC model has inspired (and is still inspiring) a wealth of studies dealing with long-term urban growth, not only in Western Europe (where the model has been originally applied), but also in countries of Eastern Europe (e.g. Ouředníček, 2007) and the Mediterranean region (e.g. Morelli et al., 2014). In this context, a more comprehensive analysis of population dynamics at the metropolitan scale revealed similarities with (and deviations from) the original predictions of the CLC model (Munafò et al., 2013; Salvati, 2014; Kurek et al., 2017; Pili, Grigoriadis, Carlucci, Clemente & Salvati, 2017; Pregi & Novotný, 2019).

Based on this premise, a multi-temporal analysis of specific aspects of population dynamics was proposed in the present study with the aim to provide a coherent description of urban transformations over a sufficiently long-time interval (e.g. Salvati & Serra, 2016; Pili et al., 2017; Zambon et al., 2018). Multivariate analysis allows a more comprehensive understanding of the intrinsic complexity of processes of population re-distribution across expanding metropolitan regions (Morelli et al., 2014). Assuming the non-neutral role of space guiding demographic dynamics (Adveev et al., 2011), a model based on four sequential phases that inspired the CLC theory (urbanization, suburbanization, disurbanization and re-urbanization) was adopted to examine the evolution of local-scale demographic age structures along the urban-rural gradient in a metropolitan region of Southern Europe (Rome, Italy) at six time points between 1971 and 2018.

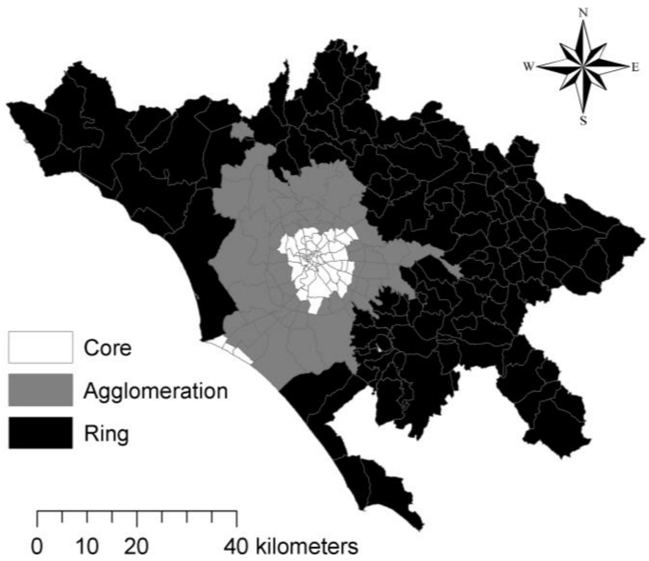
As a semi-compact and dense settlement, Rome is one of the largest Mediterranean cities experiencing a transition towards low fertility and increased residential mobility (Salvati et al., 2016). Urban concentration was the highest in 1971, at the end of a 'baby boom' starting in the 1950s (Munafò et al., 2013). The subsequent period was characterized by a steep decline in fertility with a negative impact on natural population growth and accelerated immigration in speed and scale, consistent with earlier evidence from other cities in Southern Europe, such as Barcelona, Athens and Toulouse (e.g. Morelli et al., 2014; Cuadrado-Ciuraneta et al., 2017; Duvernoy, Zambon, Sateriano & Salvati, 2018). Urban growth and intense demographic changes in Mediterranean Europe are discussed in this work based on empirical results.

Methodology

Study area

The research area covered 5,355 km^2 of land located at Nuts-3 province of Rome (belonging to administrative region of Latium, central Italy) and coincides for a large part with the Functional Urban Area (FUA) of Rome defined by the Urban Audit program carried out by Eurostat. The area (30% lowlands, 50% uplands, and 20% mountainous land) consists of semi-natural land and compact residential settlements (Salvati, 2014), being administered by 122 municipalities. One of these local authorities, the municipality of Rome (1,285 km^2), was further divided into 114 urban districts ('suddivisioni toponomastiche'). The resulting 235 spatial domains (121 municipalities and 114 urban districts) were adopted as the elementary analysis units (Figure 1). A total of 57 and 58 Rome's districts were respectively classified as 'core' (indicating 'compact city' districts) and 'agglomeration' (indicating the surrounding, suburban districts belonging to the municipality of Rome). The remaining 121 municipalities – having a mostly rural socioeconomic profile – were regarded as the outer rural 'ring' of the Rome's metropolitan region.

Figure 1: A map showing the administrative partition (municipalities and urban districts) of Rome's metropolitan region; three concentric rings are highlighted (white, grey and black respectively indicate the compact city ('core'), the suburbs ('agglomeration') and the outer rural ('ring').



Source: Author(s)

Three concentric zones model was adopted in this study because it is described the complex urban-suburban-rural dynamics typical of the post-war development in Rome better than the a classical 'core-ring' model. Additionally, Rome municipality is the largest in Europe and it includes urban and suburban settlements. Hence, looking at Rome's municipality as the inner city of the same metropolitan region can be misleading. A comprehensive analysis of long-term demographic dynamics within this administrative/statistical setting requires the adoption of a more complex, refined classification of the elementary spatial units into three concentric zones. Identification of a specific 'suburban' zone (hereafter 'agglomeration') is appropriate considering the aim of this study, i.e. focusing on divergent demographic dynamics in urban, suburban and rural locations of the investigated area.

Despite Rome's accelerated growth between 1951 and 1971, its population increased only moderately from 1971 (3.5 million) to 2018 (4.2 million). The municipality of Rome was stable in terms of population growth (2.8 million) while the rest of its area increased exponentially (from 0.8 to 1.4 million inhabitants). The majority of urban districts and municipalities in Rome had more than 1,000 inhabitants. Only very few of them had a population between 300 and 1,000 inhabitants.

Data and variables

This study examined the role of space in shaping local population age structures between 1971 and 2018. This time period was chosen to study long-term and short-term changes in population composition based on specific age groups. Population structures by age group were studied in six time periods - 1971, 1981, 1991, 2001, 2011, and 2018 - based on population census and demographic data obtained from Italy Institute of Statistics (ISTAT) and the statistic office of municipality of Rome. Age composition was studied in eight categories (0-4 years, 5-9 years, 10-14 years, 15-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years and ≥ 65 years) covering the entire study period at selected periods. Percentage share of population by age was calculated by year and spatial unit. In order to provide a basic characterization of local contexts, six additional variables were calculated at: (i) mean population age (years, MEA), (ii) index of young structural dependency (SDY), (iii) index of elder structural dependency (SDE), (iv) mean number of components per family (COM), (v) population density (inhabitants/km^2, PDE), and (vi) annual rate of population growth (%, PGR). A continuous variable quantifying the linear distance of each spatial unit from downtown Rome was finally calculated using centroids of urban districts and municipalities in the study area (DIS). Centroids of each spatial unit were determined using spatial tool provided by ArcGIS (Geographic Information System) software.

Statistical analysis

A mixed inferential-exploratory approach to the analysis of local population age structures was adopted in this study aimed at highlighting latent demographic changes and the related expansion of metropolitan regions over a time period. A pair-wise correlation analysis was carried out (based on percentage share of population in relation to total population) for each age group and the distance from downtown Rome (km) using non-parametric Spearman rank coefficients. Significant correlations were identified at $p < 0.05$ after Bonferroni's correction for multiple relationships (Zitti, Ferrara, Perini, Carlucci & Salvati, 2015; Pili et al., 2017; Zambon, Serra, Sauri, Carlucci & Salvati, 2017).

A Multiway Factor Analysis (MFA) was applied to the percentage share of population based on age group in relation to total population at each spatial unit separately for six time periods years (1971, 1981, 1991, 2001, 2011, 2018) and 7 age classes. One class (55-64 years) was excluded from the analysis with the aim to avoid multi-collinearity within the set of variables selected as the model's input (Salvati & Carlucci, 2014). Adopting the same rationale of a Principal Component Analysis, MFA is a multidimensional technique assessing three-dimensional data matrices that incorporate temporal and spatial variability in the studied variables (population composition by age group). The number of significant axes was chosen according to the scree-plot criterion (Salvati & Serra, 2016). A supplementary analysis of long-term spatial dynamics in the demographic structure of resident population was carried out by calculating the pair-wise Spearman correlation coefficient between each selected factor score and the six (supplementary) variables (MEA to PGR, see section 2.2) at each spatial unit (Colantoni, Grigoriadis, Sateriano, Venanzoni & Salvati, 2016).

Results

Basic characteristics of local population structures in Rome

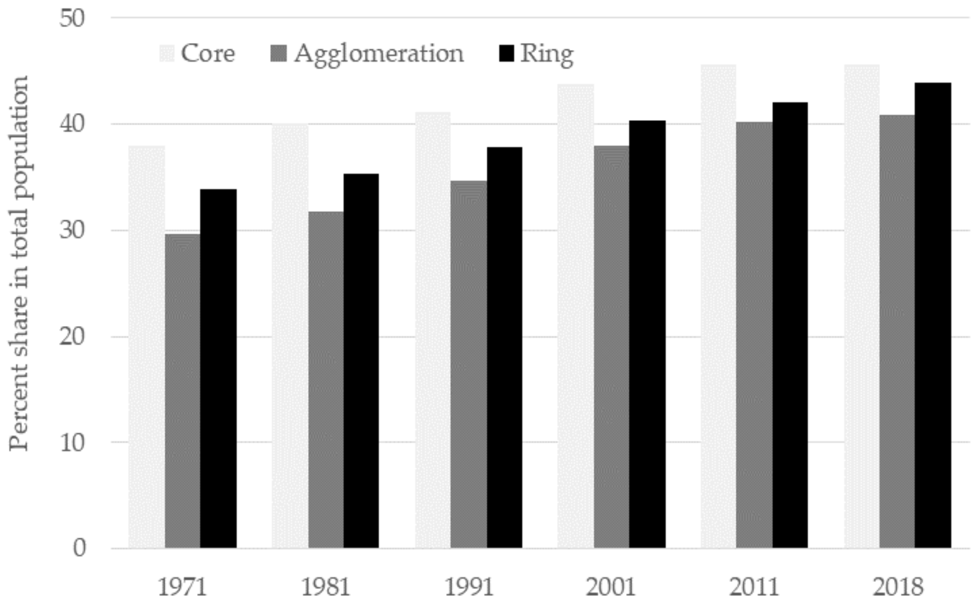
Population composition by age group was studied in Rome's metropolitan region classifying elementary spatial units in three groups (core, agglomeration, and ring) as shown in Table 1. Core districts had a higher percentage of adult and older population than ring municipalities for all the years studied. Agglomeration districts had the most balanced age structure. This structure was reflected in the spatio-temporal evolution of the mean population age (see Figure 2). A generalized process of aging was observed in the last decades, reducing the inherent differences between urban, suburban and rural populations.

The overall difference in the mean age of population residing in urban (core) and suburban (agglomeration) locations was about 10 years in 1971 (higher in core districts) and decreased to less than 5 years at the end of the study period (2018). At the same time, the age gap between suburban (agglomeration) and rural (ring) populations decreased from 5 years (1971) to 3 years (2018).

Table 1: Percentage share of population by age group (years) in relation to total population by year and concentric zone.

Year	Area	0-4	5-9	10-14	15-24	25-34	35-44	45-54	54-64	65+
1971	Core	5.8	7.1	6.3	13.3	14.1	13.9	13.1	13.6	13.6
	Agglomeration	9.6	10.5	8.8	15.0	15.9	15.5	10.4	7.5	5.8
	Ring	8.0	8.7	8.3	15.4	12.6	13.6	11.5	10.4	11.3
1981	Core	3.9	5.2	6.6	14.9	13.2	13.5	14.0	12.6	17.0
	Agglomeration	6.7	8.8	8.9	16.9	15.6	14.6	12.7	7.7	7.2
	Ring	6.5	7.6	7.9	16.0	14.3	12.2	12.3	10.6	12.7
1991	Core	3.3	3.2	4.1	13.4	16.2	12.9	14.4	12.8	18.3
	Agglomeration	5.3	5.5	6.4	16.4	17.9	15.3	13.1	10.4	8.5
	Ring	5.3	5.5	6.3	15.2	16.2	13.9	11.6	11.5	14.9
2001	Core	3.7	3.7	3.7	8.5	14.9	15.5	13.6	13.7	22.4
	Agglomeration	5.4	5.3	5.1	11.1	16.8	17.2	13.5	11.6	13.0
	Ring	4.6	4.9	5.2	11.4	15.3	16.2	13.4	11.2	18.0
2011	Core	3.7	3.8	3.8	8.0	9.8	15.1	16.5	13.2	25.9
	Agglomeration	5.2	5.4	4.8	9.7	11.6	18.1	16.6	11.5	16.2
	Ring	4.7	4.7	4.6	10.1	12.8	16.1	15.5	12.3	19.5
2018	Core	3.5	4.0	4.1	8.3	9.5	13.4	17.4	14.2	25.3
	Agglomeration	4.5	5.3	5.3	9.6	11.1	15.7	17.8	12.6	16.9
	Ring	4.0	4.7	4.8	9.4	11.2	14.4	16.7	13.9	21.7

Figure 2: Mean population age by year and concentric zone (see also Figure 1).



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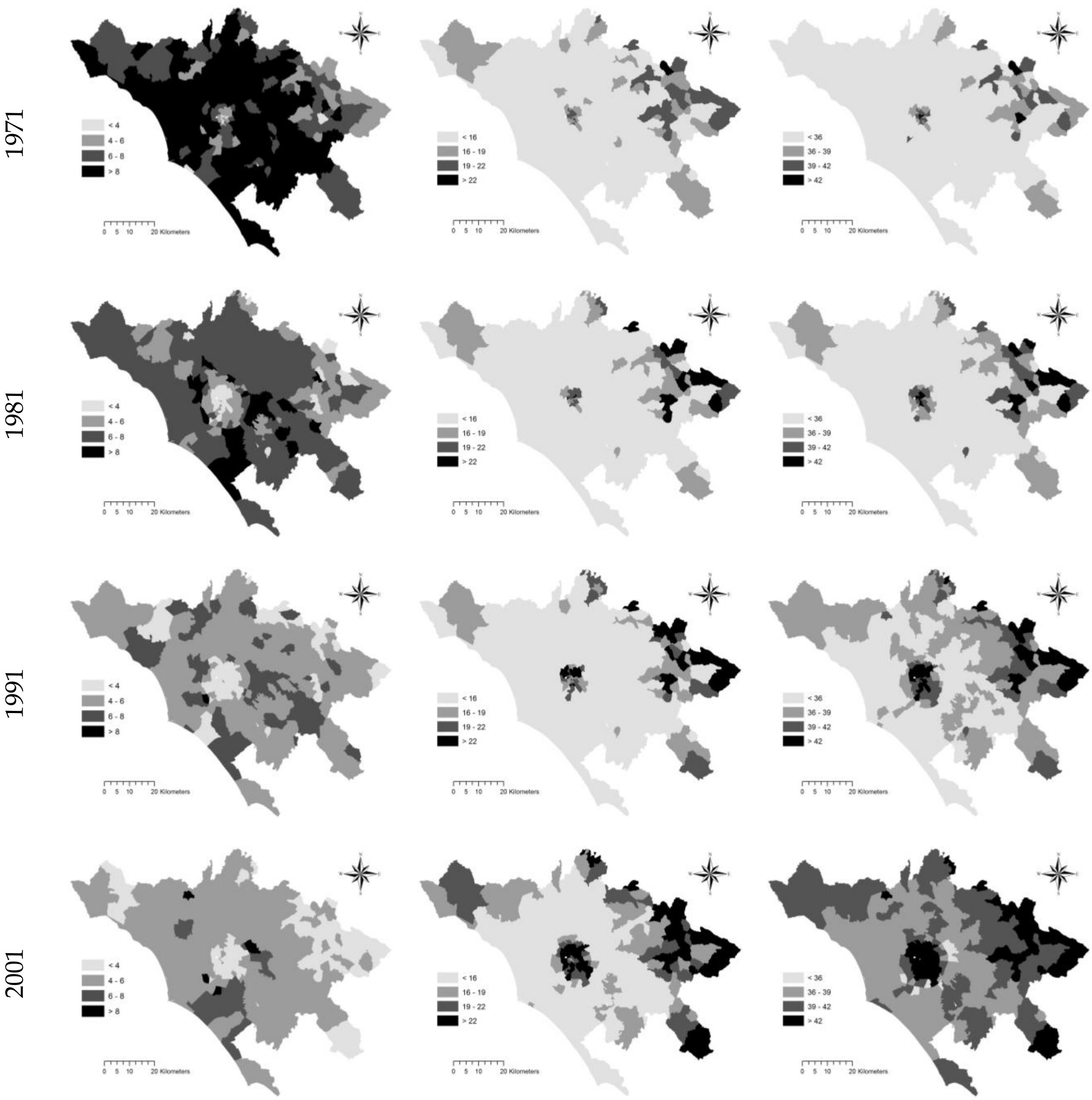
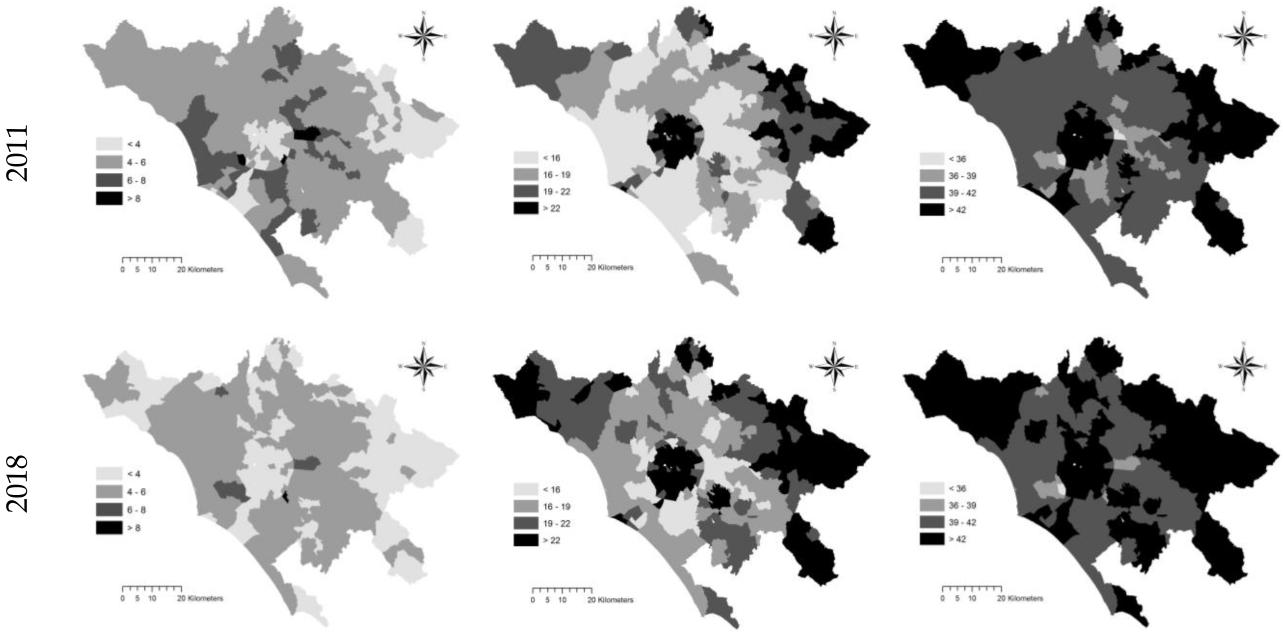
A comparative analysis of the spatial distribution of resident population according to selected age classes is shown in Figure 3. Population in Rome experienced progressive aging: the percentage share of population aged 0-4 years was more than 8% of the total population in 1971 (except for inland municipalities of Apennine mountain region) and decreased to less than 4% in 2018, with exceptions for certain fringe municipalities around Rome. These results point to a distinctive urban-suburban-rural gradient in local population age structures for all the years under study. An even clearer geographical gradient was observed for the mean population age, evidencing a strong divide between suburban and urban-rural population.

Figure 3: Spatial distribution of percentage share of selected population age group in relation to total population (left: 0-4 years; middle: 65+ years) and mean population age (right) by year in Rome's metropolitan region.





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Population age structures and distance from downtown Rome

A Spearman rank correlation analysis was run pair-wise based on population by age group in each spatial unit and the distance from downtown Rome (Table 2). In general, the percentage share of younger age groups in relation to total population increased with distance from the inner city and vice versa among the older age groups. Notably, the spatial distribution of the oldest age group (65+ years) was spatially homogeneous along the urban gradient, suggesting the key role of aging in local-scale population dynamics during the entire study period.

Table 2: Non-parametric Spearman correlation coefficients between distance from downtown Rome and percentage share of population by age group (years) in relation to total population (bold indicates a significant coefficient at $p < 0.05$ after Bonferroni's correction for multiple comparisons).

Age class	1971	1981	1991	2001	2011	2018
0-4	0.02	**0.31**	**0.41**	0.11	0.16	0.05
5-9	0.04	0.08	**0.43**	0.18	0.10	0.03
10-14	0.28	0.03	**0.34**	**0.43**	0.17	0.01
15-24	**0.38**	0.10	-0.04	**0.41**	**0.46**	0.17
25-34	**-0.44**	-0.05	-0.24	-0.24	**0.46**	**0.34**
35-44	**-0.32**	**-0.53**	-0.07	-0.05	-0.10	-0.09
45-54	-0.22	**-0.42**	**-0.70**	-0.18	**-0.40**	**-0.35**
55-64	0.04	0.03	-0.02	**-0.49**	-0.05	0.13
65+	0.20	0.16	0.11	0.08	-0.15	-0.04

A Multiway Factor Analysis of local population structures by age in Rome

Changes over time in population age structures in Rome were studied using a Multiway Factor Analysis of basic indicators assessing the composition of residents based on age group. Three main factors were extracted that explain more than 61% of the total matrix variance (Table 3). Factor 1 (accounting for 38% of total variance on average) represents the complex geography of local population structures by age in Rome, identifying unbalanced (and older) population structures at both core and ring locations and younger (and more balanced) population structures at suburban locations (agglomeration).

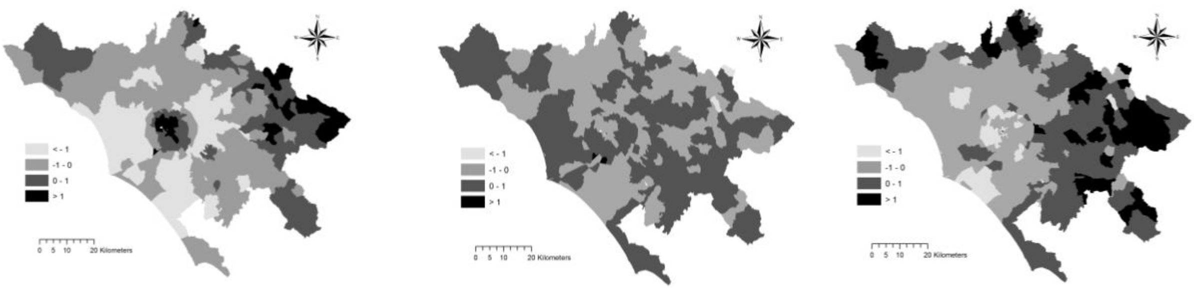
Scores of Factor 1 were correlated (i) positively with mean population age and the index of structural dependency of elders, and (ii) negatively with the average number of family members and the index of structural dependency of young. The spatial polarization in suburban locations (negative scores) and urban-rural locations (positive scores) along Factor 1 is shown in Figure 4. Factor scores were negatively correlated with population growth in 1980s, 1990s, and 2000s and during this period, population growth was associated with the young.

Table 3: Results of a Multiway Factor Analysis of local population age structures in Rome by year*.

Age	**Factor 1**						**Factor 2**						**Factor 3**					
class	1971	1981	1991	2001	2011	2018	1971	1981	1991	2001	2011	2018	1971	1981	1991	2001	2011	2018
Active variables																		
0-4	-0.74	-0.81	-0.71	-0.72	-0.80	-0.77												
5-9	-0.77	-0.83	-0.46	-0.75	-0.81	-0.78			0.71									
10-14	-0.53	-0.60	-0.74	-0.58		-0.75		0.62			0.73					0.57		
15-24			-0.56			-0.59			0.68	0.59								
25-34	-0.50	-0.63	-0.50	-0.54					-0.53				-0.60				0.54	
35-44	-0.52		-0.62	-0.50	-0.68					-0.62		0.62	-0.77					
45-54	0.57									-0.53	-0.68	-0.61			-0.84			-0.55
65+	0.81	0.86	0.89	0.91	0.87	0.82												
Supplementary variables																		
MEA	0.86	0.92	0.93	0.94	0.88	0.87												
COM	-0.58	-0.76	-0.82	-0.79	-0.79	-0.78		0.40										
SDY	-0.75	-0.82	-0.61	-0.67	-0.73	-0.70									0.65			
SDE	0.79	0.84	0.86	0.87	0.86	0.85												
PDE													-0.39	-0.41	-0.42	-0.40	-0.42	-0.26
PGR		-0.48	-0.61	-0.51								0.53						
%variance						**38.3**						**12.8**						**10.5**

* *Age group expressed in years; MEA: mean population age; COM: mean number of family members; SDY: index of young structural dependency; SDE: index of elder structural dependence; PDE: Population density (inhabitants/km²); PGR: Annual population growth rate (%).*

Figure 4: Spatial distribution of factor scores (left: axis 1; middle: axis 2; right: axis 3)



Source: Authors

Factor 2 (accounting for 13% of total variance on average) was associated with more latent demographic structures dominated by young and adult age groups and respectively associated with positive and negative scores. Factor scores were positively associated with the average number of components per family at the beginning of the study period (1971 and 1981) and with annual rate of population growth (2018). The spatial distribution of factor scores was particularly dispersed. Positive scores were associated with specific suburban locations. Factor 3 (accounting for 11% of total variance on average) outlined a traditional urban-rural divide correlated negatively with population density. This gradient evolved over time, with higher factor loadings being associated exclusively with the working age population. In 1971, the 25-34 and 35-44 age groups were negatively associated with this factor. A negative correlation for the age class 45-54 years was observed for 2018.

Discussion

Urban studies have examined processes of population redistribution across larger metropolitan regions; however, stability or changes in local population age structures have not received much attention, especially in cities experiencing complex and non-linear expansion (Hall, 1997; Allen et al., 2004; Kulu et al., 2009; Adveev et al., 2011; Lerch, 2014). Results of this study indicate space is non-neutral as far as changes in local population structures by age are concerned. The multidimensional analysis revealed to be a powerful statistical tool allowing inference on the most relevant urban transformations between 1971 and 2018 while it highlighting apparent and latent population dynamics at a sufficiently detailed spatial scale. Considering the loadings of active and supplementary variables, factor 1 extracted the most significant spatial information from the original dataset, capturing the structural divide in urban-suburban-rural populations. At the same time, factors 2 and 3 identified more latent demographic patterns but less evident spatial dimension.

Although population in the study area underwent progressive ageing since 1971, statistical analysis outlines a peculiar population age structure in suburban areas during the study period. On average, this structure was characterized by younger population and reflected extensive processes of suburbanization. By contrast, mean population age in compact and central settlements was persistently higher compared with the rest of the areas. Rural communities had a mixed socio-demographic profile distinctive from both urban and suburban populations. These findings are inconsistent with those of recent studies in Western Europe, and in some cases, in Eastern Europe, where young people (graduates and young job-seekers) tend to move to central cities of metropolitan regions while rural areas are coping with a rapid aging population (Van Criekingen, 2010; Kroll & Kabisch, 2012; Kurek et al., 2017).

Generally, differences in local population structures over time progressively reduced in recent years, indicating aging was more pronounced in areas with declining populations. This process was particularly evident in the outer rural ring during the first two decades of study (1971-1991) and corresponded with a phase of depopulation of internal municipalities and intense mobility towards core districts, reflecting late urbanization and early suburbanization (Salvati et al., 2016). In the following period (1991-2001), the study area experienced a progressive disurbanization with moderate aging. There was accelerated population growth over the last two decades (2001-2018) at suburban locations, though it was less intense in core districts with compact settlements likely due to slow processes of re-urbanization which led to a slight population recovery (Carlucci et al., 2017). Early re-urbanization of central districts in Rome was associated with processes of gentrification and social filtering already observed in other Mediterranean cities (e.g. Cuadrado Ciuraneta et al., 2017; Pili et al., 2017; Duvernoy et al., 2018).

These findings indicate that changes in local demographic structures are linked with sequential urban cycles, and areas experiencing population growth are mainly associated with younger demographic structures (Van Criekingen, 2010). The suburban areas were dominated by younger population (Kroll & Kabisch, 2012). This may be associated with social segregation at the regional scale (Kabisch & Haase, 2011), fueling suburban-urban divides in local population structures based on age (Haase et al., 2010). The increase in younger populations in suburbs compared with central cities is consistent with the suburban fertility hypothesis, which is linked to higher birth rates (Kulu et al., 2009). Peculiar population dynamics in Rome's suburbs could be due to the fact middle-class families are the main agent of early suburbanization in those areas (Salvati et al., 2016). Conversely, other population groups - retirees, divorced and single people, migrants seeking social status and affordable new housing - were more pronounced during late suburbanization, and this was reflected in accelerated aging during the recent decades (Arapoglou & Sayas, 2009).

Last but not least, immigration – and especially foreign migrants – may have a particularly relevant impact altering local population structures by age (Strozza, Benassi, Ferrara & Gallo, 2016). For instance, in 1991, foreigners (with resident status) in the study area were less than 100,000 but that figure jumped to nearly 550,000 in 2011. Concurrently, internal migration was an important component of the Rome's growth before 1991 (Salvati et al., 2016). While indirectly considered in the official statistics analyzed in our study (population growth is a result of variations in natural and migration balances in the given area), the specific role of both internal and international migration in metropolitan growth should be better clarified (Bocquier & Costa, 2015). In this regard, a specific analysis of migration rates over a long period distinguishing internal migration from foreign influx should be performed, encompassing the four stages of metropolitan growth (from urbanization to re-urbanization). As shown in our study, adopting a local perspective is appropriate in such context.

Conclusion

Changes over time in demographic structures are considered a reliable indicator of population dynamics and urban transformations. This is especially true since they are associated with a considerable reduction of family size and population aging. Results of the multivariate analysis showed balanced demographic structures - characterized by a low dependence ratio, larger families and the predominance of young age classes - were more strictly associated with population growth, being a typical feature of suburban populations in the earlier stages of growth (Kroll & Kabisch, 2012). In this regard, the interplay between urban cycles and local population age structures should be investigated with spatially explicit approaches, clarifying the contribution of both natural and migration growth shaping urban development, spatial mobility across metropolitan regions, and population aging. Implications of spatial clustering in local demographic structures are particularly relevant when planning future sustainable and smart cities, since population age structure is a crucial factor influencing mechanisms of urban growth, social cohesion and economic attractiveness of metropolitan regions.

References

Adveev, A., Eremenko, T., Festy, P., Gaymu, J., Le Bouteillec, N., & Springer, S. (2011). Populations and demographic trends of European countries, 1980-2010. *Population*, 66(1), 9-129.

Allen, J., Barlow, J., Leal, J., Maloutas, T., & Padovani, L. (2004). *Housing in southern Europe*. London: Blackwell.

Angel, S., Parent, J., Civco, D.L., Blei, A., & Potere, D. (2011). The dimensions of global urban expansion: Estimates and projections for all countries, 2000 – 2050. *Progress in Planning*, 75, 53–107.

Arapoglou, V.P., & Sayas, J. (2009). New facets of urban segregation in southern Europe – Gender, migration and social class change in Athens. *European Urban and Regional Studies*, 16(4), 345-362.

Bocquier, P., & Costa, R. (2015). Which transition comes first? Urban and demographic transitions in Belgium and Sweden. *Demographic Research*, 33, 1297-1332.

Bourne, L. (1996). Reinventing the suburbs: old myths and new realities. *Progress in Planning*, 4(3), 163-184.

Burchell, R.W., Listokin, D., & Galley, C.C. (2000). Smart growth: More than a ghost of urban policy past, less than a bold new horizon. *Housing Policy Debate*, 11(4), 821–879.

Carlucci, M., Grigoriadis, E., Rontos, K., & Salvati, L. (2017). Revisiting a hegemonic concept: Long-term 'Mediterranean Urbanization' in between city re-polarization and metropolitan decline. *Applied Spatial Analysis and Policy*, 10(3), 347-362.

Champion, A. (1989). *Counterurbanisation: The changing pace and nature of population decentralisation*. London: Arnold.

Cheshire, P. (1995). A new phase of urban development in Western Europe? The evidence for the 1980s. *Urban Studies*, 32(7), 1045-1063.

Cohen, B. (2006). Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability. *Technology and Society*, 28, 63-80.

Colantoni, A., Grigoriadis, E., Sateriano, A., Venanzoni, G., & Salvati, L. (2016). Cities as selective land predators? A lesson on urban growth, deregulated planning and sprawl containment. *Science of the Total Environment,* 545, 329-339.

Cross, D. (1990). *Counterurbanisation in England and Wales*. Aldershot: Ashgate.

Cuadrado-Ciuraneta, S., Durà-Guimerà, A., & Salvati, L. (2017). Not only tourism: Unravelling suburbanization, second-home expansion and "rural" sprawl in Catalonia, Spain. *Urban Geography*, 38(1), 66-89.

Duvernoy, I., Zambon, I., Sateriano, A., & Salvati, L. (2018). Pictures from the other side of the fringe: Urban growth and peri-urban agriculture in a post-industrial city (Toulouse, France). *Journal of Rural Studies*, 57, 25-35.

Fielding, A. (1982). Counterurbanisation in Western Europe. *Progress in Planning*, 17(1), 1-52.

Frey, W.H. (1990). Metropolitan America: beyond the transition. *Population Bulletin*, 45, 1-51.

Haase, A., Kabisch, S., Steinführer, A., Bouzarovski, S., Hall, R., & Ogden, P. (2010). Spaces of reurbanisation: Exploring the demographic dimension of inner-city residential change in a European setting. *Population, Space and Place*, 16(5), 443–463.

Hall, P. (1997). The future of the metropolis and its form. *Regional Studies*, 31, 211-220.

Kabisch, N., & Haase, D. (2011). Diversifying European agglomerations: Evidence of urban population trends for the 21st century. *Population, Space and Place*, 17(3), 236–253.

Kasanko, M., Barredo, J.I., Lavalle, C., McCormick, N., Demicheli, L., Sagris, V., & Brezger, A. (2006). Are European cities becoming dispersed? A comparative analysis of fifteen European urban areas. *Landscape and Urban Planning*, 77, 111-130.

Klaassen, L., Molle, W., & Paelinck, J. (1981). *Dynamics of urban development*. New York: St. Martin's Press.

Kontuly, T., & Tammaru, T. (2006). Population subgroups responsible for new urbanization and suburbanization in Estonia. *European Urban and Regional Studies*, 13, 319-336.

Kroll, F., & Kabisch, N. (2012). The relation of diverging urban growth processes and demographic change along an urban–rural gradient. *Population, Space and Place*, 18(3), 260–276.

Kulu, H., Boyle, P.J., & Anderson, G. (2009). High suburban fertility: Evidence from four Northern European countries. *Demographic Research*, 31, 915-944.
Kurek, S., Wójtowicz, M., & Gałka, J. (2017). Does suburbanisation contribute to the rejuvenation of a metropolitan area? Changes in the age structure of the Kraków metropolitan area in Poland in the light of recent suburbanisation. *Geographia Polonica*, 90(2), 59-70.
Lerch, M. (2014). The role of migration in the urban transition: A demonstration from Albania. *Demography*, 51(4), 1527–1550.
Lever, W.F. (1993). Reurbanisation - The policy implications. *Urban Studies*, 30, 267-284.
Mordridge, M., & Parr, J. (1997). Metropolis or region: On the development and structure of London. *Regional Studies*, 31, 97-115.
Morelli, V.G., Rontos, K., & Salvati, L. (2014). Between suburbanisation and re-urbanisation: Revisiting the urban life cycle in a Mediterranean compact city. *Urban Research & Practice*, 7(1), 74-88.
Munafò, M., Salvati, L., & Zitti, M. (2013). Estimating soil sealing rate at national level—Italy as a case study. *Ecological Indicators*, 26, 137-140.
Novotný, L. (2016). Urban development and migration processes in the urban region of Bratislava from the postsocialist transformation until the global economic crisis. *Urban Geography*, 37, 1009-1029.
Ouředníček, M. (2007). Differential suburban development in the Prague urban region. *Geografiska Annaler: Human Geography,* 89B(2), 111-125.
Pacione, M. (2005). *Urban geography: A global perspective*. London: Routledge.
Pili, S., Grigoriadis, E., Carlucci, M., Clemente, M., & Salvati, L. (2017). Towards sustainable growth? A multi-criteria assessment of (changing) urban forms. *Ecological Indicators*, 76, 71-80.
Pregi, L., & Novotný, L. (2019). Selective migration of population in functional urban regions of Slovakia. *Journal of Maps*, 15 (1), 94-102.
Roberts, S. (1991). A critical evaluation of the city life cycle idea. *Urban Geography*, 12, 431-449.
Salvati, L. (2014). Agro-forest landscape and the 'fringe'city: A multivariate assessment of land-use changes in a sprawling region and implications for planning. *Science of the Total Environment*, 490, 715-723.
Salvati, L., & Carlucci, M. (2014). A composite index of sustainable development at the local scale: Italy as a case study. *Ecological Indicators*, 43, 162-171.
Salvati, L., Sateriano, A., & Grigoriadis, S. (2016). Crisis and the city: Profiling urban growth under economic expansion and stagnation. *Letters in Spatial and Resource Science*, 9(3), 329–342.
Salvati, L., & Serra, P. (2016). Estimating rapidity of change in complex urban systems: a multidimensional, local-scale approach. *Geographical Analysis*, 48, 132-156.
Strozza, S., Benassi, F., Ferrara, R., & Gallo G. (2016). Recent demographic trends in the major Italian urban agglomerations: The role of foreigners. *Spatial Demography*, 4(1), 39-70.
Van Criekingen, M. (2010). Gentrifying the re-urbanisation debate, not vice versa: the uneven socio-spatial implications of changing transitions to adulthood in Brussels. *Population, Space and Place*, 16(5), 381–394.
Van den Berg, L., Drewett, R., Klaassen, L.H., Rossi, A., & Vijverberg, C.H.T. (1982). *Urban Europe: A study of growth and decline.* Oxford: Pergamon Press.
Zambon, I., Benedetti, A., Ferrara, C., & Salvati, L. (2018). Soil matters? A multivariate analysis of socioeconomic constraints to urban expansion in Mediterranean Europe. *Ecological Economics*, 146, 173-183.
Zambon, I., Serra, P., Sauri, D., Carlucci, M., & Salvati, L. (2017). Beyond the 'Mediterranean city': Socioeconomic disparities and urban sprawl in three Southern European cities. *Geografiska Annaler: Series B, Human Geography*, 99(3), 319-337.
Zitti, M., Ferrara, C., Perini, L., Carlucci, M., & Salvati, L. (2015). Long-term urban growth and land use efficiency in Southern Europe: Implications for sustainable land management. *Sustainability*, 7(3), 3359-3385.