Algeria's ageing population dynamics: 2020–2050 Spectrum Model Projections

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Abstract:

This study analyses the dynamics of population ageing in Algeria between 2020 and 2050, based on official demographic data and long-term quantitative projections. The DemProj model within the Spectrum software was used to generate three population scenarios: the baseline trajectory, a conservative scenario, and an accelerated ageing scenario. The results indicate that the proportion of individuals aged 60 and over will steadily increase, reaching approximately 18–20% of the total population by 2050, reflecting a structural demographic transition. This shift is expected to place increasing pressure on social protection systems, particularly pension funding and long-term healthcare services, while also increasing the burden of chronic diseases among older adults. A comparative perspective with other Maghreb countries reveals similar trends, albeit at varying rates. Based on these findings, adopting proactive, evidence-based policies is essential to ensure sustainable social and financial outcomes in the long term. Such policies include gradual reforms of the pension system, expansion of long-term healthcare and social services, and strategies to enhance the active social participation of older adults.

***Keywords**: population ageing, Algeria, demographic projections, Spectrum model, social policies, pension systems, healthcare*

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Introduction:

Over the past few decades, Algeria has undergone profound demographic transformations, most notably characterised by a rapid decline in fertility and a sustained increase in life expectancy at birth (Ouadah-Bedidi & Vallin, 2018). These dual dynamics have jointly accelerated population ageing and substantially reshaped the country's age structure to an unprecedented extent (Kouaouci, 2018). Although these developments are broadly consistent with global demographic trends, the Algerian experience remains distinctive due to its compressed pace of change and the specific historical, economic, and socio-cultural conditions that have shaped its trajectory.

In contrast to the gradual demographic transition observed in many developed countries over more than a century, Algeria has experienced this transformation over a relatively short period. This accelerated transition has significantly constrained the time available for institutional adaptation, thereby intensifying the complexity of socio-economic adjustment processes and policy responses (Notestein, 1945; Thompson, 1929; Flici & Planchet, 2020).

This demographic evolution can be understood through complementary theoretical frameworks, including demographic transition theory (Thompson, 1929; Notestein, 1945), which accounts for the transition from high to low fertility and mortality regimes, and the second demographic transition theory, which emphasises the role of value changes, including individualism and changing gender relations, in sustaining below-replacement fertility (Lesthaeghe, 2014). These perspectives are further enriched by epidemiological transition theory (Omran, 1971) and health transition approaches (Caldwell, 1986), which highlight shifts in mortality patterns and the growing influence of behavioural and socio-cultural determinants of health. Recent literature highlights the importance of contextualising these transitions within specific regional contexts, particularly in developing regions such as North Africa, where rapid socio-economic change coexists with persistent traditional structures (Dyson, 2013).

The accelerated population ageing in Algeria has significant implications for social protection systems, particularly those operating on a pay-as-you-go basis, which rely on a stable equilibrium between contributors and beneficiaries (Benhabib & Ziani, 2020). Current demographic trends are generating structural imbalances between revenues and expenditures, driven by declining dependency ratios and rising life expectancy, thereby exerting increasing financial pressure on pension funds (Flici, 2017; Mohammedi & Hamza Cherif, 2025). International institutions similarly emphasise the importance of integrating demographic dynamics into fiscal and social planning frameworks, given their macroeconomic implications, including heightened fiscal stress and potential effects on economic growth (UNFPA, 2018; World Bank, 2019). In Algeria, these challenges extend beyond financial sustainability to encompass institutional and governance

dimensions, thus requiring comprehensive structural reforms (Mohammedi & Cherif Ali, 2024).

In parallel, population ageing is exacerbated by the epidemiological transition, driven by the rising prevalence of chronic and non-communicable diseases among older populations (Flici & Chinoune, 2022), as well as the weakening of traditional family-based care systems due to urbanisation and changing household structures (Hussein & Ismail, 2016). Gender disparities further intensify these challenges, as older women are more exposed to poverty, illness, and care deficits (Saadi, 2020). These overlapping demographic, health, and social pressures necessitate integrated, multi-sectoral policy responses (Mehdi & Belkacem, 2024).

Existing studies confirm Algeria's entry into an advanced stage of demographic ageing and anticipate increasing pressure on pension systems around 2040 (Hammouda & Souag, 2018). Research has also examined healthcare system readiness (Salhi et al., 2018), the drivers of fertility decline such as education and urbanisation (Ouadah-Bedidi & Vallin, 2018), and broader socio-economic implications including employment challenges and care needs (Badji, 2019). Overall, the literature underscores the urgent need for comprehensive policy strategies to manage the consequences of demographic change.

Against this background, this study employs the DemProj model within the Spectrum software to project the evolution of Algeria's elderly population from 2020 to 2050 and assess its demographic and financial impacts. The central research question is: what impact population ageing in Algeria between 2020 and 2050 will have on the demographic and financial equilibrium of social protection systems, and what scenarios might emerge under different fertility and mortality assumptions? The study adopts a multi-scenario projection approach to provide evidence-based insights to inform long-term policy planning in the context of rapid demographic change.

METHODOLOGY

Research design and approach

This study adopts a quantitative approach for demographic projections using the DemProj model, integrated within the Spectrum policy modelling system developed by Avenir Health with support from the United States Agency for International Development (Stover et al., 2019). DemProj is widely recognised as a standard tool for population projection and is used by governments, international organisations, and researchers worldwide (United Nations, 2019).

The model applies the cohort-component method, which projects population cohorts over time by incorporating age-specific fertility, mortality, and migration rates. This method follows United Nations guidelines for population

projections, ensuring international comparability (UN DESA, 2018). It enables the generation of detailed demographic scenarios under varying fertility and mortality assumptions, thereby supporting evidence-based policy analysis and planning.

Spectrum software was selected due to its reliability across different contexts, user-friendly interface, and capacity to conduct scenario-based analysis. Its integration with modules covering health, economic, and social protection dimensions further enhance its usefulness for comprehensive policy evaluation (Stover, 2017).

The cohort-component approach is particularly advantageous as it captures population momentum and reflects how past demographic structures influence future dynamics. Compared to simpler extrapolation methods, it offers greater accuracy and transparency while remaining more practical than complex microsimulation models (Booth & Tickle, 2008).

Data sources and quality assessment

The primary demographic data were sourced from the Algerian National Office of Statistics (ONS). The dataset underwent rigorous quality assessment, aligning with established international standards.

Model specification and parameters

The 2020 population baseline was constructed using mid-year population estimates provided by the ONS, adjusted to account for under-enumeration identified through post-census surveys (ONS, 2019). Age-specific fertility rates were derived from birth registration data and corrected for underreporting using the Brass P/F ratio method (Brass, 1964). A total fertility rate (TFR) of 2.9 children per woman in 2020 was used as the starting point, with an age pattern adapted from the modified Coale–Trussell model that is consistent with Algerian data (Coale & Trussell, 1974). Mortality parameters utilised life table models for the South Asia region, selected based on goodness-of-fit tests against observed age-specific mortality rates in Algeria. Life expectancy at birth in 2020 was estimated to be 78.1 years for females and 74.5 years for males. This was calculated using ONS estimates, which were validated through multiple indirect estimation techniques (Hill, 2013). The projection model excluded migration effects under the assumption of zero net migration, justified by the limited documented international migration flows to Algeria and their negligible impact on the population age structure.

Projection scenarios

Three demographic projection scenarios were developed to explore potential future population trajectories. These scenarios were constructed in accordance with established international best practices, drawing on expert

judgement, the extrapolation of existing trends, and consideration of relevant policy contexts (Lutz et al., 2008). The report encompasses a broad spectrum of possible futures, ranging from a rapid modernisation scenario associated with a substantial decline in fertility to a cultural continuity scenario characterised by relatively high fertility levels.

The assumptions underlying each scenario were rigorously reviewed and validated through consultations with a wide range of stakeholders, including demographers, policymakers, and civil society representatives (KC & Lutz, 2017). This approach is founded on the recognition of the inherent uncertainty surrounding future demographic shifts, providing evidence-based estimates to support informed decision-making and strategic planning. Rather than presenting a single forecast, the scenario framework illustrates a spectrum of possible demographic outcomes under different development pathways and policy choices, while balancing continuity and potential structural changes resulting from socio-economic and political transformations

Low fertility scenario (H1)

This scenario is based on the assumption that accelerated modernisation will drive a rapid decline in fertility, supported by expanded educational opportunities for women, increased female labour force participation, and delayed marriage patterns (Bongaarts, 2003). The total fertility rate (TFR) is projected to decrease from 2.9 in 2020 to 1.63 by 2050, approaching fertility levels observed in Tunisia (Vallin & Ouadah-Bedidi, 2001). The continuation of this demographic transition depends on the effective implementation of family planning policies, the ongoing process of urbanisation, and socio-cultural shifts favouring smaller family sizes.

Life expectancy is projected to improve moderately, reaching 79.0 years for women and 76.0 years for men by 2050. However, these gains may be constrained by limitations within the healthcare system and the persistent presence of significant health inequalities (Boumezoued, 2016). This scenario assumes an optimistic decline in fertility within a context of rapid social transformation and effective policy implementation. This trajectory resembles the demographic transitions experienced in several East Asian countries.

Table 1. Low Fertility Scenario (H1) Parameters

Indicator	2020	2025	2030	2035	2040	2045	2050
TFR	2.90	2.69	2.48	2.27	2.05	1.84	1.63
E0 Female	78.1	78.1	78.2	78.4	78.6	78.8	79.0
E0 Male	74.5	74.7	75.0	75.2	75.5	75.7	76.0

Source: Spectrum Model Projections based on ONS data

Medium Fertility Scenario (H2)

This scenario represents the most plausible demographic trajectory based on current trends and existing policy commitments. It assumes a moderate decline in the total fertility rate (TFR), from 2.9 children per woman in 2020 to 2.13 by 2050, approaching replacement-level fertility. This outcome reflects a balance between modernisation processes and the persistence of cultural norms, within a context of gradual social change and the partial success of family planning programmes.

Improvements in life expectancy to be driven by increased healthcare investment and progress in the epidemiological transition, reaching 82.0 years for females and 79.0 years for males by 2050 (Salomon et al., 2012). These assumptions are consistent with both national development strategies and international development goals, while acknowledging implementation constraints (Millennium Development Goals Report, Algeria, 2015). This scenario serves as the primary reference framework for policy planning and represents the most probable outcome in the absence of significant structural or policy disruptions.

Table 2. Medium Fertility Scenario (H2) Parameters

Indicator	2020	2025	2030	2035	2040	2045	2050
TFR	2.90	2.77	2.64	2.52	2.39	2.26	2.13
E0 Female	78.1	78.5	79.2	79.9	80.6	81.3	82.0
E0 Male	74.5	75.2	75.9	76.7	77.4	78.2	79.0

Source: Spectrum Model Projections based on ONS data

High Fertility Scenario (H3)

This scenario assumes a modest decline in fertility due to the persistence of traditional values, political resistance, and limitations in policy implementation. The total fertility rate is projected to decrease slightly from 2.9 in 2020 to 2.63 by 2050, remaining above the replacement level throughout the projection period (Morgan, 2003). This pattern may reflect cultural resistance to modernisation, economic constraints, or the adoption of pronatalist policies in response to population ageing concerns (McDonald, 2006).

Despite this, life expectancy is projected to increase significantly, reaching 85.0 years for females and 82.0 years for males, driven by continued medical and technological progress (Oeppen & Vaupel, 2002). This scenario therefore implies continued population growth alongside increasing ageing pressures. It also acknowledges the possibility of fertility stagnation or reversal, consistent with patterns observed in some Middle Eastern countries following initial fertility declines.

Table 3. High Fertility Scenario (H3) Parameters

Indicator	2020	2025	2030	2035	2040	2045	2050
TFR	2.90	2.85	2.81	2.77	2.72	2.67	2.63
E0 Female	78.1	78.9	80.0	81.2	82.4	83.6	85.0
E0 Male	74.5	75.6	76.8	78.0	79.3	80.6	82.0

Source: Spectrum Model Projections based on ONS data

RESULTS

Total population growth trajectories

The projection results indicate population growth in Algeria across all scenarios, although with varying intensities. Under the low fertility scenario (H1), the population is projected to increase from 44.24 million in 2020 to 59.16 million in 2050 (+33.7%). Under the medium scenario (H2), the population is projected to reach 63.17 million (+42.8%), while under the high fertility scenario (H3), the population is projected to reach 67.15 million (+51.8%) by 2050. As stated in the 2023 United Nations report, these differences reflect the cumulative impact of small variations in fertility rates, resulting in substantial long-term demographic divergence.

The results also indicate a general deceleration in population growth across all scenarios, with annual growth rates declining from 1.5% to a range between 0.4% and 0.8% during 2045–2050 (World Bank, 2024). This slowdown is primarily driven by the lagged effects of fertility decline and the gradual entry of smaller birth cohorts into reproductive ages (Tabutin & Schoumaker, 2023). Despite declining fertility rates, the country's youthful age structure ensures sustained growth. Furthermore, the gap between the two scenarios increases over time, reaching approximately 8 million people by 2050. This emphasises the long-term sensitivity of population size to differences in fertility rates.

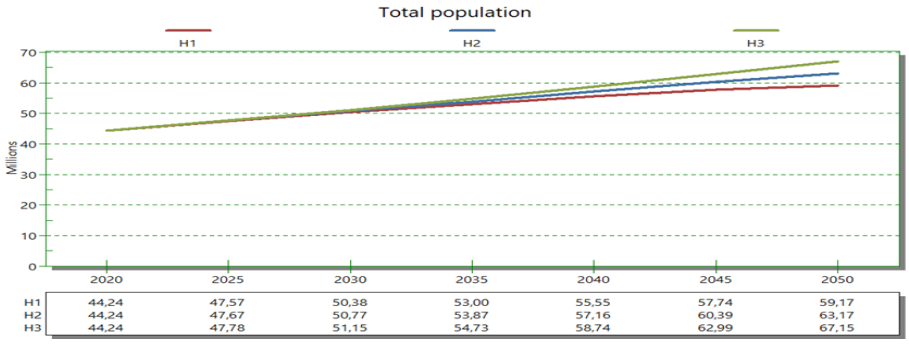


Figure 1. Population of Algeria - Outlook for 2050 (All Scenarios)

Source: Spectrum Program Projections

Table 4. Total Population Projections Under Three Scenarios (millions)

Year	Low (H1)	Medium (H2)	High (H3)
2020	44.24	44.24	44.24
2025	47.57	47.65	47.78
2030	50.38	50.63	51.15
2035	53.00	53.51	54.73
2040	55.55	56.39	58.74
2045	57.74	59.08	62.99
2050	59.16	63.17	67.15

Source: Author's calculations using Spectrum Model

Age Structure Transformations

An analysis of Algeria's age structure reveals profound demographic shifts across all projection scenarios, particularly regarding the declining share of children aged 0–14 years. This share decreases markedly under the low-fertility scenario (H1), from 30.7% in 2020 to 19.4% in 2050, while the high-fertility scenario (H3) shows a more gradual decline to 25.8% (Hammouda & Kamel, 2024).

The working-age population (15–64 years) is projected to increase initially in all scenarios, reaching approximately 66–67% between 2035 and 2040, before entering a gradual decline due to population ageing (Benbitour, 2022). This temporary expansion could offer a demographic window of opportunity for accelerated economic growth if supported by appropriate policies in human capital development, employment creation, and productivity enhancement (Dramani, 2024). However, the anticipated closure of this window around 2040 emphasises the need for urgent structural reforms and productivity-oriented investments (Ghanem & Boughzala, 2023).

Algeria's age-structure transition is occurring at a faster pace than in many advanced economies, thereby compressing the adjustment period and intensifying socio-economic and policy challenges (Canning et al., 2015). These shifts have significant implications for institutions designed for younger populations, necessitating reforms in education, healthcare, and social protection systems.

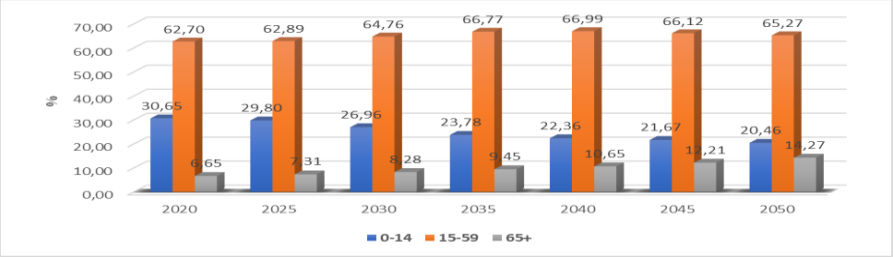


Figure 2. Comparative Age Structure Evolution (2020, 2035, 2050)

Source: Spectrum Program Projections

The transformations observed in Algeria's age structure largely reflect the general trajectories of the demographic transition, while also exhibiting features specific to the national and local socio-economic context. The prolonged youth bulge that characterised Algeria's population structure for several decades has gradually begun to recede, giving way to a more balanced age distribution and paving the way for population ageing in the coming decades (Fuller & Hoch, 2014). This generates a complex combination of opportunities and challenges. Initially, large cohorts born during periods of high fertility expand the working-age population, potentially fostering economic growth. Subsequently, however, they become a source of increasing demographic and fiscal pressure as they transition into older age groups.

The pace of these transformations varies markedly across the adopted scenarios. The low-fertility scenario results in the most rapid and profound restructuring of the age composition, whereas the high-fertility scenario preserves a relatively younger population structure throughout the demographic projection horizon.

Indicators of Population Ageing

The ageing indicators confirm that Algeria is undergoing a rapid demographic transition towards an ageing society. The proportion of individuals aged 60 and over is projected to increase from 9.76% in 2020 to around 20% by 2050 across all scenarios, with slight variation between the low, medium, and high fertility scenarios (Chikhi & Merad, 2021).

The absolute number of older persons shows a more pronounced rise, increasing from 4.32 million in 2020 to between 11.86 million (H1), 12.41 million (H2), and 12.97 million (H3) in 2050 (Benabdallah, 2017). Similarly, the old-age dependency ratio rises significantly from 9.1 in 2020 to between 20.9 and 22.8 in 2050, reflecting growing pressure on the working-age population (Aissaoui & Benhabib, 2024).

The ageing index has also shown a sharp increase, rising from 31.8 in 2020 to over 100 in the low-fertility scenario, indicating a potential reversal in the age structure where older populations outnumber children (Menasria & Tabet-Aoul, 2023). It is evident that population ageing in Algeria is inevitable, as demonstrated by these indicators. This phenomenon is driven primarily by declining fertility rates and supported by improvements in survival and life expectancy.

Figure 3 illustrates the long-term trend of population ageing in Algeria. To gain a deeper understanding of this issue, it is important to examine the absolute numerical growth of the elderly population. In this context, Table 5 provides

estimates of the expected increase in the number of individuals aged 60 and over across various demographic scenarios.

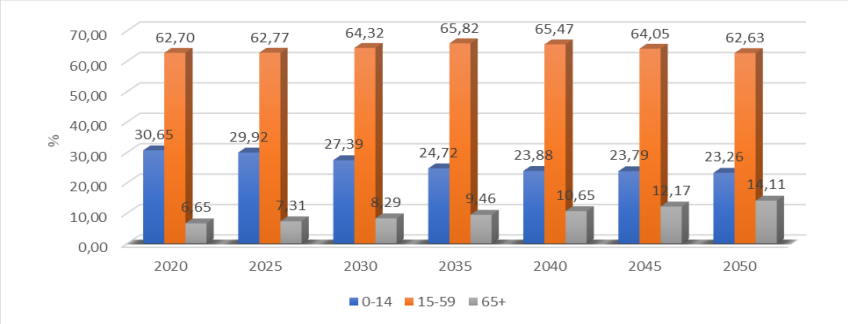


Figure 3. Multiple Aging Indicators Dashboard (2020-2050)

Source: Spectrum Program Projections

This table offers a more detailed quantitative interpretation of the demographic transition previously presented, providing a clearer understanding of the scale of population ageing.

Table 5. Population Aged 60+ Under Three Scenarios

Year	Pop 60+ H1 (millions)	% H1	Pop 60+ H2 (millions)	% H2	Pop 60+ H3 (millions)	% H3
2020	4.32	9.76	4.32	9.76	4.32	9.76
2025	5.39	10.78	5.41	10.78	5.47	10.78
2030	6.81	12.19	6.24	12.19	6.73	12.18
2035	7.36	13.69	7.84	13.67	7.52	13.65
2040	8.93	15.54	8.29	15.48	9.31	15.42
2045	10.27	17.87	10.90	17.69	11.58	17.53
2050	11.86	20.00	12.41	19.64	12.97	19.32

Source: Author's calculations using Spectrum Model

The data presented in Table 5 highlight a substantial and significant increase in the elderly population in all the demographic projection scenarios considered. These findings can be contextualised more broadly.

This comparative approach is particularly significant as it allows us to assess whether Algeria's demographic transition trajectory aligns with broader regional trends or if it exhibits unique characteristics compared to neighbouring countries such as Morocco and Tunisia.

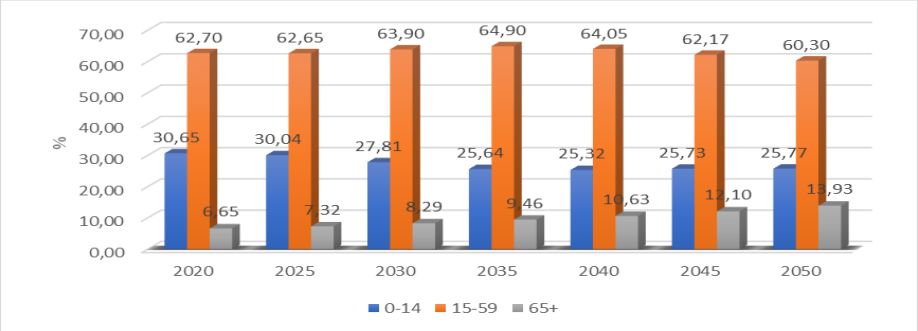


Figure 04: Age Group Proportions According to the High Hypothesis (2020-2050)

Source: Spectrum Program Projections

Algeria's population is ageing at a faster rate than the global average for developing countries, reflecting a compressed and accelerated demographic transition. The proportion of elderly individuals is projected to double from 10% to 20% within approximately 25 years, compared to 40–80 years in many developed countries. This rapid transition creates significant challenges for institutional adaptability and the effectiveness of policy responses (Sanderson & Scherbov, 2019).

Population ageing is also increasingly feminised, as women constitute a growing share of older age groups due to higher life expectancy. By 2050, women are expected to represent around 55% of individuals aged 60 and over, and approximately 60% of those aged 80 and above. Although not explicitly modelled, regional disparities are also likely, with rural areas expected to age more rapidly due to youth out-migration towards urban centres, leading to spatially uneven ageing patterns.

Discussion

Implications for social protection systems

The projected increase in Algeria's older population poses significant challenges for social protection systems originally designed under more favourable demographic conditions (Benabdallah, 2017). The pay-as-you-go pension system, which relies on high worker-to-retiree ratios, is expected to face increasing financial pressure as dependency ratios deteriorate (Chikhi & Merad, 2021). Ensuring long-term sustainability therefore requires both parametric and structural reforms (Aissaoui & Benhabib, 2024). Parametric reforms may include a gradual increase in the retirement age from 60 to 65 by 2040, with flexibility for physically demanding occupations. Structural reform options involve transitioning towards a three-pillar system combining public pensions, mandatory individual accounts, and

voluntary savings, which would improve financial sustainability while maintaining benefit adequacy (World Bank, 2024). International experiences, such as those of Tunisia and Morocco, provide useful reference points but also highlight implementation challenges (Sajoux & Chahoua, 2022). However, pension reform is constrained by political economy considerations, as current and near-retirees may resist changes perceived as reducing benefits (Holzmann & Hinz, 2005). Despite these challenges, demographic pressures make reform unavoidable, as delays increase both future adjustment costs and intergenerational inequities.

Requirements for adapting healthcare systems

Healthcare systems must transition from an acute-care orientation to models that are equipped to address the challenges posed by chronic diseases and the long-term care needs associated with ageing populations (Boukhemis & Zeghbib, 2023). The epidemiological transition towards non-communicable diseases necessitates restructuring service delivery, strengthening geriatric training, and developing integrated care pathways (Flici & Chinoune, 2022). According to the World Health Organization (2023), priority investments should be directed towards primary healthcare, home-based services, and specialised geriatric facilities. The anticipated increase in dementia prevalence (estimated at 8–10% among individuals aged 65 and over) highlights the need for dedicated memory care services and caregiver support systems (Mehdi & Belkacem, 2024). It is vital to implement policies that are sensitive to gender, given that women play dual caregiving roles and experience higher life expectancy alongside greater morbidity (Menasria & Tabet-Aoul, 2023). The implementation of digital health technologies, including telemedicine, has been shown to enhance access and efficiency (Sibai et al., 2024). Furthermore, strategic planning tools have been identified as a means to strengthen institutional capacity for effective management of demographic change (Silva et al., 2025).

Economic and labour market considerations

The impact of population ageing on the macroeconomy is substantial, affecting growth, productivity, and competitiveness (Lee & Mason, 2022). A decline in the working-age population after 2040 could limit economic growth unless offset by productivity gains (Benbitour, 2022). To achieve these objectives, policy responses should prioritise human capital development, technological innovation, and productivity enhancement (Dramani, 2024). Increasing female labour force participation offers a key opportunity to mitigate labour shortages and promote gender equality (Hammouda & Kamel, 2024). Active ageing strategies, including flexible retirement options, lifelong learning opportunities, and age-friendly work environments, have been shown to contribute to extending working lives (Ghanem & Boughzala, 2023). Migration policy adjustments may be considered to address sectoral skill shortages; however, this issue remains politically sensitive (Zaidi & Harper, 2023). Furthermore, the emerging "silver economy" presents new

opportunities for growth, employment, and entrepreneurship through increased demand for age-related goods and services.

CONCLUSION

The demographic projections confirm Algeria's irreversible transition towards an ageing society, with the elderly population expected to double by 2050 across all scenarios. The compressed timeframe of this transition, occurring within three decades, generates significant policy challenges that require urgent and comprehensive responses (Boudarbat, 2019). The convergence of ageing indicators across scenarios highlights the inevitability of this trend, driven mainly by past fertility declines and continued improvements in life expectancy (Tabutin & Schoumaker, 2023). This narrow time window before rising dependency ratios intensifies highlights the need to maximise the demographic dividend while preparing for increased ageing-related expenditures (Benbitour, 2022).

The implications of these reforms extend beyond technical pension changes, encompassing broader transformations in intergenerational relations, economic structures, and social institutions (Lee & Mason, 2022). In order to formulate effective responses, it is essential to consider three key factors: political commitment, administrative capacity, and social consensus around intergenerational equity (World Bank, 2024). While regional experiences, such as those of Tunisia and Morocco, demonstrate both reform potential and implementation challenges, they also highlight the importance of context-specific strategies (Sajoux & Chahoua, 2022). Concurrently, population ageing presents opportunities, including greater utilisation of experienced labour, intergenerational knowledge transfer, and the development of the "silver economy" (Harper, 2023).

Future research should aim to address methodological limitations by incorporating stochastic projections, sub-national analysis, and healthy life expectancy indicators (Flici & Chinoune, 2022). Further longitudinal and comparative studies across MENA countries, as well as integrated demographic-economic modelling, would enhance understanding of ageing dynamics and their broader implications (Sibai et al., 2024; Dramani, 2024). Algeria's capacity to address population ageing effectively will be pivotal in determining its long-term development prospects. Evidence-based policy formulation is therefore essential.

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