Population Aging Tendencies in Islamic Countries Between 1950-2020: A Geographical Assessment

Hasan Hekmatnia[1], Mir Najaf Mousavi[2*], Kamran Jafarpour Ghalehteimouri[3], Ali Shamsoddini[4], Ali Bagheri Kashkouli[5], and Alireza Jamshidi[2]

[1] Department of Geography, University of Payam-e-Noor
[2] Department of Geography, Urmia University
[3] Disaster Preparedness & Prevention Centre (DPPC), The Malaysia-Japan International Institute of Technology (MJIIT)
[4] Department of Geography, Islamic Azad University, Marvdasht
[5] Department of Urban Planning, Iran Ministry of Roads & Urban Development
* Mir Najaf Mousavi, corresponding author. Email: m.mousavi@urmia.ac.ir
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Abstract

In the contemporary world, population aging and the factors affecting population aging are among the topics of interest of policymakers and planners in any country. Knowledge of this situation will help to regulate and even advance substantial population programs. This study aimed to investigate the trend of the demographic aging index in Islamic countries based on the analysis of survival history. The research method was descriptive-analytical, a type of applied research, and methods of collecting documentary information. The United Nations Population Database (1950 to 2020) was used for data collection. In the present study, 57 countries were grouped and studied in ten geographical areas. The statistical method used is survival history analysis. Data were analyzed using Stata statistical methods and non-parametric methods of estimating the survival function of the Kaplan-Meier method, Nelson-Aalen estimator, and the semi-parametric model of Cox's proportional risk. Based on the results, it was found that the fertility index has a downward trend in the ten regions of the Islamic world. In contrast, the indicators of old age (with low acceleration) and life expectancy have an increasing trend. The probability of aging has a negative relationship with the total fertility rate and a positive correlation with life expectancy. Estimates of the survival function and cumulative risk for nine of the ten geographical regions (barring the Southern European region) of the Islamic world in 2020 indicate that the probability of aging in these regions is not significantly different. Likewise, the rate of entry into the aging phase does not differ significantly between the same geographical areas. Nevertheless, with the current trend of life expectancy and the reduction of fertility, many of these countries are likely to face the aging crisis in the coming years.

Keywords

Aging; fertility; Islamic world countries; life expectancy; survival history analysis

Introduction

Over the centuries, the world is constantly aging (Lutz et al., 2008). Population aging from the middle of the twentieth century has become one of the more serious problems in developed countries (Darabi & Torabi, 2017). Many countries of the world are dealing with the challenge of population aging (Gietel-Basten et al., 2020), fast aging, and its consequences (Yuan & Gao, 2020), notably, in the developed world have been often argued to constitute a serious challenge for economic growth (Crespo Cuaresma et al., 2014). On a global scale, population aging is unprecedented, pervasive, profound, and enduring (O'Brien, 2016). Population aging is known as an emerging social challenge in many parts of the world. Some clear evidence of population aging has been observed. For example, the share of the world's population over 60 has increased from 5.1% in 1950 to 9.3% in 2020 and is projected to be 15.9% by 2050 (United Nations, 2019b). World life expectancy has risen from 47 years in 1950 to 72.3 years in 2020 and is expected to increase to 76.8 years by 2050 (United Nations, 2020). Approximately two billion people will be 60 and older, and 400 million will be 80 or older by 2050 (United Nations, 2013). This increase in aging has led to high costs, especially in the healthcare sector. Social support, lack of jobs and social roles, living expenses, or especially staggering health and medical expenses are some of the cases that show the need to give serious consideration to this stratum of society (Mirzaie & Darabi, 2017).

Considering the positive point of view, population aging is a human success story, a reason to celebrate the triumph of public health, medical advancements, and economic and social development over diseases, injuries, and early deaths that have limited human life spans throughout history (United Nations, 2019a). Nonetheless, population aging is not limited to large numbers of people in the older age group. Reducing the proportion of younger people in a population will lead to an aging population (Ofori-Asenso et al., 2018). Fortunately, the aging problem has drawn considerable attention from international communities (Li et al., 2019). Every industrialized country, such as Germany and Japan, has serious labor force problems (Bloom et al., 2019; Tawatsupa et al., 2015).

Population aging has been a prominent feature worldwide, increasing life expectancy and declining fertility rates, which gradually began in Europe in the first half of the nineteenth century and increased in the later years. In developed and developing countries, life expectancy has been 60 years and above and nearly 70 years (Bhagat & Unisa, 2006; Owusu et al., 2018). Indeed, a continuous increase in life expectancy has generated a high possibility of an aging population (Véron, 2020).

The biological aspect defines aging as a 'process of the progressive overall deterioration of different parts of the body that starts after a particular age.' The aging process is a biological reality that has its dynamic, largely beyond human control. In social and demographic aspects, population aging refers to the process of increase in the proportion of the elderly (older) persons in the total population (Siddhisena, 2016). There are some serious efforts for the last three decades regarding the importance of biological aging more than chronological aging to improve older adults' abilities and capabilities (Jylhävä et al., 2017). As individuals age, physical health usually decreases, and functional limitations are observed (Østbye et al., 2010). Disability and long-term health care among older people result in increased costs of social services and medical care (Rahman et al., 2018). For example, Alzheimer's disease is one of the most common age-related diseases for people between 65-85 years old (Mount & Downton, 2006).

Furthermore, population aging and changes in age structure require comprehensive policies and development planning processes (Mai et al., 2013); desired policies are related to social benefits and insurance, and health care (Heffner et al., 2019). Population aging refers to the rising of age in a country or region. Also, the population aging in countries with rapid growth amongst the elderly segment is one of the significant issues in recent years. Population aging is a process that the number of older people significantly increases compared to the total population (United Nations, 2020).

Martin (2011) defines population aging as the growth in the part of a population that is beyond a specific age. Understanding of the population aging process is informed by the stylized facts of the demographic shift and the epidemiologic shift. Compared to the native-born population, the influence of migration on the population aging process in a delivering nation is more distinct, depending on the age distribution of immigrants and subsequent fertility. Median ages and population pyramids provide a more comprehensive picture of the population aging process. Shifts in fertility and death are the driving forces behind demographic changes. The leading causes behind population aging include demographic events such as variations in fertility and death, and population aging has significant demographic and socioeconomic implications (Martin, 2011).

Only a few decades ago, the primary concern regarding world demography was its rapid growth and increasing pressure on the ecosystem and food security (e.g., soil erosion, water contamination, arable land, and air pollution) (Leisinger et al., 2002; Kamran et al., 2020). While population growth will continue sharply in some developing countries, the population-aging phenomenon will profoundly impact various dimensions of society, and this aging trend will be intensified in the coming decades (Kudo et al., 2015). Yet, the future is not promising for the countries with population growth, population aging, and poor infrastructures (Faisal & Parveen, 2004). Many interacting mechanisms affect the population, and aging change is probably one of the most critical components of human scientific advancements. Understanding these changes in the demographic structure of a country requires the appropriateness of methods and approaches.

The Kaplan-Meier method and Nelson-Aalen estimator are recognized as effective mix methods for demographic studies (Dabrowska et al., 1989; Rossa, 2008). The Kaplan-Meier method and Nelson-Aalen estimator generally use for survival functions. However, the Kaplan-Meier method provides an understandable percentile and for decreasing failure, rates while the Nelson-Aalen estimator provides better results for increasing failure rates (Colosimo et al., 2002). Population structure and tendency in different countries move differently, aging as the most critical variable. When the sampling groups are from different geographical locations, it requires understanding whether survival varies and tests and sees the difference between them (Hu & Huffer, 2020). These hybrid methods can mix with the other methods (Santos-Fernandez, 2019) and increase the accuracy of results.

The average percentage of people over the age of 65 (older countries) in 57 countries of the Islamic world in 2005 was 8.1%, which increased to 9.5% in 2020. This slight increase is because the demographic transition in the countries of the Islamic world started in 2005, and these countries still have a young population structure. However, by 2050, most countries in the Islamic world are expected to go through the demographic transition and enter the threshold of aging. In this regard, since indicators such as total fertility and life expectancy are effective in connection with the possibility of population aging occurs in Islamic countries, this article has been intended to examine the trend of population aging and its effects.

Firstly, this paper follows the methodology to fulfill the main objectives of this study. Secondly, showing the current tendencies and changes in different Islamic countries. Thirdly, the application of the Kaplan-Meier method and Nelson-Aalen estimator for selected countries and discussion based on the findings.

Materials and Method

Study design

The descriptive-analytical method was identified as suitable to explain the historical data changes and tendencies. The research data were extracted from the United Nations Population Database (United Nations, 2019b) and were analyzed using Stata statistical methods. In this paper, raw data related to three indicators of life expectancy, total fertility, and the percentage of people aged 65 and over in the population of 57 countries of the Islamic world were collected, coded, and used separately from ten geographical regions during the years 1950 to 2020. In the present study, aging is calculated from the division of the population over 65 years to the population of 0-15 multiplied by 100 (Noroozian, 2012). Also, the aging index was estimated by the ratio of people aged 65 and over to the total population (Shryock & Siegel, 1976). The Kaplan-Meier method and Nelson-Aalen estimator are very well-matched methods to show survival function. The Kaplan-Meier method was also used to analyze the trend of population aging in the Islamic world from 1950 to 2020. The Cox regression estimation was exerted to predict the independent and dependent variables (Byberg et al., 2009; ElHafeez et al., 2012). The Nelson-Aalen estimator method was applied to estimate the collective risk of population aging (Gavrilova & Gavrilov, 2014).

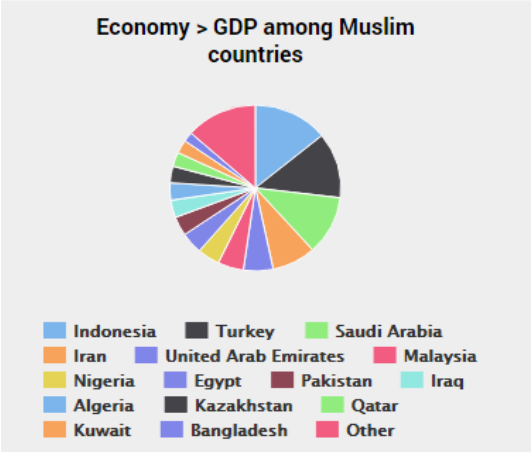
Status and tendencies

Geographical distribution of aging trend in Islamic countries

First, in geographical studies, each place introduces specific characters from selected countries (Castree, 2003; Movahed & Gahlehteimouri, 2019). These characters make them unique compared to other places. Furthermore, place values (e.g., cultural, economic, political, and social) go beyond the visible objects that we can see on the earth's surface. Muslim countries are located in different geographical locations and with different political systems.

The cultural differences between the Muslim countries have made different economic situations regarding employment-to-population ratio and woman's situation (Jones, 2012). The employment among people in Muslim world countries is significantly different. Economically, Muslim countries in the Persian Gulf (e.g., Iran, Saudi Arabia, Kuwait, and Qatar) with an oil-based economy are wealthier than other Muslim countries, except Indonesia and other wealthy Muslim countries in Southeast Asia (Figure 1).

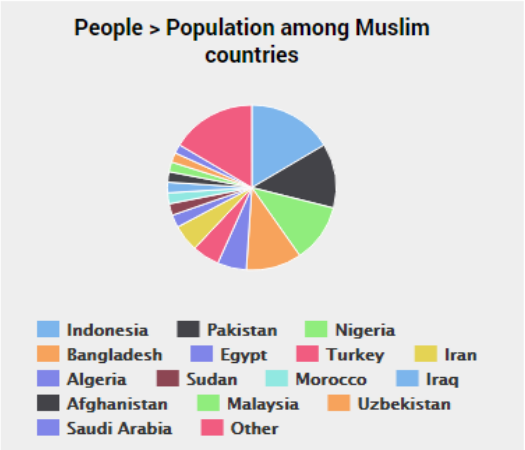
Figure 1: GDP in Muslim Countries



Note: NationMaster (2020)

The Muslim countries selected in this research do not have the same economic, social, and geographical similarities. Indonesia is the most populated Muslim country, totaling 87% of the country and 13% of the world's Muslim population. After that, India, Pakistan, Bangladesh, Nigeria, Egypt, Iran, Turkey, Algeria, and Iraq. These countries placed 65% population inside themselves that is situated in Asia, Africa, and Middle Eastern with different political systems and ideologies (United Nations, 2020) (Figure 2).

Figure 2: Population in Muslim Countries



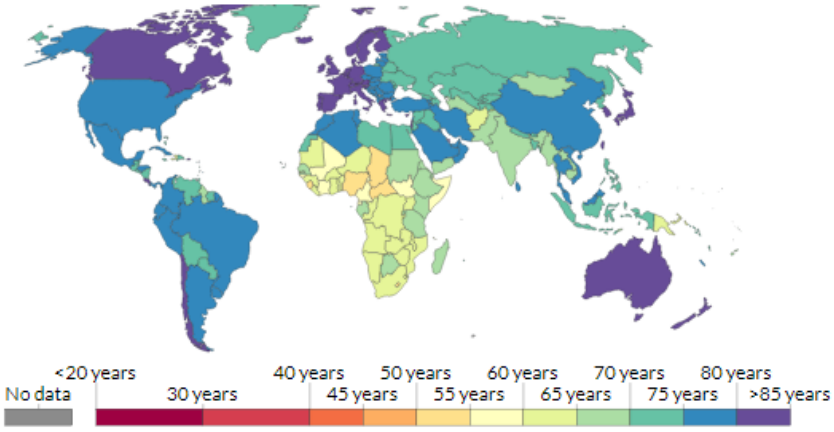
Note: NationMaster (2020)

The examination of changing trends in the age structure of 57 Islamic world countries in 10 geographical regions has shown that the average percentage of aging was 10.7 in the 1950s. Of the 57 countries, 47 had a young population structure, and 10 were in the middle-aged population structure. As Table 1 shows, in the 1950s, no aging occurred in any Islamic world countries. In the same decade, the average total fertility rate in the young countries of the Islamic world was 5.3, and in the middle-aged countries, it was 6.7 children. The average life expectancy in the Islamic world countries was 41.7 years, which in the countries with a young and middle-aged population structure were 51.2 and 39.7 years, respectively.

In the 1970s, the average percentage of aging in Islamic countries moderately declined, meaning that on average, about 3.5% of people in the Islamic world were over 65 years old,

compared to 4.1% in 1950. In the previous decade, among 57 countries, 55 had a young population structure, and only two had a middle-aged population structure. In the 1990s, compared to the 1970s, there was no such change in the aging and the percentage of people over the age of 65. However, life expectancy had increased by about 10 years due to improved health and medical facilities, from 49.7 years to 59.5 years, while the fertility rate dropped dramatically from 6.6 to 5.6 children (Figure 3). In 2005, the first two countries in the Islamic world, Tunisia and Albania, entered the aging phase. In the same year, 45 countries had a young population structure, and 10 had a middle-aged country. During this period, fertility declined significantly from 5.7 children in 1990 to 4.2 children in 2005.

Figure 3: Current Life Expectancy Status

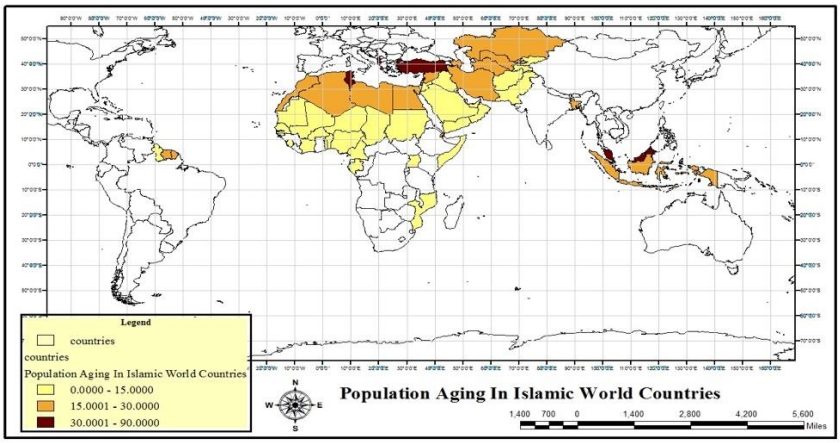


Note: Riley (2005); United Nations (2020)

The average total fertility rate in the young, middle-aged, and elderly countries of the Islamic world was 4.7, 2.3, and 2 children, respectively. Furthermore, the median age was 11.3%, with a population over 65 was 3.8%, 3.2% in young countries, 5.8% in middle-aged countries, and 8.1% in older countries. The average life expectancy has increased significantly in all years, reaching 63.3 years in 2005. The average life expectancy has increased considerably in all years, reaching 63.3 years in 2005. Turkey has also entered into aging since 2015. Therefore, the number of aging countries reached three, the middle-aged to 14 and the youngest 40.

The proportion of aging, increased to 13 in 2015, with the percentage of people aged 65 and overreaching 4%. This figure had risen to 3% in 40 countries with a young population structure. In 14 countries with a middle-aged population structure, it increased to 5.6%. Finally, in three older countries, it rose to 9.4%. In 2020, two countries, Malaysia and Lebanon, have been added to the list of oldest countries, three countries have been added to the middle-aged, and the number of young countries has been reduced to 35. The average age of 57 countries in the Islamic world was 15.5, while the average age of five countries (Malaysia, Lebanon, Tunisia, Albania, and Turkey) was 44. These five countries account for about 7.1% of the Islamic world's population, while 93% of the Islamic world's population has a young population structure (Figure 4).

Figure 4: Aging in Islamic World Countries



Note: *NationMaster (2020)*

Table 1 shows that in 2020, the average population over the age of 65 was 3% in countries with a young population structure, 5.8% in middle-aged countries, and 9.5% in older countries. The average total fertility rate has declined in most years, reaching 3.4 in 2020. Of course, this figure has been immensely varied in different countries, so that in young countries, it has decreased to 4.2 children, in middle-aged countries to 2.5 children and in older countries, it has declined to 2 children. The average life expectancy in the same decade was 68.5 years, which compared to the 1950s has increased by 17 years. In all countries of the Islamic world, the life expectancy rate has increased significantly, and this rate has become closer in these countries and has created a significant convergence. Therefore, it can be claimed that the demographic transition in the Islamic world countries started in 2005. However, these countries still have a young population structure. It is predicted that by 2050, most countries in the Islamic world will go through a demographic transition and enter the aging threshold.

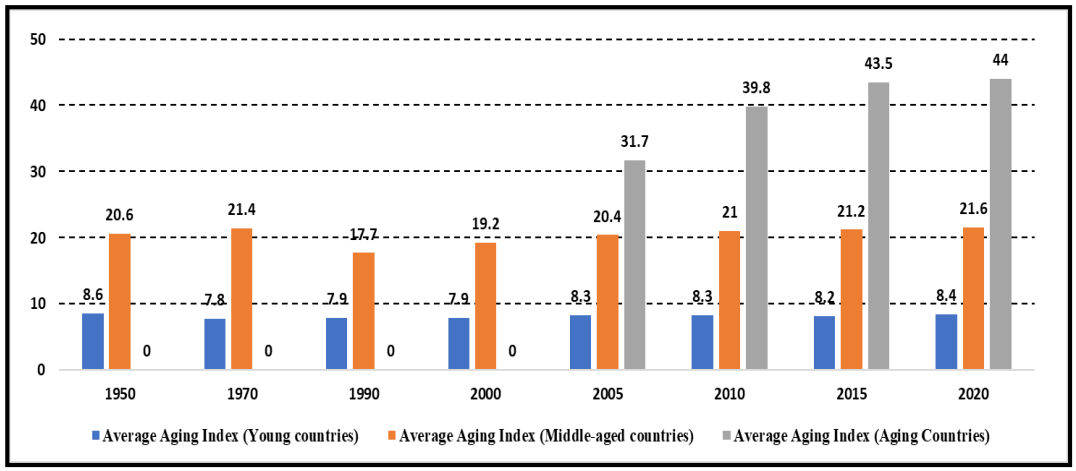
Table 1: Average Percentage of Youth, Middle Age and Population Aging, Total Fertility Rate and Life Expectancy Islamic Countries During 1950-2020 (UNDP, 2019)

Year	**1950**	**1970**	**1990**	**2000**	**2005**	**2010**	**2015**	**2020**
Number of young countries	47	5	55	47	45	43	40	35
Number of middle-aged countries	10	2	2	10	10	13	14	17
Number of aging countries	0	0	0	0	2	2	3	5
Average percentage aged 65 years or over (young countries)	6.9	3.4	3.3	3.2	3.2	3	3	3
Average percentage aged 65 years or over (middle-aged countries)	3.5	5.2	5.7	5.9	5.8	5.6	5.6	5.8
Average percentage aged 65 years or over (aging countries)	0	0	0	0	8.1	9.1	9.4	9.5
Average total fertility rate (young countries)	5.3	6.7	5.7	5	4.7	4.5	4.3	4.2
Average total fertility rate (middle-aged countries)	6.7	5.8	3.1	2.6	2.3	2.3	2.4	2.5
Average total fertility rate (aging countries)	0	0	0	0	2	1.8	2	2
Average life expectancy (young countries)	51.2	50	59.1	60.5	61.5	62.8	64.2	65.3

Average life expectancy (middle-aged countries)	39.7	43	69.8	67.9	69.9	71.3	73	72.6
Average life expectancy (aging countries)	0	0	0	0	69.7	75.1	76.2	77.4

Figure 5 illustrates that in 1950, the average age index in young countries was 8.6, which accounted for about 93.6% of the population of Islamic countries. During the same period, ten countries, including Azerbaijan, Uzbekistan, Turkmenistan, Kyrgyzstan, Kazakhstan, Lebanon, Benin, Gabon, Albania, and Suriname, had a middle-aged population structure with an aging index of 20.6, which was about 6.4% of the population of Islamic countries. In 2005, for the first time, Albania and Kazakhstan experienced a demographic transition. They entered the population aging, and with an average aging index of 31.7%, they made up about 1.3% of the population of Islamic countries. During the same period, ten countries, including Azerbaijan, Indonesia, Kyrgyzstan, Iran, Lebanon, Algeria, Tunisia, Morocco, Turkey, and Suriname, entered the middle-aged population with an average aging index of 20.4, which accounted for about 32.1% of the Islamic world's population. Although the number of middle-aged countries has not changed since 1950, their percentage has increased fivefold.

Figure 5: Average Aging Index with a Breakdown of Ternary Demographic Groups Among Islamic Countries



Note: United Nations (2019a)

In 2010, Kazakhstan pursued a policy of population growth, increased its fertility rate compared to the previous decade, moved out of aging, and gave way to Tunisia. Therefore, in 2010, Tunisia and Albania accounted for about 0.8% of the Islamic world's population at an aging index rate of 39.8%. Thirteen countries, including Azerbaijan, Uzbekistan, Indonesia, Kyrgyzstan, Kazakhstan, the Maldives, Malaysia, Iran, Lebanon, Algeria, Morocco, Turkey, and Suriname, have entered the middle age, which has constituted about 44.5% of the population of Islamic countries.

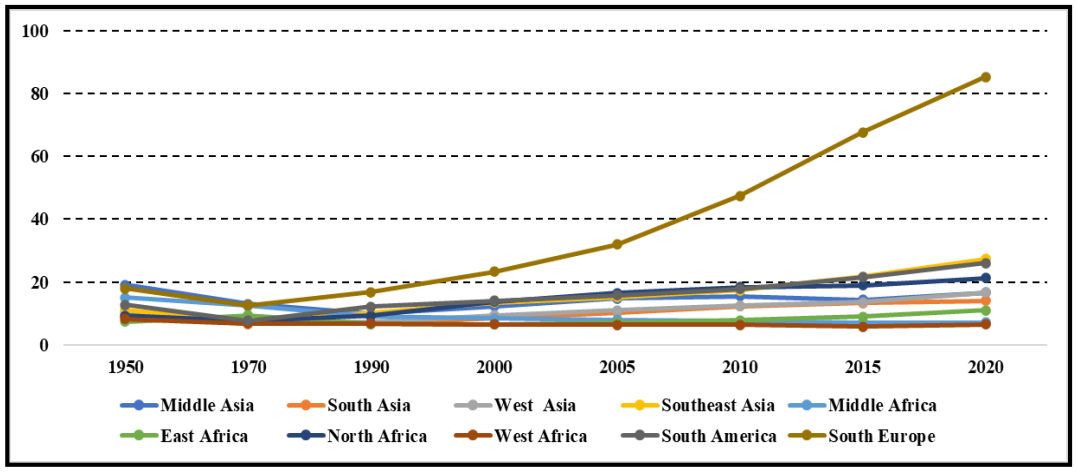
Since 2015, Turkey had been added to the list of aging countries. Generally, three countries with an aging index of 43.5 accounted for about 6.8% of the population of 57 Islamic countries. During this period, 14 countries, including Azerbaijan, Indonesia, Bangladesh, Kazakhstan, the Maldives, Malaysia, Iran, Lebanon, Egypt, Algeria, Brunei, Morocco, Suriname, and Guyana, accounted for approximately 43% of the world's population. During this period, the

young population has been equal to the middle-aged and elderly population. Finally, in 2020, Lebanon and Malaysia were added to the aging countries, and the number of aging countries has reached five. These countries, with an aging rate of 44, contain about 7.1% of the population. During the same period, 17 countries, including Azerbaijan, Uzbekistan, Indonesia, Bangladesh, Turkmenistan, Kazakhstan, Maldives, Iran, Syria, Egypt, Algeria, Brunei, Djibouti, Libya, Morocco, Suriname, and Guyana, account for about 43.1% of the world's population. During this period, 0.2% of the young population was older than the elderly and middle-aged population. These figures show that 7.1% of the Islamic world's population has entered the demographic transition, and 43% of the population is on the verge of reaching the demographic transition. Although the number of young countries in the Islamic world is much higher than the elderly and middle-aged countries, the percentage of the middle-aged and elderly population is higher. The majority of the elderly and middle-aged countries are the most populous countries in the Islamic world.

Geographical distribution of aging trend in continental regions

As shown in Figure 6, the geographical analysis of the aging population of 57 Islamic countries in ten geographical regions is relatively different. At the beginning of the study period, in the 1950s, the average population aging index was as follows: 19.4 in five Central Asian countries (Uzbekistan, Tajikistan, Turkmenistan, Kyrgyzstan and Kazakhstan), 17.9 in Southern Europe (Albanian country), 15.1 in three Central African countries (Chad, Cameroon and Gabon), 12.8 in two South American countries (Suriname and Guyana), 11.23 in two Southeast Asian countries (Malaysia and Indonesia), 10.5 in 15 West Asian countries (Azerbaijan, Jordan, United Arab Emirates, Iran, Bahrain, Syria, Iraq, Saudi Arabia, Oman, Palestine, Qatar, Kuwait, Lebanon, Yemen and Turkey), 9.3 in six North African countries (Tunisia, Sudan, Libya, Morocco, Algeria, Egypt), 9.2 in four countries of South Asia (Afghanistan, Bangladesh, Pakistan, Maldives), 8.3 in 13 West African countries (Ivory Coast, Senegal, Sierra Leone, Gambia, Guinea, Guinea-Bissau, Mali, Mauritania, Niger, Nigeria, Benin, Burkina Faso, Togo), and finally, 7.5 in six West African countries (Mozambique, Comoros, Somalia, Bruno, Djibouti and Uganda).

Figure 6: Aging Among the Countries of the Islamic World with a Breakdown of Geographical Regions from 1950 to 2020



Note: United Nations (2019a)

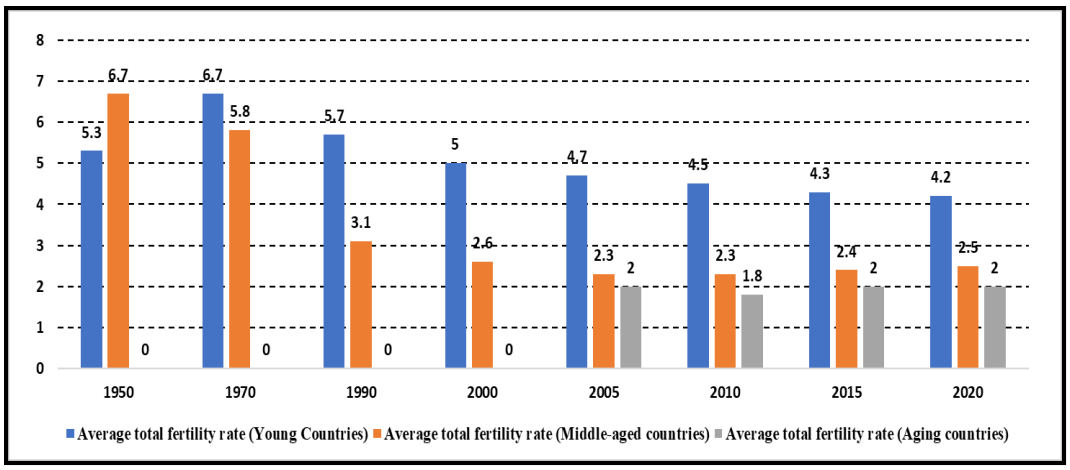
So that during this period, 57 countries of the Islamic world have had a youth structure. Southern Europe was the first geographical region that had entered the aging population since

2005. Until 2020, no geographical area has reached the population aging stage, except for Southern Europe. However, among the regions, four other countries have entered the aging. The aging difference in Southern European countries has increased in 2010 and 2015. In 2020, it reached 85.3, or about 12.9 times that of West Africa (average age 6.6), the youngest geographical area in the Islamic world. According to surveys, Central Africa with 12 times (average age 7.1), East Africa with 7.8 times (average age 11), South Asia with 6.1 times (average age 14.1), Central Asia with 5.12 times (average age 16.6), West Asia with 5.1 times (average age 16.7), North Africa with 4 times (average age 21.35), South America with 3.3 times (average age 26.1), and Southeast Asia with 3.1 times (average age 27.4), are younger than the countries of Southern Europe.

The trend of total fertility rate in Islamic countries

An investigation of the total fertility rate in the countries of the Islamic world shows that from the beginning of the study period to its end, the total fertility rate has dropped by almost half, meaning that it has fallen from 6.4 children to 3.4 in the 1950s. In the 1950s, the highest total fertility rate was in Yemen with 7.8 children and the lowest in Gabon with 4 children. In 2020, Niger with 6.95 children and the United Arab Emirates with 1.4 children had the highest and lowest rates. The fertility rate gap at the beginning and the end of the study is 3.8 and 5.55 for children. Figure 5 illustrates that the total fertility rate in countries with young, middle-aged, and elderly populations of the Islamic world has been declining from 1950 to 2020. In countries with lower fertility rates, the percentage of population aging is higher, and vice versa (Figure 7).

Figure 7: Average Total Fertility Rate with a Breakdown of Ternary Demographic Groups Among Islamic Countries

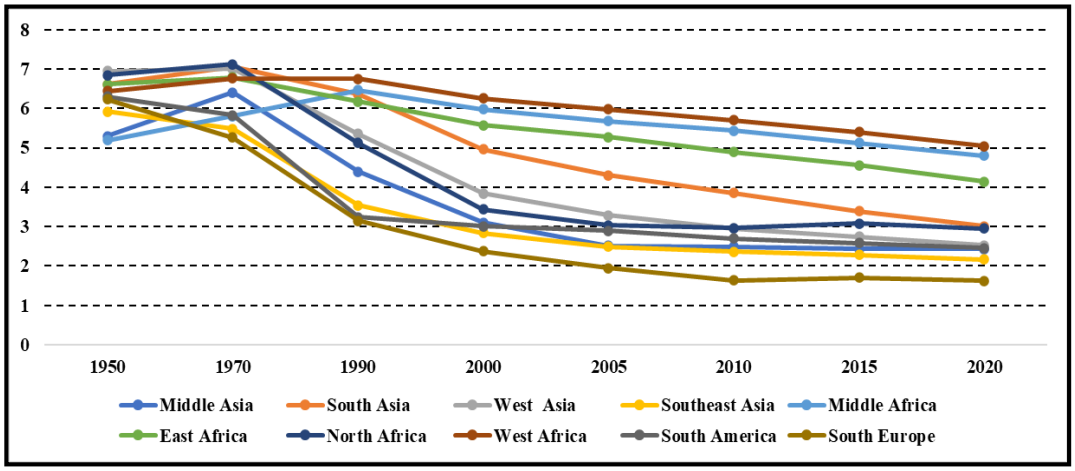


Note: United Nations (2019a)

As Figure 8 shows, the total fertility rate varies from different geographical areas in the Islamic world. The fertility rate gap in the ten geographic regions has risen from 2 children in 1950 to 3.5 children in 2020. However, from the beginning of the study period to the end, all geographical regions of the Islamic world, except Central Asia in the 1970s and Central Africa in the 1990s, show a downward trend. On the one hand, the striking differences between 1950 and 2020, and on the other hand, the declining trend in most regions, indicate that the overall fertility rate in the countries of the Islamic world is unbalanced. A survey into separate geographical regions of Islamic countries shows that in 2020, West Africa with 5.04, Central

Africa with 4.8, East Africa with 4.2, South Asia with 3.01, North Africa with 2.95, West Asia with 2.52, South America with 2.45, Central Asia with 2.43, Southeast Asia with 2.2, and South Europe with 1.62 children, have the highest to the lowest total fertility rates. The difference between the geographical areas is 3.42 children. Thus, it can be concluded that the fertility rate in the countries of the Islamic world seems extremely unbalanced and divergent.

Figure 8: Total Fertility Rates Among Islamic World Countries with A Breakdown of Geographical Regions from 1950 to 2020

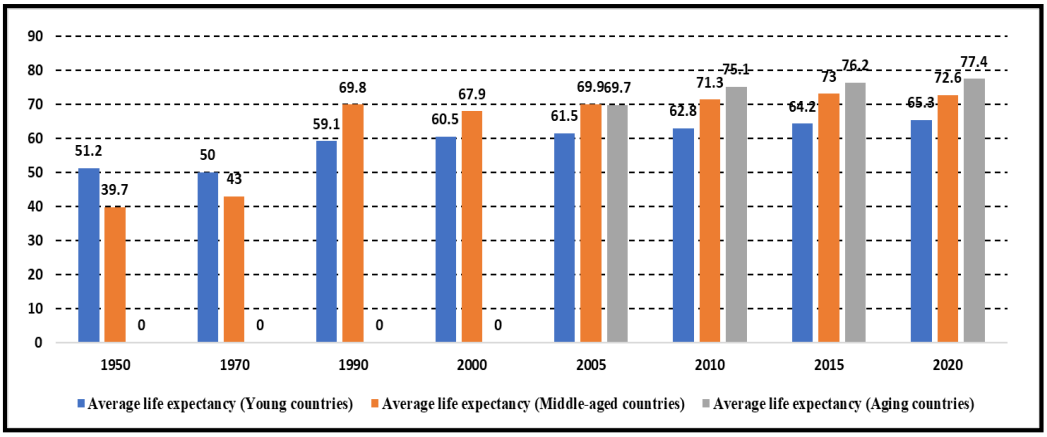


Note: United Nations (2020)

The trend of life expectancy in Islamic countries

Figure 9 reveals that the trend of increased life expectancy in different countries of the Islamic world has continually been rising from 1950 to 2020. In 1950, the average life expectancy in countries with a young population structure was 51.2 years, and in 2020, it increased to 65.3 years, which indicates that it has increased by 14.1 years during the review. This figure has risen from 39.7 years to 72.6 years in middle-aged countries in the same years, indicating an increase of 32.9 years. In aging countries in 2005, life expectancy rose from 69.7 to 77.4 in 2020. The increased life expectancy rate in aging countries has been 7.7 years. The utmost increase in life expectancy belongs to countries with a middle-aged population structure. Although life expectancy has increased in countries with different population structures, the life expectancy gap between aging and young countries is about 12.1 years. To sum up, it can be stated life expectancy in the three population structures has been unbalanced.

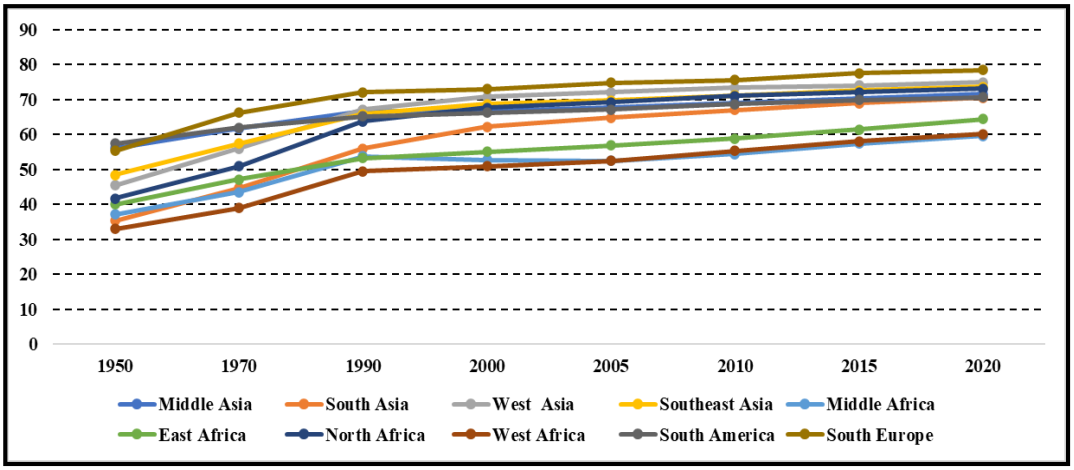
Figure 9: Average Life Expectancy with a Breakdown of Ternary Demographic Groups Among Islamic Countries



Note: United Nations (2020)

The geographical analysis of this variable has shown that in 1950, the highest life expectancy was related to South American countries with an average of 57.4 years old. The lower rate has belonged to Western African countries with 32.9 years. The life expectancy gap between the ten regions of the Islamic world has been 24.5 years. In 2020, the average life expectancy in different parts of the Islamic world was 78.4 in Southern Europe, 74.84 in Western Asia, 73.65 years in Southeast Asia, 73.11 years in North Africa, 71.5 years in Central Asia, 70.6 years in South America, 70.5 years in Southern Asia, 64.3 years in East Africa, 60.1 years in West Africa, and 59.6 years in Central Africa. Although the gap between the two regions has narrowed since the beginning of the period, there is still a difference of 18.8 years. This indicates that life expectancy is unbalanced in countries with different demographic structures in the Islamic world and in different geographical areas (Figure 10).

Figure 10: The Trend of Life Expectancy Among the Countries of the Islamic World with a Breakdown of Geographical Areas from 1950 to 2020

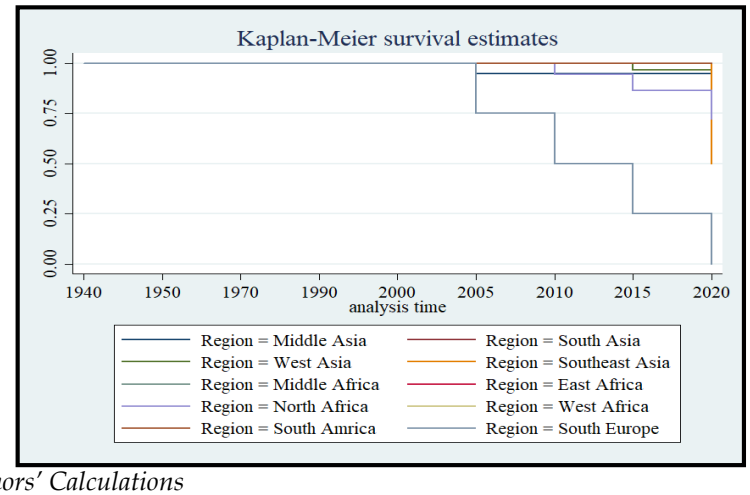


Note: United Nations (2019a)

Results

This paper examined the geographical analysis of the population aging trend in the countries of the Islamic world during seven decades. Discussion should be followed up by two statistical estimation methods. The plot was drawn by Kaplan-Meier (Figure 11) clearly shows the probability of aging in ten regions of the Islamic world. Whereas Southern Europe, the country of study, has been aging since 2005, the chart for the Southern European region has moved from probability one to zero probability. Meanwhile, the chart for Southeast Asian countries with a probability of more than 50% is complete; that is, the probability of survival for Asian countries is over 50% in 2020. For the North African region, which has been aging since 2015, the chart is complete from probability one to probability 75%. In West Asia, the two countries, Turkey and Lebanon, aging became a severe problem in 2020, with an estimated 90% chance of survival (lack of population aging). In other areas, the probability of survival is 100%. This shows that, except for five countries (Malaysia, Lebanon, Tunisia, Albania, and Turkey), the rest of the Islamic world has not yet entered aging. Still, with the current trend of life expectancy and declining total fertility rate, many of these countries are likely to enter old age in the coming years.

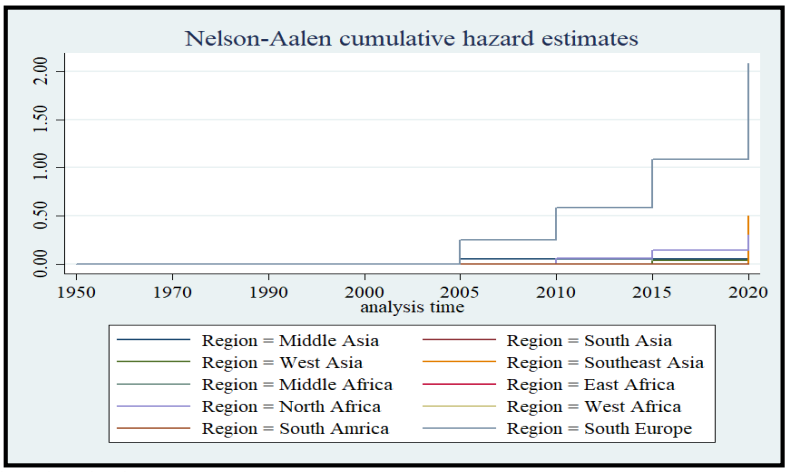
Figure 11: Population Aging Trend in the Countries of the Islamic World During the Years 1950 to 2020 using the Kaplan-Meier Method



Note: Authors' Calculations

The Nelson-Aalen estimator cumulative hazard functions chart in 2020 (Figure 12) for ten regions of the Islamic world shows that in the Southern European region, cumulative hazard estimates have reached above two due to the prevalence of aging. However, owing to the lower prevalence of this incident in Southeast Asia, the estimation of cumulative hazard is 0.5%. It is less than 0.2 in North Africa and Southeast Asia. In other areas, it is zero due to the lack of aging prevalence. Nelson-Aalen estimator's estimate is the opposite of Kaplan-Meier's estimate. In this case, the estimation of cumulative hazard is evaluated with the probability of the cumulative event occurrences. As we move forward, the probability of an aging event increases, and as a result, the value of this estimate changes from zero to one.

Figure 12: Estimation of the Cumulative Hazard of Population Aging in the Countries of the Islamic World During 1950-2020 Using the Nelson-Aalen estimator Method



Note: Authors' Calculations

Table 2 presents the coefficients obtained from Cox's estimation of the effect of total fertility rate and life expectancy on population aging for 57 Islamic countries. The independent variables in this model are the total fertility rate and life expectancy for 57 countries in the Islamic world, which were collected from 1950 to 2020. The variable is a function of the probability of aging, which is obtained by dividing the population over the age of 65 to the population under the age of 15 multiplied by 100. Based on the results obtained from Table 2, the relationship between the probability of an aging event and the total fertility rate is negative. It has a positive relationship with life expectancy. Coefficient –1.49 for the total fertility variable indicates that, for each unit decrease in total fertility, the probability of aging increases by 1.49, and vice versa. Furthermore, based on the results of Table 1, for each unit increase in life expectancy, the probability of aging increases by 0.947 units. These values reveal that the total fertility rate has a greater impact on the population aging trend than the effect on life expectancy.

Table 2: Coefficients Related to the Effect of Total Fertility Rate and Life Expectancy on Population Aging Based on Cox's Estimation (Authors' Calculations, 2020)

Variable	Beta Coefficient	Standard Deviation	P
Life expectancy	0.947	0.0094	0.000
Total fertility rate	–1.49	0.115	0.000

Discussion and conclusion

A study of total fertility and life expectancy indicators in the analysis of aging in 57 countries of the Islamic world from 1950 to 2020 shows that the number of young countries has decreased from 82.4% in 1950 to 61.4% in 2020. This indicates that countries are moving towards middle age and aging. The number of aging countries has increased from two in 2005 to five in 2020. Accordingly, in 2005 Albania, in 2010, Tunisia and Albania with an aging index rate of 39.8%, in 2015 Turkey, and finally in 2020 Lebanon and Malaysia will be added to the aged countries and the number of older countries reached five. These countries, with an aging

rate of 44%, consisted of about 7.1% of the population. The main reason has been the decrease in total fertility and the increase in life expectancy in these countries. Therefore, it can be opined that the demographic transition in the countries of the Islamic world started in 2005. However, these countries still have a young population structure, and it is predicted that by 2050 most Islamic countries will go through demographic transition and enter the verge of aging. In this regard, the geographical analysis of the aging trend of the population for 57 Islamic world countries in ten geographical regions is relatively different.

An examination of the total fertility rate in the Islamic world shows that the total fertility rate in countries with a young, middle-aged, and elderly population structure has declined from 1950 to 2020. In countries with low fertility rates, the aging population has increased, and vice versa. It should be noted that the geographical analysis of the general total fertility rate has been different in various geographical areas of the Islamic world, so that the fertility rate in the countries of the Islamic world is extremely unbalanced and divergent.

The average life expectancy has increased by 17 years compared to the 1950s. In all the countries of the Islamic world, life expectancy has increased significantly, and the life expectancy of these countries has become closer and has created a significant convergence. Life expectancy is highest in countries with a middle-aged population structure. Although life expectancy has increased in countries with different demographic structures, the life expectancy gap between old and young countries is about 12.1 years. As a result, life expectancy in the three population structures has been unbalanced. The geographical study of this variable shows that the gap between the geographical areas has decreased compared to the beginning of the period. However, there is still a difference of 18.8 years. This indicates that life expectancy is unbalanced in countries with different demographic structures in the Islamic world and in different geographical areas.

The interpretation of the Kaplan-Meier method, as mentioned earlier, shows that, except for five populations aged countries of the Islamic world (Malaysia, Lebanon, Tunisia, Albania, and Turkey), the rest of the country has not yet entered aging. Still, with the current trend of life expectancy and the reduction of fertility, many of these countries are likely to enter aging in the coming years. In this regard, the Nelson-Aalen estimator cumulative hazard functions chart demonstrates the general concept that as we move forward, the probability of an aging event in these countries increases, because according to the coefficients obtained from Cox's estimation, the relationship between the probability of an aging event and the total fertility rate is negative. It has a positive correlation with life expectancy. Considering the realm of the context, the coefficient of –1.49 for the total fertility variable clearly shows that for each unit decrease in total fertility rate, the probability of aging increases by 1.49, and vice versa.

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