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Age-Friendly Cities Performance Index: proposal of model

Índice de Desempeño de Ciudades Amigables con las Personas Mayores: propuesta de modelo

Índice de desempenho das Cidades Amigas do Idoso: proposta de modelo

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ABSTRACT: The aim of this research was to build an index model capable of assessing and monitoring the performance of cities as age-friendly ones. The hierarchy of the variables was determined using the "Hierarchical Process Analysis" technique based on the weight assigned by the social actors in a selected municipality in northern Portugal (Trofa). The "Principal Component Analysis" resulted in the Age-Friendly Cities Performance Index (AgeCPI) model, with 29 indicators validated by the participation of the Local Council of Social Action. This case study, evidence the potentiality of the model for the diagnosis of the municipality status, in relation to all municipalities participating in the research.

Keywords: Active ageing; Decision-making process; Performance measures; Social validation.

RESUMEN: *El objetivo de esta investigación fue construir un modelo de índice capaz de evaluar y monitorear el desempeño de las ciudades como amigables con las personas mayores. La jerarquía de las variables se determinó mediante la técnica de "Análisis de procesos jerárquicos" en función del peso asignado por los actores sociales en un municipio seleccionado del norte de Portugal (Trofa). El "Análisis de Componentes Principales" resultó en el modelo del Índice de Desempeño de Ciudades Amigas de las Personas Mayores (AgeCPI), con 29 indicadores validados por la participación del Consejo Local de Acción Social. Este caso de estudio, evidencia la potencialidad del modelo para el diagnóstico del estado del municipio, en relación a todos los municipios participantes en la investigación.*
Palabras clave*: Envejecimiento Activo; Proceso de toma de decisiones; Medidas de desempeño; Validación social.*

RESUMO: *O objetivo desta pesquisa foi construir um modelo de índice capaz de avaliar e monitorar o desempenho de Cidades Amigas do Idoso. A hierarquia das variáveis foi determinada através da técnica de "Análise Hierárquica do Processo" com base no peso atribuído pelos atores sociais de um município do Norte de Portugal selecionado (Trofa). A "Análise de Componentes Principais" resultou no modelo de Índice de Desempenho de Cidades Amigas do Idoso (AgeCPI), com 29 indicadores validados com a participação do Conselho Local de Ação Social. Este estudo de caso evidencia a potencialidade do modelo para o diagnóstico da situação do município, em relação a todos os municípios participantes da pesquisa.*
Palavras-chave: *Envelhecimento Ativo; Processo de tomada de decisão; Medidas de desempenho; Validação social.*

Introduction

Currently, the world observes two unprecedented demographic phenomena: urbanization and population ageing (Muenz 2007; Ribeiro and Paúl 2011; UN 2002; WHO 2007). This reconfiguration of the demographic and age structure implies the re-dimensioning of social demands and, the offer of services to attend them. In the scope of

public services, it is necessary to provide decision-makers with information so that they can respond effectively to ensure that the actual demands are met.

According to the United Nations (UN 2011), in 2010, more than half of the world's population lived in cities and will be over 68% in 2050. On the other hand, the world population with 60 and over years will double from 11% in 2010 to 21.8% in 2050, approximately 2 billion old people (UN 2009; WHO 2007).

Aware of the phenomena of urbanization and population ageing, the UN held the Second World Assembly on Ageing in Madrid in 2002 and defined the guidelines for health and social public policies regarding the older population for the 21st century.

This scenario points out the need for public policies for older people that include, among other concerns, diagnostic mechanisms that guide decision-making of public and private stakeholders, to strength the care network and the promotion of quality of life of old people.

The article 11 of the Political Declaration of Second World Assembly's on Ageing (UN 2002) highlighted the importance of international research on ageing and age-related issues as an instrument for the formulation of ageing policies based on reliable and uniform indicators, prepared by national and international statistical organizations (UN, 2003, p. 21).

The Process of Human Ageing

Human ageing is a phenomenon that must be regarded at the biopsychosocial level (Fernández-Ballesteros, 2009; McMullin, 2000; Okuma, 1998; Paúl and Ribeiro, 2012; Sant'anna, Câmara and Braga, 2003). At the biological level it is characterized by the decline of physical capacities and the increase of vulnerability to diseases, which is called senescence. At the psychological level, there are changes in intellectual and motivational capacity, and at the social level, there are also changes of social status namely due to retirement (Fontaine, 2000; Paúl, 2005).

According to Fernández-Ballesteros, *et al.* (2013), only 25% of the way one gets older is the result of genetic aspects, with 75% being influenced by the environment and behavioral aspects. Thus, individual ageing is not a random phenomenon, but the individual is an active agent in its determination.

M. Powell Lawton's "Competence / Press Model" describes the interrelation between individual competencies and the social and physical pressures of the environment, explaining the connections between epidemiology and gerontology, and was therefore also called "Ecological Model of Ageing" (Lawton and Nahemow, 1973; Satariano, 2006). In this model, the individual and the environment are considered as an interdependent system, in which both factors influence each other (Wahl and Weisman 2003).

For WHO, policies and programs should focus on enabling processes that regain function and increase the participation of older people in all activities of society. Therefore, maintaining functional capacity and autonomy during the ageing process is a fundamental goal for individuals and government (WHO 2002).

Active Ageing

The term active Ageing was adopted by WHO in the late 1990s to designate "The process of optimizing health, participation and safety opportunities with the objective of improving the quality of life as people age" (WHO, 2002, p. 13).

According to some authors, active ageing is not a new concept but represents the efforts of international organizations, such as the United Nations (UN), WHO, The Organization for Economic Co-operation and Development (OECD), and the European Union (EU), to incorporate and operationalize the term in national political agendas (Boudiny, 2013; Hutchison *et al.*, 2006; Lynott and Lynott, 1996; McMullin, 2000). According to Hutchison *et al.* (2006), the term active ageing can be traced back to the early 1960s in the United States where it was stated that the key to successful ageing was activity and financial success.

Active Ageing is an emerging political orientation of the WHO, at an international level, focusing on social determinants of health, such as: economic determinants (income, social protection, decent work opportunities), social determinants (social support and education), personal determinants (biological, genetic and psychological factors), behavioral determinants (healthy lifestyle, active participation in health care), physical environment (accessibility to transport services, housing and safe neighborhood), social and health services (health promotion and prevention of accessible and quality diseases) and the cross-sectional determinants of culture and gender (Hutchison *et al*.. 2006; WHO

2002). For WHO (2007), these determinants must be viewed from a life-cycle perspective, recognizing that older people are not a homogenous group and that individual diversity increases with age.

In a broader vision, the concept of healthy ageing, which had been advocated until then, was incorporated in active ageing in 2002 by the WHO, in addition to socioeconomic, psychological and environmental aspects, and all those aspects act as predictors of ageing with quality of life (Ribeiro and Paúl, 2011; WHO, 2007).

To Marques, Batista and Silva (2012), the active ageing paradigm calls for a reformulation of the balance between activity and reform, work and health, participation and exclusion, in order to move towards a more inclusive society with no age discrimination.

Performance Measurement Models for Active Ageing

Policymakers generally agree that we can and should do better in measuring social and economic progress as a means of making improvements. An index that measures the well-being of older people can draw attention to successes and help progress, as well as identify areas that still need to be addressed by public policy. The main existing instruments are briefly summarized below as well as the main critics raised by their utilization that we try to overcome with a new proposal.

Active Ageing Index - AAI

The Active Ageing Index (AAI) was developed by the European Center for Social Welfare Policy and Research in Vienna (ECV) in collaboration with the Directorate General for Employment, Social Affairs and Inclusion of the European Commission and the United Nations Economic Commission for Europe as part of the European Year of Active Ageing and Solidarity between Generations 2012 (Zaidi *et al*., 2013).

According to Zaidi *et al.* (2013), the AAI is a new analytical tool that aims to help policy makers in developing policies for active and healthy Ageing. To the author, mobilizing the potential of older individuals is critical to ensuring prosperity for all generations in Ageing societies.

To reflect the multidimensional concept of active Ageing, AAI is built on four different domains: employment, participation in society, independent, healthy and safe living. Each domain has a different aspect of active and healthy Ageing and aggregates 22 indicators:

- Employment: aggregates the indicators employment rate 55-59 years, employment rate 60-64 years, employment rate 65-69 years and employment rate 70-74 years.
- Participation in Society: aggregates the indicators voluntary activities, care of children and grandchildren, care of other elderly and political participation.
- Independent, healthy and safe living: aggregates the indicators physical exercise, access to health and dental care, independent living, financial security, physical security and lifelong learning.

Global Age Watch Index

According to the NGO HelpAge International (HelpAge International, 2013, p. 12), the Global AgeWatch Index was developed to promote the development of policies and programs that improve the quality of life and well-being of current and future generations.

The Global AgeWatch Index aggregates 13 different indicators across the four domains: income security, health status, education and employment, and an age-friendly environment where internationally comparable data are available.

Income Security: Describes access to enough income and the ability to use it independently to meet basic needs at an older age.
Health Status: Advancing age is linked to physical fragility and is also closely associated with the risk of health problems and disability.
Employment and Education: This domain describes elements of the coping capacity and capability attributes of older people.
Enabling environment: Older people want to have the freedom of choice to live independent, and self-reliant lives. They wish to feel safe in the environment they are living in and have access to good public transport.

Futurity Index

The State Secretariat of Assistance and Social Development (SEADS) of the State of São Paulo built the Futurity Index (IF), under the auspices of the United Nations Population Fund - UNFPA, taking as dimensions of active Ageing, Health, Safety and the participation (SEADS, 2008, pp. 14-15).

The FI brings 8 indicators distributed over 3 dimensions, namely:

- Health: Identifies whether there is a high rate of early mortality among the elderly, that is, mortality among people aged 60 to 69 years.
- Social Protection: measures basic and special social protection actions carried out by municipalities for the benefit of the older people who are in a situation of social vulnerability.
- Participation: Identifies whether there is an offer of culture, sports and tourism activities and / or programs carried out by the city government for the elderly population.

The index models identified in the literature allow comparisons at national (Active Ageing Index and the AgeWatch Index) and at local level (Futurity Index) but most of the times the profiles obtained are too abstract to inform political decisions. Let's look, for example, to the classification made with the AAI of Portugal (UNECE/EC 2019, p. 27). In fact, Portugal appears in a comfortable position (9 out 28) due to a high percentage of people working after 65 years. This could understood as having good public policies toward old people implemented but in fact it means manly that pensions are too low or inexistent to allow people to retired. So, this kind of indicators did not lead to any valuable policy to be implemented in order to raise active Ageing. On the other hand, in order to evaluate the results of the efforts undertaken, it is necessary to develop simple evaluation tools that can periodically capture the results of the implemented actions. These instruments should serve as antennas in order to capture and signal the changing needs of public policies.

Our main objective was to create and implement a new instrument (AgeCPI) that may be easily used at municipality level all around the world. Specific aims of this research were: 1. to test its utility in a municipality (Trofa); 2. to diagnose the stage of optimization of active Ageing opportunities and 3. to propose political changes based on the empowerment of the population in the definition of public policies, at the local level.

Methodological Procedures

The scarcity of resources and the excessive demands faced by policy makers require decision-makers to use increasingly efficient and flexible instruments without the need to make major investments in time and resources in their use.

The statistical techniques applied in the construction of Age-Friendly Cities Performance Index (AgeCPI) were:

The Multicriteria Hierarchical Analytical Process (AHP) that was developed at the Wharton School of Business by the mathematician Thomas Saaty with the aim of facilitating the solution of complex problems related to decision making (Liberatore and Nydick, 2003; Islam and Saaty, 2010).

The AHP methodology seeks to integrate different dimensions of analysis, in a structured and systematic way. Through this, weights and priorities are derived from a set of subjective judgments, made by evaluators or participants involved in the process. The model also allows the development of a hierarchical structure in which the relationships between the main goal or objective to be achieved and the other elements considered for decision making are visualized (Silva, Cândido and Martins, 2009).

The Principal Component Analysis (PCA) technique, being one of the factorial methods of integrated data analysis in the field of multivariate statistics, allows the analysis of the data with a view to its reduction, elimination of overlaps and the choice of the most representative forms of data from linear combinations of the original variables (Oliveira and Amaral, 2007).

The methodology for granting and developing the proposed AgeCPI model is based on the need to take into account a set of aggregated indicators, weighted and legitimized from the subjectivities of social actors working in local institutions directly involved with the theme when formulating new strategies for structuring the decision-making process. The basic assumption of the research is that the more adequate and legitimate the information available in the decision-making process, the better the conditions for the viability of local actions towards the active ageing of the population.

For a better understanding of the proposed model, it was applied to a case study in a Portuguese municipality, (Trofa). This Portuguese municipality belonging to the

Porto Metropolitan Area (AMP), has about 72.3 km² and 38,999 inhabitants (INE, 2011). With regard to population density, the municipality of Trofa has 538.51 inhabitants /km².

This article is based on the system of indicators developed in Pinheiro *et al.* (2015). The developed indicator system comprises the underlying concept of active ageing and its scope is to assess the performance of policies and programs to promote friendly cities for older people. Therefore, the indicators were selected to evaluate opportunities for optimizing safety, health, and people's participation as they age.

In order to achieve the proposed goal, the following steps were necessary:

Step 1: Hierarchy of the indicator system

The hierarchy sought to identify, among the variables of the indicator system, the order of importance (priority) perceived by local social actors, so that organized society can contribute to decision-making on policies and practices aimed at making cities. The methodology proposed here sought to legitimize subjective value judgments, assuming that subjectivity is present in the decision-making process.

The strategy of approach to the social actors would be through the Local Council of Social Action - CLAS. Trofa's CLAS consists of 35 institutions that act in the social protection of vulnerable groups, i.e., the municipal council of the older people (Pinheiro *et al*., 2018).

Step 2: Select the indicators for AgeCPI

In the process of selecting the indicators for the composition of AgeCPI, the PCA statistical technique was applied to the indicators of the conceptual model related to each theme of the dimensions considered in the conceptual model developed in Pinheiro *et al.* (2015), according table 1.

Table 1 - Conceptual model of age-friendly cities performance assessment indicators system

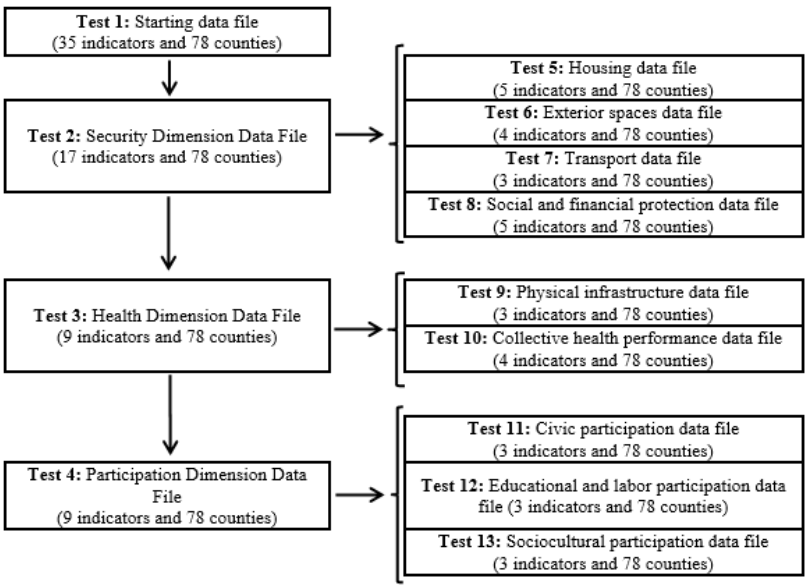
DIMENSIONS	THEMES	INDICATORS
SECURITY	Housing	1. Adequacy of housing
		2. Overcrowded accommodation
		3. Accessibility to buildings
		4. Elderly person households
		5. Telecare domiciliary
	Outdoor Spaces	6. Urban green spaces
		7. Crime rate
		8. Density population elderly
		9. Spending on environment
	Transport	10. Accidents road with elderly
		11. Public Transportation access
		12. Firefighters per capita elderly

	Social and Financial Protection	13. Potential Support Ratio 14. Proportion of old age pensioners 15. Average value of the old age pension 16. Social facilities 17. Senior citizen card
HEALTH	Physical Infrastructure	18. Access to basic health services 19. Beds per capita 20. Pharmacies per capita
	Infrastructure Human Resources	21. Nurses per capita 22. Doctors per capita
	Collective Performance in Healthcare	23. Ageing index 24. Longevity index 25. Early mortality of elderly 26. Difficulties among elderly residents
PARTICIPATION	Civic Participation	27. City council of the elderly 28. Participation in elections 29. Bank volunteer
	Educational and Laboral Participation	30. Employment rate of the elderly 31. Literacy rate 32. Compulsory education
	Sociocultural Participation	33. Cultural facilities 34. Collectivities access 35. Telecommunications access 36. Official website of city

Source: Pinheiro *et al.* (2015, p. 629)

Thus, the PCA technique inserted in this stage of the work allowed identifying, for each theme of the model, the indicators that had a strong association, in order to allow the maintenance of the indicators that best fit the model (figure 2). We have retained, by factorial axis, the variables with the highest coordinate in absolute value.

Fig. 2 - ACP Data Exploration Testing Plan, around here



Step 3: AgeCPI Calculation Model

The procedure for calculating an "I" index was derived from the sum of the output of each of its indicators versus the weighting attributed by local actors, according to expression 1:

$$I = [W_1 \times I_1 + W_2 \times I_2 + W_3 \times I_3 + \cdots + W_n \times I_n] \quad (1)$$

Where: I - index; I_1, I_2, I_3 ... I_n - n indicators; W_1, W_2, W_3 ... W_n - weight assigned to each index ($\Sigma W_n = 1$)

Mathematically, AgeCPI was calculated by the additive weighted aggregation of its 3 thematic indexes, according to expression 2:

$$AgeCPI = [(WSGI \times SGI) + (WHEI \times HEI) + (WPAI \times PAI)] \quad (2)$$

Where: AgeCPI - Age-Friendly Cities Performance Index; SGI - Security Index; HEI - Health Index; PAI - Participation Index; (WSGI, WHEI, WPAI) - weight assigned to each index.

Step 4: Validation of AgeCPI

AgeCPI allows analyzing the evolution of a municipality for a period and / or establishing an analysis of a given municipality comparative with a set of municipalities for a specific moment in time.

In this stage, AgeCPI was validated in its ability to analyze the current state of the performance of the municipality of Trofa in relation to a set of 77 municipalities in the Portuguese mainland, with a population between 20 and 100 thousand inhabitants, population. Data from the variables of the 2011 census and of the annuals from 2010 to 2012 were used, as well as a survey on the website of each municipality, in the year 2013.

From a diagnostic point of view and performance monitoring, the results of the various indicators will only make sense if they can adequately measure and communicate progress against certain quantified goals or targets.

To do so, in the transformation of the data into information and for each of the indicators, a scale was constructed whose values, maximum and minimum, correspond to 1.00 (ideal performance) and 0.00 (unacceptable performance), respectively. This research adopted a scale of performance, where for a relative situation among the 78

municipalities participating in the survey in the range between 0.76-1.00 corresponds a performance called "Ideal"; values between 0.51-0.75 corresponds to an "Acceptable" performance; values between 0.26-0.50 corresponding to an "Alert" performance and, values ≤ 0.25 representing a "Critic" performance.

Results and Discussion

The system of indicators developed in Pinheiro *et al.* (2018), with the participation of 55 social actors working in about 91.7% of the partner organizations of the Trofa social network, results the hierarchical system appearing in the table 2.

Table 2 - Hierarchy of indicators system by social actors

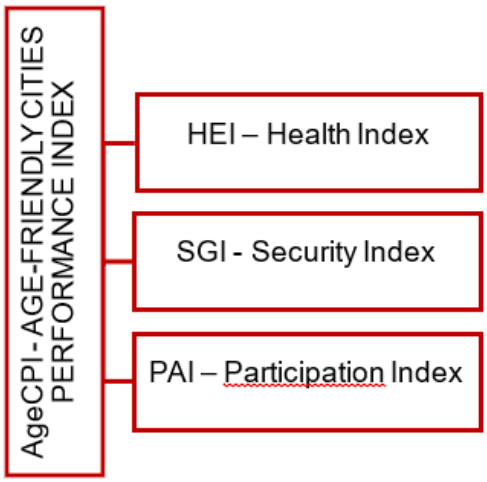
Dimension	Weight	Themes	Weight	Indicators	Weight
Security	0.292	Housing	0.330	1. Elderly Person Households	0.242
				2. Adequacy of Housing	0.231
				3. Accessibility to Buildings	0.207
				4. Overcrowded Accommodation	0.170
				5. Telecare Domiciliary	0.150
		Outdoor Spaces	0.155	6. Crime Rate	0.383
				7. Density Population Elderly	0.238
				8. Urban Green Spaces	0.221
				9. Spending on Environment	0.159
		Transport	0.190	10. Public Transportation Access	0.448
				11. Firefighters per Capita Elderly	0.304
				12. Accidents Road with Elderly	0.248
		Social and Financial Protection	0.325	13. Potential Support Ratio	0.282
				14. Average Value of the Old Age Pension	0.245
				15. Social Facilities	0.208
				16. Proportion of Old Age Pensioners	0.175
				17. Senior Citizen Card	0.090
Health	0.500	Physical Infrastructure	0.230	18. Access to Basic Health Services	0.510
				19. Beds per Capita	0.304
				20. Pharmacies per Capita	0.186
		Infrastructure Human Resources	0.270	21. Doctors per Capita	0.510
				22. Nurses per Capita	0.490
		Collective Performance in Healthcare	0.500	23. Early Mortality of Elderly	0.298
				24. Difficulties among Elderly Residents	0.280
				25. Ageing Index	0.215
				26. Longevity Index	0.207
Participation	0.208	Civic Participation	0.302	27. City Council of the Elderly	0.438
				28. Bank Volunteer	0.282
				29. Participation in Elections	0.280
		Educational and Laboral Participation	0.388	30. Literacy Rate	0.412
				31. Employment Rate of the Elderly	0.307
				32. Compulsory Education	0.281
		Sociocultural Participation	0.310	33. Collectivities Access	0.335
				34. Cultural Facilities	0.285
				35. Telecommunications Access	0.256
				36. Official Website of City	0.124

AgeCPI Model Proposal

The Ageing process, whether individual or demographic, is characterized by its complexity, mutability and irreversibility, and has required the efforts of public managers and decision makers to adequately address their challenges and opportunities.

This proposal of performance index of friendly cities for old people results from the weighted aggregation of three sets of hierarchical and organized indicators in their respective indexes: Health Index, Safety Index and Participation Index, consistent with the dimensions of the conceptual model (figure 1).

Fig. 1 - Proposal Model of AgeCPI, around here



In the approach used for the AgeCPI proposition, two analytical tools were used: AHP and PCA, both with the purpose of elaborating an index that ordered a set of indicators that, as far as possible, better reflect the local reality studied, so as to enable transparency and understanding by experts and the general public.

According to Silva, Cândido and Martins (2009), some analysts adopt the posture of considering a high number of indicators in index construction, hoping not to lose any information. For the author, the result of the methodologies thus considered, translate, in part, into an index whose meaning is difficult to perceive. Following the parsimony principle, the number of indicators present in an index should be as small as possible, but not less than necessary.

The use of PCA in this research is associated with the idea of reducing the dimensionality of the starting data in order to obtain the smallest possible number of linear

combinations (main components) of the initial set of proposed hierarchical indicators that retain the maximum information contained in each theme of the original variables.

In the process of statistical selection of the indicators to compose AgeCPI, the measure of importance used for the selection of the indicators was the decomposition of the covariance matrices in their eigenvalues obtained by the PCA (explained variance). The first eigenvalue determined corresponded to the highest percentage of the total variability contained in the indicators of each studied subject and so on. Once the associations between the indicators (linear combinations) were identified, the decision of which to exclude was, whenever possible, based on the indicator that received the least weight in the AHP.

Another aspect considered in the interpretation of the PCA, regarding the exclusion of indicators, was that when two or more indicators presented a strong association, it was only considered if it was observed along the different codings (initial data matrix, data matrix of the dimensions and matrix of subject data). When this association manifested itself in only one of the encodings, it was chosen to keep them in the final model of AgeCPI.

Health Index – HEI

The health dimension was hierarchized by the AHP method as the most important dimension for the AgeCPI.

After the implementation of the HEI test plan, which resulted in the exclusion of the Beds per Capita (BPC) and Longevity Index (LGI) indicators, the weighted ISA proposal is composed of the following indicators: Access to Basic Health Services (ABH), Pharmacies per Capita (FPC), Nurses per Capita (NPC), Doctors per Capita (DPC), Ageing Index (AGI), Early Mortality of Elderly (EME) and Difficulties among Elderly Residents (DER).

After the reduction of the number of indicators, it was necessary to reanalyze the AHP to correct the values of the weights of the indicators in each theme, as recommended by Costa (2006, p. 74).

For the validation of the AgeCPI model, we sought to apply it to a case study for the municipality of Trofa. Therefore, after defining the indicators of each index, the calculation for each index will be presented, ending with the calculation of AgeCPI.

Table 3 shows the composition and weighting of the health dimension indicators in the IDCAI after the application of the PCA methods and correction of the weights by the AHP in each theme, as well as the calculation of the health index (HEI) for the city of Trofa.

Table 3 - Final composition and calculation of the HEI for the city of Trofa

Theme	Indicators	Relative Performance of Trofa (a)	Weight on Dimension			HEI (a*b*c)
			Weight of Theme (b)	Weight of Indicator (c)	Weighting (b*c)	
Collective Performance in Healthcare	EME	0.234	0.500	0.380	0.190	0.044
	DER	0.336		0.348	0.174	0.058
	AGI	0.850		0.272	0.136	0.116
Infrastructure Human Resources	DPC	0.205	0.270	0.510	0.138	0.028
	NPC	0.141		0.490	0.132	0.019
Physical Infrastructure	ABH	0.284	0.230	0.711	0.164	0.046
	FPC	0.364		0.289	0.066	0.024
Total			**1.000**		**1.000**	**0.336**

Mathematically, the HEI is the additive aggregation of the weighting of the indicators (b*c) with the relative performance of Trofa (a).

Therefore, the final expression for the HEI calculation is given by the following expression:

$$HEI = [0.164(ABH) + 0.066(FPC) + 0.132(NPC) + 0.138(DPC) + 0.136(AGI) + 0.190(EME) + 0.174(DER)]$$

$$HEI = 0.336$$

Security Index - SGI

Second in the hierarchy scale defined by the AHP method, the security dimension of the information system was applied the PCA method to reduce the number of indicators.

Following the implementation of the SGI test plan, which resulted in the exclusion of Overcrowded Accommodation (OVA), Urban Green Spaces (UGS) and Proportion of Old Age Pensioners (PAP) indicators, the weighted SGI proposal is thus composed of the following indicators Elderly Person Households (EPH), Adequacy of Housing (TAH), Accessibility to Buildings (ACB), Home Telecare (TDO), Potential Support Ratio (PSR), Average Value of the Old Age Pension (VAP), Social Facilities (SOF), Senior Citizen Card (SCC), Public Transportation Access (PTA), Firefighters per Capita Elderly (FPE),

Accidents Road with Elderly (ARE), Crime Rate (CRA), Density Population Elderly (DPE), Spending on Environment (SEN).

After the application of the PCA and correction of weights, in each issue of the security dimension, the security index was calculated for the city of Trofa (Table 4).

Table 4 - Final composition and calculation of the SGI for the city of Trofa

Theme	Indicators	Relative Performance of Trofa (a)	Weight on Dimension			SGI (a*b*c)
			Weight of Theme (b)	Weight of Indicator (c)	Weighting (b*c)	
Housing	EPH	0.928	0.330	0.300	**0.099**	0.092
	TAH	0.543		0.280	**0.092**	0.050
	ACB	0.866		0.243	**0.080**	0.069
	TDO	1.000		0.177	**0.058**	0.058
Social and Financial Protection	PSR	0.756	0.325	0.342	**0.111**	0.084
	VAP	0.645		0.309	**0.100**	0.065
	SOF	0.111		0.241	**0.078**	0.009
	SCC	1.000		0.108	**0.035**	0.035
Transport	PTA	0.000	0.190	0.448	**0.085**	0.000
	FPE	0.263		0.304	**0.058**	0.015
	ARE	0.950		0.248	**0.047**	0.045
Outdoor Spaces	CRA	0.972	0.155	0.485	**0.075**	0.073
	DPE	0.143		0.321	**0.050**	0.007
	SEN	0.094		0.194	**0.030**	0.003
Total			**1.000**		**1.000**	**0.605**

The Safety Index for Trofa was calculated according to expression 1, according to table 3, obtaining an SGI value of 0.605. The final expression for SGI determination is given by:

$$SGI = [0.099(EPH) + 0.092(TAH) + 0.080(ACB) + 0.058(TDO)] + [0.111(PSR) + 0.100(VAP) + 0.078(SOF) + 0.035(SCC)] + [0.085(PTA) + 0.058(FPE) + 0.047(ARE)] + [0.075(CRA) + 0.050(DPE) + 0.030(SEN)]$$

$$SGI = 0.605$$

Participation Index - PAI

The participation dimension was ranked in the third order of importance for the evaluation of Trofa's performance in AgeCPI.

After completing the PAI test plan, which resulted in the exclusion of the Compulsory Education (CED) indicator and Official Website of City (WEB), the weighted PAI proposal is composed of the following indicators: City Council of the Elderly (CCE), Volunteering Bank (BAV) Participation in Elections (PEL), Employment

Rate of the Elderly (ERE), Literacy Rate (LRT), Collectivities Access (COL), Cultural Facilities (CUL) and Telecommunications Access (TEL).

Table 5 shows the composition and weighting of the indicators of the participation dimension in the AgeCPI after the application of the PCA method and correction of the weights by the AHP in each theme, as well as the calculation of the participation index for the city of Trofa.

Table 5 - Final composition and calculation of the PAI for the city of Trofa

Theme	Indicators	Relative Performance of Trofa (a)	Weight on Dimension			PAI (a*b*c)
			Weight of Theme (b)	Weight of Indicator (c)	Weighting (b*c)	
Educational and Laboral Participation	LRT	0.887	0.388	0.550	**0.213**	0.189
	ERE	0.212		0.450	**0.175**	0.037
Sociocultural Participation	COL	0.558	0.310	0.394	**0.122**	0.068
	CUL	0.203		0.314	**0.097**	0.020
	TEL	0.165		0.292	**0.090**	0.015
Civic Participation	CCE	1.000	0.302	0.438	**0.132**	0.132
	PEL	0.858		0.281	**0.085**	0.073
	BAV	1.000		0.280	**0.085**	0.085
Total			**1.000**		**1.000**	**0.619**

The calculated value for the Participation Index was 0.619 and the final expression for the PAI determination is given by:

$$PAI = [0.213(LRT) + 0.175(ERE)] + [0.122(COL) + 0.097(CUL) + 0.090(TEL)] + [0.132(CCE) + 0.085(PEL) + 0.085(BAV)]$$

$$PAI = 0.619$$

Calculation of AgeCPI for Trofa

Mathematically, AgeCPI was calculated by the additive weighted aggregation of its three indexes: HEI, SGI and PAI, according to expression 2, offering relevant information for the definition of public policies appropriate to the reality of the municipality of Trofa, so that it is possible to establish the bases to make it a friendly municipality for older people.

In AgeCPI, the HEI, SGI and PAI index weights were, respectively 0.500; 0.292 and 0.208. The calculated value for the AgeCPI of Trofa municipality was 0.475 and the final expression for AgeCPI determination is given by:

$$AgeCPI = [0.500(HEI)] + [0.292(SGI)] + [0.208(PAI)]$$
$$AgeCPI = [0.500x0.336] + [0.292x0.619] + [0.208x0.605]$$
$$AgeCPI = 0.475$$

This result shows, for the municipality of Trofa, in a comparison with the other 77 municipalities of the research, an "Alert" situation, but very close to an "Acceptable" condition. Table 6 shows the health, safety and participation indexes, as well as AgeCPI, performances in relation to being friendly to old people.

Table 6 - Levels of performance of the municipality of Trofa

THEME INDEX	PONTUATION	PERFORMANCE SCALE
HEI	0.336	ALERT
SGI	0.619	ACCEPTABLE
PAI	0.605	ACCEPTABLE
AgeCPI	**0.475**	**ALERT**

This decision-making aid tool enables public managers and the local community to: Generate a diagnosis of the situation of the municipality, within a framework that approximates the multidimensionality of the concept of active ageing; Conduct a local comparative analysis at various points in its history, and; To visualize, at a given moment, the needs and imbalances of the municipality, in order to help in defining the dimensions in which the implementation and / or adjustments in the public policies are necessary.

Discussion

The model adopted for the calculation of AgeCPI required the creation of indexes, according to the dimensions adopted in the model, which are: Health Index - HEI, Security Index - SGI and Participation Index - PAI. Each index was formed by the additive weighted aggregation of its indicators. Therefore, mathematically, AgeCPI was calculated by the additive weighted aggregation of its 3 (three) indexes.

For the validation of AgeCPI it was decided to apply it to a Portuguese municipality, Trofa, located in the northern region of Portugal.

In this perspective, the conclusions obtained with the application of the AgeCPI model show that Trofa is in a relative performance situation classified as "Alert", but very close to an "Acceptable" condition.

The Health Dimension, considered by the social actors as the most important relative to the municipality of Trofa, that is, which should receive greater attention from public decision-makers in improving the quality of life of the old population, presented a diagnosis characterized by a situation of "Alert". Only the Ageing Index indicator is in an "Ideal" condition, the remaining indicators being in a "Critical" or "Alert" condition.

The main liabilities identified referred to a high rate of early mortality of old people, probably reflecting the precarious infrastructure in human resources (e.g. doctors and nurses per inhabitant), a fact verified by social actors, placing them as critical aspects for Trofa.

Regarding Physical Infrastructure in Health, Trofa has only one health center with two extensions, for a population of almost 40 thousand inhabitants. There are no public hospitals, and users are referred to hospitals in Santo Tirso and Famalicão nearby cities. Although neighbor municipalities, the lack of regular public transportation linking the three municipalities makes it difficult to access hospital services.

This finding leads to the need for policies and actions to improve these indicators, considering that this dimension was pointed out by all social actors as the most important for improving the performance of Trofa as a friendly city to old people.

The 14 indicators of the Security Dimension are organized, in the order of priorities revealed by the social actors, in the themes: Housing, Social and Financial Protection, Transport and Outdoor Spaces. This dimension had a diagnosis characterized by an "Acceptable" situation, explained in part by the good performance of the housing theme. Of the four indicators, three present an "Ideal" situation (Elderly Person Households, Accessibility to Buildings and Home Telecare) and one in an "Acceptable" situation (Adequacy of housing).

In this dimension, the most critical situations have to do with the capacity of social facilities, access to urban public transport, the great dispersion of the old people in the territory (low Population Density of the Elderly) and the low investment in environment.

The issues of the Participation Dimension are organized in the themes: Educational and Labor Participation, Sociocultural Participation and Civic Participation. These gather the following indicators: City Council of the Elderly, Volunteering Bank, Participation in Elections, Employment Rate in the Elderly, Literacy Rate, Collectivities Access, Cultural facilities and Telecommunications access.

Placed in third and last order of priority in the concerns of social actors, the Participation Dimension had a diagnosis that places it in an "Acceptable" situation, due mainly to the high rates of literacy of the population and the creation of mechanisms of civic participation of the population, either by the existence of Volunteering Bank and City Council of the Elderly, as well as by the Participation in Elections that decide the destination of the municipality.

The worst performances have to do with the Employment Rate in the older Population, pulled by women, and the indicator Cultural Facilities. These findings suggest the need for policies and actions to improve these indicators of the Participation Dimension, considering that the capacity and the effort expended by governments and local society are fundamental in transforming the Trofa in an Age-friendly City.

Conclusions

The concept of active ageing, even though it has been widely used in the last decade and has become a mandatory reference in academic, political and social debates, is far from having a consensual meaning. The complexity and lack of consensus on the term was a stimulus for the construction of a new proposal for a decision support instrument, embodied in this research.

The innovative aspect adopted in the construction of AgeCPI concerns the hierarchization of local issues by social actors, in a clear commitment of the decision-maker to the empowerment of the organized society at the local level. The multicriteria AHP analysis technique was used not to eliminate the subjectivity present in decision making, but to apprehend it, transforming it into decision subsidies.

In this sense, the AHP multicriteria analysis method, as it was applied to a data sheet, directly on the computer, and which result could be viewed immediately after the trial, proved to be versatile and easy to use by local social actors.

In the search for a simpler index, with fewer variables and keeping the most relevant information of the phenomenon to be simulated, the use of the PCA method allowed the reduction of the number of variables of the hierarchical information system, to select as main components, by size and themes, the indicators pointed out by the social actors as those that presented the greatest relative importance for the analysis of the performance of the friendly cities to old people.

With the application of the PCA technique, 29 indicators were selected for the construction of AgeCPI, due to their greater weight in the final index. Although the same ordering of the indicators obtained through the AHP method was not maintained in some subjects studied, it was considered satisfactory the level of consistency of the results achieved with the decision to use the two statistical techniques.

In conclusion, the results obtained in this specific analysis for the municipality of Trofa validate the proposed model and demonstrate that Trofa, in comparison with the other 77 municipalities in this research, is in a relative performance classified as “Alert”, but close to an "Acceptable" condition.

Future research should use this new AgeCPI in different cultural contexts, to further prove its utility for political and planning proposes (e.g. assessing the effectiveness of interventions that favor quality of life of older cohorts) and allowing transcultural comparisons.

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