Proceeding Paper

Major Trends in Ageing Population Research: A Bibliometric Analysis from 2001 to 2021 [†]

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Abstract: People aged 65 years and above currently outnumber children below five years old. Globally, there were 727 million persons aged 65 years or over in the world in 2020. This increase in the ageing population has called for more research to be conducted concerning this group. This study presents a bibliometric analysis of the publications on ageing population research retrieved from the Scopus database between 2001 and 2021. The findings show that there has been a continuous growth in publications in research on the ageing population for 20 years since 2001. The results obtained from this research will provide the researcher with an overview of the trends in research related to the ageing population and allow them to strategize further research in different areas in the future.

Keywords: ageing; ageing population; bibliometric analysis; elderly; older people

1. Introduction

According to reports, a significant change in demographics known as the "age quake" is currently taking place across the world. Gerontologists refer to the sudden shift in the world's population as the "age quake", which they believe began in the early 21st century. This phenomenon occurs when a growing percentage of the population is anticipated to live into elderly age [1–3]. History reveals that young children have always outnumbered older individuals since the beginning of human history [4]. However, things are starting to change now. People over the age of 65 will outnumber youngsters under the age of five for the first time in history. This tendency is not only happening in one place, it is happening everywhere around the world. According to [3,5], the world population's rising mortality rate and declining fertility rate are consistent with this prognosis. Additionally, studies conducted by the National Institute on Aging and the National Institute of Health in the United States of America revealed that 8% of the world's population—approximately 500 million people—are over the age of 65 today [3]. The percentage of people over 60 climbed globally from 9 percent in 1994 to 12 percent in 2014 and was projected to reach 21 percent by 2050. The World Population Organization (WPO) of the United Nations (UN) states that a population is considered to be ageing when the proportion of people 60 or older in a country's total population reaches at least 10% of the total population. As a result, this nation or area ages. Figures 1 and 2 below show the proportions of young children, older adults, and persons 60 years of age or older in significant regions in the years 1994, 2014, and 2050, respectively. These figures make it abundantly evident that the elderly is becoming a larger portion of the worldwide population.
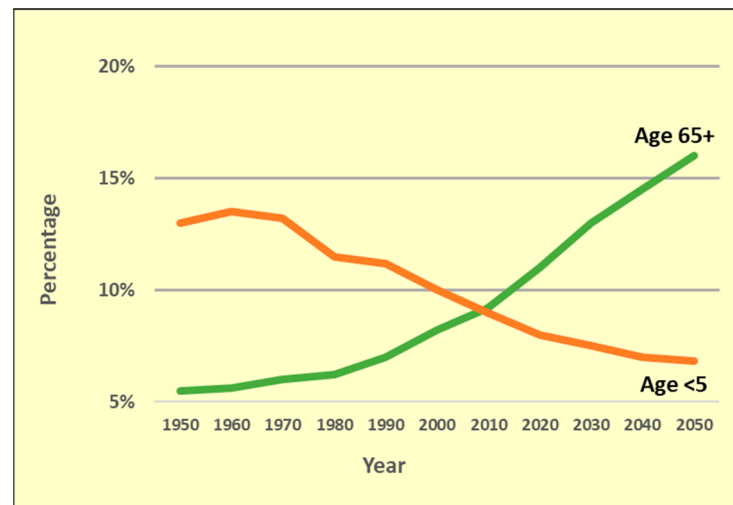
Figure 1. Young children and older people as a percentage of the global population [3].
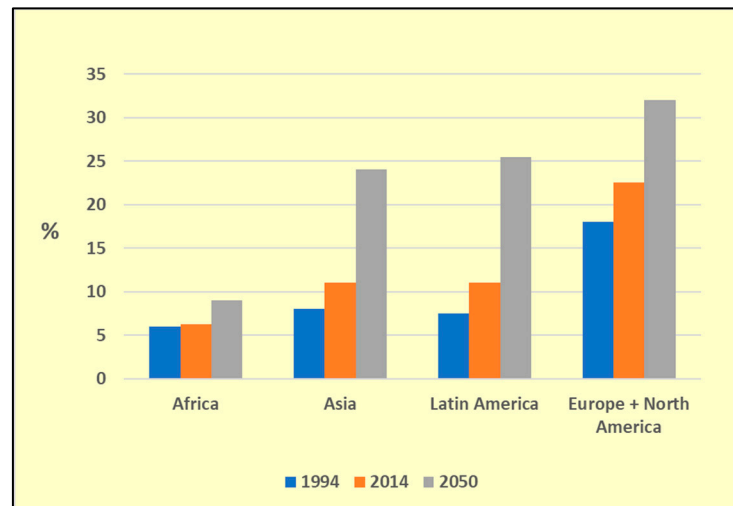
Figure 2. Percentage of population aged 60 years or older for major areas for the years 1994, 2014 and 2050 [3].

By the year 2050, the population of elderly people will grow quickly and surpass that of children. It is clear that by the year 2050, the world's population will consist primarily of older people because the number of older individuals has increased beyond the percentage that the UN uses to define an elderly population. People with various points of view analysing the effects of an ageing population on nations have responded in a variety of ways to ageing population challenges. According to reports from the World Economic Forum 2011, the phenomenon of an ageing population has significant effects on a country's economy and society due to the increase in elderly persons and changes in working-age populations. Along with this, a variety of research projects have been carried out to assist authorities in addressing the challenges and opportunities presented by an ageing population.

This study is being conducted to better understand the direction of current ageing population-related research by analysing the trends and advancements in the field. This study will help researchers comprehend the whole perspective of ageing population research and therefore plan for future research.

2. Methodology

In this study, publications related to the ageing population were retrieved from the Scopus database. Scopus is a bibliographic database that covers nearly 36,377 titles from roughly 11,678 publishers, of which 34,346 are peer-reviewed journals in the top-tier subject fields of life sciences, social sciences, physical sciences, and health sciences. Based on this, Scopus was chosen as it is the largest electronic database available. The search was made on all types of documents published between 2001 and 2021, thereby allowing the search engine to identify the broad spectrum of research in the literature. This review adopted PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) [6,7] guidelines for conducting systematic reviews of research. The search string "ageing population" was used to retrieve documents from the Scopus database. This initial search yielded 3954 documents which were then used in the bibliometric analysis. The 3954 Scopus-indexed documents' bibliographic details, which describe their characteristics, made up the data studied for this analysis. These "meta-data" include the names, titles, publication dates, author affiliations, and Scopus citation details of the documents. Microsoft Excel software was used to conduct the frequency analysis; for citation metrics and analysis, Harzing's Publish or Perish was used, and VOSviewer was used for data visualisation. The publications' trends, collaboration, authorship patterns, productive authors, countries' contributions, most active institutions, favourite journals, and most-cited articles were some of the common bibliometric variables used in this study to summarise the findings.

3. Results and Discussion

This section presents the results obtained from this study; it includes document profiles, research trends analysis, the geographical distribution of publications analysis, authorship and affiliation analysis, source title analysis, citation analysis, and keyword analysis.

3.1. Document Profiles

Document profiles refer to the recording and analysis of the characteristics of a document. In this study, a total of 3954 documents were retrieved—the majority of which (2543; 64.31%) were research articles. The second most common type of document was review articles (354; 8.95%). Other types of the document were book chapters, conference papers, editorials, notes, letters, books, errata, and short surveys. Details about the types of retrieved documents are shown in Table 1.

Table 1. Document type.

Document Type	Total Publications (TP)	Percentage (%)
Article	2543	64.31
Review	354	8.95
Book Chapter	302	7.64
Conference Paper	259	6.55
Editorial	181	4.58
Note	118	2.98
Letter	56	1.42
Book	51	1.29
Erratum	50	1.26
Short Survey	40	1.01
Total	**3954**	**100.00**

The majority of retrieved documents were published in English (3671; 91.11%). Other commonly encountered languages included French (69; 1.71%), Spanish (59; 1.46%), Portuguese (38; 0.94%), and German (31; 0.77%). Most of the published documents were research works related to the field of medicine (2011; 50.86%). Other subject areas included social sciences (1012; 25.59%), biochemistry, genetics, and molecular Biology (454; 11.48%),

economics, econometrics, and finance (386; 9.76%), and nursing (350; 8.85%). Details of the top ten subject areas are presented in Table 2 below.

Table 2. Top ten subject areas.

Subject Area	Total Publications (TP)	Percentage (%)
Medicine	2011	50.86
Social Sciences	1012	25.59
Biochemistry, Genetics, and Molecular Biology	454	11.48
Economics, Econometrics, and Finance	386	9.76
Nursing	350	8.85
Engineering	214	5.41
Psychology	186	4.70
Environmental Science	181	4.58
Business, Management and Accounting	178	4.50
Computer Science	170	4.30

3.2. Research Trend Analysis

Examining the documents according to the year of publication enables the researcher to track the development and soaring interest in the research topic through time [8]. With a total of 364 documents produced, 2021 saw the most output—while 2002 saw the lowest, with just 60 publications. The number of documents published throughout the study period showed an increasing trend within the last 20 years, as seen in Figure 3. However, the number of citations illustrated by the line showed a decreasing trend. Due to the short period that had passed since their publication, the number of citations per publication was highest for documents released in 2005 (43.04 citations per publication) and lowest for those published in 2020 (1.42 citations per publication).
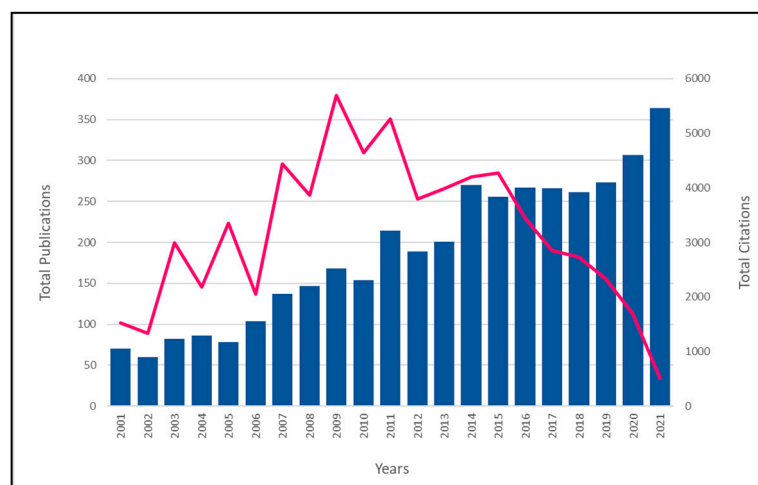
Figure 3. Research trends 2001–2021.

3.3. Geographical Distribution of Publications Analysis

The release of the collected materials involved researchers from 114 different nations. With a total of 1044 documents (26.44%), the United States of America came out on top—followed by the United Kingdom (470; 11.88%), China (317; 8.01%), Australia (244; 6.17%), and Canada (236; 5.97%). In Figure 4, the map displays 114 nations arranged into five distinct groups—each of which is coloured differently.
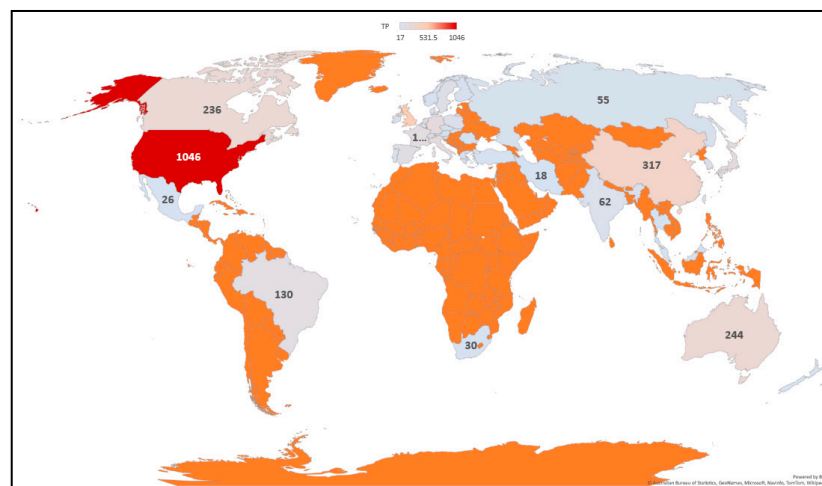
Figure 4. Geographical distribution of publications.

3.4. Authorships and Affiliations Analysis

Table 3 provides a summary of the top institutions with at least five publications. With a total of 48 publications, the University of Alberta in Canada is the most productive institution in this discipline (1.21%). Following this were University College London (42; 1.06%), King's College London (38; 0.98%), University of Cambridge (35; 0.88%) and Inserm (33; 0.83%).

Table 3. Most influential institutions with a minimum of five publications.

Affiliation	TP	NCP	TC	C/P	C/CP	*h*	*g*
University of Alberta	48	31	317	6.60	19.00	10	16
University College London	42	38	1477	35.17	21.00	19	38
King's College London	38	34	1564	41.16	20.00	17	38
University of Cambridge	35	34	2149	61.40	19.00	18	35
Inserm	33	30	1156	35.03	19.00	17	33
Fudan University	33	31	361	10.94	17.00	12	17
National Institute on Aging	33	30	1845	55.91	21.00	18	33
Pontifícia Universidade Católica do Paraná	33	22	167	5.06	9.00	8	12
Lunds Universitet	33	31	831	25.18	18.00	15	28
Karolinska Institutet	30	27	892	29.73	18.00	13	29

Notes: TP (total number of publications); NCP (number of cited publications); TC (total citations); C/P (average citations per publication); C/CP (average citations per cited publication); *h* (h-index); and *g* (g-index).

As shown in Table 4, the most productive author was Tonelli, M. (University of Calgary, Canada), with a total of 36 publications (0.91%). He was also the author with the highest number of cited publications. Other productive authors in the area included Riella, M. (32: 0.81%). Lima-Costa, M.F. (22; 0.56%), Brayne, C. (18; 0.46%), and Elmståhl, S. (16;0.40%).

Table 4. Most productive authors.

Author's Name	TP	NCP	TC	C/P	C/CP	*h*	*g*
Tonelli, M.	36	24	169	4.69	7.04	8	12
Riella, M.	32	20	124	3.88	6.20	6	10
Lima-Costa, M.F.	22	21	383	17.41	18.24	11	19
Brayne, C.	18	17	1122	62.33	66.00	12	18
Elmståhl, S.	16	14	465	27.35	33.21	7	17
Firmo, J.O.A.	15	16	644	40.25	40.25	13	16
Mason, A.	15	13	243	16.20	18.69	10	15
Scherbov, S.	13	13	1151	88.54	88.54	8	13
Guest, R.	11	10	52	4.73	5.20	5	6
Lee, S.H.	10	9	114	11.40	12.67	3	10

Notes: TP (total number of publications); NCP (number of cited publications); TC (total citations); C/P (average citations per publication); C/CP (average citations per cited publication); *h* (h-index); and *g* (g-index).
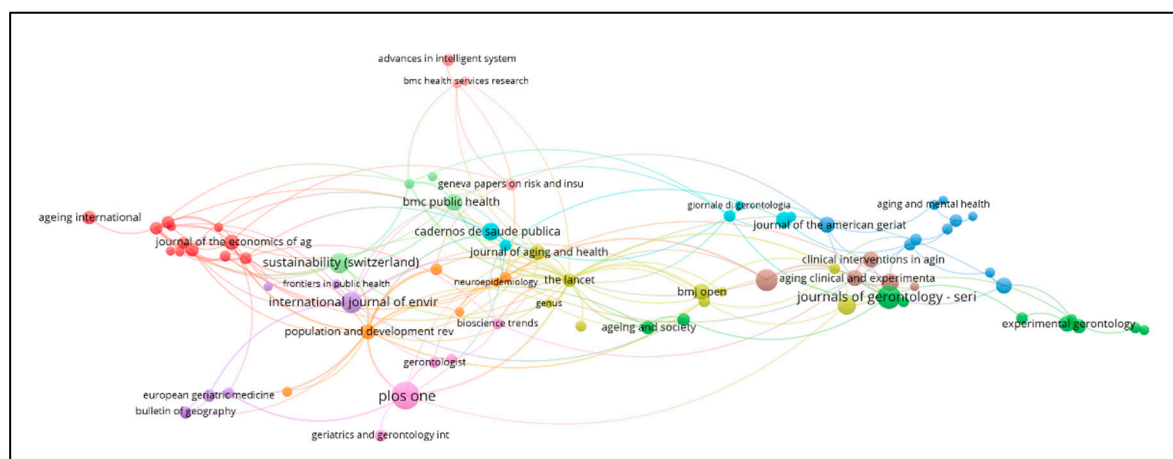
3.5. Source Title Analysis

Table 5 lists the top ten journals that have published research related to ageing populations. PLOS One ranked first with 45 documents (1.14%), followed by the Journals of Gerontology - Series A Biological Sciences and Medical Sciences (32; 0.181%), Archives of Gerontology and Geriatrics (29; 0.73%), International Journal of Environmental Research and Public Health (27; 0.68%), and Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics; 26; 0.66%).

Table 5. The most active source titles.

Source Title	TP	TC	Cite Score	SJR 2020	SNIP 2020
PLOS One	45	877	5.3	0.99	1.349
Journals of Gerontology—Series A Biological Sciences and Medical Sciences	32	934	9.1	2.134	1.771
Archives of Gerontology and Geriatrics	29	499	4.3	0.985	1.361
International Journal of Environmental Research and Public Health	27	277	3.4	0.747	1.356
Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	26	112	1.8	0.249	0.628
Sustainability Switzerland	25	151	3.9	0.612	1.242
Age and Ageing	20	999	9.6	2.014	2.753
Population Ageing in Central and Eastern Europe Societal and Policy Implications	20	40	N/A	N/A	N/A
Cadernos De Saude Publica	19	203	2.3	0.633	1.267
BMC Geriatrics	18	289	4.5	1.414	1.758

Notes: TP (total number of publications); TC (total citations).

A network visualisation map for the co-citation analysis of journals with a minimum of 50 citations is shown in Figure 5 below. PLOS One was frequently co-cited by other journals, showing the maximum number of linking lines from other journals. Additionally, this publication had the largest circle size, indicating that it had the most citations for research on ageing populations.

Figure 5. Co-citation analysis of source titles network visualization map.

3.6. Citation Analysis

Citation analysis is a method of determining the relative importance or impact of an author, an article, or a publication by calculating the number of times that an author, article, or publication has been cited by other works. This paper examined the impact of the documents retrieved from the Scopus database that are related to ageing population

research. The citation metrics are summarized in Table 6 below. A total of 3954 documents with articles titled "ageing population" published from 2001 to 2021 were retrieved from the database. A total number of 67,140 citations were recorded for all these publications.

Table 6. Citation Metrics.

Metrics	Data
Papers	3954
Citations	67,140
Years	20
Cites_Year	3197.14
Cites_Paper	16.98
Cites_Author	23,670.96
Papers_Author	1865.4
Authors_Paper	3.44
h_index	105
g_index	170

The top ten cited articles related to ageing populations are shown in Table 7. The article titled "Ageing populations: the challenges ahead" authored by Christensen, Doblhammer, Rau, and Vaupel was published in The Lancet—a medical journal—in 2009 and received the highest number of citations. It received a total of 2207 citations and was the most impactful article based on citations per year (169.77 citations/y). This was followed by the article "The coming acceleration of global population ageing" authored by Lutz, Sanderson, and Scherbov (847; 60.5 citations/y); "The Aging Population and Its Impact on the Surgery Workforce", authored by Etzioni, Liu, Maggard, and Ko (578; 30.42 citations/y); "Inflammatory markers in population studies of aging", authored by Singh and Newman (518; 47.09 citations/y); and "Immunosenescence: Emerging challenges for an ageing population", authored by Aw, Silva, and Palmer (578; 30.42 citations/y).

Table 7. Most highly cited articles.

Authors	Title	Cites	Cites per Year
Christensen, Doblhammer, Rau, and Vaupel (2009)	Ageing populations: the challenges ahead	2207	169.77
Lutz, Sanderson, and Scherbov (2008)	The coming acceleration of global population ageing	847	60.5
Etzioni, Liu, Maggard, and Ko (2003)	The Aging Population and Its Impact on the Surgery Workforce	578	30.42
Singh and Newman (2011)	Inflammatory markers in population studies of aging	518	47.09
Aw, Silva, and Palmer (2007)	Immunosenescence: Emerging challenges for an ageing population	511	34.07
Bell, Tsai, Yang, Pidsley, Nisbet, Glass, Mangino, Zhai, Zhang, Valdes, Shin, Dempster, Murray, Grundberg, Hedman, Nica, Small, Dermitzakis, McCarthy, Mill, Spector, and Deloukas (2012)	Epigenome-wide scans identify differentially methylated regions for age and age-related phenotypes in a healthy ageing population	483	48.3
Smit, Brinkman, Geerlings, Smit, Thyagarajan, van Sighem, de Wolf, and Hallett (2015)	Future challenges for clinical care of an ageing population infected with HIV: A modelling study	417	59.57
Fox, Richardson, Maidment, Savva, Matthews, Smithard, Coulton, Katona, Boustani, and Brayne (2011)	Anticholinergic medication use and cognitive impairment in the older population: The medical research council cognitive function and ageing study	408	37.09
Pollack (2005)	Intelligent technology for an aging population: The use of AI to assist elders with cognitive impairment	391	23
Fried, Carlson, Freedman, Frick, Glass, Hill, McGill, Rebok, Seeman, Tielsch, Wasik, and Zeger (2004)	A Social Model for Health Promotion for an Aging Population: Initial Evidence on the Experience Corps Model	369	20.5

3.7. Keywords Analysis

A keyword analysis is a process of evaluating and analysing keywords and search phrases available in a document to ascertain which ones are used most in an article. Using VOSviewer software, author keywords with minimum occurrences of 25 were mapped. After the core search, query-related keywords were eliminated, and the results revealed that the terms "humans", "ageing", "aged", "male", "female", "middle-aged adult", "aged", "80 and beyond", "major clinical study", "extremely elderly", "risk factor", and "age" were the most often-found author terms.

Figure 6 above depicts a network visualization map of the authors' keywords. Circles of the same colour group imply that the publications share a common subject; each represents a subfield of the field of ageing population research. The 111 total items were divided into seven clusters. The green cluster was the largest, originated by the keyword "ageing", and had 656 occurrences, followed by population ageing (380 occurrences), elderly (157 occurrences), epidemiology (85 occurrences), and dementia (59 occurrences).

Figure 6. Network visualization map of author keywords.

4. Conclusions

The impact of demographic changes on ageing populations in many countries has made it important that governments and other stakeholders return to the subject which is the ageing population and find ways to enhance contributions toward this group through research. In this paper, we analysed 3954 documents retrieved from the Scopus database using bibliometric analysis. The majority of the documents were research articles published in the English language related to the field of medicine. The research trends analysis results showed that there was an increasing trend in publications related to ageing populations—starting from the year 2001 with a total of 70 publications and increasing to 366 publications in the year 2021. The results also showed the United States of America as the largest contributor to research related to ageing populations, followed by the United Kingdom,

China, Australia, and Canada. Malaysia recorded only 43 publications in the past 20 years, which is considered very low, and ranked number 25 in the Scopus database in terms of the number of publications. The most productive institution in this research area was the University of Alberta, located in Canada, with a total of 48 publications—while the most productive author was Tonelli, M. from the University of Calgary, Canada. PLOS One remained the main source of titles related to ageing population research. In conclusion, even though it has been observed that there is an increasing number of research works on the ageing population area, the number is still considered low relative to the duration of 20 years of observation. Many research works have focused on the medicine domain and research is still lacking in other domains such as the social sciences, information technology, business and management, and so on. This study can provide comprehensive information for future researchers to better understand the development trends of research related to ageing populations and, subsequently, to strategize for more research studies to be carried out concerning ageing populations, for the betterment of the nation.

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