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Identifying and Ranking the Drivers of Population Ageing in Tehran: A Futures-Studies Approach Using Delphi and MARCOS

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ABSTRACT

Background: Population ageing is one of the defining demographic trends of the twenty-first century, and Tehran is particularly exposed to it because of falling fertility, rising life expectancy, rapid lifestyle change and complex economic conditions. **Objective:** To identify and rank the drivers of population ageing in Tehran from a futures-studies perspective. **Method:** A three-stage exploratory design was used. Initial drivers were identified through a scoping review, 15 semi-structured expert interviews and the STEEPV framework. They were refined in a two-round Delphi survey (36 experts in round 1, 31 in round 2) with a predefined consensus criterion, which expanded the list to 69 drivers in eight domains and retained 66. Ten senior experts then scored the 66 drivers from 1 to 10, and the drivers were ranked with the MARCOS multi-criteria method. **Findings:** The highest-ranked drivers were the mortality rate ($f(K) = 0.805$), lifestyle (0.794), the fertility rate (0.792), social inequality (0.777), economic inequality (0.771), and urbanization, migration and health technologies (0.770 each). Economic drivers had the highest average utility, followed by values and ecological–demographic drivers; technological and political drivers ranked lowest. Expert agreement was significant but weak (Kendall's $W = 0.218$, $p < .001$), although the ranking was stable when single experts were omitted. The 36 highest-ranked drivers were selected for cross-impact analysis. **Conclusions:** Population ageing in Tehran arises from the interaction of demographic, economic, social, cultural, spatial and institutional factors, and responding to it requires integrated, anticipatory governance, a sustainable pension system, support for families and an age-friendly city.

1. INTRODUCTION

1.1. Urbanization and global population ageing

Urban growth over recent decades has produced diverse prospects and harmful consequences for cities [1]. More people now live in cities and urban regions than at any earlier time in history, and urbanization appears to be irreversible [2]. The twenty-first century is characterized by two major trends. One is an urban population: according

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to the United Nations, more than half of the world's population now lives in cities. The other is population ageing, especially in developed countries, driven by rising life expectancy and falling infant mortality [3]. Ageing is becoming a global phenomenon. Not only is the number of older people increasing in most parts of the world, but their share of national populations is also rising markedly, and some researchers regard population ageing as perhaps the most important demographic challenge of the twenty-first century [4]. The share of older people in the world population is projected to rise from 13% to 21% by 2050 and to 23% by the end of the century, although the pace and level of ageing will differ substantially between regions and countries [5].

1.2. Population ageing in Iran and Tehran

Iran is undergoing one of the fastest ageing transitions in the world. Estimates suggest that around 19% of the population will be older people by 2041 (1420 in the Iranian calendar) and about 26% by 2051 (1430), when the country will be in a phase of advanced ageing [6]. According to census data, the share of the population aged 65 and over rose from 5.2% in 2006 to 5.7% in 2011, 6.1% in 2016 and 6.4% in 2019 [7]. Declining birth rates, fertility falling below replacement level and the population's entry into the ageing phase create new imperatives for policymakers in many social and economic domains [8, 9]. The population of Tehran Province is projected to reach 15 million by 2036, with older people making up 20% of it, compared with about 17% nationally. Tehran is therefore ageing faster than the country as a whole [10].

1.3. Futures studies of ageing

Managing an ageing population requires a precise understanding of the global and national demographic, social, cultural and technological megatrends and of the drivers behind them. Population ageing, urbanization, technological change, political and economic instability and the interdependence of the global economy are among the most important megatrends shaping the future [4, 11]. A committee of the U.S. National Research Council concluded that the future course of population ageing depends on mortality, fertility and migration, the three main drivers of ageing in the United States [12]. These demographic changes will have wide-ranging social, economic, political and environmental consequences. Veenman [13] showed that, although policymakers often pay little attention to uncertainty, futures studies of ageing have influenced how uncertainty is handled in policymaking.

A substantial share of futures research on ageing concerns services and their future challenges. Wright et al. [14] examined older people's future housing preferences. Milner anticipated the transformation of health programs, an increasing number of health professionals and the redefinition of ageing stereotypes [15, 16]. Clarke and Warren [17] studied older people's hopes and fears about the future and argued that "active ageing" strategies must support living well at every stage of life. Roux and Viljoen [18] criticized planners' neglect of older people's economic participation. Lloyd et al. [19] studied children's images of their own old age, and Jang and Lee [20] studied older Korean workers' perceptions of the future labour market; both groups held a pessimistic view of the future. Flick et al. [21] used horizon scanning to identify the main ethical and social issues of information and communication technologies (ICT) for health and ageing: the view of older people as a collection of diseases, the human dimension of ICT, privacy and informed consent, autonomy, and stereotyping.

In Iran, urbanization, economic instability, recession and environmental hazards have been identified as the most important trends and drivers of change [22, 23]. Global demographic drivers, namely population growth and ageing in developed countries, may also affect Iran's demographic future [24, 25]. Falling birth and marriage rates, social and economic change and rising welfare will further accelerate ageing, while incoherent policymaking and the multiplicity of intervening institutions may undermine population policy [26]. Zanjari et al. [8] identified governance of ageing, pension funds, micro- and macro-level consumption expenditure, welfare distribution, fertility and family size, and insurance and pension coverage as key drivers. These drivers shape the geriatric workforce, intergenerational relations, social participation, lifestyle and older people's quality of life. The authors developed four scenarios and argued that the desirable scenario requires smart, anticipatory governance of ageing, equal distribution of welfare, sustainable pension funds, active economic and social participation of older people, and fertility above replacement level. Dehghan Banadaki [27] identified the decline of extended households, shrinking household size, rising permanent singlehood and the feminization of ageing as aggravating factors. The same report named rising health-care costs, the need for care infrastructure, an unstable welfare system and older people's

increasing dependence as the main future challenges. Adib Roshan et al. [28] explored images of the future of Iranian older people with respect to sport and physical activity.

1.4. Research gap and objective

The evidence shows that Iran is in the final stages of its demographic transition, with fertility and mortality levels converging. Understanding demographic behavior and the changing structure, distribution and growth of the population is essential for anticipating opportunities and challenges and for integrated policymaking. The situation is more acute in Tehran, the country's political and social center, and population ageing will be one of the city's main issues in the coming decades. Existing Iranian futures studies of ageing, however, operate at the national level and focus on scenarios. They do not provide a systematic, city-level inventory and prioritization of drivers that can feed into structural analysis. This study therefore aims to identify the drivers of population ageing in Tehran and to rank them by importance and impact.

2. METHODOLOGY

The study is applied in purpose and uses a mixed, exploratory design in three stages (Figure 1).

2.1. Stage 1: Initial identification of drivers

Initial drivers were identified through a scoping review and semi-structured interviews. The scoping review covered international databases (Scopus, Web of Science) and Iranian databases (SID, Magiran, Noormags) for 2000–2023, using combinations of the terms ageing, older population, future, foresight, trend and driver; 64 sources met the inclusion criteria and were coded for drivers. To ensure comprehensiveness, the STEEPV framework was used. STEEPV extends the classical STEEP environmental-scanning categories with a "values" dimension and is intended to ensure that all relevant perspectives are considered [29, 30]. Drivers were collected in the social (S), technological (T), economic (E), ecological (E), political (P) and values (V) domains. To complete the list, 15 semi-structured interviews (35–60 minutes) were conducted with purposively selected experts with at least ten years of research or policy experience on population, ageing or urban affairs; interviews continued until no new drivers emerged in the last three interviews. The interviews were transcribed and coded deductively against the STEEPV categories by the author and a second coder, and new drivers were added.

2.2. Stage 2: Delphi refinement

The Delphi method is a set of procedures for eliciting and refining the opinions of a group of experts [31]. Its procedures are designed to reduce the undesirable effects of group interaction and to achieve reliable consensus without direct confrontation among experts [32]. The method has three distinguishing features: anonymity, controlled feedback and a statistical group response [33].

In the first round, a questionnaire listing the 28 initial drivers was sent to 40 experts, of whom 36 responded (90%). Experts were selected from different disciplines so that all domains would be covered. They rated the importance of each driver on a five-point Likert scale and, in an open-ended section, added important drivers they considered missing. Their suggestions were consolidated, and the second-round questionnaire was compiled with 69 drivers in eight domains; two domains were added to the STEEPV structure: health and mental health, and institutional (laws and regulations). In the second round, 31 of the 36 experts (86%) rated the 69 drivers on the same five-point scale and received the group median and interquartile range (IQR) of the first round as controlled feedback. Consensus was defined in advance as at least 70% of experts rating a driver as important or very important (4 or 5) together with an IQR of at most 1. Sixty-six drivers met this criterion; the remaining three (virtual services, household size and social protests) did not and were excluded, and the Delphi process was ended because consensus had been reached for the retained list.

2.3. Stage 3: Ranking with MARCOS

In the final stage, ten senior experts, drawn from the round-2 panel to cover futures studies, demography, sociology, urban planning, economics, environment, new technologies, political science, health and urban management (one per field), scored each of the 66 drivers from 1 to 10 according to its importance and impact on

population ageing in Tehran. The wider 1–10 scale was used in this stage to discriminate between drivers that had all reached consensus on the five-point scale. The scores were analyzed with the MARCOS method, a multi-criteria decision-making method proposed by Stević et al. [34] that ranks alternatives according to their position relative to an ideal and an anti-ideal solution [35, 36]. In this study, the drivers are the alternatives (m = 66) and the experts are the criteria (n = 10). All criteria are of the benefit type and receive equal weights ($w_j = 0.1$). The procedure has six steps.

Step 1: Decision matrix. The matrix $X = [x_{ij}]_{66\times10}$ contains the score given by expert j to driver i.

Step 2: Extended matrix. The anti-ideal (AAI) and ideal (AI) solutions are added as two additional rows. Because all criteria are of the benefit type, they are defined for each criterion (expert) j as

$$AAI_j = \min_i x_{ij}, \qquad AI_j = \max_i x_{ij}. \tag{1}$$

Step 3: Normalization. Each element is divided by the ideal value of its *column*:

$$n_{ij} = \frac{x_{ij}}{x_{ai,j}}. \tag{2}$$

Step 4: Weighted sums. The weighted normalized matrix is $v_{ij} = w_j n_{ij}$, and the sum for each alternative (and for AAI and AI) is $S_i = \sum_{j=1}^{n} v_{ij}$.

Step 5: Utility degrees. The utility degrees of each alternative relative to the anti-ideal and ideal solutions are

$$K_i^- = \frac{S_i}{S_{aai}}, \qquad K_i^+ = \frac{S_i}{S_{ai}}. \tag{3}$$

Step 6: Utility function and ranking. The utility functions relative to the ideal and anti-ideal solutions are

$$f(K_i^+) = \frac{K_i^-}{K_i^+ + K_i^-}, \qquad f(K_i^-) = \frac{K_i^+}{K_i^+ + K_i^-}, \tag{4}$$

and the overall utility function is

$$f(K_i) = \frac{K_i^+ + K_i^-}{1 + \frac{1-f(K_i^+)}{f(K_i^+)} + \frac{1-f(K_i^-)}{f(K_i^-)}}. \tag{5}$$

Alternatives are ranked in descending order of $f(K_i)$. Agreement among the ten experts was assessed with Kendall's coefficient of concordance (W), corrected for ties, and the robustness of the ranking was examined by repeating the MARCOS analysis ten times, each time omitting one expert (leave-one-expert-out).

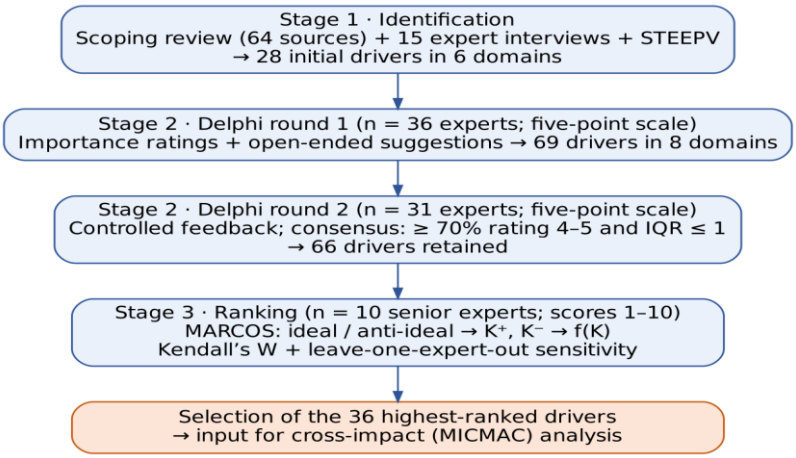


Fig. 1. Research design.

3. RESULTS

3.1. Stage 1: Initial drivers

The initial screening identified major global and Iranian trends and then the main drivers of ageing. These drivers were screened against the characteristics of Tehran, revised through the expert interviews and organized with the STEEPV model. The result was 28 initial drivers in six domains (Table 1).

3.2. Stage 2: Delphi rounds

Table 1 shows the first-round ratings (n = 36). Economic inefficiency (M = 4.26), change in traditional beliefs and values (4.16) and rising economic inequality (4.16) received the highest mean importance, followed by the spread of individualism (4.00), the pension-fund crisis (4.00) and health and medical technologies (3.94). Technology-related drivers such as transport and electric vehicles (2.61), new spiritualities (2.64), the digital economy (2.66) and artificial intelligence (2.66) received the lowest ratings.

Table 1. First Delphi round: initial drivers and their importance ratings (n = 36; five-point scale).

No.	Driver	Domain	*M*	*SD*	Range
1	Economic inefficiency (liquidity growth, inflation, recession, falling purchasing power, budget deficit, sanctions)	Economic	4.26	0.73	2–5
2	Change in traditional beliefs and values	Values	4.16	0.93	1–5
3	Rising economic inequality	Economic	4.16	0.86	2–5
4	Spread of individualism and personal values	Values	4.00	0.82	2–5
5	Pension-fund crisis	Economic	4.00	1.13	1–5
6	Development of health and medical technologies	Technological	3.94	1.03	1–5
7	Declining mortality and rising life expectancy	Ecological–demographic	3.90	0.91	1–5
8	Rising poverty and social inequality	Social	3.87	1.31	1–5
9	Declining fertility	Ecological–demographic	3.84	0.97	1–5
10	Rising migration (internal, international, environmental)	Ecological–demographic	3.74	0.89	1–5
11	Lifestyle change	Social	3.68	0.94	1–5
12	Political instability (discontent, social movements, demands for democracy)	Political	3.45	1.02	2–5

13	Declining social capital	Social	3.31	1.06	1–5
14	Growth of urbanization	Ecological–demographic	3.29	1.00	1–5
15	Rising divorce, later marriage and singlehood	Social	3.27	1.12	1–5
16	Environmental hazards (greenhouse gases, pollution, climate change, water scarcity)	Ecological–demographic	3.12	1.18	1–5
17	Water conflicts	Political	2.97	1.11	1–5
18	Labour shortage	Economic	2.95	1.12	1–5
19	Religious diversification and declining role of religion	Values	2.94	1.01	1–5
20	Development of the internet and ICT	Technological	2.87	1.04	1–5
21	Growing role of women in society	Social	2.83	1.06	1–5
22	Rising energy prices	Economic	2.73	1.18	1–5
23	War and geopolitical/international conflicts	Political	2.72	1.16	1–5
24	Smart grids and smartification	Technological	2.67	1.11	1–5
25	Development of artificial intelligence	Technological	2.66	1.19	1–5
26	Development of the digital economy	Economic	2.66	1.09	1–5
27	New spiritualities and meaning-seeking	Values	2.64	0.96	1–4
28	Development of transport and electric vehicles	Technological	2.61	1.11	1–5

The open-ended answers led to a substantial expansion and disaggregation of the list. Composite drivers were split into specific variables. For example, “economic inefficiency” was split into the economic situation of society, purchasing power, inflation and recession, and “rising migration” into immigration, emigration, internal and climate-related migration. Two new domains, health and institutional, were added. The second-round questionnaire thus comprised 69 drivers (Table 2).

Table 2. Drivers included in the second Delphi round, by domain.

Domain	Drivers
Social (12)	Poverty; social inequality; social capital; lifestyle; women’s role in society; divorce rate; mean age at marriage; singlehood; generation gap; quality of life; leisure patterns; familism
Health and mental health (6)	Mental illness; stress and anxiety; physical activity and mobility; nutrition culture; pandemics; physical (chronic) diseases
Technological (11)	Internet and ICT; online social networks; smartphone app services; health and medical technologies; health-monitoring technologies; smart grid and smartification; urban transport; electric vehicles; virtual (remote) services; smart robots; artificial intelligence
Economic (10)	Economic situation of society; purchasing power; inflation; economic recession; pension-fund status; economic inequality; digital and internet economy; online business; energy prices; employment and unemployment
Ecological–demographic (16)	Urbanization; informal settlements; migration rate; immigration from abroad; emigration; internal migration; climate and environmental migration; mortality rate and life expectancy; fertility rate; household size; environmental hazards; climate change; climate hazards; changes in precipitation patterns; water resources; air quality
Political (5)	Political stability; water conflicts; social protests; geopolitical and regional conflicts; parties and groups supporting older people
Values (4)	Individualism and personal values; social beliefs and values; religious beliefs; globalization and modern values
Institutional (5)	Youthful Population and Family Support Law; retirement laws; insurance laws; health-service laws; labour and employment laws

3.3. Stage 3: MARCOS ranking

The ideal solution, the highest score given by each expert, was AI = (10, 10, 10, 10, 9, 10, 9, 10, 10, 8). The anti-ideal solution, each expert’s lowest score, was AAI = (1, 3, 1, 4, 2, 3, 3, 2, 2, 1). After normalization by the ideal

values, S_{ai} = 1.000 and S_{aai} = 0.228. The resulting utility functions were $f(K^+)$ = 0.814 and $f(K^-)$ = 0.186. Table 3 reports the full ranking, and Figure 2 shows the 36 highest-ranked drivers.

The mortality rate ranked first (f(K) = 0.805), followed by lifestyle (0.794) and the fertility rate (0.792). These were followed by social inequality (0.777), economic inequality (0.771), urbanization, the migration rate and health and medical technologies (tied at 0.770), inflation (0.757) and purchasing power (0.755). The next ten drivers were pension-fund status, environmental hazards, singlehood, employment and unemployment, political stability, economic recession, mean age at marriage, quality of life, the economic situation of society and nutrition culture (ranks 11–20). The lowest-ranked drivers were changes in precipitation patterns (0.338), women's role in society (0.469), electric vehicles (0.504), smart robots (0.510) and poverty (0.516).

Table 3. MARCOS ranking of the 66 drivers of population ageing in Tehran (ten experts; scores 1–10).

Rank	Driver	Domain	*M* (*SD*)	S_i	f(K)
1*	Mortality rate	Ecological–demographic	8.00 (0.94)	0.839	0.805
2*	Lifestyle	Social	7.90 (1.20)	0.828	0.794
3*	Fertility rate	Ecological–demographic	7.90 (0.88)	0.825	0.792
4*	Social inequality	Social	7.80 (2.20)	0.809	0.777
5*	Economic inequality	Economic	7.80 (2.39)	0.803	0.771
6*	Urbanization	Ecological–demographic	7.70 (1.34)	0.803	0.770
6*	Migration rate	Ecological–demographic	7.70 (1.49)	0.803	0.770
6*	Health and medical technologies	Technological	7.70 (1.49)	0.803	0.770
9*	Inflation	Economic	7.70 (3.16)	0.789	0.757
10*	Purchasing power	Economic	7.60 (2.41)	0.787	0.755
11*	Pension-fund status	Economic	7.40 (2.67)	0.764	0.733
12*	Environmental hazards	Ecological–demographic	7.40 (2.17)	0.763	0.732
13*	Singlehood	Social	7.30 (2.31)	0.756	0.725
14*	Employment and unemployment	Economic	7.30 (2.67)	0.753	0.723
15*	Political stability	Political	7.30 (2.83)	0.751	0.721
16*	Economic recession	Economic	7.30 (2.91)	0.749	0.718
17*	Mean age at marriage	Social	7.20 (1.40)	0.748	0.718
18*	Quality of life	Social	7.20 (2.04)	0.746	0.716
19*	Economic situation of society	Economic	7.00 (1.56)	0.732	0.702
20*	Nutrition culture	Health	7.00 (2.58)	0.728	0.698
21*	Familism	Social	6.90 (1.20)	0.719	0.690
22*	Stress and anxiety	Health	6.90 (2.60)	0.715	0.686
23*	Individualism and personal values	Values	6.80 (1.32)	0.711	0.682
23*	Youthful Population and Family Support Law	Institutional	6.80 (1.55)	0.711	0.682
25*	Physical (chronic) diseases	Health	6.80 (2.66)	0.704	0.675
26*	Health-service laws	Institutional	6.80 (2.57)	0.703	0.675
27*	Air quality	Ecological–demographic	6.80 (2.94)	0.703	0.674
28*	Religious beliefs	Values	6.70 (1.57)	0.699	0.671
29*	Physical activity and mobility	Health	6.70 (1.83)	0.699	0.671
30*	Globalization and modern values	Values	6.70 (1.42)	0.698	0.670
31*	Emigration	Ecological–demographic	6.70 (1.83)	0.696	0.668
32*	Divorce rate	Social	6.60 (1.51)	0.692	0.664
33*	Insurance laws	Institutional	6.70 (2.31)	0.690	0.662
34*	Retirement laws	Institutional	6.70 (2.45)	0.689	0.661
35*	Social beliefs and values	Values	6.60 (1.51)	0.687	0.659
36*	Climate change	Ecological–demographic	6.70 (3.02)	0.686	0.658

37	Urban transport	Technological	6.60 (2.07)	0.681	0.653
38	Social capital	Social	6.50 (2.12)	0.675	0.647
39	Health-monitoring technologies	Technological	6.40 (2.12)	0.670	0.643
40	Internal migration	Ecological–demographic	6.40 (1.96)	0.667	0.640
41	Informal settlements	Ecological–demographic	6.40 (1.71)	0.667	0.640
42	Digital and internet economy	Economic	6.40 (2.63)	0.660	0.633
43	Online business	Economic	6.40 (2.37)	0.657	0.630
44	Internet and ICT	Technological	6.30 (2.45)	0.648	0.622
45	Climate and environmental migration	Ecological–demographic	6.20 (1.99)	0.645	0.619
46	Smart grid and smartification	Technological	6.30 (2.58)	0.645	0.619
47	Climate hazards	Ecological–demographic	6.20 (2.86)	0.636	0.610
48	Leisure patterns	Social	6.10 (2.08)	0.636	0.610
49	Water resources	Ecological–demographic	6.10 (2.96)	0.628	0.602
50	Energy prices	Economic	6.10 (2.88)	0.627	0.602
51	Online social networks	Technological	6.10 (2.08)	0.627	0.602
52	Labour and employment laws	Institutional	6.00 (2.54)	0.622	0.597
53	Smartphone app services	Technological	6.00 (2.00)	0.618	0.593
54	Artificial intelligence	Technological	5.80 (2.66)	0.594	0.570
55	Immigration from abroad	Ecological–demographic	5.70 (2.41)	0.594	0.570
56	Parties and groups supporting older people	Political	5.70 (2.16)	0.593	0.569
57	Mental illness	Health	5.70 (2.00)	0.592	0.568
58	Pandemics	Health	5.60 (3.10)	0.583	0.559
59	Water conflicts	Political	5.60 (3.03)	0.574	0.551
60	Geopolitical and regional conflicts	Political	5.50 (3.24)	0.558	0.535
61	Generation gap	Social	5.30 (2.41)	0.545	0.523
62	Poverty	Social	5.10 (1.45)	0.538	0.516
63	Smart robots	Technological	5.20 (2.49)	0.532	0.510
64	Electric vehicles	Technological	5.10 (1.91)	0.525	0.504
65	Women's role in society	Social	4.70 (1.89)	0.489	0.469
66	Changes in precipitation patterns	Ecological–demographic	3.40 (1.78)	0.352	0.338

Note. *M* (*SD*) = mean (standard deviation) of the ten expert scores; S_i = sum of the weighted normalized scores; f(K) = MARCOS utility function. * = among the 36 drivers selected for cross-impact analysis. Tied drivers share the same rank.

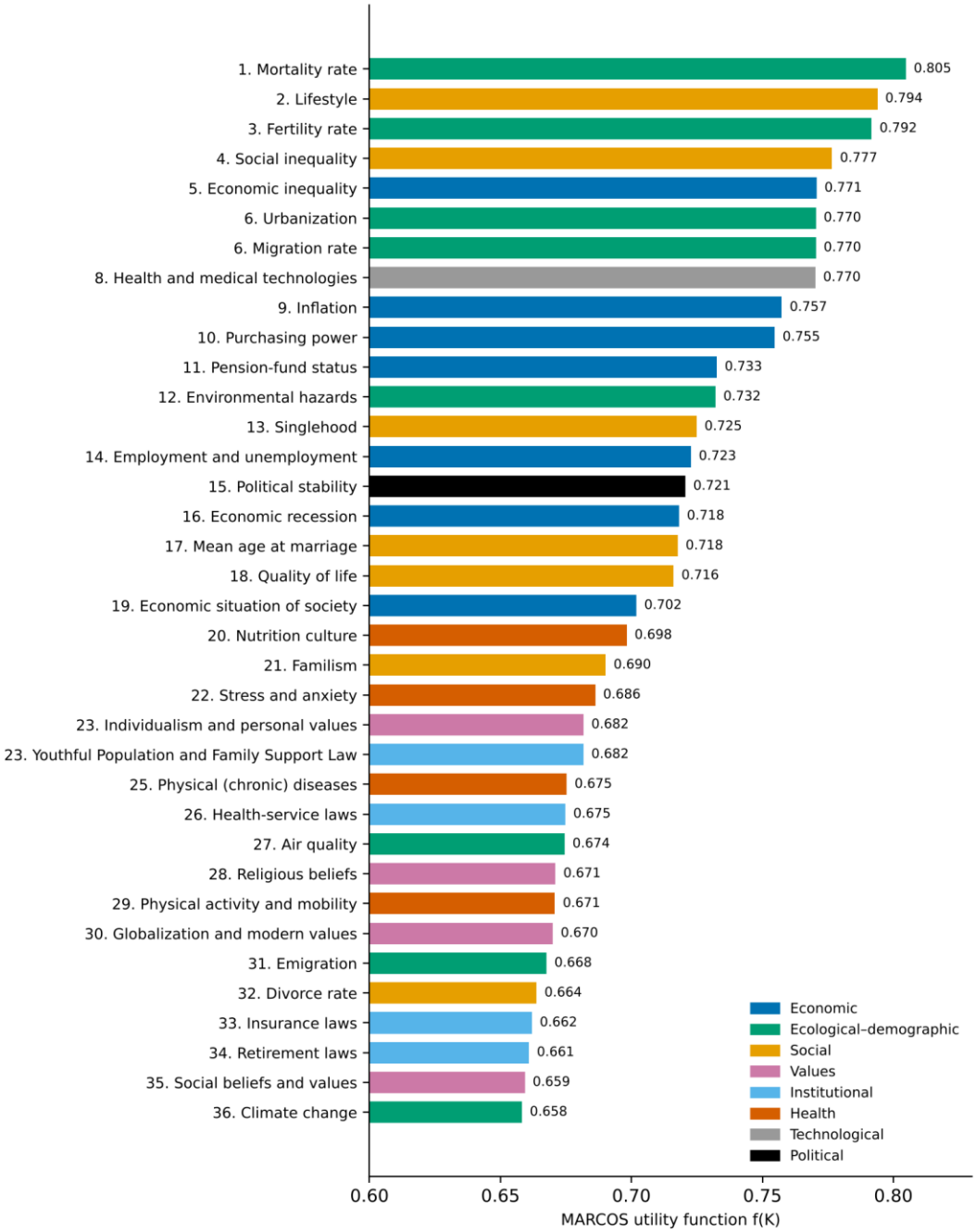


Fig. 2. The 36 highest-ranked drivers by MARCOS utility f(K), colored by domain. The horizontal axis starts at 0.60 to make the differences visible.

Domain-level pattern. Averaged by domain, economic drivers had the highest utility (mean $f(K) = 0.702$; 7 of 10 among the top 36). They were followed by values (0.670; 4 of 4), ecological–demographic drivers (0.659; 8 of 15), institutional drivers (0.655; 4 of 5), social drivers (0.654; 7 of 12) and health drivers (0.643; 4 of 6). Technological (0.608; 1 of 10) and political (0.594; 1 of 4) drivers ranked lowest. The only exceptions in these two domains were health and medical technologies (rank 8) and political stability (rank 15).

Expert agreement. Kendall's coefficient of concordance was $W = 0.218$ ($\chi^2(65) = 141.9$, $p < .001$). The experts' rankings were thus significantly concordant, but the strength of agreement was weak. Because the criteria are equally

weighted and of the benefit type, the MARCOS ranking is almost identical to a ranking by mean score (Spearman's $\rho = 0.998$). The result is therefore robust to the choice of aggregation method. In the leave-one-expert-out analysis, the rankings correlated with the full ranking at Spearman's $\rho = 0.93$–0.98, eight of the ten highest-ranked drivers remained in the top ten in every run, and 33 of the 36 selected drivers remained in the top 36 in at least nine of the ten runs, so the selection for the next stage does not depend on any single expert.

Selection for cross-impact analysis. In line with the study design, the 36 highest-ranked drivers ($f(K) \geq 0.658$, marked with * in Table 3) were selected for the next stage of the research, an analysis of their cross-impacts.

4. DISCUSSION

4.1. A multidimensional phenomenon

The main finding is that population ageing in Tehran is not merely a demographic outcome of people growing older. It arises from the complex, multilevel interaction of demographic, social, cultural, economic, technological, institutional and spatial variables. Fertility and mortality are at the top of the ranking, but they cannot by themselves explain the changing age structure of the city. Ageing in Tehran takes shape within family change, value change, economic inequality and insecurity, population movements, the capacity of the welfare and pension system, and the quality of urban and national governance. Its consequences are reflected in all these domains.

4.2. The demographic core

The **mortality rate** (rank 1) and the **fertility rate** (rank 3) are among the three highest-ranked drivers. This is consistent with demographic transition theory and with the conclusion that mortality, fertility and migration are the fundamental drivers of ageing [12]. A sustained decline in fertility reduces entries into the youngest age groups, and declining mortality increases the number and share of older people. Ageing in Tehran therefore results from a narrowing of the age pyramid at its base and its widening at the top. The high rank of these drivers also confirms that Tehran is at an advanced stage of the demographic transition [7, 9]. In such a context, ageing policy cannot be limited to short-term support for today's older people. It must take a life-course perspective that accounts for the long-term effects of policies on fertility, marriage, employment, housing, childcare and work–family balance. Successful ageing policy in Tehran is therefore inseparable from family and population policy. The relatively high ranks of **singlehood** (13), the **mean age at marriage** (17), the **Youthful Population and Family Support Law** (23) and the **divorce rate** (32) reinforce this argument. Later marriage, temporary or permanent singlehood, marital instability and shrinking households reduce the opportunity and desire to have children, and they push the age structure toward ageing. These trends may also intensify *solitary* ageing in Tehran, especially among women without spouses or family support networks, as Dehghan Banadaki [27] warns.

4.3. Economic security as a central axis

A central finding is the prominence of **economic** drivers, which form the highest-scoring domain. Economic inequality (5), inflation (9), purchasing power (10), pension-fund status (11), employment and unemployment (14), economic recession (16) and the economic situation of society (19) all rank among the top 20. This shows that ageing is closely tied to economic security and the capacity of social protection. Under high inflation and falling purchasing power, the real value of pensions declines while the cost of basic needs, medicines, treatment, care and housing rises. The financial instability of pension funds threatens the income security of today's older people and of future generations. This agrees with Zanjari et al. [8], who identify pension funds, welfare distribution and insurance coverage as key drivers of ageing in Iran. In Tehran, where living, housing, transport and health costs exceed those of most other Iranian cities, ineffective pension and insurance systems may increase older people's dependence on their families, reduce their autonomy and deepen old-age poverty. Employment and unemployment matter beyond the working-age population. They affect the timing of family formation and childbearing, savings for retirement, and children's capacity to support their parents. Employment policy and ageing policy should therefore be designed as one system. Its components include sustainable job creation, support for women's employment combined with work–family reconciliation, suitable job opportunities for capable older people, and pension reform.

4.4. Inequality and spatial differentiation

Social inequality (4) and **economic inequality** (5) rank immediately after the demographic core and lifestyle. Together with the high ranks of **urbanization** and the **migration rate** (both 6), this indicates that ageing in Tehran is closely tied to the uneven spatial development of the city. As the country's largest metropolis, Tehran concentrates services, jobs, medical facilities and communication networks. Migration affects ageing through several channels: the in-migration of young people, the out-migration of young people from the city or the country (emigration ranks 31), the movement of households from central to peripheral areas, and the concentration of older people in old neighborhoods with long-standing residents. Neighborhoods experiencing the loss of young residents, physical decay, poor access to services, weakening neighborly ties and declining household income may become concentrations of vulnerable older people. Ageing will therefore not be evenly distributed. Low-income older people, those living alone, older women, people with chronic diseases, residents of deteriorated urban fabrics and those without adequate insurance or pensions will face compounded vulnerability. The appropriate policy response is a shift from a single model of *ageing* to plural *ageings*: recognizing that the experience of old age differs by gender, class, place of residence, family situation, health and access to resources. Planning for ageing in Tehran must therefore go beyond the city level and be designed with regional, neighborhood and class differences in mind.

4.5. Lifestyle, family and values

Lifestyle ranked second overall. This shows that demographic change cannot be analyzed independently of cultural change and urban ways of living. In recent decades Tehran has experienced growing consumerism and individualism, changing leisure patterns, rising female employment, changing expectations of marriage, rising living costs and a transformation in definitions of individual and family success. These changes influence decisions about marriage, childbearing, care for older parents and older people's social participation. **Familism** (21) and **individualism and personal values** (23) both ranked in the upper half, which points to a structural tension. On the one hand, the family remains the main provider of emotional, care and economic support for older people. On the other, growing individualism, intergenerational independence and shrinking household care capacity limit informal support. Ageing policy should therefore avoid a simple dichotomy between family and state and move toward a model of *shared care*, in which families, the state, the municipality, the private sector, non-governmental organizations and local networks jointly provide for older people's welfare. All four value drivers were among the top 36: individualism (23), religious beliefs (28), globalization and modern values (30) and social beliefs and values (35). Values are therefore not peripheral. They shape attitudes toward childbearing, children's responsibility for their parents, acceptance of independent living in old age, social participation, consumption patterns and how people approach later life. Seen this way, ageing in Tehran is not only a statistical issue but also a cultural and intergenerational phenomenon.

4.6. Health and technology

Health and medical technologies ranked eighth. Advances in medical technology, early diagnosis, new treatments, telecare, electronic health records and monitoring tools reduce mortality and increase life expectancy, and so contribute directly to the growth of the older population. Health-related lifestyle drivers also ranked in the top 36: nutrition culture (20), stress and anxiety (22), chronic diseases (25) and physical activity (29). The importance of health technologies should not, however, be interpreted only as a longer lifespan. The more fundamental issue is turning longer lives into more years of healthy, independent and good-quality life. If technological development is not accompanied by equitable access, insurance coverage, health literacy, affordability, adapted services and support for family caregivers, it may widen the health gap between advantaged and disadvantaged older people [21].

Conversely, general-purpose technologies such as the internet, artificial intelligence, smart robots and smart grids ranked low. This should not be read as meaning that they are unimportant for the future of ageing. It indicates that, in the current context of Tehran, the experts judged their direct and immediate relationship with ageing to be weaker than that of demographic, family and economic factors. In the medium and long term, artificial intelligence, remote services, smart transport and care technologies could substantially redefine older people's independence, access to services and quality of care.

4.7. Institutions and governance

Four of the five institutional drivers were among the top 36: the Youthful Population and Family Support Law (23), health-service laws (26), insurance laws (33) and retirement laws (34). Their presence shows that ageing in Tehran is not only the product of autonomous and uncontrollable demographic trends. Policy design, institutional coordination, quality of implementation, sustainable financing and continuous evaluation of laws can moderate or intensify the course of ageing. The adoption of a law, however, does not guarantee its effectiveness. Population and ageing policies work only when they fit the economic and social realities of households, including housing costs, job insecurity, inflation, access to childcare, new ways of living and class differences. Otherwise, the gap between official goals and actual demographic behavior widens. The governance of ageing in Tehran should therefore coordinate the Tehran Municipality, the relevant ministries, the Social Security Organization, pension funds, the Ministry of Health, civil-society organizations, the private sector and local institutions, as Zanjari et al. [8] also emphasize.

4.8. Limitations and future research

The study has several limitations. First, the final ranking rests on the judgments of ten experts, and their agreement was weak ($W = 0.218$); although the leave-one-expert-out analysis showed that the overall ranking and the selection of the 36 drivers are stable, the order of drivers with similar scores should be interpreted with caution. Second, the final panel was smaller than the Delphi panel, and the rating scale differed between the Delphi rounds (five-point) and the ranking stage (1–10); the change was deliberate, but it means that the two stages cannot be compared directly. Third, equal weights were assigned to all experts; weighting experts by expertise could change the ranking. Fourth, the ranking captures perceived importance and impact, not causal relationships among drivers. Future research should carry out the planned cross-impact analysis of the 36 selected drivers, for example with the MICMAC method [37], to distinguish key drivers from dependent variables, and then identify critical uncertainties and develop alternative scenarios and robust policies for the future of ageing in Tehran.

5. CONCLUSION

The future of ageing in Tehran is shaped most strongly by the demographic drivers of mortality and fertility, but these do not operate in a vacuum. Lifestyle, social and economic inequality, urbanization and migration, health technologies, inflation and purchasing power, the sustainability of pension funds, patterns of marriage and family, values, and the quality of laws and governance form an interconnected system. This system will determine the alternative futures of ageing in the city. Ageing should therefore not be seen merely as a "problem" or a "social and economic burden". With appropriate infrastructure, it can become an opportunity to draw on the human capital, experience, knowledge and participatory capacity of older people. Realizing this opportunity requires a shift from reactive and sectoral policies toward anticipatory, cross-sectoral, equitable and evidence-based governance. The next stage of this research, the cross-impact analysis of the 36 selected drivers, will reveal the direct and indirect relationships among them. It will thereby identify the key drivers and critical uncertainties of the future of ageing in Tehran and lay the groundwork for alternative scenarios and robust policies.

Conflict of interest

The author declares no conflict of interest.

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Ethics

Participation of the experts was voluntary and anonymous, informed consent was obtained before the interviews and questionnaires, and no personal data were collected.

Data availability

The expert rating matrix is reported in summary form in Table 3 and is available from the author.

Use of AI tools

An AI-based tool was used to improve the language of the manuscript; the author reviewed the text and takes full responsibility for it.

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