

## THE EVOLUTION OF A PROGRESSIVELY GRAYING STAFF: A BIBLIOMETRIC ANALYSIS

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### ABSTRACT

Workforce ageing research began in the 1970s. The publications related to labor force is abundant and the concentration of this subject matter because of population ageing is studied for highest citation count. This study aims to assess the most significant publication & the association trends and crucial drivers in the research related to labor force. A total of 773 publications of the highest citation in the Scopus database with minimum of 5 citations were identified & analysed. Pearson's correlations revealed a positive (*p*-value) between the no of years of publication and the number of citations counts of a paper. Bradford's law of scattering revealed that 1/3 of the publications were published in 35 core journals with Ageing and Society outranked the other journals with 31 papers. Using VOSviewer visualisations, a network based on countries was constructed. The main contributor is United States in the labor force publication, 24.32 % of 773. Ageing and Society is the leading publication in labor force with 31 publications. For the key terms of co-occurrence, older adults care research is the most published topic in the research area. In short, the bibliometric analysis shed a light on the effect & contribution of labor force in the rise of population aging.

Keywords: workforce, ageing population, older adults, Bradford's Law

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### INTRODUCTION

Graying staff is defined by the workforce average age is increasing as more elderly stays in labor force as a result of population ageing. The dynamic of workforce changes with population ageing as it affects the labor market in terms of social and economic aspect. Population life expectancy grows due to lower infant and elderly mortality. In fact, a lower fertility rate leads to more older adults and fewer young people. Increased life expectancy is good for society, but it must be managed because more elderly people depend on government programmes. An ageing workforce means more older workers will leave later due to fewer young workers. Longevity risk will extend retirement, and older people would need medical goods to maintain their fitness and health.

Many nations have raised the retirement age from 55 to 60 due to older adults living longer. Older adults said they must be fit to work to help their company. Seniors are urged to work longer. Higher schooling reduces the number of young workers. Old adults, regardless of health or fitness, manage age imbalance. According to the third Sustainable Development Goal (SDG) (SDG 3: Good health and well-being), population ageing is an emerging issue that needs to be addressed because older workers' fitness and health contribute to their wellbeing, notably in extending their working life.

If the existing retirement system, workforce participation, and pension age continue unchanged until 2050, it is expected that the retirement system will fail because of the public debt (Bongaarts, 2005). To mitigate the pension risk, the working life is extended to ensure there is more pension contributions by older workers who take up the pension fund more than before due to their longevity risk (Carr et al., 2016) Older workers have their own perspectives on retiring late, but there are stigmas of their slow productivity and low skills (Lumsdaine & Mitchell, 1999; Thang, 2011; van Dalen et al., 2009; Van Dalen et al., 2010; Yamazaki et al., 2012)

The decision to extend the statutory retirement age by involving older workers in the market and discourage early retirement (Bjursell et al., 2017; Elmeskov, 2004; Frimmel & Pruckner, 2020; Szinovacz, 2011) and it is found that the low-income groups tend to work longer to keep up with the living standards (Hofacker & Naumann, 2015). The increase in statutory retirement age did not consider income level or working preference of the old people making the policy not well perceived by the old workers (Carr et al., 2016). In fact, the socio-economic welfare affects the health of a society especially if they live in rural areas and attain low education (Kumar et al., 2015) (Crespo Cuaresma et al., 2016; Loichinger, 2015), thus working extra years until retirement can be burdensome for some workers. Retirement preference by to retire early are usually preferred by female workers and workers with chronic diseases (Cloostermans et al., 2015; Hofacker & Naumann, 2015; Szinovacz, 2011; Thang, 2011). Chronic diseases not only disrupt productivity, but it also affect the economy in the sense that workers are unable to work longer in conjunction with longevity risk and rise in statutory retirement age but also healthcare expenses though mortality rates is improving (Cohen, 2009; Fleming et al., 2003).

Poor health forces 50% of men and 20% of women to resign early, limiting economic growth. In fact, older people with poor health exit the workforce faster whilst healthier baby boomers may end up working more regardless of work stress (Mutambudzi et al., 2018; D. J. Schofield et al., 2007). Multiple metrics show pre-retirement health decline (those aged from 40 to 64 years) especially when they suffer Diabetes Type 1. Numerous diseases and health conditions can affect older workers, affecting their work and health. Arthritis, cancer, dementia, and vision and hearing loss are common in older people. With long life, older workers must maintain their health and treat chronic diseases well (Andrée et al., 2016; Vlachou et al., 2018). Several diseases that usually hit older workers are chronic diseases related to diabetes (Mutambudzi et al., 2018; D. Schofield et al., 2017; D. J. Schofield et al., 2007), heart complications (D. J. Schofield et al., 2012), stroke (H.-J. Kim et al., 2012) and Alzheimer [(Bettio et al., 2006)] and dementia (Bjursell, Nystedt, Björklund, Sternäng, et al., 2017) is some of the major concern among older workers with regards to memory (Bloom et al., 2010b) Without chronic disease, older workers prefer to stay longer in the labor force (D. Schofield et al., 2014; D. B. Schofield et al., 2008) Dementia can be avoided while maintaining an active social networking at golden ages and prevention of cardiovascular diseases. Though most diseases are non-fatal (Bongaarts, 2004, 2005) preventions and treatment of diseases and top-notch medical care are important in maintaining healthy older workers and medical systems. Non-communicable disease (NCD) such as heart disease, cancer and mental health always attack older people especially in developing countries since the healthcare is not free and it also contributes to poverty (Bloom et al., 2010b). Chronically ill people may benefit from working regardless of money and those people who don't work and don't socialise may have a deficit in terms of social and cultural interaction (Callander & Schofield, 2013). Chronic diseases influence labor force participation and economy in negative manners Health and social measures that help carers continue in the workforce may save governments money and improve carers' finances (D. Schofield et al., 2018)

Immigration policy alleviates labour shortages caused by low birth rates (A. E. Kim, 2009a; Rowthorn, 2008; Zimmermann, 2005). Migration for nursing, long-term care, and other reasons causes problems, notably for female long-term care workers. Nurses (Buerhaus et al., 2000; Stilwell et al., 2004) and physician (Bourassa Forcier et al., 2004) influence the insufficient health worker projection. Licensing and local doctors' interests have hampered international physician migration deals. Thus, OECD nations promote foreign physician immigration while minimising host nation negative effects. International recruitment, looser immigration standards, and health system learning promote immigration (Bourassa Forcier et al., 2004) Immigration and labour force participation vary by region. Some countries make it easy for skilled immigrants to work, while others prefer unskilled immigrants for certain jobs. Immigrants can replace a shortage of trained or unskilled workers at a certain age worker (Mackie, 2010; Ogawa, 2011; Rowthorn, 2008). The labour shortage in Japan, but the issue of unskilled immigrants to enter Japanese labour force is concerning (Mackie, 2010; Ogawa, 2011) while European raises concern of creating a reliable source of importing highly skilled workers and produce a higher demand for local unskilled workers (Callander & Schofield, 2013). Income stagnation among low-wage migrants (Hui, 2013) (Reddy, 2016) raises concerns about labour shortage and employment security due to demographic changes affecting labour force wages on various working skills and age groups (Docquier et al., 2019). Immigration makes multi-ethnic countries like Korea, but it only contributes 1% to GDP fiscal policy (Hansen et al., 2017; Rowthorn, 2008) (Kudrna et al., 2015), which can be sustained by government financial welfare incentives (Hansen et al., 2017; Rowthorn, 2008). Poor labour market performance, early retirement, and universal Danish welfare systems create barriers (Nannestad, 2004). Long-term residents use welfare. Even though an ageing population will raise dependency rates, immigration has worsened them (Nannestad, 2004).

Low fertility in women, reduces the number of young participations in labour force. Skewing the age structure of population (Bongaarts, 2005; A. E. Kim, 2009a) stated that the low fertility in South Korea and OECD countries respectively affect the structure of migrations and labor force participation. China fertility concern has been highlighted since 1992 until present (Huang et al., 2019; Tien et al., 2017.; Yi, 2007). In combating their fertility, labor force participation and socio-economic matters, China changes its number of children policy from one to two children per household (Yi, 2007) to as many babies as they want after 2032 but (Kumar et al., 2015) in contrast, recommends that having children of less than 5 for China and India will reduce the national socio-economic gap in fighting poverty.

In general, women have lower labour force participation rates than men, owing in part to caregiving responsibilities and gender-role-based societal expectation as they may feel compelled to retire earlier to fulfil their caregiving duties. (Krueger, 2017) As immigration is seen as an alternative to labor shortage, the long-term care of female migrants and their huge migrations in the Southern European region (Bettio et al., 2006; Browne & Braun, 2008). Migration of female care workers to the United States (developed countries) is an issue to disturbance in family tradition while still balancing the needs of caregivers in their own countries without discrimination the feminization, race and economic imbalance among supplying countries and the receiving end (Browne & Braun, 2008). highlight that female labor who must care for their old parents does not affect the working hours and employment in urban China (Liu et al., 2010). The migration of old immigrants varies across different groups of European immigrants (Warnes et al., 2007).

Bibliometric analysis is used to determine which journals, papers and citation have had the most impact on the field. (Kar et al., 2022; Maditati et al., 2018) Bibliometric analysis has progressed a great deal since the 1940s. Alan Pritchard introduced the mathematical methodology for the interpretation of books and communication media in 1960. and since then, bibliometric analysis has expanded to cover a wider range of disciplines and topics, and to assess the quality, productivity, and impact of a body of published work (Kar et al., 2022; Maditati et al., 2018) To the best of our knowledge, there is yet any bibliometric analysis on labor force while conducting this analysis.

There are a few stages in bibliometric analysis. The main part of the analysis is backward and forward citation, followed by visualisation via Hiscite, CiteScape, VosViewer, Bibexcel and CITENet Explorer (Pan et al., 2018) (Bankar & Lihitkar, 2019) (Wardikar & Gudadhe, 2013) Researchers writing the analysis have to depend on such software tools to be able to statistically analyse the trends of publication, terms occurrence, co -word, co-author and co-citation of a specific research interest based on scholarly citation and reputation. In fact, content analysis can also be performed either conventionally or directed to identify the conceptual dynamic of a specific area of study.

With the presence of numerous articles and publication related to ageing workforce, the impact of the journals, research output, collaborators and research interest and potentials can be discovered via bibliometric analysis. Bibliometric analysis provides advantages in work related to assessing the impact of research outputs, identifying potential research collaborators,

determining journals for article publication, and finding newly emerging research areas. Various bibliometric studies have been conducted to identify the trends and important drivers in diverse fields for the growth and development of particular field of study. Despite the rising literature on ageing workforce in recent years, the bibliometric analysis is missing on the evidence this topic since the very first publication of an article on labor force participation in 1956.

The study of graying staff has gained increasing attention in recent years due to its significance in labor market and pension system. The novelty of this bibliometric analysis is the exploration of the trends, collaboration patterns and contribution of the labor force studies and measurement of population ageing on labor force (SDG 8: Decent work and economic growth), which is the economic factor that affects the workers distribution in the working sector. While some researchers and policymaker recommend extending the retirement age, it raises a concern whether the older adults are fit for the working world at later life. The health effects after retirement have also been a major concern for them to work, as well as the caregiver for the older workers. Caregiver comes from many backgrounds, including immigrants from third world country, nurses and female workers taking care of their old parents [1]. Such caregiving services ensure the welfare of older adults are well taken care of while still maintaining the longevity of their age.

The purpose of this study is to conduct a citation analysis based on the most cited articles to identify trends, the most influential articles, and key drivers in the ageing workforce, particularly in terms of demographic factors, health issues, economic factors, and care providers. The citation analysis in this labor force studies highlights the influence and impact of publication related to the graying staff studies for future research areas in the future. Consequently, publication analysis is used to examine the development and evolution of the ageing workforce. Initially, (1) to measure the growth and citation of publications in ageing workforce since the first scholarly publication; (2) to assess the trends in publication related to ageing workforce in terms of nations and international collaboration; and (3) to assess the terms frequency used in relation to aging workforce via bibliometric analysis.

With the aid of visualisation software, these three research questions guide this investigation. What are the leading journals, influential affiliations, and influential and leading trends in demographically ageing population articles? How do demographic factors influence the ageing of the population, and what research streams lie beneath the ageing factor? How can the demographic factors be used to measure population ageing and aligned in a unified framework to explain the overall picture of population ageing, based on the core papers?

Currently, there is not many bibliometric analysis that focuses on labor force participation. Bibliometric analysis on organisational contribution to ageing workforce (Nagarajan et al., 2019) the effect on labor force participation when the statutory retirement age is extended in light of population ageing were reviewed systematically (Pilipiec et al., 2021). Using VOSviewer, the three research questions were answered. For the first research question, bibliometric citation analysis metric, while citation mapping combined with content analysis for second question. Lastly, knowledge synthesis approach is applied.

The findings in the first research question are crucial for publication targeting the current impactful work in the field based on key journals while being beneficial for research collaboration and employment. Second question will answer the flow of how the terms contribute to the research streams of the frequently used method. In fact, the research trends and most used words in the articles summarises the current research prospect and dynamic to explain population aging.

The later section of this paper is presented as follows. Section 2 depicts the method in this study and result of co-authorship analysis. Section 3 presents the term occurrences of population aging and the demographic research streams recognised. Section 4 and 5 of this paper are showing the detailed.

This bibliometric study is conducted to explore what is the current interest and trend in publication of the past 5 years regarding demographic changes as population aging. Using the Scopus database, VOSviewer software is used to illustrate the result of the bibliometric analysis. The focus of this paper is on the co-authorship and terms-occurrence analysis.

## **MATERIALS AND METHODS**

### **Data Collection**

The data for this study is based on the open-source collections of documents from Scopus database to be refined and selected based on the objectives of this paper, First and foremost, data is extracted since Scopus is a huge source of data for social sciences. Data was extracted using the search strategy TITLE-ABS-KEY ("Population" AND "Ageing") AND (Labor). The result shows 3119 results and the results were further refined to a specific category. The book and book chapters were filtered out from document types since such documents has no journal ranking for further use in publication analysis. That leaves us with 2493 articles. 227 unrelated journals were removed from the database. The journals from 1980 until 2021 of the highest cited journals were analysed to observe the most cited journals as well as the most used key terms in the research field. The articles were filtered out only to English documents. The bibliometric data of the first 1000 most-cited papers are extracted and assessed. The labor scope of this paper does not include pregnancy labor, thus such articles are excluded in the analysis.

### **Data Extraction**

On October 3, 2022, all the bibliometric information that was retrieved through the search in the Scopus database was converted into a format that used comma-separated values, and then the data were sorted using Microsoft Excel. An Excel file was used to extract and record bibliometric information. This information included authors, article or chapter titles, journal or book titles, publication type, publication year, volume, issue, page count, digital object identifier, link, affiliation and correspondence address, publisher, PubMed ID, language, country of origin, abstract, keywords, total citation count, impact factor, and SCImago Journal Rank.

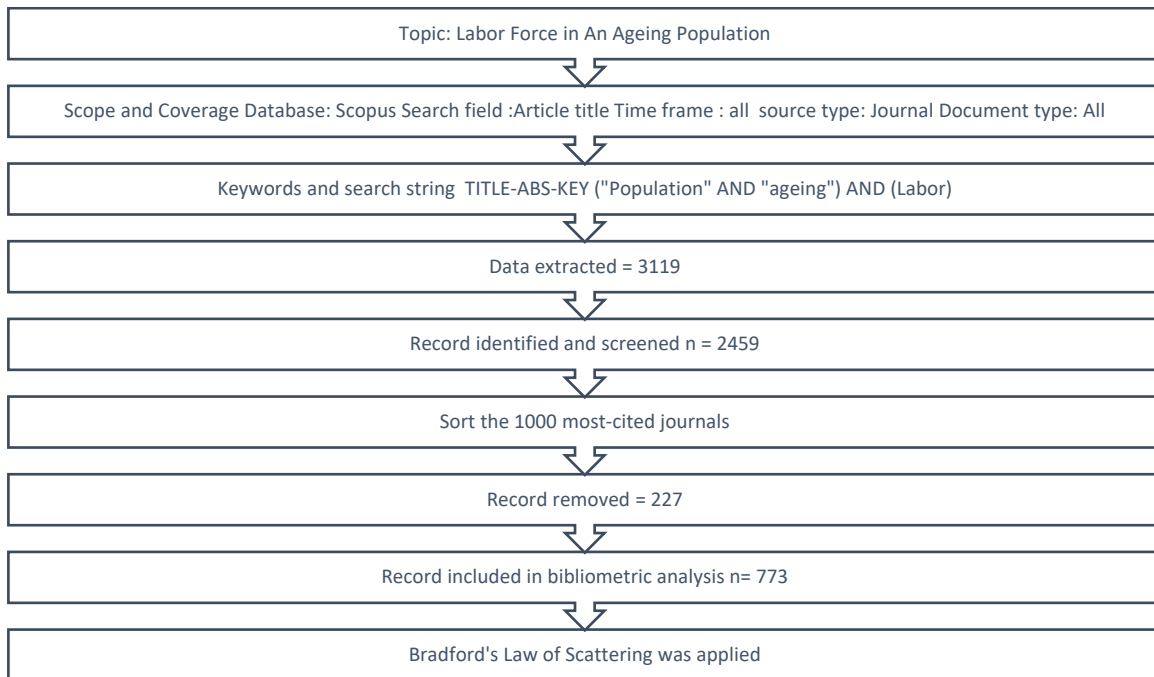
To analyse the co-authorship and terms occurrence analysis, visualisation of the 773 articles was conducted using VOSviewer is used to generate map and network. The research framework is as follows:

## Data Analysis

In this section, the broad data received from Scopus database is refined to ensure that the selections match the scope of the analysis. Before going deeper into the research, unrelated topics of the published works are removed and refined to reveal the patterns of our interest. Manual sorting was performed on the list of documents extracted into the Excel file by eliminating non-journal articles and those with fewer than five citations. (Kar et al., 2022)

In the study of the papers with at least five citations that made the cut, Bradford's law of scattering was applied. This rule defines the quantitative link between journals and the articles they publish. According to the rule, only a limited number of core journals provide the highly productive papers on a specific topic, which make for a significant portion of the first third (one-third) of the articles. (Wardikar & Gudadhe, 2013)

The flow of data analysis by Bradford's law is shown in Figure 1.



**Figure. 1: Schematic diagram of data acquisition**

## Data Visualisation

VOSviewer was used to visualise networks based on keywords, researchers, research institutions, countries, scientific publications, and journals as components of the gathered articles. VOSviewer is a device for building and visualising bibliometric networks. (van Eck & Waltman, 2021) The output is provided as a network in which the relationship between network nodes is visualised based on the visualisation type and settings employed. In this study, VOSviewer was used to show the network of co-authorship by country and build an overlay map of the 773 publications linked to ageing workforce with at least five citations each. The default minimum number of publications per country is five. On the map, countries that were not connected to one another were omitted. VOSviewer was also used to produce a map of co-occurrence of key phrases based on text data from 773 articles linked to ageing workforce. The minimum number of term occurrences was set at 50, and manual filtering was performed to eliminate ageing workforce-irrelevant elements (e.g., articles, responders, questionnaires, etc.) and repeated phrases (e.g., probability, projection, association, etc.). The incorporated phrases were then utilised to produce a network visualisation map.

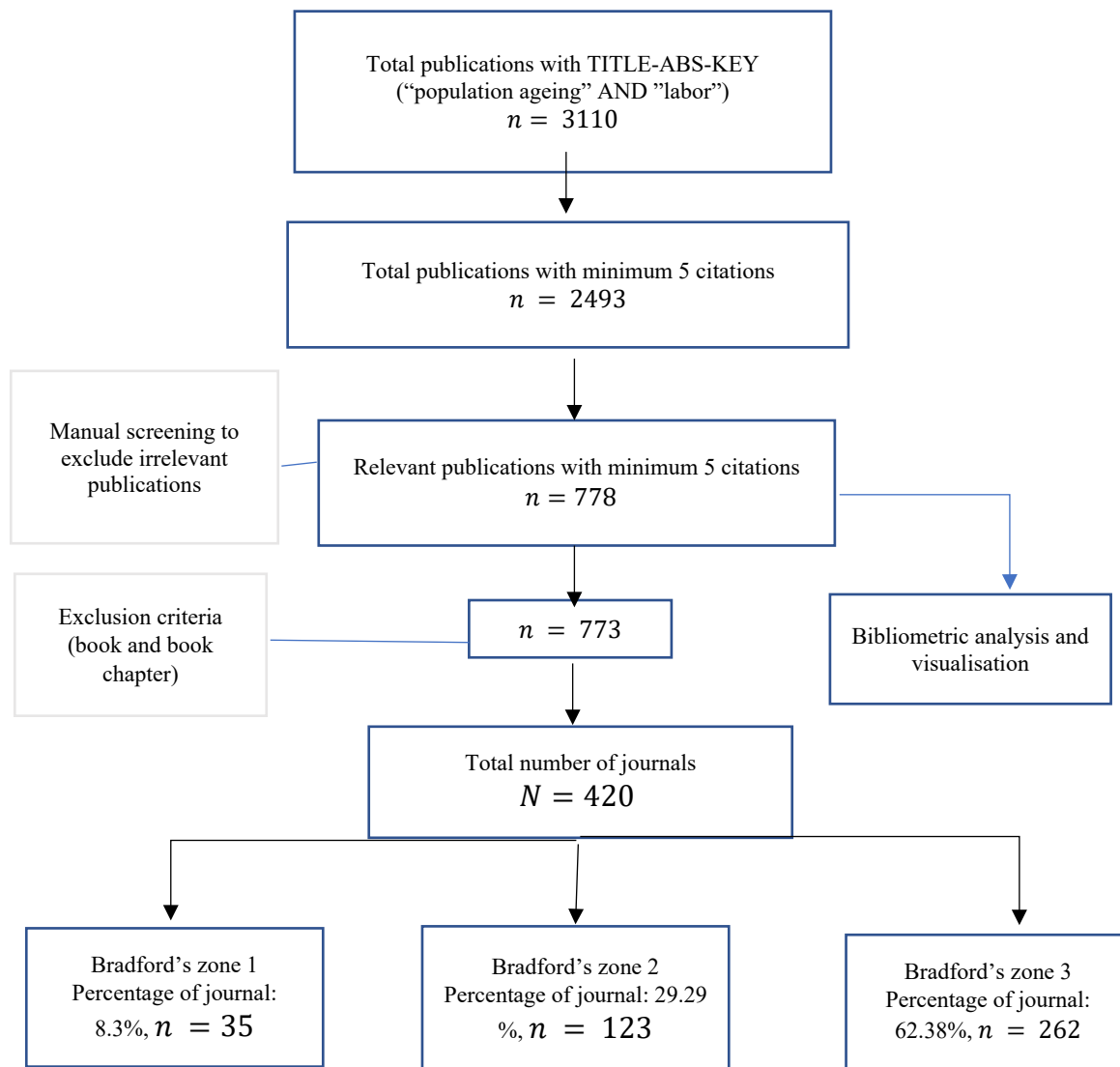


Figure 2 : Flow diagram

### Statistical Analysis

To identify the relationship between number of publication and total citation, the Pearson correlation is generated to identify the strength of the relationship between the two variables of the 773 articles included in the study. SPSS software version 23.0 (IBM) was used to conduct the test. The graph of number of years since publication in the x-axis versus the number of citations of every article in the y-axis is presented in terms of scatter plot. The value of Pearson's coefficients lies between -1 to 1 of a linear line. For each coordinate, the closer is the observed point in x and y axis to the line, the stronger is the relationship of the two variables.

The result of the correlation is indicated as significant given the p-value is less than 0.01 ( $p < 0.01$ ). Meanwhile, the positive and negative values of the correlation reflect the direction of the linear relationship. If the number of citations per articles increases as number of years since publication increases, then it is a positive linear relationship. Otherwise, are the number citations per article decrease as number of years since publication decreases, then it is a negative correlation.

## RESULTS AND FINDINGS

### Distribution of Publications by Publication Year

In 1956, the first article about the ageing workforce was published in Scopus. Since then, till October 3, 2022, 2493 publications pertinent to the ageing workforce have been published. Since the earliest scholarly publication on the subject of an ageing workforce, Figure 2A depicts the number of articles that have been authored on the topic. The number of publications pertaining to the study of an ageing workforce has gradually increased throughout the years, indicating a rising trend. In contrast to Google Scholar, Scopus was the only database utilised for this investigation. This study did not utilise the database created by the latter since it lacks clarity, transparency, and dependability in terms of the sourced materials. (Halevi et al., 2017)

Scopus, Web of Science, and Google Scholar provide comparable coverage and citation statistics in the health and medical sciences (Martín-Martín et al., 2018). Nevertheless, according to database comparisons in the Library Guide by Iowa State

University Library, Scopus provides better coverage of journals published outside the United States, as well as those published in languages other than English, and is more focused on health science than Web of Science, which only covers "journals of influence." For the purposes of this study, Scopus was chosen as the single database from which bibliometric data would be extracted.

As reported in 1956, cardiac illnesses were the leading cause of death. The population of the United States was threatened by the lethal sickness, which raises concerns for the workforce. Some employees may be able to return to work within a few months, however the other, more severe patient, may not be able to return to the workforce since their vital organ is in jeopardy. (Chapman, D.W., Lai, 1956) investigated the re-entry of heart disease patients into the labour market and emphasised the necessity for human resources and physicians to manage cardiac situations. Since then, there has been an increase in the number of research pertaining to older workers, as life expectancy continues to climb and economic activity continue. Since then, studies on diseases affecting the health of older workers became the spotlight of workforce to stay fit and healthy when working (Vos et al., 2017; Wang et al., 2016).

Research on the ageing workforce, which covers the health of older workers, the migration of professionals and caretakers, and long-term care for the older workers, has been prompted by a growing interest in such activities. Consequently, as shown in Fig. 2A, the number of publications concerning the ageing workforce has increased over time. The figure below depicts the trends in labor force research in population aging phenomenon.

From 2493 publications in the year 1980 to 2021

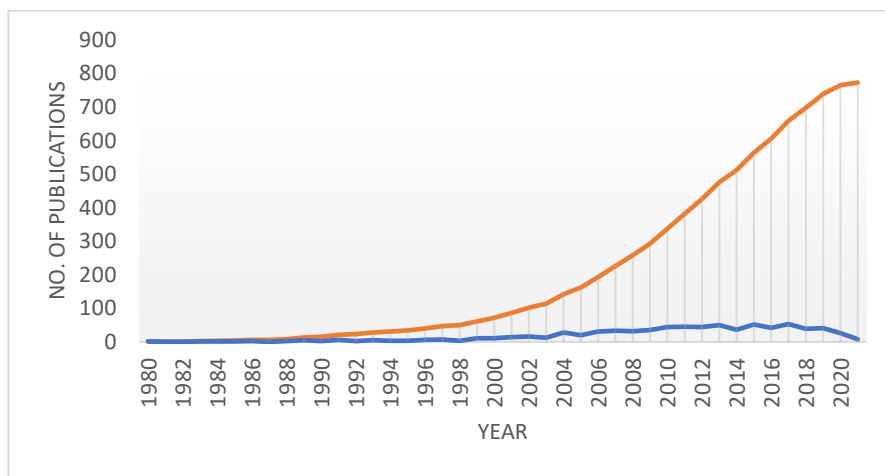


Figure. 2a: Annual and cumulative number of publications on ageing workforce research from 1980 to 2021

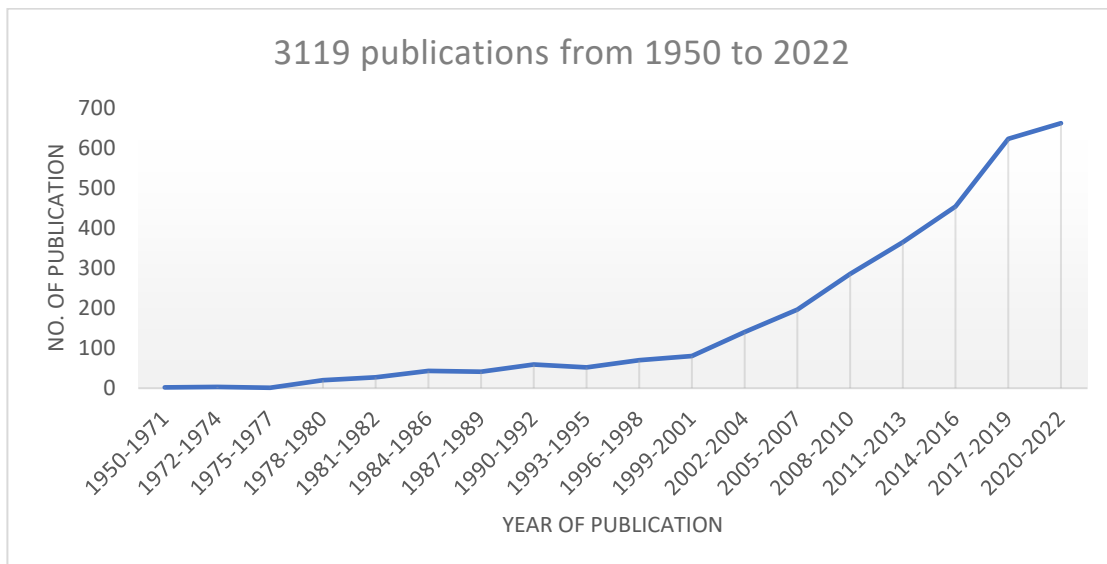


Figure 2B: Trends in the number of publications on ageing workforce research with a minimum of five citations

**Distribution of Publications with a Minimum of Five Citation Counts**

This bibliometric study includes 773 papers from a total of 2493 on the topic of ageing workforces in the Scopus database. Each paper included in this study received at least five citations. Figure 2B demonstrates that the proportion of papers containing at least five citations was relatively low between 1956 and 1978, but then rose steadily from 1978 to 2001. The growth of publications

with at least five citations is most noticeable between 2002 and 2013, and then again between 2014 and 2019. There may have been a slight decline between 2020 and the present because the papers published during this time are relatively new and need more time to accumulate citations. The observed trend indicates that, between 2010 and 2019, there will be more publications receiving at least five citations than in any previous year.

Most of these publications are research articles ( $n = 678$ ), followed by review articles ( $n = 67$ ) and a conference paper ( $n = 21$ ). The rest of the documents are short survey ( $n = 3$ ), notes ( $n = 2$ ) and editorial ( $n = 2$ ). Most of the research articles are focusing on the variables related to pension, retirement, care givers that affects the working hours directly or indirectly, migration of workforce and their old life as well diseases related to old people that do not cause fatality but influence their daily activities to do things on their own. Moreover, some researchers wrote review papers based on this labor force participation and working older workers existing literature and comments on the ageing workforce. As secondary literature, these review papers use secondary data to present their results theoretically, and not empirical. Despite the secondary sources, each review highlights the importance of the literature and provide directions as well as gaps for further investigations by research. That explains why the labor force research receives numerous attentions from many fields. (Snyder, 2019)

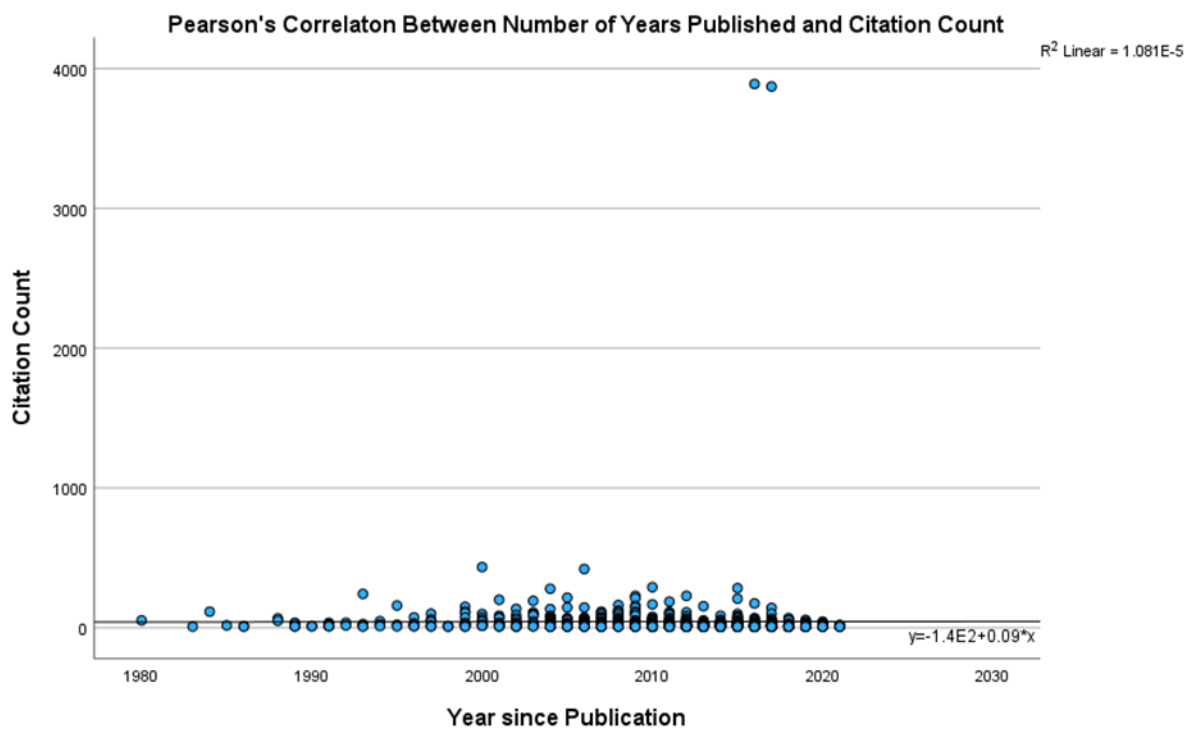
Looking into the top 10 most-cited papers (Wang et al., 2016); (Vos et al., 2017) (Buerhaus et al., 2000) (Bettio et al., 2006) (Foster & Walker, 2014) (Bloom et al., 2010a) ;(Fratiglioni et al., 1993) ; (Bonsang et al., 2012); (Simonazzi, 2009); and (Francisco, 2005). , these minimum of 5 citation journals are listed in Table 1. Among the 10 top papers, 4 are related to the causal of diseases in old people and sufferings caused during working life and cognitive deterioration. Alzheimer, Dementia and heart diseases are the common diseases old ages suffer after retirement, and researcher's informative topics to focus on. Some of them faces financial crisis and lack of savings causing more stress and less enjoyable life. As a result, old people are reluctant to rejoin the workforce after retirement and rather indulge in the worry-free life. 3 other articles are related to caregivers and homecare to the older workers after retirement (Bettio et al., 2006) and another 2 articles focuses on migration of healthcare workers as the supply of care workers will be affected as more caregivers and nurses migrates to developing countries (Buerhaus et al., 2000; Stilwell et al., 2004)(Stilwell et al., 2004) As older workers are less fit due to health issues, they rely on nurses and caregivers during their late life to continue living. The imbalance of old people and enough support. From the top 10 most cited articles, only one articles disuses the impact of ageing workforce on economic perspectives. This has been identified as a gap in the literature since more older workers and retirees rely on government policy to sustain, the higher is the national cost to keep up with them. In fact, the working older workers is seen as liabilities if they are paid expensively for their expertise, yet they cannot be productive to meet the employer's expectation. The focus of interest in labor force participation varies based on research interest. From diseases to caregiver to immigrants and retirement age and female participation. The cycle of ageing workforce is highly impacted. The management of older workers and older workers costs the government money, time and resources. The changes in the patterns of working age group should also be focus on to mitigate the population ageing issue well.

**Table 1: Top 10 most-cited ageing workforce-related publications arranged according to total citation counts**

Rank	Title	Journal	Type	Year	Total Citation Count	References
1	Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015	The Lancet	Review	2016	3889	174
2	Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016	The Lancet	Review	2017	3871	58
3	Implications of an aging registered nurse workforce	JAMA	Article	2000	434	25
4	Change in care regimes and female migration: The 'care drain' in the Mediterranean	Journal of European Social Policy	Article	2006	420	50
5	Implications of population ageing for economic growth	Oxford Review of Economic Policy	Article	2010	290	31
6	Active and successful aging: A European policy perspective	Gerontologist	Article	2015	283	42
7	Migration of health-care workers from developing countries: Strategic approaches to its management	Bulletin of the World Health Organization	Article	2004	279	25
8	Risk factors for late-onset Alzheimer's disease: A population-based, case-control study	Annals of Neurology	Article	1993	242	56
9	Does retirement affect cognitive functioning?	Journal of Health Economics	Article	2012	228	54

10	Care regimes and national employment models	Cambridge Journal of Economics	Article of	2009	228	32
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We also analysed the relationship between the number of years after publication and the number of citations for articles with at least five citations pertaining to the ageing workforce (Fig. 3). The number of years since publication was hypothesised to influence the number of citations. This assumption has already been proved to be somewhat valid, as papers released more recently have a shorter time frame than those published in the past, and hence require more time to collect citations (Aksnes et al., 2019). However, the results of the Pearson’s correlation test showed that there is no relationship between the number of years published with citation count. The correlation coefficient, ( $r = 0.03$ ) does not show any relationship between the two variables. This research demonstrates that older publications that have been accessible for a longer length of time do not necessarily have higher citation counts than recently published papers. Other criteria such as accessibility (i.e., open access vs. subscription documents), authors' citation behaviour, language, field of research, and, most crucially, publication quality may influence the number of citations a publication receives. (Aksnes et al., 2019)



**Figure 3: Pearson’s correlation analysis on the relationship between the number of citations and years since publication of the 773 publications on ageing workforce a minimum of five citations.  $r = -0.030$ ,  $P > 0.01$ ,  $N = 773$**

Ageing workforce with a minimum of five citations.  $r = -0.03$ ,  $P > 0.01$ ,  $N = 773$ . Correlation was not significant at the 0.01 level (two-tailed).

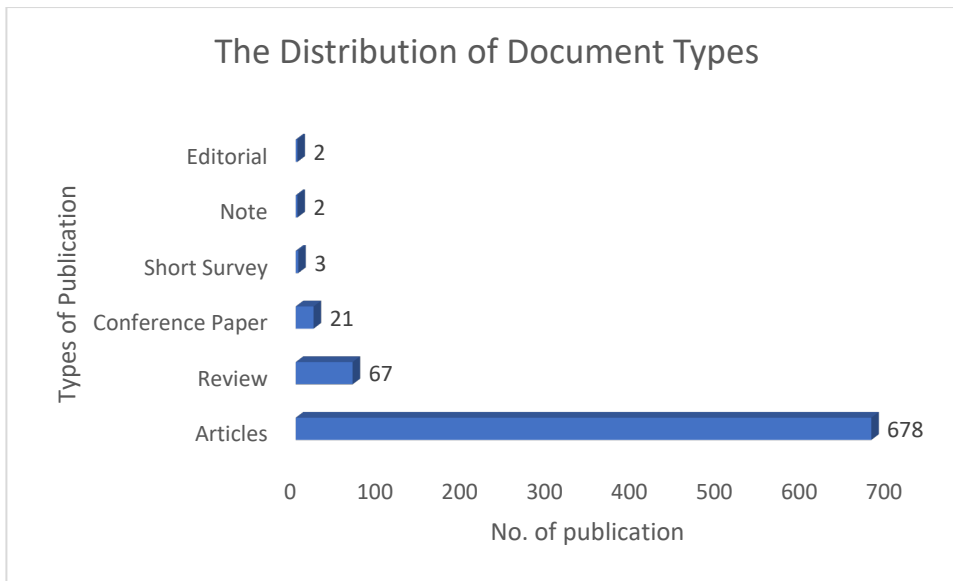


Figure 4: The distribution of Document Types for Ageing Population

### 3.3 Journal Analysis and Journal Level Metrics

The Bradford's Law of Scattering is growth in the documents on a given "subject" is distributed (scattered) according to a certain mathematical function so that a growth in papers on a subject requires a growth in the number of journals/information sources, calculated using Bradford's multiplier as with Zipf's law (about word frequencies in natural language texts) and Lotka's law (about distribution of authors' productivity) as one among the three most important bibliometric laws (Hjørland & Nicolaisen, 2005). The distribution of journals is divided into three zones based on one third of the total journals in a zone.

Table 2: Distribution of Journals in Bradford's Zones

Bradford's Zones	Number of Journals	% Journals	Number of Articles
1	35	8.33%	254
2	123	29.29%	257
3	262	62.38%	262
<b>Total number of journals</b>		420	773
<b>Average number of articles in each zone =257</b>			

Among the 773 documents with a minimum of five citations, 678 were classified as journal articles (nonbook and nonbook chapter). Based on Bradford's law of scattering, one-third of the 773 papers ( $n = 326$ ) were published in 35 core journals (Table 2). Due to the large amount of core journals identified, Table 3 only shows the top 14 core journals: Ageing And Society ( $n = 31$ ), Social Science And Medicine ( $n = 17$ ), Journal Of Aging And Social Policy ( $n = 13$ ), International Journal Of Environmental Research And Public Health ( $n = 11$ ), Economic Modelling ( $n = 10$ ), Gerontologist ( $n = 10$ ), Journal Of Population Economics ( $n = 10$ ), Population Research And Policy Review ( $n = 9$ ), PloS One ( $n = 8$ ), Scandinavian Journal Of Work, Environment And Health ( $n = 8$ ), Population And Development Review ( $n = 7$ ), BMJ Open ( $n = 6$ ), Human Resources For Health ( $n = 6$ ), and Journal Of European Social Policy ( $n = 6$ ). Among the top Based on Table 3, the four most active journals publishing FIG. 3: Pearson's correlation analysis on the relationship between the number of citations and years since publication of the 773 publications on labor force participation in ageing workforce with a minimum of five citations.  $r = -0.003, P > 0.01, N = 773$ . Correlation was not significant at the 0.01 level (two-tailed). The advantages is that the topic of labor force in ageing workforce is highly accepted by numerous journals as it is a vital research area worth exploring.

Table 2: List of 25 core journals in which one-third of 773 publications on ageing workforce were published

No.	Source Title	No. of papers
1	Ageing And Society	31
2	Social Science And Medicine	17
3	Journal Of Aging And Social Policy	13
4	International Journal Of Environmental Research And Public Health	11
5	Economic Modelling	10

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6	Gerontologist	10
7	Journal Of Population Economics	10
8	Population Research And Policy Review	9
9	PloS One	8
10	Scandinavian Journal Of Work, Environment And Health	8
11	Population And Development Review	7
12	BMJ Open	6
13	Human Resources For Health	6
14	Journal Of European Social Policy	6
15	Journal Of Social Policy	6
16	Journal Of The Economics Of Ageing	6
17	Research On Aging	6
18	Australian Journal Of Social Issues	5
19	Canadian Journal On Aging	5
20	Demography	5
21	European Journal Of Ageing	5
22	European Journal Of Population	5
23	International Journal Of Manpower	5
24	Journal Of Health Economics	5
25	Journal Of Policy Modeling	5

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Rank	Authors	Title	Journal	Publisher	Country	Total Citation Count
1	Wang et al., (2016)	Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015	The Lancet	Elsevier	U.S	3889
2	Vos et al., (2017)	Global, regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990-2016: A systematic analysis for the Global Burden of Disease Study 2016	The Lancet	Elsevier	U.S	3871
3	Buerhaus et al., (2000)	Implications of an aging registered nurse workforce	JAMA	American Medical Association	U.S	434
4	Bettio et al., (2006)	Change in care regimes and female migration: The 'care drain' in the Mediterranean	Journal of European Social Policy	SAGE Publication Ltd	U.K	420
5	Bloom et al., (2010)	Implications of population ageing for economic growth	Oxford Review of Economic Policy	Oxford University Press	U.K	290
6	Foster and Walker (2015)	Active and successful aging: A European policy perspective	Gerontologist	Oxford University Press	U.S	283
7	Stilwell et al., (2004)	Migration of health-care workers from developing countries: Strategic approaches to its management	Bulletin of the World Health Organization	World Health Organization	Switzerland	279
8	Fratiglioni et al., (1993)	Risk factors for late-onset Alzheimer's disease: A population-based, case-control study	Annals of Neurology	John Wiley and Sons Inc.	U.S	242
9	Bonsang et al., (2012)	Does retirement affect cognitive functioning?	Journal of Health Economics	Elsevier	Netherlands	228
10	Simonazzi, A. (2009)	Care regimes and national employment models	Cambridge Journal of Economics	Oxford Academic	U.K	228
11	Stacey, C.L. (2005)	Finding dignity in dirty work: The constraints and rewards of low-wage home care labour	Sociology of Health and Illness	Wiley Blackwell Publishing Ltd.	U.S	215
12	Westerlund et al., (2009)	Self-rated health before and after retirement in France (GAZEL): a cohort study	The Lancet	Elsevier B.V.	U.K	211
13	Bauer et al., (2015)	Impacts of Informal Caregiving on Caregiver Employment, Health, and Family	Journal of Population Ageing	Springer Science and Business Media Ltd.	Switzerland	208

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14	Boeri et al, (2001)	Would you like to shrink the welfare state? A survey of European citizens	Economic Policy	Blackwell Publishing Ltd	England	200
15	Carmichael F., Charles, S. (2003)	The opportunity costs of informal care: Does gender matter?	Journal of Health Economics	Elsevier	Netherlands	192
16	Bianchi S. M. (2011)	Family Change and Time Allocation in American Families	Annals of the American Academy of Political and Social Science	SAGE Publication Inc	U.S	187
17	Smagula et al., (2016)	Risk factors for sleep disturbances in older adults: Evidence from prospective studies	Sleep Medicine Reviews	Elsevier B.V.	U.K	174
18	Van Dalen et al., (2010)	Productivity of older workers: Perceptions of employers and employees	Population and Development Review	Wiley Blackwell Publishing Ltd.	U.K	167
19	Bolin et al., (2008)	Your next of kin or your own career?. Caring and working among the 50+ of Europe	Journal of Health Economics	Elsevier	Netherlands	162
20	Ettner, S. L. , (1995)	The impact of "parent care" on female labor supply decisions	Demography	Duke University Press	U.S	159

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### 3.4 Publication Analysis Based on Regions, Countries and Authors

In the publication of the 1000 most cited papers, in total, 1871 authors contributed to the publications.

**Table 3: The Number of Publications with Respect to Countries**

Country	No. of Publications	Percentage
United States	188	24.32%
United Kingdom	102	13.20%
Australia	84	10.87%
Germany	66	8.54%
Netherlands	59	7.63%
China	42	5.43%
Japan	41	5.30%
Canada	37	4.79%
Sweden	29	3.75%
Belgium	18	2.33%
<b>Total</b>	<b>666</b>	<b>86.16%</b>

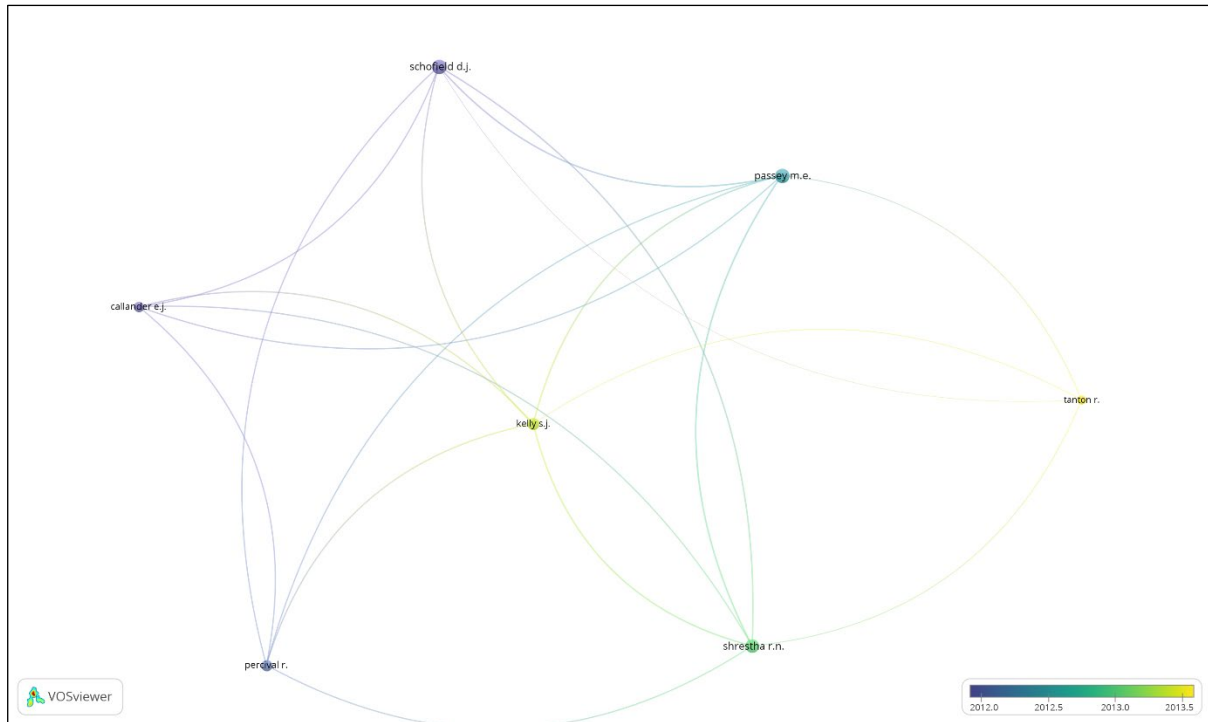
Out of the 773 publications, United States outranked the other countries in terms of its publication volumes by almost a quarter of the total. This rank is leading by the United Kingdom ( $n = 102$ ), Australia with ( $n = 84$ ), Germany ( $n = 62$ ), Netherlands ( $n = 59$ ), China ( $n = 42$ ), Japan ( $n = 41$ ), Canada ( $n = 37$ ), Sweden ( $n = 29$ ) and Belgium ( $n = 18$ ).

The top countries are mostly concerned about the fitness of their older workers for the government to revise their policy to these non-working crowd. Meanwhile for China and Japan, they are taking steps based on the imbalance of age group in each population due to low fertility.

The practise of co-authorship facilitates international collaboration between researchers and serves to promote academic exchanges and the dissemination of new ideas (Tao et al., 2020). The thickness of the line represents the average number of articles co-authored with that country or territory.

A network diagram depicting the international participation in 773 publications on the subject of population ageing is shown in Fig. 4A. A country is represented by a node, and the node's size indicates the degree to which that country contributed to the overall publication count for the topic of ageing. Cooperation between nations is represented by the line connecting the nodes. Connectivity between nodes is strengthened and the number of collaborations is represented by a smaller distance between them. Figure 4B is an overlay visualisation of the co-authorship network for 773 articles on the ageing workforce, based on the countries involved in their publication. The colours and intensities of the colours represent the average publication years for each country. The top 10 countries have an average publication age of more than four decades. The United States, the United Kingdom, and United Kingdom are just a few of the countries that have been consistently publishing articles through a variety of international collaborations since the late 1990s and early 2000s. Recent years have seen an uptick in the number of publications about China's ageing workforce, with the number peaking after 2015. This may be indicative of increased international cooperation in this area. There has been an upward trend in the number of publications in China related to the field of an ageing workforce, so while the country is currently ranked third in terms of the total number of publications in this area, we expect this number to grow in the near future. The United States is considered to be the most powerful nation in terms of publication on the ageing workforce, with the highest number of papers reported. As can be seen in Fig. 4, the United States has close ties to other countries that have been very prolific in publishing research on the subject of an ageing workforce, such as Australia and the United Kingdom. Despite the average publication year being 2009., this finding shows that the United States remains the leading contributor in research related to the ageing workforce through international collaborations followed by United Kingdom at 2010.64 Given that the United States has the highest average publication year (1998.26), it appears that the country has made steady contributions to the study of the effects of an ageing workforce.



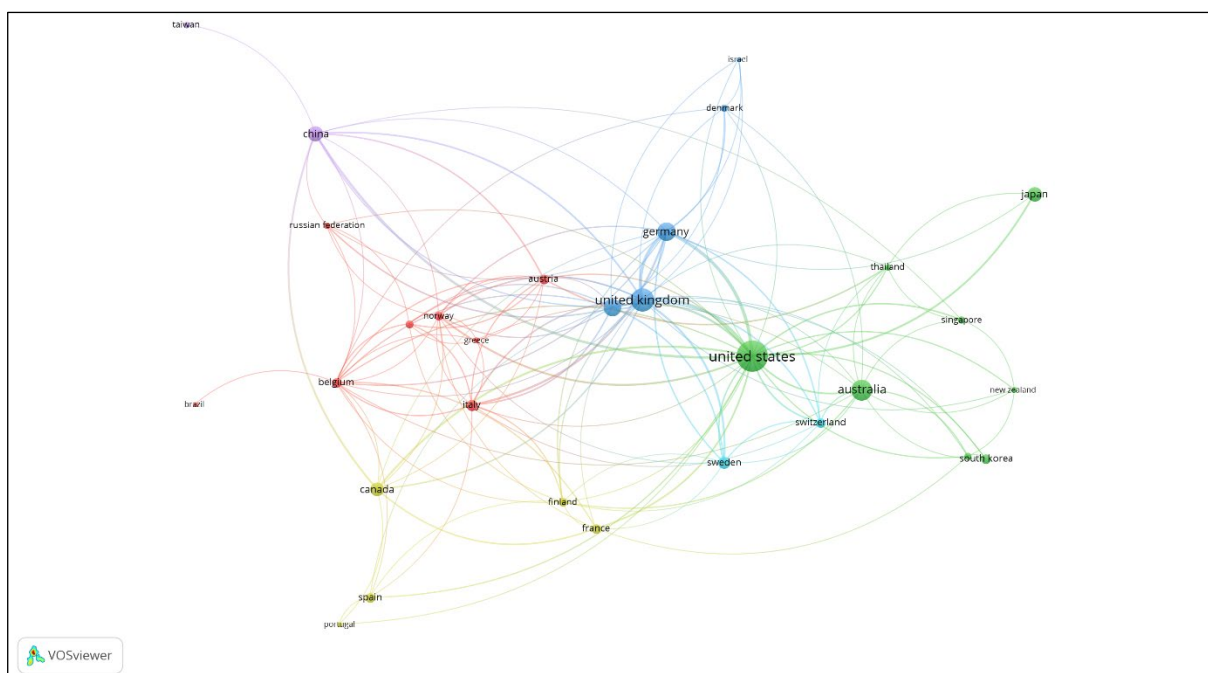


**Figure 5. Overlay visualisation of co-authorship based on authors contributing to the 773 publications related to ageing workforce with a minimum number of five citations (based on VOSviewer). The relatedness of countries involved in co-authorship is represented by the distance between two nodes.**

In terms of co-authorship, several authors team up with one another to contribute to the literature. Passey, M.E (D. Schofield et al., 2017, 2018; D. J. Schofield et al., 2012). from Australia collaborated with Schofield, D.(D. Schofield et al., 2014, 2017, 2018; D. B. Schofield et al., 2008; D. J. Schofield et al., 2012) from Canberra collaborate with Prskawetz, A. (Sánchez-Romero et al., 2016) from Germany and also Callander, E.J (Callander & Schofield, 2013; D. J. Schofield et al., 2012). from Monash University. These are the top authors in the labor force documents.

These authors collaborated to monitor the impacts of chronic diseases on labor force participation in Australia including backpain, arthritis and many other chronic diseases.(D. Schofield et al., 2014, 2017, 2018; D. B. Schofield et al., 2008; D. J. Schofield et al., 2012)

#### Analysis of the Co-Occurrence of Key Terms





Due to the large amount of core journals identified, Table 4 only shows the top 25 core journals: Ageing and Society ( $n = 31$ ), Social Science and Medicine ( $n = 17$ ), Journal of Aging and Social Policy ( $n = 13$ ), International Journal Of Environmental Research And Public Health ( $n = 11$ ), Economic Modelling ( $n = 10$ ), Gerontologist ( $n = 10$ ), Journal Of Population Economics ( $n = 10$ ), Population Research And Policy Review ( $n = 9$ ), PloS One ( $n = 8$ ), Scandinavian Journal Of Work, Environment And Health ( $n = 8$ ), Population and Development Review ( $n = 7$ ), BMJ Open ( $n = 6$ ), Human Resource for Health ( $n = 6$ ), and European Social Policy ( $n = 6$ ). These 25 journals are all still active in their publications. Based on Table 4, the four most active journals publishing ageing workforce-related articles are Ageing and Society, Social Science and Medicine, Journal of Aging and Social Policy, and International Journal of Environmental Research and Public Health, which have a main focus on the longevity risk of old people, with regards to their lengthened retirement age. Given then more older people a population, their health issues and physical disability influence their retirement decisions. In fact, disabled and unhealthy older adults require the professional care workers or their children who are actively working to take care of them. Consequently, there are shift in supply and demands for workers when longevity risk affects the working age structure and retirement funds, Among the top 14 core journals, The Population and Development Review has been identified as the most influential characterized by its impact factor of 10.515, which is the highest (based on the 2021 Journal Citation Report) of the journals included in this research. Some information in Table 4 is marked as not available due to the unavailability of data following the search.

**Table 4: List of top 14 core journals in which one-third of 773 publications on ageing workforce were published**

No.	Source There are no sources in the current document.e Title	No. of papers	2021 impact factor <sup>1</sup>	5-year impact factor <sup>2</sup>	SJR <sup>3</sup>	SNIP 2021 <sup>4</sup>	CiteScore 2021 <sup>5</sup>
1	Ageing And Society	31	3.718	3.705	0.703	1.61	4.3
2	Social Science And Medicine	17	5.379	5.887	1.806	2.25	n/a
3	Journal Of Aging And Social Policy	13	7.084	5.129	1.569	2.18	6.5
4	International Journal Of Environmental Research And Public Health	11	2.791	4.799	0.814	1.44	4.5
5	Economic Modelling	10	3.875	3.807	1.065	1.73	4.8
6	Gerontologist	10	5.422	6.123	1.759	2.41	8
7	Journal Of Population Economics	10	4.7	4.19	1.731	2.28	6.5
8	Population Research And Policy Review	9	1.899	2.329	0.731	1.09	2.8
9	PloS One	8	3.752	4.069	0.852	1.37	5.6
10	Scandinavian Journal Of Work, Environment And Health	8	5.492	5.41	1.363	1.81	7.3
11	Population And Development Review	7	10.515	7.675	1.213	1.93	4.2
12	BMJ Open	6	3.006	3.587	0.982	1.61	3.9
13	Human Resources For Health	6	4.837	5.104	1.358	2.38	5.1
14	Journal Of European Social Policy	6	2.536	3.079	0.98	2.06	5

<sup>1</sup>Impact factor based on the 2021 Journal Citation Reports (Clarivate Analytics, 2021). <sup>2</sup>bFive-year impact factor based on the 2021 Journal Citation Reports(Clarivate Analytics, 2020). <sup>3</sup>SCImago Journal Rank (SJR) based on year 2021 . <sup>4</sup>Source Normalized Impact per Paper (SNIP). <sup>5</sup>CiteScore data from 2021

**Table 5: Ageing Workforce According To Their Categories**

Categories	Classifications	Articles
<b>Migration</b>	Migration due to demographic changes	(Bourassa Forcier et al., 2004; Browne & Braun, 2008; de Haas & Fokkema, 2002.; Dyer et al., 2008; Fonseca, 2008; Hansen et al., 2017; Hui, 2013; A. E. Kim, 2009b; Krueger, 2017; Nannestad, 2004; Pond & Mcpake, 2006; Serrano et al., 2011; Stilwell et al., 2004; Warnes et al., 2007)
	Migration of skilled and unskilled worker	(Rowthorn, 2008; Zimmermann, 2005)
<b>Labor force participation</b>	Shortage of healthcare professionals	(Buerhaus et al., 2000; Stilwell et al., 2004); (Segal & Bolton, 2009)
	Female workers	(French & Strachan, 2015) (Colley, 2013; Dey, 2006; Kelle, 2020; Lyberaki, 2011)
	Human capital	(Berk & Weil, 2015)

	Employment/Unemployment	(Angeloni & Borgonovi, 2016; Felstead, 2010)
	Robotisation	(Chance G., 2016; Willcocks, 2020)
<b>Demographic changes</b>	Labor force shortage	(Cai & Wang, 2006; Cao et al., 2012; Dyson, 2001; Foster & Walker, 2014; Varianou-Mikellidou et al., 2019)
	Fertility rate	(Li & Deng, 2017; Liu, 2010)(Fang, 2018; Felstead, 2010; Guest & Swift, 2008; Hondroyiannis1 & Papapetrou2, 2002.; Lee & Mason, 2014; McDonald & Kippen, 2001; Tien et al., 1992.; Tyers & Shi, 2007; Yip et al., 2001)
	Age structure shift	(Angel et al., 2017; Blanchet, 1988; Boom'' et al., 2001; Borsch-Supan, 1991; Bujard, 2015; Q. Chen et al., 2017; Clark, 2010; Hsu et al., 2015; Irmen, 2017; Káčerová et al., 2014; Lindh, 2003; Nelson & Sewall, 2003; Prskawetz & Sambt, 2014; Thiede et al., 2017; Wei et al., 2019; Yip,et al., 2010)
	Education	(Crespo Cuaresma et al., 2016; Loichinger, 2015)
<b>Retirement statutory age</b>	Increase in statutory retirement age	(Drydakis et al., 2018; Elmeskov, 2004; Frimmel & Pruckner, 2020)
	Retirement preference	(Bjursell et al., 2017; Cloostermans et al., 2015; Szinovacz, 2011; Thang, 2011)
	Others	(Ferreira & dos Santos, 2013; Hofacker & Naumann, 2015; Polivka & Luo, 2015; Sánchez Martín et al., 2010; van Sonsbeek, 2010)
<b>Chronic diseases</b>	Chronic disease on labor force participation	(Antonova et al., 2017; D. B. Schofield et al., 2008; Silvaggi et al., 2020; Uppal & Information, 2007)
	Caretakers handling older adults with chronic diseases	(D. Schofield et al., 2014, 2018)
	Physical deterioration	(Bonsang et al., 2012)
	Chronic diseases in general	(H.-J. Kim et al., 2012)
	Diabetes	(Mutambudzi et al., 2018)
	Stroke	(H.-J. Kim et al., 2012)
	Heart diseases	(D. J. Schofield et al., 2012)
	Dementia	(R. Chen et al., 2011; Fratiglioni et al., 1993; Schikhof et al., 2010; Schikhof & Mulder, 2008; Smagula et al., 2016; Yamamoto et al., 2017)
<b>Welfare caregivers</b>	Long-term care	(Antonio et al., 2017); (Mosca et al., 2017)
	Informal care	(Bolin et al., 2008; Chaouni et al., 2020; Jang et al., 2012; Stanfors et al., 2019; Takeda et al., 2004)
	Professional eldercare	(Schulz et al., 2004)
	Female worker for parental care	(Bookman et al., 2019; Takeda et al., 2004)
<b>Economy effect</b>	Economic growth and changes	(Bloom et al., 2010b; Cristea et al., 2020; Dolls et al., 2019; Elgin & Tumen, 2012; Hsu et al., 2015; Irmen, 2017; Peng, 2008; Prskawetz & Sambt, 2014)
	Fiscal policy	(Kudrna et al., 2015; Razin & Sadka, 2007)

## CONCLUSION

The ageing workforce is portrayed from many perspectives in this bibliometric study. Trends and the volume of articles published in the most-cited journals can shed light on the state of the field and reveal areas where further research is needed. All the goals set out for this study have been met by the findings. To the best of our knowledge, the labour force participation publications have increased considerably as more persons of all sexes and sexual orientations have entered the labour force. Since its inception, the volume has risen, and in the near future, it is expected to outpace its present citation and publishing rates. To offset the demographic shifts that are now difficult to counteract, effective strategies for managing an ageing workforce must be devised. This bibliometric study suggests that other databases be used to go deeper into the literature on the evolution of the labour force, as Scopus was the only source used for this analysis. Scopus, the primary database used in this research, represents excellent results in the field of social science, but additional sources are always welcome.

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