Applied Research Advances

Journal homepage: www.ara-journal.org
ISSN: 3104-2643

A System Dynamics Framework for Analyzing and Ranking Factors Influencing Life Expectancy

Mehdi Faridzad[1], Mahdi Yousefi Nejad Attari[2], Ali Ala[3,4,*]

[1] Department of Industrial Engineering, Tabriz Branch, Islamic Azad University, Tabriz, Iran
[2] Department of Industrial Engineering, Bonab Branch, Islamic Azad University, Bonab, Iran
[3] School of Mechanical & Materials Engineering, University College Dublin, D04 V1W8, Ireland
[4] Departments of Industrial Engineering & Management, School of Mechanical Engineering, Shanghai Jiao Tong University, Shanghai, China

ARTICLE INFO

Article history:
Received 14 June 2025
Received in revised form 25 August 2025
Accepted 5 September 2025
Available online 7 September 2025

Keywords:
System Dynamics Modeling; Life Expectancy Determinants; Vensim Simulation; Health Policy; Socio-Economic Factors

ABSTRACT

Life expectancy is a key measure of public health and development, but its determinants are complex and interdependent, making accurate prediction and policymaking challenging. This study adopts a system dynamics modeling approach to identify, rank, and simulate the factors influencing life expectancy, with a focus on healthcare clinics in Iran. Based on an extensive literature review and expert consultations, 25 indicators are selected and validated through a structured questionnaire, yielding a Cronbach's alpha of 0.74, confirming acceptable internal consistency. Simulation experiments are carried out by Vensim software under baseline, inflationary, and deflationary conditions, and complemented by sensitivity analysis. The findings indicate that inflation has the most substantial negative impact, reducing life expectancy by more than four years under a 10% annual increase, while improvements in environmental quality, healthcare access, and nutrition exert positive and reinforcing effects. The study contributes by demonstrating the value of system dynamics in capturing feedback relationships often overlooked in conventional approaches, thereby providing policymakers with integrated insights to design effective strategies for improving life expectancy.

1. Introduction

Life expectancy has long been recognized as one of the most important indicators of public health and socio-economic development. It represents the average number of years a person is expected to live under prevailing mortality conditions, reflecting not only biological factors but also the broader health, social, and economic environment. Infant and early childhood mortality exert the most significant influence on life expectancy at birth, since deaths in these stages result in the loss of decades of potential life. Consequently, life expectancy is often used as a composite measure of a population's overall health status and quality of life.

* *Corresponding author.*
E-mail address: ali.ala@ucd.ie

https://doi.org/10.65069/ara1120253

The determinants of life expectancy are highly complex and interdependent, including healthcare quality, nutrition, environmental standards, income, lifestyle, education, and broader socio-economic conditions. Traditional approaches to measuring life expectancy often overlook these interconnections, leading to limited explanatory power. In particular, the relationships between these factors may be non-linear, dynamic, and influenced by feedback loops across health and economic systems. Therefore, capturing these dynamics requires more sophisticated analytical methods beyond conventional statistical models.

The life expectancy index is affected by various factors such as social, healthcare, political, and economic. Therefore, all these factors identified from past research and the experts on this subject are considered dominant factors in determining the life expectancy index. The former refers to how quickly individuals age, whereas the latter describes how quickly communities age. In this paper, we examined and simulated dynamic feedback modeling in Figure 1 using Vensim simulation tools. Then, demonstrated a basic Vensim model for life expectancy with a population-based strategy.

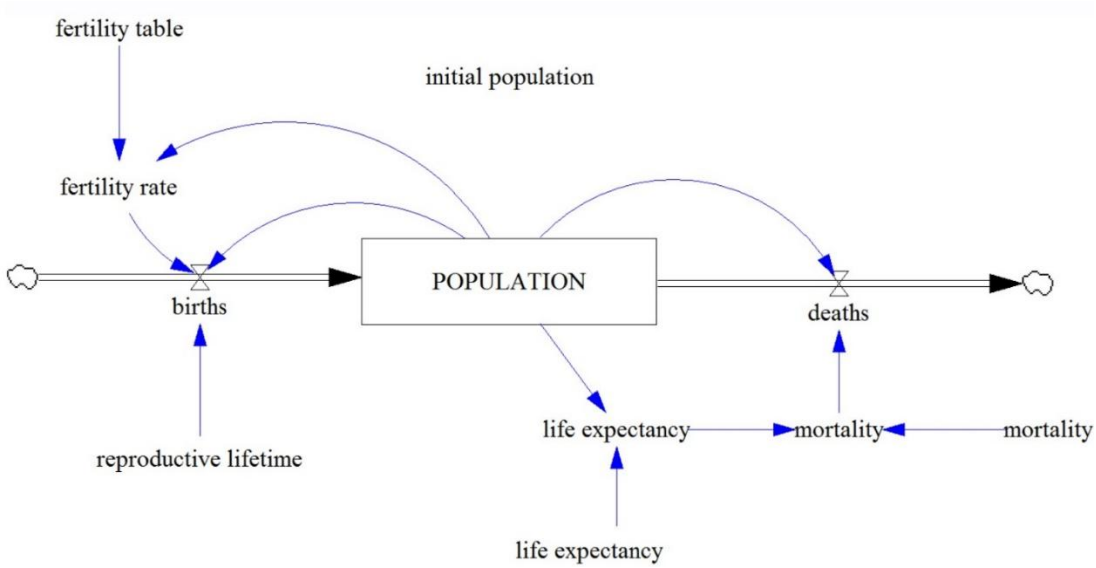


Fig. 1. Simulation of the primary new model with population and life expectancy

The present study applies a system dynamics modeling approach to identify, rank, and simulate the factors influencing life expectancy. The insights derived from this research aim to provide policymakers with a more holistic understanding of how multiple drivers interact over time to shape life expectancy outcomes. Also, the contribution of this work is organized based on several factors, including average life span and relative variation in life-size, as follows:

i. improving and enforcing environmental standards, and their effect on the meaning of life;
ii. inflation's impact on the family therapy basket;
iii. developing public health in improving the performance of the healthcare system;
iv. the effects of urbanization rates on living standards;
v. the effects of healthy agriculture on proper and healthy nutrition.

The remainder of the article is organized as follows. In Section 2, we present research methods in life expectancy in healthcare. Considering the simulation dynamic systems approach in Section 3, the simulation Implementation on life expectancy is addressed. Section 4 describes the study's results and discussion. Finally, Section 5 concludes the paper and discusses future research directions.

2. Literature Review

Ahmadi & Shojaee [1] studied the elasticity factors affecting the life expectancy index in Iran during the years 1980-2010. This study states that the determinants of life expectancy in Iran are related to selected social, economic, and environmental factors. According to the experimental results, life expectancy is sensitive to nutrition, food availability, education level, and health expenditures. In Iranian society, these factors can positively increase human life expectancy, whereas smoking appears to have the opposite effect. Nasiri & Joukar [2] found a positive and significant correlation between the meaning of life and hope, happiness, and life satisfaction, as well as a significant negative correlation with depression, in a study aimed at investigating the relationship between the meaning of life and hope and mental health indicators. The findings revealed that hope significantly mediated the relationship between life meaning, life satisfaction, and mental health indicators. Life meaning can boost happiness and life satisfaction. In other words, the meaning of life, combined with hope, can increase happiness and life satisfaction and reduce depression.

Sepehrdoost & Ibrahim [3] stated that one of the central concepts of sustainable development is human development, and improving the health index in social welfare depends on economic factors such as the development of life insurance and health considerations. In the study of human development indicators focusing on gender discrimination and inequality in rural areas, Alipour et al. [4] identified the leading indicators of this index, which include the general education index, per capita income index, and life expectancy. Moreover, life span equality has deteriorated in many regions and communities within countries over the last few decades. However, the average life expectancy improved or differed from those that enhanced equality in life spans in industrialized countries. Despite these exceptions and disparities, life expectancy and equality in life expectancy are often moving in the same direction. According to the findings in the gender discrimination index, the differences between women and men are minor, both regarding education and income, demonstrating men's superiority over women in all cases.

Alam *et al.* [5] attempted to investigate the nonlinear effect of life expectancy, as a critical indicator of health, on the evolution of Iran's per capita GDP. The results of estimating the mild transfer regression model while confirming the hypothesis of a nonlinear effect of life expectancy on per capita production growth revealed that life expectancy affected economic growth in the form of a two-diet structure. Khaksar & Yazdani Charati [6] addressed that life expectancy is one of society's most essential health assessment indicators. The fact that their values and trends change over time indicates the result of the functioning of the health system. A study was carried out in another province to estimate the changes in life expectancy. This descriptive epidemiological study examines life expectancy and mortality by age and sex from 2001 to 2005 using demographic information. The data was analyzed using statistical and demographic formulas, and a life table was created using SPSS and Excel software.

Saffari Nia *et al.* [7] conducted a study to assess the efficacy of group hope therapy in increasing life expectancy in HIV-positive patients. The findings revealed that group hope therapy significantly increased life expectancy in HIV patients. The consistency of the research hypothesis results with other research results indicates that this research is approved and conforms to further research in hope therapy. Bahrami & Noori [8] discussed the impact of the misery index on health costs in Iran. One of the main challenges in health care is identifying the factors that influence the number of resources allocated to health care by the country. The estimated coefficient of education and income inequality has a negative and significant impact on health expenditures in Iran. Leng *et al.* [9] studied the life expectancy of schizophrenic patients in China. Patient care costs were calculated based on gender, age, and life expectancy for each group.

Hauck *et al.* [10] researched social health indicators to identify small influential determinants using existing and experimental data. Agricultural production, access to clean water, health, personal health costs, HIV prevalence, income, and general costs in health, education, and employment are among the indicators mentioned in this study. They also said conditions of international trade, foreign investment, export or import of agriculture, urbanization, and environmental degradation. It was also stated that the findings could inform future research priorities and actions for social determinants. Chetty *et al.* [11] highlighted essential factors such as household income, gender, and geographical area. Health behaviors and area characteristics were also mentioned as factors and indicators that caused differences in life expectancy in some areas. Furthermore, the factors and indicators that caused differences in life expectancy in some areas were mentioned as health behaviors and characteristics of the area.

Nusselder *et al.* [12] investigated the effects of physical activity on life expectancy in people with cardiovascular disease. They claimed that avoiding sedentary behavior in adulthood prevents cardiovascular disease while independent of other risk factors. It also slows and promotes life expectancy for both men and women with cardiovascular disease. Katzmarzyk & Lee [13] conducted a sedentary behavior study and concluded that reducing sedentary behaviors such as sitting and watching television may increase life expectancy. Finally, Table 1 provides related works as well as our research on life expectancy.

Table 1
Related works as well as our research on life expectancy

Unemployment	Medicine shortage	Insurance	Human development	Social welfare	Mental problems	Life style	Public health	Physical activities	Disease	Smoking	Income	Environmental	Medical expences	Saftey	Sanitary	Personal hygine	Nutrition	Socio-economic	Mortality	Life expect.	References
	*		*		*		*	*			*			*	*		*	*		*	Rafiei *et al.* [14]
		*				*			*	*				*					*	*	Roffia *et al.* [15]
*				*			*									*			*	*	Sepehrdoost & Ibrahim [3]
*			*						*	*		*		*				*		*	Alam *et al.* [5]
*							*							*				*		*	Gracia-de-Rentería *et al.* [16]
			*					*			*			*			*		*	*	Naimark [17]
			*		*					*		*	*						*		Loukine *et al.* [18]
	*	*				*	*		*	*		*	*	*		*	*	*	*	*	Our research

3. Methodology

This study employed a system dynamics modeling framework to identify, prioritize, and simulate elements affecting the Life Expectancy Index. The procedure comprised four primary phases:

i. discovery and selection of factors;
ii. design and validation of the questionnaires;
iii. building of causal and flow models;
iv. simulation and sensitivity analysis.

The procedure commences with a literature review and expert interviews to ascertain factors, followed by questionnaire formulation, pilot testing, and data gathering. The inputs are subsequently

converted into causal loop and flow diagrams, executed in Vensim for simulation and sensitivity analysis, finally yielding policy insights and a ranking of life expectancy determinants.

3.1 Effective Indicators

More than 40 indicators were collected from previous studies. A panel of 12 experts reviewed the list and ranked them by relevance. Based on consensus, 25 factors were retained. Environmental health, engineering, the environment, urban management, economy, agriculture, education, and healthcare management have all been analyzed and refined using a statistical population. Variables that directly and indirectly affect the flow rate, the meaning of life, and the rate of state or life expectancy are as follows: unemployment, medicine shortage, insurance, human development, social welfare, mental problems, lifestyle, public health, physical activities, disease, smoking, income, environmental, medical expenses, safety, sanitary, personal hygiene, nutrition, socio-economic, mortality, life expectancy were selected for modeling.

3.2 Drawing Cause-and-Effect Relationships

By identifying the primary factors and considering the principles of system dynamics, we analyzed the cause-and-effect relationships and modeled and attempted to provide a comprehensive model for previous work that can provide several factors in this model for simulation. In addition, the model in Figure 2 was created by considering the nature of each factor and the logical relationship with other factors to create a network that can show the correct simulation of the natural system.

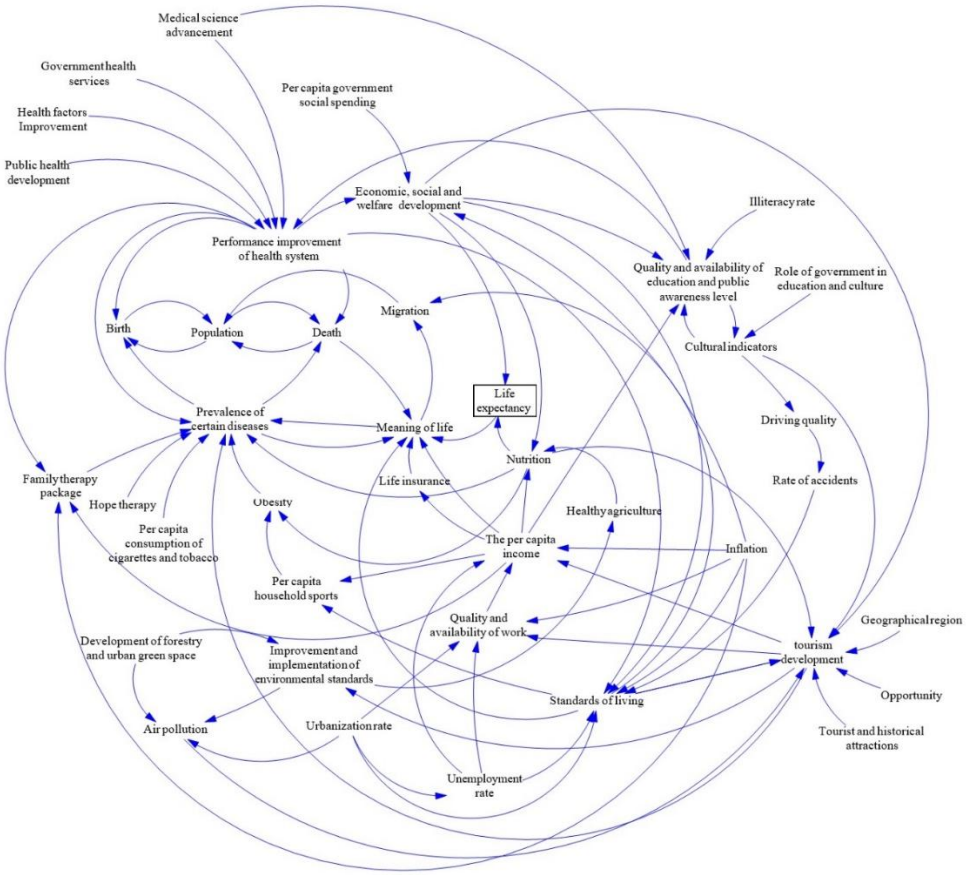


Fig. 2. Cause-and-effect relationship simulation considering the nature of life expectancy

3.3 Questionnaire Design and Validation

A standardized 20-item questionnaire was developed to assess the relative importance and interrelationships among the identified factors. Responses were measured on a 5-point Likert scale (1 = very low impact, 5 = very high impact). To ensure clarity and reliability, the questionnaire was first piloted with 30 participants (faculty members and graduate students at Tabriz University of Medical Sciences), yielding a Cronbach's alpha of 0.74, which indicates acceptable internal consistency. Using Cochran's formula with a target population of 1,500,000 and a 5% margin of error, the required sample size was calculated as 384. The final survey responses were collected from both students and academic staff in the medical sciences field. Cronbach's alpha formula confirmed the questionnaire's validity and reliability in an acceptable range (between 0.6 and 0.8).

$$\partial = \frac{k}{k-1}\left(1 - \frac{-\sum_{i=1}^{k} s_i^2}{s^2}\right) \tag{1}$$

$$n = NZ^2 \frac{NZ^2\, pq}{Nd^2 + Z^2\, pq} \tag{2}$$

In this case, k is the number of questions, s_i^2 represents the variance of each question, and s^2 denotes the variance of the total questions.

The factors are ranked, and the data extracted from the questionnaire were defined to add to the model by studying the statistical population and analyzing the questionnaires. Also, by re-analyzing the model and data, it has been modified. Factors are removed from the model, or their relationships are reviewed to make the simulation result more realistic. After ensuring that the model in Figure 3 is correct, the relationships are determined and implemented in the software. The Vensim software implements the flow diagram, and the relevant data is entered to simulate the model. The model is implemented in software, and the output is analyzed.

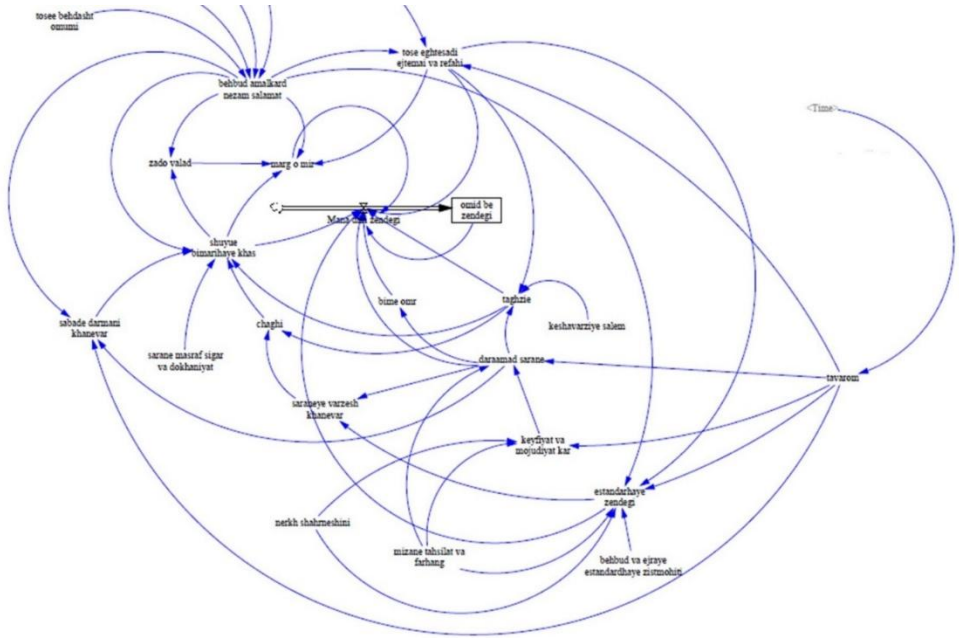


Fig. 3. Flow chart of factors affecting life expectancy from statistical information and questionnaires

The model was run for a 4-year period using annual time steps. Scenarios tested included neutral inflation, positive inflation (10%–50%), and negative inflation (–5% to –10%). Sensitivity analysis was conducted by varying coefficients within ±10% to test robustness.

4. Results & Analysis

4.1 Baseline Scenario

The data is analyzed so that each section contains several questions to assess the severity of the relationship between the analyzed factors. The factors are ranked after analyzing the questionnaire data. A careful examination of the data reveals that each factor studied has distinct effects on life expectancy, directly and indirectly. Meanwhile, in the diagram, the significant factor of life, the flow rate, influences the same life expectancy by being influenced by rate factors. According to sensitivity analysis, studies show that most factors are directly affected by inflation due to their reliance on inflation and play a significant role in life expectancy.

The analysis of life expectancy changes without inflation is examined in the first stage. In four years, Vensim software has presented data in diagrams by simulating the introduced model. Figure 4 depicts a software output diagram of the changes in the life expectancy index over the next four years. It should be noted that the rate of increase in inflation is considered neutral in this part of the simulation. The baseline simulation was performed under neutral inflation conditions, while other socio-economic and health variables were maintained constant. Figure 4 depicts the anticipated alterations in the Life Expectancy Index during a four-year span. The model forecasts a slight increase of 0.0297 years, ascending from 74.20 to 74.23 years. This conclusion indicates that, without inflationary pressures, enhancements in healthcare services, environmental quality, and nutrition progressively enhance life expectancy.

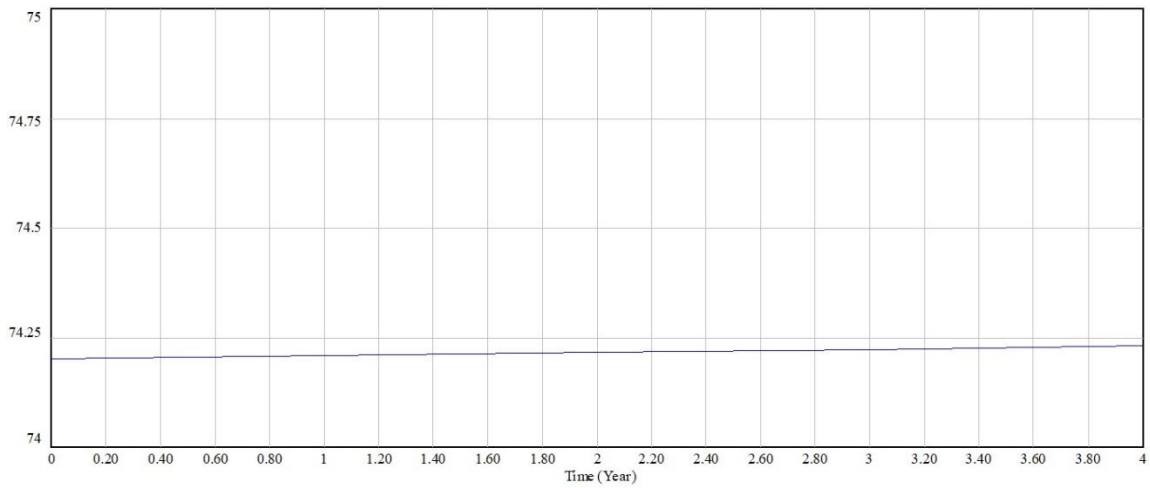


Fig. 4. Life expectancy changes without inflation using the software Vensim

Figure 5 analysis shows that the life expectancy index is increasing in the mentioned conditions. According to Figure 5, the life expectancy index in the statistical sample is expected to rise by 0.0297 years after four years.

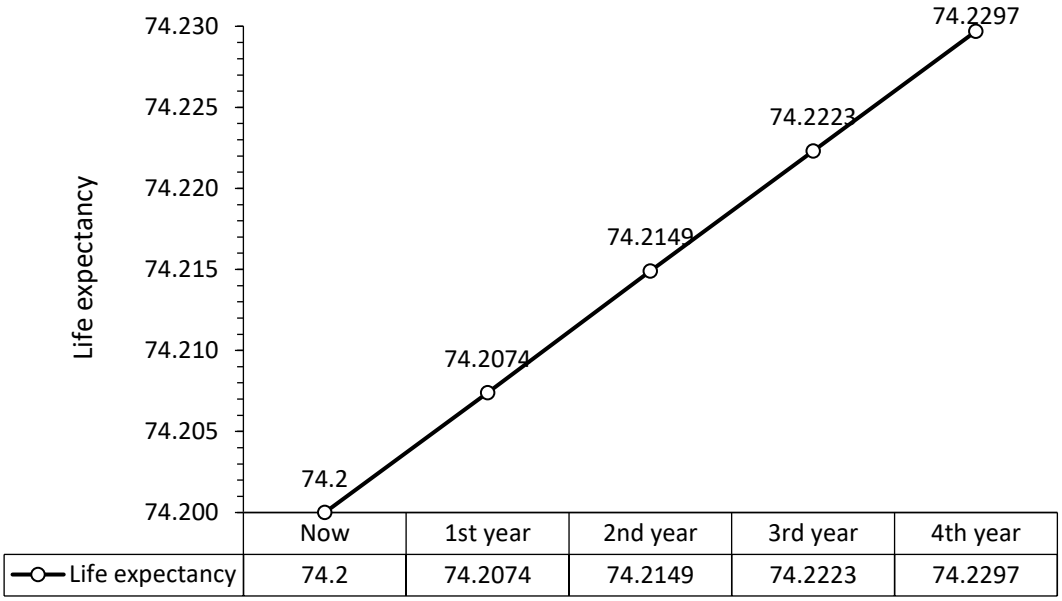


Fig. 5. The rate of change in life expectancy without inflation in the statistical chart over four years

4.2 Positive Inflation Scenarios

To examine the effect of economic instability, the model was tested under inflation rates ranging from +10% (Figure 6) to +50% (Figure 7). Results demonstrate a clear negative trend: each incremental rise in inflation reduced life expectancy, with a 10% annual inflation rate lowering average life expectancy to 69.73 years over four years. In the extreme scenario of 50% inflation, life expectancy dropped by more than 4.4 years compared to the baseline. Statistical analysis confirmed the strength of this relationship. Regression outputs yielded an R^2 value of 0.81, indicating a strong fit between inflation rates and life expectancy decline. Sensitivity coefficients showed that inflation had the highest negative elasticity among all tested variables.

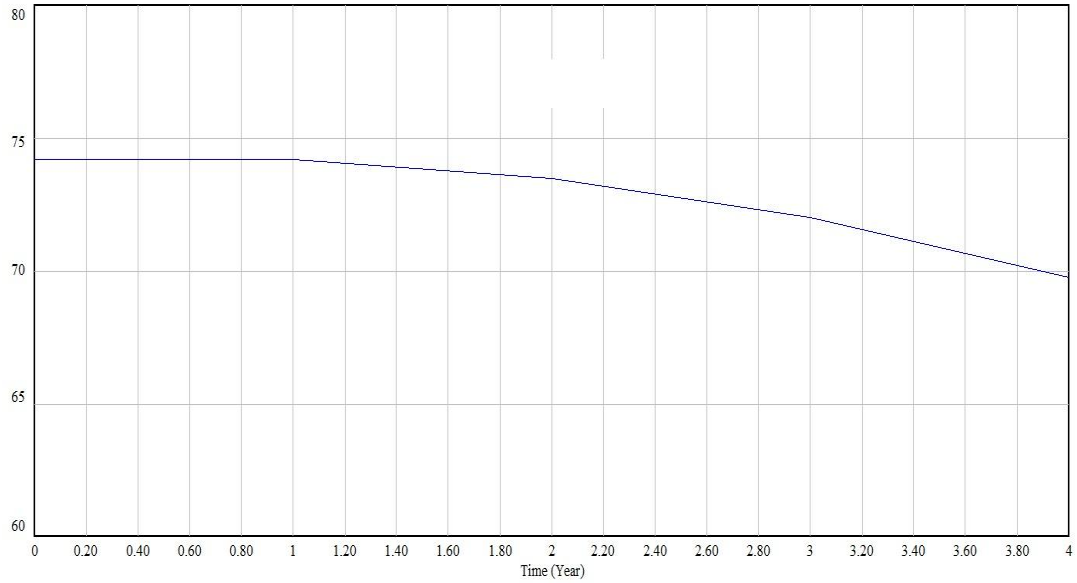


Fig. 6. Life expectancy changes with 10% inflation using Vensim simulations

Figure 6 and Figure 7 show examples of Vensim software output with 10% and 50% inflation rates. Our findings indicate that some, but not all, factors are important. The most significant improvements in life expectancy, at 15 months per capita, are associated with decreases in healthcare inflation, followed by ten-month improvements in gender inequality. Farming systems, social stability, access to clean drinking water and sanitation, effective governance, and elementary school enrollment are all associated with 8 to 10-month increases in life expectancy.

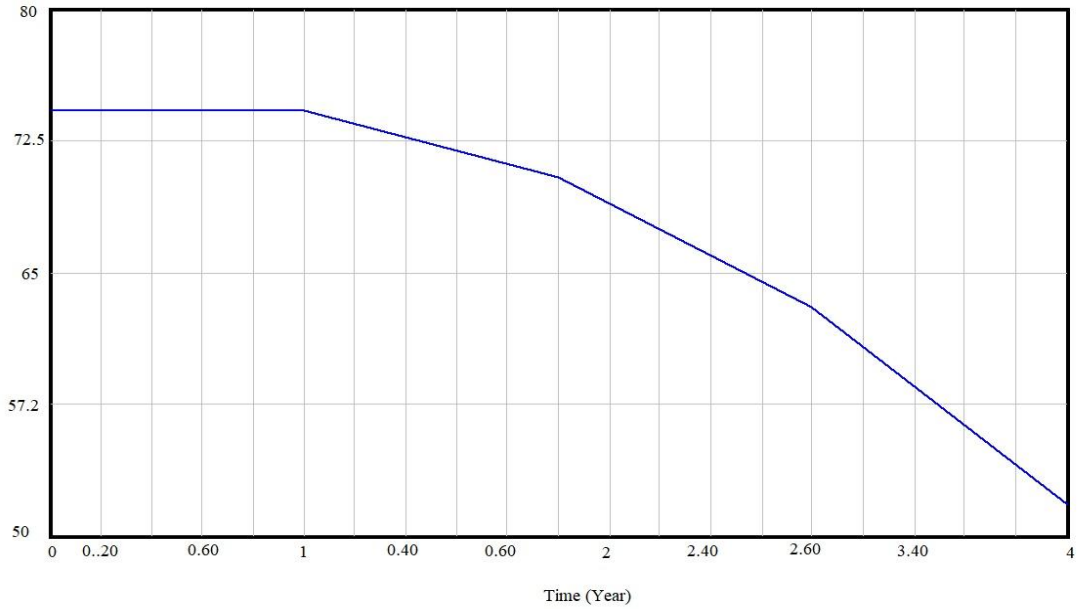


Fig. 7. Life expectancy changes with 50% inflation using Vensim simulations

4.3 Negative Inflation Scenarios

Simulations with negative inflation coefficients (–5% and –10%) revealed the opposite effect: average life expectancy increased to 75.1 years (Figure 8) and 76.2 years (Figure 9), respectively.

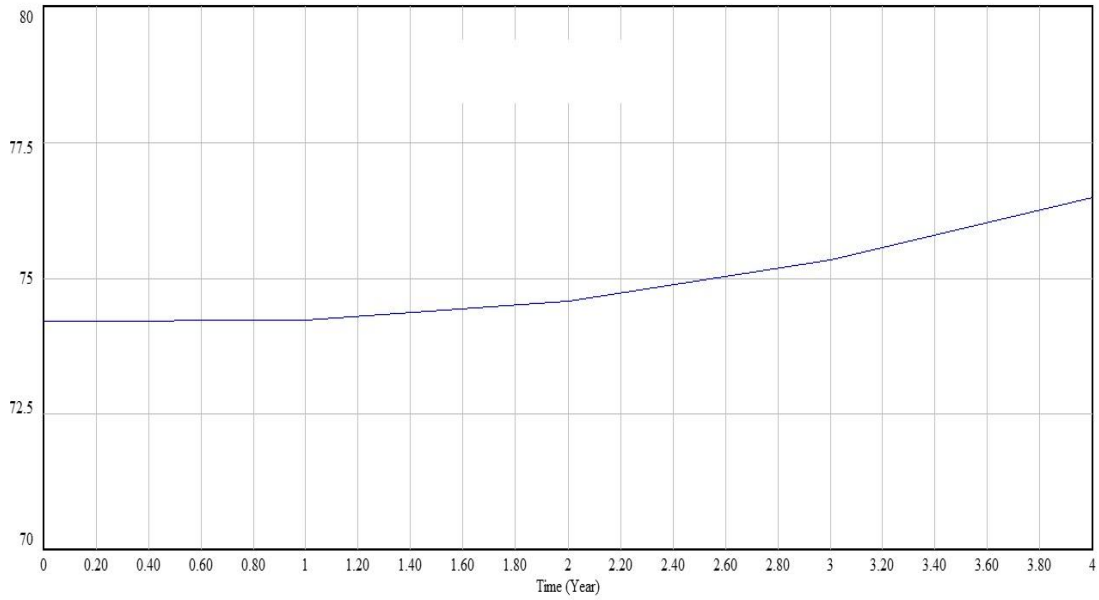


Fig. 8. Life expectancy changes with -5% inflation using Vensim simulations

These results highlight that economic stability and reduced inflation directly enhance life expectancy outcomes by improving the affordability of healthcare and essential goods. A sensitivity analysis was conducted by varying model coefficients ±10%. The analysis revealed that the most influential factors were:

i. inflation rate (sensitivity coefficient: –0.62);
ii. environmental quality index (+0.41);
iii. access to healthcare services (+0.39);
iv. nutrition and food security (+0.35).

These results indicate that economic and environmental variables dominate life expectancy outcomes, outweighing purely social or lifestyle-related factors. Besides, Figure 8 and Figure 9 show that the life expectancy index significantly changes when applying a negative inflation coefficient. Observing the slope of the software output graphs after applying different coefficients to the model reveals that the inflation factor affects the life expectancy index.

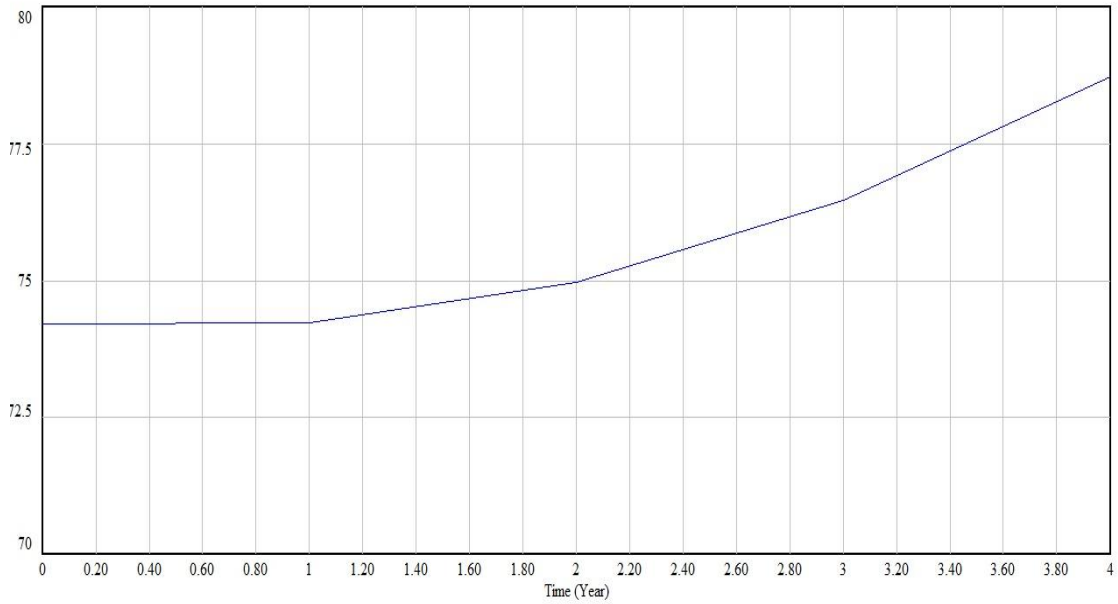
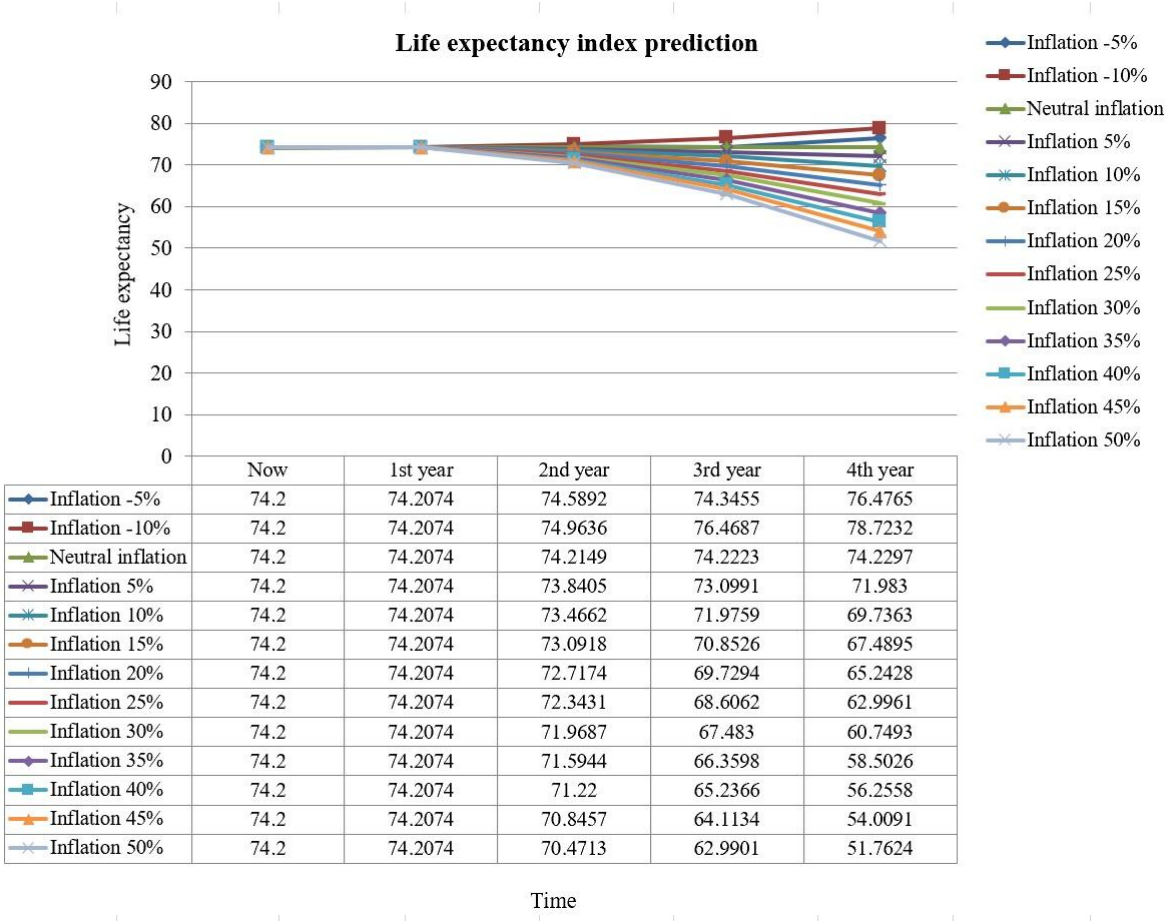


Fig. 9. Life expectancy changes with -10% inflation using Vensim simulations

Figure 10 depicts the forecasted life expectancy index with various inflation rates. The char's slope with different inflation rates demonstrates that the higher the inflation rate, the lower the life expectancy. According to the chart, life expectancy has a positive slope, considering the neutral effect of inflation on the model. It is determined to increase from 74.2 years at the time of research to 74.2297 years after four years. Inflation is expected to decrease life expectancy as it rises. For example, suppose the model's inflation rate increases by 10% per year. In that case, the life expectancy index after four years is determined to be 69.7363 years, comparable to the life expectancy index at the time of the research, which is 74.2 years. Otherwise, a decrease of 4.4637 years is determined.

According to the findings in Figure 10, inflation, a crucial indicator of a country's life expectancy status, has a negative and minimal link with life expectancy minus inflation. At the same time, data reveal that a 5-50 percent increase in inflation reduces life expectancy by 0.005085 percent. Life expectancy has a significant and negative association with population growth. After determining the

long-run result among the model's variables, we can find the short-run dynamics among the model's variables. Markedly, the main disadvantage is the growing population. It reduces life expectancy. The administration should try to control population growth by increasing life expectancy. The effects of dynamic systems on factors have a dual effect on life expectancy, increasing the educated population while improving health conditions and protection.



	Now	1st year	2nd year	3rd year	4th year
Inflation -5%	74.2	74.2074	74.5892	74.3455	76.4765
Inflation -10%	74.2	74.2074	74.9636	76.4687	78.7232
Neutral inflation	74.2	74.2074	74.2149	74.2223	74.2297
Inflation 5%	74.2	74.2074	73.8405	73.0991	71.983
Inflation 10%	74.2	74.2074	73.4662	71.9759	69.7363
Inflation 15%	74.2	74.2074	73.0918	70.8526	67.4895
Inflation 20%	74.2	74.2074	72.7174	69.7294	65.2428
Inflation 25%	74.2	74.2074	72.3431	68.6062	62.9961
Inflation 30%	74.2	74.2074	71.9687	67.483	60.7493
Inflation 35%	74.2	74.2074	71.5944	66.3598	58.5026
Inflation 40%	74.2	74.2074	71.22	65.2366	56.2558
Inflation 45%	74.2	74.2074	70.8457	64.1134	54.0091
Inflation 50%	74.2	74.2074	70.4713	62.9901	51.7624

Fig. 10. Predicting life expectancy indicators using various inflation rates

Our study proposes a methodical approach based on pure system dynamics. Regarding constraints, we can highlight population health variables for which data show strong relationships over the last two decades. They should be prioritized in future research and action on socio-economic health determinants. According to the findings, the inflation rate substantially influences life expectancy results. The study also discovers an inverse relationship, with life expectancy decreasing by almost 20% for every unit increase in the inflation rate. Changes in economic position due to the inflation rate are among the factors that predict the population's life expectancy. Markedly, the rising inflation rate significantly reduces the average life expectancy of a country's population.

Our findings correspond with previous research that found inflation and economic shocks as significant predictors of health outcomes. Bahrami [8] indicated that increasing inflation diminished healthcare costs, resulting in deteriorated health metrics. Likewise, Chetty *et al.* [11] demonstrated robust correlations among income, inequality, and life expectancy in the United States. Our findings, however, diverge from those of Taheri et al. [19], who determined that government health expenditure has minimal significant influence on life expectancy. Our model suggests that indirect impacts through inflation and environmental quality [20] indicate that expenditure is more significant when associated with comprehensive socio-economic stability. The consistency and divergence from

previous studies emphasize the significance of a system dynamics approach, which accounts for feedback loops and interdependencies sometimes neglected in conventional econometric models.

5. Conclusion and Future Studies

This study concluded the ranking of factors affecting the life expectancy index using system dynamics in Tabriz, Iran. According to the long-run results, the population had a positive and significant relationship with life expectancy. Inflation had a negative and insignificant relationship with life expectancy. We considered different inflation percentages and examined people's life expectancies using the dynamic system method. The results showed that the life expectancy index significantly changed when a negative inflation coefficient was applied. Observing the slope of the software output graphs after applying different coefficients to the model revealed that the inflation factor affected the life expectancy index. Moreover, the factors and life expectancy index, which had an initial value of 74.2 years at the time of the study, were applied and analyzed from various angles using different inflation rates.

This study has some limitations. Most importantly, the study cannot establish causation, and some proposed factors may represent others. Determinants not included in the models or the relationship were highly complex and influenced by external factors. Gender, genetics, access to health care, sanitation, food and health, activity, lifestyle, and crime rates all influence life expectancy. The imputation of incomplete information impacts our results.

Future researchers investigating the life expectancy index should consider the following suggestions:

i. examine the effect of other variables involved in the proposed model on the life expectancy index;
ii. utilize simulation methods in a larger statistical sample by considering an extended time period.

Funding
This study did not receive any external financial support.

Conflicts of Interest
The author declares no conflicts of interest.

References
[1] Ahmadi, A., & Shojaee, M. (2011). Estimation of life expectancy changes in Chaharmahal va Bakhtiyary Province, Iran, during 2005-2009. *Journal of Shahrekord Uuniversity of Medical Sciences*, *13*, 74-80.
[2] Nasiri, H. A., & Joukar, B. (2008). The relationship between life's meaningfulness, hope, happiness, life satisfaction and depression in a group of employed women, 157-176.
[3] Sepehrdoost, H., & Ibrahim N. S. (2015). The relationship between the development of life insurance and social welfare with health in Iran from 1981 to 2011. *Social Welfare Research, 14*, 53
[4] Alipour, A., Hantoushzadeh, S., Hessami, K., Saleh, M., Shariat, M., Yazdizadeh, B., *et al.* (2022). A global study of the association of cesarean rate and the role of socioeconomic status in neonatal mortality rate in the current century. *BMC Pregnancy and Childbirth, 22*(1), 821. https://doi.org/10.1186/s12884-022-05133-9.
[5] Alam, M. S., Islam, M. S., Shahzad, S. J. H., & Bilal, S. (2021). Rapid rise of life expectancy in Bangladesh: Does financial development matter? *International Journal of Finance & Economics*, *26*(4), 4918-4931. https://doi.org/10.1002/ijfe.2046.
[6] Khaksar, S., & Yazdani Charati, J. (2015). Life Expectancy Trends in Mazandaran Province, 2005-2011. *Journal of Mazandaran University of Medical Sciences, 25*(128), 91-96.

[7] Saffari Nia, M., Eisazadeh, F., & Hamzehei, Z. (2021). Life expectancy predictions based on perceived social support and mental health among those recovering from COVID-19 disease. *Journal of Sabzevar University of Medical Sciences*, *28*(1), 2-9.
[8] Bahrami, R., & Noori, K. (2021). Life expectancy in rural areas of Kurdistan province, Iran in 2013. *Journal of Advances in Environmental Health Research*, *9*(3), 177-182. https://doi.org/10.32598/JAEHR.9.3.1180.
[9] Leng, A., Xu, C., Nicholas, S., Nicholas, J., & Wang, J. (2019). Quality of life in caregivers of a family member with serious mental illness: Evidence from China. *Archives of Psychiatric Nursing, 33*(1), 23-29. https://doi.org/10.1016/j.apnu.2018.08.010.
[10] Hauck, K., Martin, S., & Smith, P. C. (2016). Priorities for action on the social determinants of health: Empirical evidence on the strongest associations with life expectancy in 54 low-income countries, 1990-2012. *Social Science & Medicine*, *167*, 88-98. https://doi.org/10.1016/j.socscimed.2016.08.035.
[11] Chetty, R., Stepner, M., Abraham, S., Lin, S., Scuderi, B., Turner, N., *et al.* (2016). The association between income and life expectancy in the United States, 2001-2014. *JAMA*, *315*(16), 1750-1766. https://doi.org/10.1001/jama.2016.4226.
[12] Nusselder, W. J., Franco, O. H., Peeters, A., & Mackenbach, J. P. (2009). Living healthier for longer: comparative effects of three heart-healthy behaviors on life expectancy with and without cardiovascular disease. *BMC Public Health, 9*(1), 487. https://doi.org/10.1186/1471-2458-9-487.
[13] Katzmarzyk, P. T., & Lee, I. (2012). Sedentary behaviour and life expectancy in the USA: a cause-deleted life table analysis. *BMJ*, *2*(4), e000828. https://doi.org/10.1136/bmjopen-2012-000828.
[14] Rafiei, E., Hashemi Nazari, S. S., & Mehrabi, Y. (2015). Indirect estimation of infant and child mortality rates in Iran: Using 2006 and 2011 census data. *Journal of Mazandaran University of Medical Sciences*, *24*(122), 32-43.
[15] Roffia, P., Bucciol, A., & Hashlamoun, S. (2023). Determinants of life expectancy at birth: a longitudinal study on OECD countries. *International Journal of Health Economics and Management, 23*(2), 189-212. https://doi.org/10.1007/s10754-022-09338-5.
[16] Gracia-de-Rentería, P., Ferrer-Pérez, H., Sanjuán, A. I., & Philippidis, G. (2023). Live and let live: understanding the temporal drivers and spillovers of life expectancy in Europe for public planning. *The European Journal of Health Economics, 24*(3), 335-347. https://doi.org/10.1007/s10198-022-01469-3.
[17] Naimark, D. MJ. (2016). *International Encyclopedia of Public Health* (2nd ed.). Elsevier (pp. 419-431).
[18] Loukine, L., Waters C., Choi, C. K., & Ellison, J. (2012). Impact of diabetes mellitus on life expectancy and health-adjusted life expectancy in Canada. *Population Health Metrics, 10*, 7. https://doi.org/10.1186/1478-7954-10-7.
[19] Taheri, Z., Taheri, Z., Sarteshnizi, N. T., Ghafari, M., & Amiri, M. (2015). Study of distribution the elderly population in Chaharmahal and Bakhtiari Province from 1966 to 2011. *Epidemiology and Health System Journal, 2*(2), 82-87.
[20] Sarioglu, M., Ozsoz, E., Simic, V., & Kara, K. (2025). Integrated Reporting Quality as a Determinant of Financial Performance: Evidence from Emerging and Developed Markets. *Management Science Advances, 2*(1), 239-259. https://doi.org/10.31181/msa21202524.