

# Network Analysis in the Field of Population Aging

## **Based on Web of Science**

Hanqing Ding, Beijing Normal University

Nian Liu, Capital University of Economics and Business

Yik Chan Chin, Beijing Normal University

Jing Zhu, Beijing Normal University

Ke Li, Xi'an-Jiaotong Liverpool University

This report conducts network analysis of relevant academic literature related to Regional Action Plan on Healthy Ageing's five objectives.

December 2021

## TABLE OF CONTENTS

1.	Intro	duction1
2.	Meth	odology2
2	2.1 \$	Selection of Database2
2	2.2 N	Materials Related to Each Objective2
3.	Anal	ysis8
Ĵ	8.1 F	Results Related to Objective 18
	3.1.1	Publications by Year and Country8
	3.1.2	Co-author Network9
	3.1.3	Co-institution Network14
	3.1.4	Co-category Network16
	3.1.5	Co-keyword Network17
	3.1.6	Co-citation Network17
Ĵ	8.2 F	Results Related to Objective 221
	3.2.1	Publications by Year and Country21
	3.2.3	Co-institution Network27
	3.2.4	Co-category Network
	3.2.5	Co-keyword Network
	3.2.6	Co-citation Network
Ĵ	8.3 I	Results Related to Objective 3
	3.3.1	Publications by Year and Country34
	3.3.2	Co-author Network
	3.3.3	Co-institution Network40
	3.3.4	Co-category Network43
	3.3.5	Co-keyword Network43
	3.3.6	Co-citation Network44
Ĵ	8.4 F	Results Related to Objective 448
	3.4.1	Publications by Year and Country48
	3.4.2	Co-author Network
	3.4.3	Co-institution Network53
	3.4.4	Co-category Network55
	3.4.6	Co-citation Network

-	3.5	Results Related to Objective 5		
	3.5	.1 Publications by Year and Cou	ntry60	
	3.5	.2 Co-author Network	61	
	3.5	.3 Co-institution Network		
	3.5	.4 Co-category Network		
	3.5	.5 Co-keyword Network		
	3.5	.6 Co-citation Network	70	
4.	Co	nclusion		
5.	Ref	ferences		
6.	Ap	pendices		
(	5.1	Modularity Value		
(	5.2	Silhouette Value		
6.3 Selection of Different Databases				

#### 1. Introduction

Population aging is becoming a major development trend globally. In the Western Pacific Region (WPR), the population aging phenomenon is especially prominent. According to United Nations (2019a; 2019b), there are more than 700 million older people aged 65 and over worldwide, of which 240 million reside in the Western Pacific Region, and this number may double by 2050 (United Nations, 2019b). Simultaneously, the Region is also experiencing a deepening aging population, with the number of people aged 75 and over proliferating. At present, the Region's population of people aged 75 and over stands at approximately 84 million and is expected to triple by 2050 (United Nations, 2019b).

Under the circumstances, World Health Organization (WHO) issued the Regional Action Plan on Healthy Ageing (RAP), which aims to support all Member States in improving the health and well-being of the aged population in the Region to thrive and contribute to society. RAP outlines five objectives for achieving the vision of healthy aging in the WPR. They can be broadly categorized as objectives to enable social return (Objective 1), objectives to support healthy ageing (Objectives 2–4), and objectives to enable categorized as objectives 5).

Under the guidance of RAP, in order to master the research status of population aging in WPR, the report conducts network analysis of relevant academic literature in compliance with the five objectives, including influential researchers and research institutions, discipline fields involved in this research field, intellectual base and frontier of the research and the crucial literature in the research, which aims to comprehensively describe the overview of the academic field of relevant researches.

#### 2. Methodology

#### 2.1 Selection of Database

The database, Web of Science (WoS), was selected with the help of an information specialist as relevant for contributions in the field of sciences, social sciences, arts and humanities. It includes multiple sub-databases: Science Citation Index Expanded, Social Sciences Citation Index, Arts & Humanities Citation Index, Conference Proceedings Citation Index—Science, Conference Proceedings Citation Index—Social Science & Humanities, Emerging Sources Citation Index, Current Chemical Reactions and Index Chemicus.

#### 2.2 Materials Related to Each Objective

To identify the relevant papers for network analysis, the analysts used terms related

to RAP's each objective to search electronic databases. RAP's five objectives are as

below:

Objective 1: Transforming societies as a whole to promote healthy ageing, based on understanding the implications of population ageing;

- Objective 2: Transforming health systems to address each individual's lifelong health needs by providing necessary health and non-health services in a coordinated way;
- Objective 3: Providing community-based integrated care for older adults tailored to individual needs:
- Objective 4: Fostering technological and social innovation to promote healthy ageing

Objective 5: Strengthening monitoring and surveillance systems and research on older adults to inform programmes, services and policies.

(World Health Organization Regional Office for the Western Pacific, 2020)

The search string includes three components, including

- Population terms related to ageing, such as aging and older people; ٠
- Terms related to RAP's each objective; ٠
- 37 countries and areas of the WHO WPR. ٠

According to the keywords provided by WHO, the final search string as follows:

Objective 1: (TS="aging" OR TS="ageing" OR TS="older people" OR TS="older ٠ adults" OR TS="older persons" OR TS="older population" OR TS="seniors" OR TS="senior citizens" OR TS="elderly" OR TS="elders" OR TS="the aged people") AND (TS="ageism" OR TS="age discrimination" OR TS="employment" OR TS="inclusion" OR (TS="age-friendly" AND TS="transportation") OR TS="agefriendly housing" OR (TS="age-friendly" AND TS="outdoor space" AND TS="building\*") OR TS="social participation" OR (TS="communication" AND TS="information")) AND (TS="American Samoa" OR TS="New Caledonia" OR TS="Australia" OR TS="New Zealand" OR TS="Brunei Darussalam" OR TS="Niue" OR TS="Cambodia" OR TS="Northern Mariana Islands" OR TS="China" OR TS="Palau" OR TS="Cook Islands" OR TS="Papua New Guinea" OR TS="Fiji" OR TS="Philippines" OR TS="French Polynesia" OR TS="Pitcairn Island" OR TS="Guam" OR TS="Republic of Korea" OR TS="Hong Kong" OR TS="Samoa" OR TS="Japan" OR TS="Singapore" OR TS="Kiribati" OR TS="Solomon Islands" OR TS="Lao People's Democratic Republic" OR TS="Tokelau" OR TS="Macao" OR TS="Tonga" OR TS="Malaysia" OR TS="Tuvalu" OR TS="Marshall Islands" OR TS="Vanuatu" OR TS="Micronesia" OR TS="Viet Nam" OR TS="Mongolia" OR TS="Wallis and Futuna" OR TS="Nauru");

Objective 2: (TS="aging" OR TS="ageing" OR TS="older people" OR TS="older adults" OR TS="older persons" OR TS="older population" OR TS="seniors" OR TS="senior citizens" OR TS="elderly" OR TS="elders" OR TS="the aged people") AND (TS="health system\*" OR TS="integrated care" OR TS="long term care" OR TS="primary health care" OR TS="palliative care" OR TS="oral health" OR TS="dental health" OR TS="self care" OR TS="self-care" OR TS="health service\*" OR TS="curative services" OR TS="preventive services" OR TS="social services" OR TS="welfare services") AND (TS="American Samoa" OR TS="New Caledonia" OR TS="Australia" OR TS="New Zealand" OR TS="Brunei Darussalam" OR TS="Niue" OR TS="Cambodia" OR TS="Northern Mariana Islands" OR TS="China" OR TS="Falau" OR TS="Cook Islands" OR TS="Papua New Guinea" OR TS="Fiji" OR TS="Philippines" OR TS="French

Polynesia" OR TS="Pitcairn Island" OR TS="Guam" OR TS="Republic of Korea" OR TS="Hong Kong" OR TS="Samoa" OR TS="Japan" OR TS="Singapore" OR TS="Kiribati" OR TS="Solomon Islands" OR TS="Lao People's Democratic Republic" OR TS="Tokelau" OR TS="Macao" OR TS="Tonga" OR TS="Malaysia" OR TS="Tokelau" OR TS="Marshall Islands" OR TS="Vanuatu" OR TS="Micronesia" OR TS="Viet Nam" OR TS="Mongolia" OR TS="Wallis and Futuna" OR TS="Nauru");

- Objective 3: (TS="aging" OR TS="ageing" OR TS="older people" OR TS="older ٠ adults" OR TS="older persons" OR TS="older population" OR TS="seniors" OR TS="senior citizens" OR TS="elderly" OR TS="elders" OR TS="the aged people") AND (TS="community-based care" OR TS="person-centred care" OR TS="person-centered care" OR TS="social prescribing" OR TS="link worker\*" OR TS="community health worker\*" OR TS="chronic disease\* management" OR TS="ageing in place" OR TS="aging in place" OR TS="home care" OR TS="day care" OR TS="residential care" OR TS="community participation" OR TS="social isolation" OR TS="loneliness" OR TS="mental health") AND (TS="American Samoa" OR TS="New Caledonia" OR TS="Australia" OR TS="New Zealand" OR TS="Brunei Darussalam" OR TS="Niue" OR TS="Cambodia" OR TS="Northern Mariana Islands" OR TS="China" OR TS="Palau" OR TS="Cook Islands" OR TS="Papua New Guinea" OR TS="Fiji" OR TS="Philippines" OR TS="French Polynesia" OR TS="Pitcairn Island" OR TS="Guam" OR TS="Republic of Korea" OR TS="Hong Kong" OR TS="Samoa" OR TS="Japan" OR TS="Singapore" OR TS="Kiribati" OR TS="Solomon Islands" OR TS="Lao People's Democratic Republic" OR TS="Tokelau" OR TS="Macao" OR TS="Tonga" OR TS="Malaysia" OR TS="Tuvalu" OR TS="Marshall Islands" OR TS="Vanuatu" OR TS="Micronesia" OR TS="Viet Nam" OR TS="Mongolia" OR TS="Wallis and Futuna" OR TS="Nauru");
- Objective 4: (TS="aging" OR TS="ageing" OR TS="older people" OR TS="older adults" OR TS="older persons" OR TS="older population" OR TS="seniors" OR

TS="senior citizens" OR TS="elderly" OR TS="elders" OR TS="the aged people") AND (TS="digital health" OR TS="eHealth" OR TS="digital medicine" OR TS= "telemedicine" OR TS="assistive technology" OR TS="tablets" OR TS="computers" OR TS="laptops" OR TS="smartphones" OR TS="internet of things" OR TS="IoT" OR TS="wearable" OR TS="social media" OR TS="ecommerce" OR TS="metaverse" OR TS="sensors" OR TS="robots" OR TS="robotics" OR TS="artificial intelligence" OR TS="computer vision" OR TS="natural language processing" OR TS="big data" OR TS="analytics" OR OR TS="apps" OR TS="application" TS="predictive analytics" OR TS="smartapp" OR TS="smartphone apps" OR TS="living labs" OR TS="cocreation" OR TS="co-creating" OR TS="human-centered design" OR TS="human centred design" OR TS="design thinking" OR TS="gamification" OR TS="gamified" OR TS="serious games" OR TS="virtual reality" OR TS="augmented reality" OR TS="information and communication technology" OR TS="ICT" OR TS="innovation" OR TS="monitoring device" OR TS="entrepreneurship" OR TS="50 plus" OR TS="social enterprise" OR TS="volunteer" OR TS="self-help club" OR TS="silver market") AND (TS="American Samoa" OR TS="New Caledonia" OR TS="Australia" OR TS="New Zealand" OR TS="Brunei Darussalam" OR TS="Niue" OR TS="Cambodia" OR TS="Northern Mariana Islands" OR TS="China" OR TS="Palau" OR TS="Cook Islands" OR TS="Papua New Guinea" OR TS="Fiji" OR TS="Philippines" OR TS="French Polynesia" OR TS="Pitcairn Island" OR TS="Guam" OR TS="Republic of Korea" OR TS="Hong Kong" OR TS="Samoa" OR TS="Japan" OR TS="Singapore" OR TS="Kiribati" OR TS="Solomon Islands" OR TS="Lao People's Democratic Republic" OR TS="Tokelau" OR TS="Macao" OR TS="Tonga" OR TS="Malaysia" OR TS="Tuvalu" OR TS="Marshall Islands" OR TS="Vanuatu" OR TS="Micronesia" OR TS="Viet Nam" OR TS="Mongolia" OR TS="Wallis and Futuna" OR TS="Nauru");

• Objective 5: (TS="aging" OR TS="ageing" OR TS="older people" OR TS="older

adults" OR TS="older persons" OR TS="older population" OR TS="seniors" OR TS="senior citizens" OR TS="elderly" OR TS="elders" OR TS="the aged people") AND (TS="national survey" OR TS="longitudinal survey" OR TS="longitudinal data" OR TS="research agenda" OR TS="ageing indicator\*" OR TS="health indicator\*" OR (TS="cost-effective" AND TS="intervention\*") OR (TS="intervention" AND TS="sustainability\*")) AND (TS="American Samoa" OR TS="New Caledonia" OR TS="Australia" OR TS="New Zealand" OR TS="Brunei Darussalam" OR TS="Niue" OR TS="Cambodia" OR TS="Northern Mariana Islands" OR TS="China" OR TS="Palau" OR TS="Cook Islands" OR TS="Papua New Guinea" OR TS="Fiji" OR TS="Philippines" OR TS="French Polynesia" OR TS="Pitcairn Island" OR TS="Guam" OR TS="Republic of Korea" OR TS="Hong Kong" OR TS="Samoa" OR TS="Japan" OR TS="Singapore" OR TS="Kiribati" OR TS="Solomon Islands" OR TS="Lao People's Democratic Republic" OR TS="Tokelau" OR TS="Macao" OR TS="Tonga" OR TS="Malaysia" OR TS="Tuvalu" OR TS="Marshall Islands" OR TS="Vanuatu" OR TS="Micronesia" OR TS="Viet Nam" OR TS="Mongolia" OR TS="Wallis and Futuna" OR TS="Nauru").

The search for Objective 1 was carried out on 23 November 2021, resulting in 1,817 publications. The search for Objective 2 was carried out on 30 November 2021, resulting in 3,633 publications. The search for Objective 3 was carried out on 16 November 2021, resulting in 3,264 publications. The search for Objective 4 was carried out on 17 November 2021, resulting in 2,020 publications. The search for Objective 5 was carried out on 26 November 2021, resulting in 712 publications.

The analysts and WHO agreed on general inclusion and exclusion criteria, which helped define the relevant studies for the screening based on titles and abstracts. Contributions were comprised if they were published in English in peer-reviewed international journals after 1990 and were available in full text electronically. Contributes were eliminated if they were published as duplicates, reviews, and on the subjects irrelevant to RAP's each objective. The screening process resulted in a data corpus of 1,320

publications for Objective 1, 3,277 publications for Objective 2, 2,270 publications for Objective 3, 1,354 publications for Objective 4, and 628 publications for Objective 5 for further analyses.

#### 3. Analysis

CiteSpace 5.8.R3 was used as a tool of network analysis and data visualization. Five types of networks were analyzed, including co-author network, co-institution network, co-category network, co-keyword network, and co-citation network. Some parameters were pre-set before the formal network analysis. According to the publication date of the literature, the period between 1991 and 2021 was set as Time Slicing for Objective 2, the period between 1990 and 2021 was set as Time Slicing for Objective 2, the period between 1991 and 2021 was set as Time Slicing for Objective 3, the period between 1991 and 2021 was set as Time Slicing for Objective 4, the period between 1991 and 2021 was set as Time Slicing for Objective 5. Each year was set as one time slice except for the keyword network. In the keyword network, the time slice was set to be five years to explore the research trends across different time periods. According to different types of network analysis, five node types were selected respectively, including Author, Institution, Category, Keyword, and Reference. The top 50 nodes per slice was set as Selection Criteria.

#### 3.1 Results Related to Objective 1

#### 3.1.1 Publications by Year and Country

Figure 1 shows the distribution of publications by year since 1991. Figure 2 displays the top 10 publishing countries/areas. 65 publishing countries/areas are identified in the ageing studies involving the WPR.



Figure 1. Number of Publications Over Time<sup>1</sup>



Figure 2. Top 10 publishing countries/areas

#### 3.1.2 Co-author Network

Figure 3 shows a network of co-authors, including 3,910 authors and 10,836 coauthorships. The network density is 0.0014, which demonstrates the co-authorship

<sup>&</sup>lt;sup>1</sup> The number of publications in 2021 is incomplete, as the data was collected on 23 November 2021.

network is sparse and disconnected. The modularity value is 0.987 and the silhouette value is 0.981 through the cluster analysis, indicating the clustering effect is statistically significant and reliable. The largest network cluster is composed of 254 authors, accounting for 6% of the network. Five main clusters are presented in Figure 4.



**Figure 3. Co-author Network** 



Figure 4. Main Network Clusters of Co-authorships

Table 1 lists co-authorship details of the top 5 clusters. The topic of each cluster is automatically generated by CiteSpace and are displayed as red labels in Figure 4. The representative publications of top authors are provided in Table 2.

Cluster ID	Size	Silhouette	Mean (Year)	Cluster Label	Top Authors (by frequency)
					Katsunori Kondo
				Construction 1	Ichiro Kawachi
0	144	0.969	2015	Tunctional	Jun Aida
				status	Naoki Kondo
					Taishi Tsuji
					Takashi Oshio
					Satoshi Shimizutani
8	39	0.999	2016	care recipient	Haruko Noguchi
					Rikiya Matsukura
					Naohiro Ogawa
		0.995	2018		Junichiro Miyachi
				general	Katsuyuki Mura
9	36			Japanese	Mieko Nakamura
				population	Motohiko Miyachi
					Yuko Handa
					Kemmyo Sugiyama
		20     0.998       15     0.998	2019 2012	affected	Ichiro Tsuji
17	20			coastal	Yumi Sugawara
				communities	Mitsuaki Katayanagi
					Yusuke Utsumi
					Yasuki Kobayashi
20	15			Voor	Akira Babazono
23	15			yeai	Masatoshi Matsumoto
					Bongmin Yang

Table 1. Top 5 Clusters of Co-authorship

## Table 2. Top Authors (by frequency) in Top 5 Clusters

Top Author	Affiliation	Publication Example
Katsunori Kondo	Chiba University	Ichida, Y., Kondo, K., Hirai, H., Hanibuchi, T., Yoshikawa, G., & Murata, C. (2009). Social capital, income inequality and self-rated health in Chita peninsula, Japan: a multilevel analysis of older people in 25 communities. <i>Social science &amp;</i> <i>medicine</i> , <i>69</i> (4), 489-499.
Takashi Oshio	Hitotsubashi University	Oshio, T., & Shimizutani, S. (2021). Will working longer enhance the health of older adults? A pooled analysis of repeated cross-sectional data in Japan. <i>Journal of Epidemiology</i> , JE20210030.
Junichiro Miyachi	Nagoya University	Tsuda, S., Nakamura, M., Aoki, S., Ono, H., Takagi, M., Ohashi, H., Miyachi, J. & Ojima, T. (2018). Impact of patients' expressed wishes on their surrogate decision makers' preferred decision- making roles in Japan. <i>Journal of palliative medicine</i> , <i>21</i> (3), 354-360.
Kemmyo	Tohoku	Ikeda, T., Sugiyama, K., Aida, J., Tsuboya, T., Watabiki, N.,

Sugiyama	University	Kondo, K., & Osaka, K. (2019). Socioeconomic inequalities in
		low back pain among older people: the JAGES cross-sectional
		study. International journal for equity in health, 18(1), 1-11.
	The University of Tokyo	Ishizaki, T., Kai, I., Kobayashi, Y., Matsuyama, Y., & Imanaka,
V1-:		Y. (2004). The effect of aging on functional decline among older
		Japanese living in a community: a 5-year longitudinal data
Kobayashi		analysis. Aging clinical and experimental research, 16(3), 233-
		239.

Table 3 shows the top 10 authors identified as the most productive authors' number, collaborators or mediators, respectively. Examples of representative publications by top authors are displayed in Table 4.

Frequency	Author	Degree Centrality	Author	Betweenness Centrality	Author
40	Katsunori Kondo	74	Katsunori Kondo	13573.0	Katsunori Kondo
17	Ichiro Kawachi	45	Jun Aida	11661.7	Ichiro Kawachi
15	Jun Aida	43	Naoki Kondo	8170.0	Atsushi Miyawaki
14	Naoki Kondo	40	Ichiro Kawachi	7017.7	Haruko Noguchi
11	Jean Woo	34	Toshiyuki Ojima	6972.0	Toshiyuki Ojima
10	Taishi Tsuji	29	Kokoro Shirai	4446.0	Kemmyo Sugiyama
8	Jeni Warburton	27	Yueqin Huang	3805.3	Hiroyuki Kikuchi
8	Ken Osaka	27	Zhaorui Liu	3346.0	Yasuki Kobayashi
8	Hal Kendig	26	Jie Li	3273.3	Jun Aida
7	Takashi Oshio	25	Martin J Prince	3162.0	Satoshi Shimizutani
7	Kimiko Tomioka	25	Richard Uwakwe		
7	Norio Kurumatani				

Table 3. Top 10 Authors (as productive authors, collaborators or mediators)<sup>2</sup>

#### **Table 4. Top Authors and Publication examples**

 $<sup>^2</sup>$  In the frequency ranking, there are three authors who rank 10th, so 12 authors are listed. In the degree centrality ranking, there are two authors who rank 10th, so 11 authors are listed.

Influence Indicator	Author	Affiliation	Publication Example
	Katsunori Kondo	Chiba University	Ichida, Y., Kondo, K., Hirai, H., Hanibuchi, T., Yoshikawa, G., & Murata, C. (2009). Social capital, income inequality and self- rated health in Chita peninsula, Japan: a multilevel analysis of older people in 25 communities. <i>Social science &amp;</i> <i>medicine</i> , <i>69</i> (4), 489-499.
Number of publications	Ichiro Kawachi	Harvard University	PS, K. I. S. D. V. (1994). Weiss ST. Symptoms of anxiety and risk of coronary heart disease. The Normative Aging Study. <i>Circulation</i> , 90, 2225-2229.
	Jun Aida	Tohuku University	Kanamori S, Kai Y, Aida J, Kondo K, Kawachi I, Hirai H, et al. (2014) Social participation and the prevention of functional disability in older Japanese: The JAGES cohort study. <i>PLoS ONE</i> , 9(6): e99638.
	Katsunori Chiba Kondo University		Ichida, Y., Kondo, K., Hirai, H., Hanibuchi, T., Yoshikawa, G., & Murata, C. (2009). Social capital, income inequality and self- rated health in Chita peninsula, Japan: a multilevel analysis of older people in 25 communities. <i>Social science &amp;</i> <i>medicine</i> , <i>69</i> (4), 489-499.
Degree centrality	Jun Aida	Tohuku University	Kanamori S, Kai Y, Aida J, Kondo K, Kawachi I, Hirai H, et al. (2014) Social participation and the prevention of functional disability in older Japanese: The JAGES cohort study. <i>PLoS ONE</i> , 9(6): e99638.
	Naoki Kondo	The University of Tokyo	Saito, J., Haseda, M., Amemiya, A., Takagi, D., & Kondo, K. (2019). Community-based care for healthy ageing: Lessons from Japan. <i>Bulletin of the World Health Organization</i> , 97(8), 570-574.
Betweenness centrality	Katsunori Chiba Kondo University Ichiro Harvard		Ichida, Y., Kondo, K., Hirai, H., Hanibuchi, T., Yoshikawa, G., & Murata, C. (2009). Social capital, income inequality and self- rated health in Chita peninsula, Japan: a multilevel analysis of older people in 25 communities. <i>Social science &amp;</i> <i>medicine</i> , <i>69</i> (4), 489-499. PS, K. I. S. D. V. (1994). Weiss ST.
	Kawachi	University	Symptoms of anxiety and risk of coronary

		heart disease. The Normative Aging Study <i>Circulation</i> 90 2225-2229
Atsushi Miyawaki	RIKEN Center for Brain Science	<ul> <li>Watanabe, T., Seki, T., Fukano, T., Sakaue-Sawano, A., Karasawa, S., Kubota, M., &amp;</li> <li>Miyawaki, A. (2017). Genetic visualization of protein interactions harnessing liquid phase transitions. <i>Scientific reports</i>, 7(1), 1-13.</li> </ul>

#### 3.1.3 Co-institution Network

As shown in Figure 5, the co-institution network contains 884 institutions and 2,398 collaborations between or among institutions. The network density is 0.0061, indicating that institutional collaboration network is relatively intensive. The modularity value of 0.7307 and the silhouette value of 0.9141 implies that the clustering effect is statistically significant and reliable. The largest network cluster consists of 638 institutions, accounting for 72% of the entire network.



CiteSpace

#### Figure 5. Main Network Clusters of Co-institution Network

Table 5 provides five substantial clusters in the co-institution network.

Cluster ID	Size	Silhouette	Mean (Year)	Cluster Label	Top Institutions (by frequency)		
0	123	0.895	2012	social participation	The University of Sydney Monash University		

Table 5. Top 5	<b>Clusters</b> of	Institutions
----------------	--------------------	--------------

	r				
					La Trobe University
					The University of Queensland
					Griffith University
					The University of Tokyo
					National Center for Geriatrics
1	04	0.945	2012	nippon data	and Gerontology
1	94	0.843	2015	2010	Chiba University
					Tohuku University
					University of Tsukuba
					The University of Melbourne
		0.894	2013		The Chinese University of Hong
2	(9			socioeconomic	Kong
2	08			group	National University of Singapore
					City University of Hong Kong
					Sun Yat-sen University
					Fudan University
		0.897	2014	rural China	Chinese Academy of Sciences
3	58				Renmin University of China
					Wuhan University
					Zhejiang University
					Tokyo Metropolitan Institute of
		0.949			Gerontology
1	50		2011	employment	Kyoto University
4	52			status	Osaka University
					Nagoya Univeristy
					The University of Michigan

Table 6 shows the top 10 institutions ranked by publications' number, degree centrality, and betweenness centrality.

## Table 6. Top 10 institutions

Frequency	Institution	Degree Centrality	Institution	Betweenness Centrality	Institution
56	The University	60	The University	20257 5	The University of
50	of Tokyo	09	of Tokyo	39337.3	Melbourne
40	The University	(0)	The University	28041.0	The University of
49	of Sydney	09	of Melbourne	38941.0	Tokyo
41	National Center for Geriatrics and Gerontology	62	Monash University	26685.2	The University Sydney
40	Monash University	55	The University Sydney	21849.0	The University of Queensland
39	La Trobe	52	Chiba	19501.7	Monash
	University		University		University

39	Chiba Univerisity	51	National Center for Geriatrics and Gerontology	18236.6	Peking University
37	The University of Melbourne	47	The University of Queensland	18138.5	National University of Singapore
35	Hong Kong Polytech University	46	Kyoto University	16971.9	The University of Hong Kong
32	Chinese University of Hong Kong	36	Tokyo Metropolitan Institute of Gerontology	13830.6	Hong Kong Polytech University
32	The University of Hong Kong	36	Tokyo Medical and Dental University	11694.6	Harvard University

#### 3.1.4 Co-category Network

Figure 7 shows a network of WoS scientific disciplines, including 98 disciplines and 573 cross- or inter-disciplinary publications. The network density is 0.1206, demonstrating cross- or inter-disciplinary research to be relatively intensive. The largest network component comprises 95 WoS disciplines, accounting for 96% of the network.



CiteSpace

Figure 6. Co-category network

#### 3.1.5 Co-keyword Network

From Figure 7 below, we can see a network of keywords used in publications, including 265 keywords and 1,351 co-occurrence relationships. The network density is 0.0386, indicating that the keyword relationships are intensive. The largest network cluster consists of 252 keywords, accounting for 95% of the network.



Figure 7. Co-keyword Network

#### 3.1.6 Co-citation Network

Figure 8 shows a network of co-citation relationships, indicating the frequency with which two publications are cited together by other publications. This network contains 8,246 publications and 25,580 times of co-citations. The network density is only 0.0008, demonstrating that the citation relationships are scattered.



Figure 8. Co-citation Network<sup>3</sup>

The dominating clusters in the co-citation network are presented in Figure 9. The modularity value is 0.988 and the silhouette value is 0.9734, indicating that the clustering effect is significant and reliable. The largest network cluster is composed of 1,115 publications, accounting for 13% of the network.



Figure 9. Main Co-citation Network Clusters

Table 7 shows top 5 clusters of co-citation network.

<sup>&</sup>lt;sup>3</sup> The literature related to WHO is marked with a blue box in Figure 8.

Cluster ID	Size	Silhouette	Mean (Year)	Cluster Label	Top Cited Publications
0	371	0.933	2016	self-perceived uselessness	Kanamori S (2014) WHO (2015) Takagi D (2013) Tomioka K (2017) Douglas H (2017)
1	131	0.984	2008	social inclusion approach	Petriwskyj A (2012) Wagner N (2010) Heenan D (2010) Smith A (2007) Borowski A (2007)
3	85	0.998	2011	evidence-based care	Subramaniam M (2015) Prince M (2013) Diniz BS (2013) Moher D (2010) Courtney M (2009)
5	68	0.999	2011	proactive personality age	Billett S (2011) Klehe U C (2012) Minami Ushio (2015) Van Dalen HP (2009) Posthuma RA (2009)
6	67	0.996	2012	cross-cultural meta-analysis	Luo BZ (2013) Lim LL (2011) North MS (2012) North MS (2013) Borenstein M (2011)

Table 7. Top 5 Co-citation Network Clusters

Table 8 provides top 10 cited publications in the co-citation network, which can be seen as the most significant publications.

Table 8. Top	p 10 Most	Cited	Publications
--------------	-----------	-------	--------------

Publication	Frequency
Kanamori, S., Kai, Y., Aida, J., Kondo, K., Kawachi, I., Hirai, H., & JAGES	
Group. (2014). Social participation and the prevention of functional disability in	20
older Japanese: the JAGES cohort study. <i>PloS one</i> , 9(6), e99638.	
World Health Organization. (2015). World report on ageing and health. World	15
Health Organization. https://apps.who.int/iris/handle/10665/186463	15
Takagi, D., Kondo, K., & Kawachi, I. (2013). Social participation and mental	
health: moderating effects of gender, social role and rurality. BMC public	15
<i>health</i> , <i>13</i> (1), 1-8.	
Tomioka, K., Kurumatani, N., & Hosoi, H. (2017). Association between social	14
participation and 3-year change in instrumental activities of daily living in	14

community-dwelling elderly adults. Journal of the American Geriatrics	
<i>Society</i> , <i>65</i> (1), 107-113.	
Douglas, H., Georgiou, A., & Westbrook, J. (2016). Social participation as an	
indicator of successful aging: an overview of concepts and their associations with	13
health. Australian Health Review, 41(4), 455-462.	
Hikichi, H., Kondo, N., Kondo, K., Aida, J., Takeda, T., & Kawachi, I. (2015).	
Effect of a community intervention programme promoting social interactions on	
functional disability prevention for older adults: propensity score matching and	11
instrumental variable analyses, JAGES Taketoyo study. J Epidemiol Community	
Health, 69(9), 905-910.	
Kondo, K., & Rosenberg, M. (2018). Advancing universal health coverage through	
knowledge translation for healthy ageing: lessons learnt from the Japan	10
Gerontological Evaluation Study. Geneva: World Health Organization.	10
https://apps.who.int/iris/bitstream/handle/10665/279010/9789241514569-eng.pdf	
Satake, S., Senda, K., Hong, Y. J., Miura, H., Endo, H., Sakurai, T., & Toba, K.	
(2016). Validity of the K ihon Checklist for assessing frailty status. Geriatrics &	9
gerontology international, 16(6), 709-715.	
Zhao, Y., Hu, Y., Smith, J. P., Strauss, J., & Yang, G. (2014). Cohort profile: the	
China health and retirement longitudinal study (CHARLS). International journal of	9
<i>epidemiology</i> , <i>43</i> (1), 61-68.	
Hikichi, H., Kondo, K., Takeda, T., & Kawachi, I. (2017). Social interaction and	
cognitive decline: Results of a 7-year community intervention. Alzheimer's &	9
Dementia: Translational Research & Clinical Interventions, 3(1), 23-32.	

#### 3.2 Results Related to Objective 2

#### 3.2.1 Publications by Year and Country

Figure 10 shows the distribution of publications by year since 1990. Figure 11 displays the top 10 publishing countries/areas. 102 publishing countries/areas are identified in the ageing studies involving the WPR.



Figure 10. Number of Publications Over Time<sup>4</sup>

<sup>&</sup>lt;sup>4</sup> The number of publications in 2021 is not accurate, as the data was collected on 30 November 2021.



Figure 11. Top 10 publishing countries/areas

#### 3.2.2 Co-author Network

Figure 12 shows a network of co-authors, including 4,137 authors and 13,265 coauthorships. The network density is 0.0016, which demonstrates the co-authorship network is sparse and disconnected. The modularity value is 0.985 and the silhouette value is 0.984 through the cluster analysis, indicating the clustering effect is statistically significant and reliable. The largest network cluster is composed of 355 authors, accounting for 8% of the network. Five main clusters are presented in Figure 13.









Figure 13. Main Network Clusters of Co-authorships

Table 9 lists co-authorship details of the top 5 clusters. The topic of each cluster is automatically generated by CiteSpace and are displayed as red labels in Figure 13. The representative documents of top authors are provided in Table 10.

Cluster ID	Size	Silhouette	Mean (Year)	Cluster Label	Top Authors (by frequency)
					Hidenori Arai
		0.981	2012		Hirohiko Hirano
0	103			otassha study	Hiroyuki Shimada
					Takao Suzuki
					Takehiko Doi
					Nanako Tamiya
				plasma say	Tatsuro Ishizaki
3	71	0.982	2012	hormone level	Katsuya Iijima
				normone lever	Kenji Toba
					Taeko Watanabe
	60	0.986	2014		Katsunori Kondo
				functional disability	Ichiro Tsuji
5					Yasutake Tomata
					Jun Aida
					Naoki Kondo
					Eduardo Bernabe
	52	0.987		elderly	Theo Vos
7			2013	population	Christopher J L Murray
				population	Mohsen Naghavi
					Alan D Lopez
					Sumio Akifusa
				problem-	Maya Izumi
21	30	0.975	2012	based learning	Takeshi Kikutani
				observation	Yoshihisa Yamashita
					Toru Takeshita

Table 9. Top 5 Cluster of Co-authorship

#### Table 10. Top Authors (by frequency) in Top 5 Clusters

$-\cdots - \mathbf{r} - $				
Top author	Affiliation	Publication Example		

Hidenori Arai	National Center for Geriatrics & Gerontology	Kawamura, K., Kondo, I., Osawa, A., Tanimoto, M., Matsui, Y., & Arai, H. (2021). Walking speed and short physical performance battery are associated with conversion to long-term care need: A study in outpatients of a locomotive syndrome-frailty clinic. Geriatrics and Gerontology International., 21(10), 919-925.
Nanako Tamiya	University of Tsukuba	<ul> <li>Kim, H., Jeon, B., Frisina Doetter, L., Tamiya, N., &amp; Hashimoto,</li> <li>H. (2021). Same same but different? Comparing institutional</li> <li>performance in the long-term care systems of Japan and South</li> <li>Korea. Social Policy &amp; Administration., Social policy &amp;</li> <li>administration., 2021.</li> </ul>
Katsunori Kondo	Chiba University	Aida, Jun, Kondo, Katsunori, Osaka, Ken, Takeuchi, Kenji, & Glogauer, Michael. (2013). Social participation and dental health status among older Japanese adults: A population-based cross- sectional study. <i>PloS One</i> , 8(4), E61741.
Ichiro Kawachi	Harvard Medical School	Nakagomi Atsushi et al. (2021). General health checks and incident dementia: A six-year follow-up study of community- dwelling older adults in Japan. Preventive medicine, 153pp. 106757-106757.
Eduardo Bernabe	University of Tokyo	de Oliveira Cesar et al. (2021). Complete tooth loss and allostatic load changes later in life: A 12-year follow-up analysis of the English Longitudinal Study of Ageing. Psychosomatic Medicine, 83(3),
Sumio Akifusa	Kyushu Dental University	Kenji Takeuchi et al. (2019). Denture Wearing Moderates the Association between Aspiration Risk and Incident Pneumonia in Older Nursing Home Residents: A Prospective Cohort Study. International Journal of Environmental Research and Public Health, 16(4), pp. 554- 554.

Table 11 shows the top 10 authors identified as the most productive authors' number, collaborators or mediators, respectively. Examples of representative documents by top authors are displayed in Table 12.

Frequency	Author	Degree Centrality	Author	Betweenness Centrality	Author
54	Katsunori Kondo	48	Katsunori Kondo	22371.5	Naoki Kondo
31	Ichiro Tsuji	48	Ichiro Tsuji	14284.1	Ichiro Kawachi
30	Nanako Tamiya	48	Nanako Tamiya	11002.4	Yoshinori Fujiwara
28	Yasutake Tomata	48	Yasutake Tomata	10874.4	Nanako Tamiya
27	Jean Woo	48	Jean Woo	10508.8	Masashige Aaito

Table 11. Top 10 Authors (as productive authors, collaborators or mediators)

26	Ngaire Kerse	48	Ngaire Kerse	9634.0	Jun Aida
25	Merryn Gott	48	Merryn Gott	8863.5	Katsuya Iijima
24	Iris Chi	48	Iris Chi	7917.1	Kenji Takeuchi
22	Jun Aida	48	Jun Aida	8863.4	Soufiane Boufous
20	Na ala: Kan da	4.4	Na ala: Kan da	7017.1	Yoshihisa
20	Naoki Kondo	44	Naoki Kondo	/91/.1	Yamashita

Influence Indicator	Author	Affiliation	Publication Example
Number of Documents	Katsunori Kondo	Chiba University	Takeuchi, K., Aida, J., Kondo, K., & Osaka, K. (2013). Social participation and dental health status among older Japanese adults: a population-based cross-sectional study. <i>PloS one</i> , <i>8</i> (4), e61741.
	Ichiro Tsuji	Tohoku University	Yamazaki, T., Sugawara, Y., Sone, T., & Tsuji, I. (2021). Subgroup characteristics of the association between volunteering and the risk of functional disability among older Japanese people: The Tsurugaya project. Archives of Gerontology and Geriatrics., 96, 104465.
	Nanako Tamiya	University of Tsukuba	Kim, H., Jeon, B., Frisina Doetter, L., Tamiya, N., & Hashimoto, H. (2021). Same same but different? Comparing institutional performance in the long-term care systems of Japan and South Korea. Social Policy & Administration., Social policy & administration. , 2021.
Degree Centrality	Katsunori Kondo	Chiba University	Takeuchi, K., Aida, J., Kondo, K., & Osaka, K. (2013). Social participation and dental health status among older Japanese adults: a population-based cross-sectional study. <i>PloS one</i> , 8(4), e61741.
	Ichiro Tsuji	Tohoku University	Yamazaki, T., Sugawara, Y., Sone, T., & Tsuji, I. (2021). Subgroup characteristics of the association between volunteering and the risk of functional disability among older Japanese people: The Tsurugaya project. Archives of Gerontology and Geriatrics., 96, 104465.
	Nanako Tamiya	University of Tsukuba	Kim, H., Jeon, B., Frisina Doetter, L., Tamiya, N., & Hashimoto, H. (2021). Same same but different? Comparing

Table 12. Top Authors and Publication Examples

			institutional performance in the long-term
			care systems of Japan and South Korea.
			Social Policy & Administration., Social
			policy & administration. , 2021.
			Nishio, M., Takagi, D., Shinozaki, T., &
			Kondo, N. (2021). Community social
			networks, individual social participation
	Naoki	Kyoto University	and dietary behavior among older Japanese
	Kondo		adults: Examining mediation using
			nonlinear structural equation models for
			three-wave longitudinal data. Preventive
			Medicine., 149, 106613.
D	Ichiro Kawachi		Nakagomi Atsushi et al. (2021). General
Gentrelite		Harvard Medical School	health checks and incident dementia: A
Centrality			six-year follow-up study of community-
			dwelling older adults in Japan. Preventive
			medicine, 153pp. 106757-106757.
			Abe, T., Seino, S., Tomine, Y., Nishi, M.,
		Taluva Matuanalitan	Hata, T., Shinkai, S., Kitamura, A.
	Fujiwara,	Institute of	(2022). Identifying the specific
	Yoshinori	Concentral a res	associations between participation in social
		Gerontology	activities and healthy lifestyle behaviours
			in older adults. Maturitas., 155, 24-31.

#### 3.2.3 Co-institution Network

As shown in Figure 14, the co-institution network contains 965 institutions and 3,299 collaborations between or among institutions. The network density is 0.0071, indicating that institutional collaboration network is relatively intensive. The modularity value of 0.6669 and the silhouette value of 0.8938 implies that the clustering effect is statistically significant and reliable. The largest network cluster consists of 763 institutions, accounting for 79% of the entire network.



**Figure 14. Main Network Clusters** 

Table 13 provides five substantial clusters in the co-institution network.

Cluster	Size	Silhouette	Maan (Vaar)	Cluster Lobel	Top Institutions
ID	SIZE	Simouette	Wieali (Teal)	Cluster Laber	(by frequency)
	162	0.798	2008	Care facilities	The University of Sydney
0					Monash University
					The University of Adelaide
	105				Flinders University
					The University of New South
					Wales
		0.895	2007	Longitudinal study	The University of Tokyo
	148				National Center for Geriatrics &
1					Gerontology
					Tohoku University
					Tokyo Medical and Dental
					University
					Tokyo Metropolitan Institute
					Gerontology
2	116	0.834	2008	Hong Kong	The University of Hong Kong
					The Chinese University of Hong
					Kong
					Fudan University
					Hong Kong Polytech University
					Sichuan University
3	78	0.904	2000	Southeast Asia Nation The U	National University of Singapore
5	/0	0.204	2009		The University of Queensland

Table 13. Top 5 Clusters of Institutions

					Duke University
					Griffith University
					Duke NUS Medicine School
4	55	0.989	2009	Dementia research	Peking University
					King's College London
					WHO
					Medicine University of Havana
					Voluntary Health Service

Table 14 shows the top 10 institutions ranked by documents' number, degree centrality, and betweenness centrality.

Frequency	Institution	Degree Centrality	Institution	Betweenness Centrality	Institution
140	The University of	01	The University of	27012 26	The University
149	Sydney	91	Sydney	3/915.20	of Tokyo
125	The University of	86	The University of	22202 61	The University
155	Tokyo	80	Tokyo	32392.01	of Sydney
131	The University of	68	The University of	28711 36	Keio
	Hong Kong	08	Hong Kong	28744.30	University
	The Chinese		The Chinese		The University
111	University of	68	University of	27460.28	of Melbourne
	Hong Kong		Hong Kong		of Webburne
	National Center		National Center		Deking
110	for Geriatrics &	64	for Geriatrics &	24260.91	University
	Gerontology		Gerontology		Oniversity
107	the University of	63	the University of	23003 62	Kings Coll
107	Auckland	05	Auckland	23003.02	London
103	Monash 59		Monash	21372 28	The University
	University	59	University	21372.20	of Hong Kong
102	National		National		National
	University of 59		University of	19323.41	University of
	Singapore	ngapore			Singapore
96	The University of		The University of	16183 54	The University
	Melbourne	59	Melbourne	10105.54	of Queensland
82	Tohoku	56	Tohoku	16080 39	The University
82	University	50	University	10000.37	of Michigan

### Table 14. Top 10 Institutions

## 3.2.4 Co-category Network

Figure 15 shows a network of WoS scientific disciplines, including 140 disciplines

and 690 cross- or inter-disciplinary documents. The network density is 0.0709, demonstrating cross- or inter-disciplinary research to be relatively intensive. The largest network component comprises 136 WoS disciplines, accounting for 97% of the network.

NURSING **HEALTH POLICY & SERVICES** GENERAL & INTERNAL MEDICINE BUSINESS & ECONOMICS **HEALTH CARE SCIENCES & SERVICES** GERIATRICS & GERONTOLOGY SCIENCE & TECHNOLOGY - OTHER TOPICS PSYCHIATRY GERONTOLOGY SOCIAL WORK PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH MEDICINE, GENERAL & INTERNAL ENVIRONMENTAL SCIENCES **ENVIRONMENTAL SCIENCES & ECOLOGY DENTISTRY, ORAL SURGERY & MEDICINE** MULTIDISCIPLINARY SCIENCES

Figure 15. Co-category Network

#### 3.2.5 Co-keyword Network

From Figure 16 below, we can see a network of keywords used in documents, including 228 keywords and 1,329 co-occurrence relationships. The network density is 0.0514, indicating that the keyword relationships are intensive. The largest network cluster consists of 219 keywords, accounting for 96% of the network.



Figure 16. Co-keyword Network

#### 3.2.6 Co-citation Network

Figure 17 shows a network of co-citation relationships, indicating the frequency with which two documents are cited together by other documents. This network contains 8,656 documents and 27,554 times of co-citations. The network density is only 0.0007, demonstrating that the citation relationships are scattered. The modularity value is 0.986 and the silhouette value is 0.9839, indicating that the clustering effect is significant and reliable. The largest network cluster consists of 2,228 documents, accounting for 25% of the network.



## Figure 17. Co-citation Network<sup>5</sup>

Table 15 shows top 5 clusters of co-citation network.

Cluster ID	Size	Silhouette	Mean (Year)	Cluster Label	Top Cited Documents
					WHO(2015)
					Satake S(2016)
0	378	0.962	2015	Societal cost	Chen LK(2014)
					Livingstong(2017)
					Hikichi H(2015)
					Arai Y(2004)
l				Qualitative	Asahara Kiyomi(2002)
1	165	0.973	2003	comparative	Arai Y(2003)
				study	Fed Int For Agre(2004)
					Acton Gayle J(2002)
					Acosta D(2008)
2	161	0.959			WHO(2008)
					Anonymous(2005)
			2007	Dementia	Aroney CN(2006)
				research group	Center for Research And
					Control Of
					Cardiovascular
					Diseases(2005)
					Abernethy AP(2006)
				Anti abalinargia	Abramson MJ(2006)
3	131	1	2015	load	Abernethy Amy P(2005)
					Aoun S(2007)
					Abernethy AP(2008)
					Nat I Pop Soc Sec(2008)
5	118	0.99	2006		Min Health Lab
				Highests long-	Welfare(2007)
				term care	Min Health Lab
				expenditure	Welfare(2010)
					OECD(2006)
					OECD(2006)

Table 15. Top 5 Co-citation Network Clusters

Table 8 provides top 10 cited documents in the co-citation network, which can be seen as the most significant documents.

#### Table 8. Top 10 Most Cited Documents

<sup>&</sup>lt;sup>5</sup> The literatures related to WHO are marked with a blue box in Figure 17.

Publication	Frequency
Kanamori, S., Kai, Y., Aida, J., Kondo, K., Kawachi, I., Hirai, H., & JAGES	
Group. (2014). Social participation and the prevention of functional disability in	20
older Japanese: the JAGES cohort study. PloS one, 9(6), e99638.	
World Health Organization. (2015). World report on ageing and health. World	15
Health Organization. https://apps.who.int/iris/handle/10665/186463	
Takagi, D., Kondo, K., & Kawachi, I. (2013). Social participation and mental	
health: moderating effects of gender, social role and rurality. BMC public	15
<i>health</i> , <i>13</i> (1), 1-8.	
Tomioka, K., Kurumatani, N., & Hosoi, H. (2017). Association between social	
participation and 3-year change in instrumental activities of daily living in	
community-dwelling elderly adults. Journal of the American Geriatrics	14
Society, 65(1), 107-113.	
Douglas, H., Georgiou, A., & Westbrook, J. (2016). Social participation as an	
indicator of successful aging: an overview of concepts and their associations with	13
health. Australian Health Review, 41(4), 455-462.	
Hikichi, H., Kondo, N., Kondo, K., Aida, J., Takeda, T., & Kawachi, I. (2015).	
Effect of a community intervention programme promoting social interactions on	
functional disability prevention for older adults: propensity score matching and	11
instrumental variable analyses, JAGES Taketoyo study. J Epidemiol Community	
Health, 69(9), 905-910.	
Kondo, K., & Rosenberg, M. (2018). Advancing universal health coverage through	
knowledge translation for healthy ageing: lessons learnt from the Japan	10
Gerontological Evaluation Study. Geneva: World Health Organization.	
https://apps.who.int/iris/bitstream/handle/10665/279010/9789241514569-eng.pdf	
Satake, S., Senda, K., Hong, Y. J., Miura, H., Endo, H., Sakurai, T., & Toba, K.	
(2016). Validity of the K ihon Checklist for assessing frailty status. Geriatrics &	9
gerontology international, 16(6), 709-715.	
Zhao, Y., Hu, Y., Smith, J. P., Strauss, J., & Yang, G. (2014). Cohort profile: the	
China health and retirement longitudinal study (CHARLS). International journal of	9
<i>epidemiology</i> , <i>43</i> (1), 61-68.	
Hikichi, H., Kondo, K., Takeda, T., & Kawachi, I. (2017). Social interaction and	
cognitive decline: Results of a 7-year community intervention. Alzheimer's &	9
Dementia: Translational Research & Clinical Interventions, 3(1), 23-32.	
# 3.3 Results Related to Objective 3

# 3.3.1 Publications by Year and Country

Figure 18 shows the distribution of publications by year since 1992. Figure 19 displays the top 10 publishing countries/areas. 68 publishing countries/areas are identified in the ageing studies involving the WPR.



Figure 18. Number of Publications Over Time<sup>6</sup>

<sup>&</sup>lt;sup>6</sup> The number of publications in 2021 is not accurate, as the data was collected on 16 November 2021.



Figure 19. Top 10 Publishing Countries/Areas

# 3.3.2 Co-author Network

Figure 20 shows a network of co-authors, including 4,207 authors and 12,496 coauthorships. The network density is 0.0014, which demonstrates the co-authorship network is sparse and disconnected. The modularity value is 0.9826 and the silhouette value is 0.9949 through the cluster analysis, indicating the clustering effect is statistically significant and reliable. The largest network cluster is composed of 665 authors, accounting for 15% of the network. Five main clusters are presented in Figure 4.



**Figure 20. Co-author Network**<sup>7</sup>



Figure 21. Main Network Clusters of Co-authorships

Table 17 lists co-authorship details of the top 5 clusters. The topic of each cluster is automatically generated by CiteSpace and are displayed as red labels in Figure 21. The representative publications of top authors are provided in Table 18.

<sup>&</sup>lt;sup>7</sup> WHO academic partners are labelled in Figure 20.

			<b>I</b>		<b>A</b>
Cluster ID	Size	Silhouette	Mean (Year)	Cluster Label	Top Authors (by frequency)
					Craig Whitehead
				1 .	Maria Crotty
0	132	0.99	2013	analgesic use	Stephen R Lord
				pain	Hiroyuki Shimada
					Julie Ratcliffe
					Ngaire Kerse
					Matthew Parsons
1	111	0.965	2012	advanced age	Sally Keeling
					Elizabeth Robinson
					John Parsons
					Gill Lewin
	104	0.984	2012	cross-sectional	Duncan Boldy
2				data linkage	Jeni Warburton
				study	Elissa Burton
					Betty Haralambous
					Philip J Schluter
		0.989		acute care	Hamish A Jamieson
3	88		2014		Wendy Moyle
					Gary Cheung
					Rebecca Abeynesbit
		0.999			Hal Kendig
			2012	understanding	Peter Butterworth
6	69			understanding	Colette Browning
				ageing	Kaarin J Anstey
					Claudia Meyer

# Table 17. Top 5 clusters of co-authorship

# Table 18. Top authors (by frequency) in Top 5 clusters

Top Author	Affiliation	Publication Example
Craig Whitehead	Flinders University	Crotty, Halbert, J., Rowett, D., Giles, L., Birks, R., Williams, H., & Whitehead, C. (2004). An outreach geriatric medication advisory service in residential aged care: a randomised controlled trial of case conferencing. Age and Ageing, 33(6), 612–617. https://doi.org/10.1093/ageing/afh213
Ngaire Kerse	The University of Auckland	Jefferis, Iliffe, S., Kendrick, D., Kerse, N., Trost, S., Lennon, L. T., Ash, S., Sartini, C., Morris, R. W., Wannamethee, S. G., & Whincup, P. H. (2014). How are falls and fear of falling associated with objectively measured physical activity in a cohort of community- dwelling older men? BMC Geriatrics, 14(1), 114–114. https://doi.org/10.1186/1471-2318-14-114
Gill Lewin	Curtin University	Burton, Farrier, K., Lewin, G., Pettigrew, S., Hill, AM., Airey, P., Bainbridge, L., & Hill, K. D. (2017). Motivators and Barriers for

		Older People Participating in Resistance Training: A Systematic			
		Review. Journal of Aging and Physical Activity, 25(2), 311-324.			
		https://doi.org/10.1123/japa.2015-0289			
		Maher, Cary, M. P., Slack, M. C., Murray, C. J., Milligan, M., &			
Dhilin I	University	Schluter, P. (2001). Uterine Preservation or Hysterectomy at			
Schluter	of	Sacrospinous Colpopexy for Uterovaginal Prolapse? International			
	Canterbury	rbury Urogynecology Journal, 12(6), 381–385.			
		https://doi.org/10.1007/s001920170017			
		Clemson, Cumming, R. G., Kendig, H., Swann, M., Heard, R., &			
Hal	Australian	Taylor, K. (2004). The Effectiveness of a Community-Based Program			
Паі Vandia	National	for Reducing the Incidence of Falls in the Elderly: A Randomized			
Kendig	University	Trial. Journal of the American Geriatrics Society (JAGS), 52(9),			
		1487–1494. https://doi.org/10.1111/j.1532-5415.2004.52411.x			

Table 19 shows the top 10 authors identified as the most productive authors' number, collaborators or mediators, respectively. Examples of representative publications by top authors are displayed in Table 20.

Frequency	Author	Degree Centrality	Author	Betweenness	Author
16	Ngaire Kerse	51	Ngaire Kerse	114846.8	Ian D
12	Matthew Parsons	49	Sally Keeling	101376.3	Nancye M Peel
12	Christine Stephens	34	Matthew Parsons	92657.1	Stephen R Lord
11	Gill Lewin	34	Stephen R Lord	81279.6	Lindy Clemson
10	Philip J Schluter	33	Kathy Peri	63604.2	Henry Brodaty
10	Fiona Alpass	32	Gill Lewin	52179.3	Philip J Schluter
9	Sally Keeling	32	Philip J Schluter	50355.8	Dafna Merom
9	Hamish A Jamieson	31	Wendy Moyle	50265.6	Sally Keeling
8	Wendy Moyle	31	John Parsons	48339.9	Gill Lewin
8	Joanne Allen	29	Simon A Moyes	45899.3	Hamish A Jamieson

Table 19. Top 10 Authors (as productive authors, collaborators or mediators)

### Table 20. Top Authors and Publication Examples

Influence Author Affiliation	Publication Example
------------------------------	---------------------

Indicator			
			Jefferis, Iliffe, S., Kendrick, D., Kerse, N., Trost,
			S., Lennon, L. T., Ash, S., Sartini, C., Morris, R.
			W., Wannamethee, S. G., & Whincup, P. H.
	Ngaire	I ne	(2014). How are falls and fear of falling
	Kerse	A valuand	associated with objectively measured physical
		Auckland	activity in a cohort of community-dwelling older
			men? BMC Geriatrics, 14(1), 114-114.
			https://doi.org/10.1186/1471-2318-14-114
			Kerse, Peri, K., Robinson, E., Wilkinson, T.,
Number of			Randow, M. von, Kiata, L., Parsons, J., Latham,
Publications		The	N., Parsons, M., Willingale, J., Brown, P., &
	Matthew	Inc University of	Arroll, B. (2008). Does a functional activity
	Parsons	Weikete	programme improve function, quality of life, and
		w alkato	falls for residents in long term care? Cluster
			randomised controlled trial. BMJ, 337(7675),
			M494-915. https://doi.org/10.1136/bmj.a1445
			Noone, & Stephens, C. (2008). Men, masculine
	Christine Stephens	Massey University	identities, and health care utilisation. Sociology of
			Health & Illness, 30(5), 711–725.
			https://doi.org/10.1111/j.1467-9566.2008.01095.x
			Jefferis, Iliffe, S., Kendrick, D., Kerse, N., Trost,
		The	S., Lennon, L. T., Ash, S., Sartini, C., Morris, R.
			W., Wannamethee, S. G., & Whincup, P. H.
	Ngaire	University of	(2014). How are falls and fear of falling
	Kerse	Auckland	associated with objectively measured physical
			activity in a cohort of community-dwelling older
			men? BMC Geriatrics, 14(1), 114–114.
			https://doi.org/10.1186/1471-2318-14-114
			Watkins, A., Curl, A., Pocock, T., Gilden, J., &
			Keeling, S. (2020). Assessing the microscale
Degree	Sallv	The	geography of outdoor falls among older adults
Centrality	Keeling	University of	using virtual audits. Proceedings of the New
	8	Otago	Zealand Geographical Society (NZGS) Biennial
			Conference. (pp. 107). Retrieved from
			https://nzgsconference2020.gitlab.io
			Kerse, Peri, K., Robinson, E., Wilkinson, T.,
			Randow, M. von, Kiata, L., Parsons, J., Latham,
		The	N., Parsons, M., Willingale, J., Brown, P., &
	Matthew	University of	Arroll, B. (2008). Does a functional activity
	Parsons	Waikato	programme improve function, quality of life, and
			falls for residents in long term care? Cluster
			randomised controlled trial. BMJ, 337(7675),
			M494-915. https://doi.org/10.1136/bmj.a1445

			Cameron, Dyer, S. M., Panagoda, C. E., Murray,
			G. R., Hill, K. D., Cumming, R. G., Kerse, N., &
	Ian D		Cameron, I. D. (2018). Interventions for
	Cameron	University of	preventing falls in older people in care facilities
		Sydney	and hospitals. Cochrane Library, 2020(1).
			https://doi.org/10.1002/14651858.CD005465.pub4
			Comans, Peel, N. M., Cameron, I. D., Gray, L., &
	Non ava M	The	Scuffham, P. A. (2015). Healthcare resource use
		University of	in patients of the Australian Transition Care
	Peel	Queensland	Program. Australian Health Review, 39(4), 411-
D (			416. https://doi.org/10.1071/AH14054
Gentrality			Ambrens, Stanners, M., Valenzuela, T., Razee, H.,
Centrality			Chow, J., van Schooten, K. S., Close, J. C. T.,
			Clemson, L., Zijlstra, G. A. R., Lord, S. R.,
		N-massionas	Tiedemann, A., Alley, S. J., Vandelanotte, C., &
		Neuroscience Desearch	Delbaere, K. (2021). Exploring Older Adults'
	Stephen R	Research	Experiences of a Home-Based, Technology-
	Lord	Australia,	Driven Balance Training Exercise Program
		Sydney,	Designed to Reduce Fall Risk: A Qualitative
		Australia	Research Study Within a Randomized Controlled
			Trial. Journal of Geriatric Physical Therapy
			(2001), Publish Ahead of Print.
			https://doi.org/10.1519/JPT.000000000000321

# 3.3.3 Co-institution Network

As shown in Figure 22, the co-institution network contains 860 institutions and 2,495 collaborations between or among institutions. The network density is 0.0068, indicating that institutional collaboration network is relatively intensive. The modularity value of 0.7114 and the silhouette value of 0.9286 implies that the clustering effect is statistically significant and reliable. The largest network cluster consists of 677 institutions, accounting for 78% of the entire network.



Figure 22. Main Network Clusters

Table 21 provides five substantial clusters in the co-institution network.

Cluster ID	Size	Silhouette	Mean (Year)	Cluster Label	Top Institutions (by frequency)
0	165	0.904	2010	Hong Kong	The University of Sydney The University of Queensland Monash University The University of Melbourne Flinders University
1	135	0.936	2012	Hong Kong	The Chinese University of Hong Kong The University of Hong Kong National University of Singapore The Hong Kong Polytechnic University Shandong University
2	114	0.882	2009	great east Japan earthquake	The University of Tokyo National Center for Geriatrics and Gerontology Chiba University University of Tsukuba Tohoku University
3	87	0.935	2010	advanced age	The University of Auckland University of Otago Massey University

 Table 21. Top 5 Clusters of Institutions

					Canterbury District Health Board University of Canterbury
4	79	0.954	2011	dementia research group	Peking University King's College London Anhui Medical University University of Cambridge Public Health Foundation of India (PHFI)

Table 22 shows the top 10 institutions ranked by publications' number, degree centrality, and betweenness centrality.

Frequency	Institution	Degree Centrality	Institution	Betweenness Centrality	Institution
98	The Chinese University of Hong Kong	79	The University of Melbourne	32159.39	The University of Melbourne
92	The University of Hong Kong	69	The University of Sydney	26848.12	The University of Sydney
81	The University of Sydney	68	Monash University	26495.48	The University of Tokyo
70	The University of Queensland	53	The University of Queensland	26235.89	King's College London
69	The University of Auckland	52	The Chinese University of Hong Kong	25368.53	Tokyo Metropolitan Institute of Gerontology
69	Monash University	52	The University of Tokyo	19178,24	The University of Hong Kong
68	The University of Melbourne	49	Flinders University	18212.34	The Chinese University of Hong Kong
67	The University of Tokyo	48	The University of Hong Kong	17410.97	National University of Singapore
66	National University of Singapore	46	King's College London	15081.95	The University of Queensland
58	Flinders University	44	National University of Singapore	14483.21	University of New South Wales

 Table 22. Top 10 Institutions

#### 3.3.4 Co-category Network

Figure 23 shows a network of WoS scientific disciplines, including 52 disciplines and 239 cross- or inter-disciplinary publications. The network density is 0.1802, demonstrating cross- or inter-disciplinary research to be relatively intensive. The largest network component comprises 51 WoS disciplines, accounting for 98% of the network.



Figure 23. Co-category Network

#### 3.3.5 Co-keyword Network

From Figure 24 below, we can see a network of keywords used in publications, including 198 keywords and 1,102 co-occurrence relationships. The network density is 0.0565, indicating that the keyword relationships are intensive. The largest network cluster consists of 184 keywords, accounting for 92% of the network.



Figure 24. Co-keyword Network

# 3.3.6 Co-citation Network

Figure 25 shows a network of co-citation relationships, indicating the frequency with which two publications are cited together by other publications. This network contains 8,696 publications and 28,045 times of co-citations. The network density is only 0.0007, demonstrating that the citation relationships are scattered. The modularity value of 0.982 and the silhouette value of 0.9841 implies that the clustering effect is statistically significant and reliable. The largest network cluster consists of 3,371 publications, accounting for 38% of the network.



Figure 25. Co-citation Network<sup>8</sup>

Table 23 shows top 5 clusters of co-citation network.

Cluster ID	Size	Silhouette	Mean (Year)	Cluster Label	Top Cited Publications
0	443	0.952	2016	health status	World Health Organization (WHO) (2015) Holt-Lunstad J (2015) Zhong BL (2017) Wang GJ (2017) Steptoe A (2015)
1	226	0.938	2011	health status	Luo Y (2014) Chen Y (2014) Su D (2012) Wu ZQ (2010) Tamiya N (2011)
2	142	0.997	2000	self-rated economic condition	Chou KL (2001) Boey KW (2000) Gandek B (2005) CHOU KL (1999) Chi I (2001)
3	134	0.992	2008	later life	Luanaigh CO (2008) Golden J (2009)

 Table 23. Top 5 Co-citation Network Clusters

 $<sup>^{\</sup>rm 8}\,$  The literatures related to WHO are marked with a blue box in Figure 25.

					Cornwell EY (2009) Theeke LA (2009)
					Savikko N (2008)
					Chuan SK (2008)
				montal boolth	Demyttenaere K (2004)
5	131	0.998	2005		Quine S (2007)
				service	Strine TW (2005)
					OConnor DW (2006)

Table 24 provides top 10 cited publications in the co-citation network, which can be seen as the most significant publications.

Publication	Frequency
World report on ageing and health. (2015). World Health Organization.	36
Holt-Lunstad, Smith, T. B., Baker, M., Harris, T., & Stephenson, D. (2015).	
Loneliness and Social Isolation as Risk Factors for Mortality: A Meta-Analytic	25
Review. Perspectives on Psychological Science, 10(2), 227-237.	23
https://doi.org/10.1177/1745691614568352	
WILEY, LEIBING, A., GUBERMAN, N., REEVE, J., & ALLEN, R. E (2012).	
The meaning of Aging in Place to older people. The Gerontologist, 52(3), 357-	16
366. https://doi.org/10.1093/geront/gnr098	
Zhong, Chen, SL., Tu, X., & Conwell, Y. (2017). Loneliness and Cognitive	
Function in Older Adults: Findings From the Chinese Longitudinal Healthy	
Longevity Survey. The Journals of Gerontology. Series B, Psychological	16
Sciences and Social Sciences, 72(1), 120–128.	
https://doi.org/10.1093/geronb/gbw037	
Wang, Hu, M., Xiao, S., & Zhou, L. (2017). Loneliness and depression among	
rural empty-nest elderly adults in Liuyang, China: a cross-sectional study. BMJ	15
Open, 7(10), e016091-e016091. https://doi.org/10.1136/bmjopen-2017-016091	
Zeng, Feng, Q., Hesketh, T., Christensen, K., & Vaupel, J. W. (2017). Survival,	
disabilities in activities of daily living, and physical and cognitive functioning	14
among the oldest-old in China: a cohort study. The Lancet (British Edition),	14
389(10079), 1619-1629. https://doi.org/10.1016/S0140-6736(17)30548-2	
Valtorta, Kanaan, M., Gilbody, S., Ronzi, S., & Hanratty, B. (2016). Loneliness	
and social isolation as risk factors for coronary heart disease and stroke:	
systematic review and meta-analysis of longitudinal observational studies. Heart	14
(British Cardiac Society), 102(13), 1009–1016. https://doi.org/10.1136/heartjnl-	
2015-308790	
YAOHUI ZHAO, YISONG HU, SMITH, J. P., STRAUSS, J., & GONGHUAN	
YANG. (2014). Cohort Profile: The China Health and Retirement Longitudinal	12
Study (CHARLS). International Journal of Epidemiology, 43(1), 61-68.	15
https://doi.org/10.1093/ije/dys203	
YE LUO, & WAITE, L. J. (2014). Loneliness and Mortality Among Older Adults	13

# Table 24. Top 10 Most Cited Publications

in China. The Journals of Gerontology. Series B, Psychological Sciences and	
Social Sciences, 69(4), 633-645. https://doi.org/10.1093/geronb/gbu007	
Courtin, & Knapp, M. (2017). Social isolation, loneliness and health in old age: a	
scoping review. Health & Social Care in the Community, 25(3), 799–812.	13
https://doi.org/10.1111/hsc.12311	

# 3.4 Results Related to Objective 4

## 3.4.1 Publications by Year and Country

Figure 26 shows the distribution of publications by year since 1991. Figure 27 displays the top 10 publishing countries/areas. 63 publishing countries/areas are identified in the ageing studies involving the WPR.



Figure 26. Number of Publications Over Time<sup>9</sup>



<sup>&</sup>lt;sup>9</sup> The number of publications in 2021 is not accurate, as the data was collected on 17 November 2021.

#### Figure 27. Top 10 Publishing Countries/Areas

#### 3.4.2 **Co-author Network**

Figure 28 shows a network of co-authors, including 5,002 authors and 13,709 coauthorships. The network density is 0.0011, which demonstrates the co-authorship network is sparse and disconnected. The modularity value is 0.995 and the silhouette value is 1 through the cluster analysis, indicating the clustering effect is statistically significant and reliable. The largest network cluster is composed of 47 authors, accounting for 1% of the network. Five main clusters are presented in Figure 29.



a social capital





### Figure 29. Main Network Clusters of Co-authorships<sup>10</sup>

Table 25 lists co-authorship details of Cluster 0 on the topic of social capital automatically generated by CiteSpace. The representative documents of top authors are provided in Table 26.

Cluster ID	Size	Silhouette	Mean (Year)	Cluster Label	Top Authors (by frequency)
					Katsunori Kondo
					Ichiro Kawachi
0	47	1	2018	social capital	Naoki Kondo
					Jun Aida
					Masayoshi Zaitsu

Table 25. Top 1 Cluster of Co-authorship

Table 20, Top Authors (by frequency) in Cluster	Table 26.	<b>Top Authors</b>	(by frequency)	in Cluster
---	-----------	--------------------	----------------	------------

Top author	Affiliation	Document Example			
		Aida, Jun, Kondo, Katsunori, Osaka, Ken, Takeuchi, Kenji, &			
Katsunori	Chiba	Glogauer, Michael. (2013). Social participation and dental health			
Kondo University		status among older Japanese adults: A population-based cross-			
		sectional study. PloS One, 8(4), E61741.			
Ichiro Harvard Kawachi University	Uomond	PS, K. I. S. D. V. (1994). Weiss ST. Symptoms of anxiety and risk			
	Liniversity	of coronary heart disease. The Normative Aging			
	University	Study. Circulation, 90, 2225-2229.			
Nachi	University of	Saito, J., Haseda, M., Amemiya, A., Takagi, D., & Kondo, K.			
Kondo	Talana	(2019). Community-based care for healthy ageing: Lessons from			
	токуо	Japan. Bulletin of the World Health Organization, 97(8), 570-574.			

<sup>&</sup>lt;sup>10</sup> WHO academic partner is labelled in Figure 29.

Jun Aida	Tohuku University	Kanamori S, Kai Y, Aida J, Kondo K, Kawachi I, Hirai H, et al. (2014) Social participation and the prevention of functional disability in older Japanese: The JAGES cohort study. <i>PLoS ONE</i> , 9(6): e99638.
Masayoshi Zaitsu	Dokkyo Medical University	Zaitsu, M., Kawachi, I., Ashida, T., Kondo, K., & Kondo, N. (2018). Participation in community group activities among older adults: Is diversity of group membership associated with better self-rated health? <i>Journal of Epidemiology</i> , JE20170152.

Table 27 shows the top 10 authors identified as the most productive authors' number, collaborators or mediators, respectively. Examples of representative documents by top authors are displayed in Table 28.

Frequency	Author	Degree Centrality	Author	Betweenness Centrality	Author
9	Katsunori Kondo	42	Paul Kowal	644.5	Katsunori Kondo
8	Naonori Kodate	39	Somnath Chatterji	385.0	Masayoshi Zaitsu
7	Wendy Moyle	37	Karl Peltzer	326.0	Hidenori Arai
6	Jeni Warburt ON	35	Katsunori Kondo	287.0	Bo Wang
6	Ke Chen	34	Nadia Minicuci	276.0	Yuan Li
6	Cindy Jones	34	Nirmala Naidoo	251.2	Elizabeth Beattle
6	Paul Kowal	31	Nancy Phaswanamafuya	241.5	Jean Woo
5	Somnath Chatterji	28	Bo Wang	230.0	Jenny Lee
5	Jean Woo	27	Fan Wu	216.0	Naoki Karnon
5	Kimiko Tomioka	26	Yuqi Liu	210.0	Jonathan Karnon

 Table 27. Top 10 authors (as productive authors, collaborators or mediators)

# Table 28. Top Authors and Documents Examples

Influence Indicator	Author	Affiliation	Document Example
Number of Documents	Katsunori Kondo	Chiba University	Takeuchi, K., Aida, J., Kondo, K., & Osaka, K. (2013). Social participation and dental health status among older Japanese adults: a population-based cross-sectional study. <i>PloS one</i> , <i>8</i> (4), e61741.

	Naonori Kodate	University College Dublin	Saito, J., Haseda, M., Amemiya, A., Takagi, D., Kondo, K., & Kondo, N. (2019). Community-based care for healthy ageing: lessons from Japan. <i>Bulletin of the</i> <i>World Health Organization</i> , <i>97</i> (8), 570.
	Wendy Moyle	Griffith University	Moyle, W., Cooke, M., Beattie, E., Jones, C., Klein, B., Cook, G., & Gray, C. (2013). Exploring the effect of companion robots on emotional expression in older adults with dementia: a pilot randomized controlled trial. <i>Journal of gerontological</i> <i>nursing</i> , <i>39</i> (5), 46-53.
Degree Centrality Betweenness Centrality	Paul Kowal Newcastle University		Gorrindo, T., Chatterji, S., Kowal, P., Epstein, Z., & Weinstein, M. (2013). A cross-country comparison of sociodemographic correlates of depression in the WHO Study of Global Aging and Adult Health (SAGE). In <i>Applied</i> <i>demography and public health</i> (pp. 45-60). Springer, Dordrecht.
	Somnath Chatterji	World Health Organization	Stewart Williams, J., Myléus, A., Chatterji, S., & Valentine, N. (2020). Health systems responsiveness among older adults: Findings from the World Health Organization Study on global AGEing and adult health. <i>Global public health</i> , <i>15</i> (7), 999-1015.
	Karl Peltzer	Asia University	Kowal, P., Chatterji, S., Naidoo, N., Biritwum, R., Fan, W., Lopez Ridaura, R., & SAGE Collaborators. (2012). Data resource profile: The World Health Organization Study on global AGEing and adult health (SAGE). <i>International journal</i> <i>of epidemiology</i> , <i>41</i> (6), 1639-1649.
	Katsunori Kondo	Chiba University	Takeuchi, K., Aida, J., Kondo, K., & Osaka, K. (2013). Social participation and dental health status among older Japanese adults: a population-based cross-sectional study. <i>PloS one</i> , <i>8</i> (4), e61741.
	Masayoshi Zaitsu	Dokkyo Medical University	Zaitsu, M., Kawachi, I., Ashida, T., Kondo, K., & Kondo, N. (2018). Participation in community group activities among older adults: Is diversity of group membership associated with

16			
			better self-rated health? Journal of
			epidemiology, JE20170152.
			Cruz-Jentoft, A. J., Landi, F., Schneider, S.
			M., Zúñiga, C., Arai, H., Boirie, Y., &
		National Center for	Cederholm, T. (2014). Prevalence of and
	Hidenori	Geriatrics and	interventions for sarcopenia in ageing
	Arai	Gerontology, Kyoto	adults: a systematic review. Report of the
		University	International Sarcopenia Initiative
			(EWGSOP and IWGS). Age and
			ageing, 43(6), 748-759.

#### 3.4.3 Co-institution Network

As shown in Figure 30, the co-institution network contains 1,157 institutions and 2,255 collaborations between or among institutions. The network density is 0.0034, indicating that institutional collaboration network is relatively intensive. The modularity value of 0.8397 and the silhouette value of 0.9537 implies that the clustering effect is statistically significant and reliable. The largest network cluster consists of 661 institutions, accounting for 57% of the entire network.



Figure 30. Main Network Clusters

Table 29 provides five substantial clusters in the co-institution network.

Cluster ID	Size	Silhouette		Cluster Label	Top Institutions
			(Year)		(by frequency)
					Monash University
					La Trobe University
0	83	0.92	2013	Care facilities	Griffith University
					University of Melbourne
					Wuhan University
					University of Tokyo
					National Center for
					Geriatrics and
1	79	0.947	2013	Social	Gerontology
-	,,,		-010	participation	Chiba University
					Tokyo Metropolitan
					University
					Hokkaido University
	66		2012	Assistive pet robot	Chinese University of
					Hong Kong
					Hong Kong Polytechnic
2		0.932			University
		0.932			University of Hong Kong
					City University of Hong
					Kong
					Tsinghua University
					University of Queensland
	50				Chinese Academy of
					Sciences
2			2014		Queensland University of
5	39		2014	Senior care	Technology
					University of New South
					Wales
					Xi'an Jiaotong University
					University of Auckland
					University of Western
				Demalation	Australia
4	48	8 0.974	2014	ropulation	Curtin University
				structure	University of Otago
					Nanjing University of
					Science and Technology

Table 29. Top 5 Clusters of Institutions

Table 30 shows the top 10 institutions ranked by publications' number, degree centrality, and betweenness centrality.

# Table 30. Top 10 Institutions

Frequency	Institution	Degree Centrality	Institution	Betweenness Centrality	Institution
42	University of	16	University of	52529 (	University of
42	Tokyo	40	Newcastle	52558.0	Tokyo
	Chinese		University of		Hong Kong
29	University of	40		38533.6	Polytech
	Hong Kong		Токуо		University
27	Hong Kong Polytech University	38	Kyoto University	33415.9	Kyushu University
26	University of Hong Kong	37	University Western Australia	31742.3	University of Singapore
24	University Sydney	35	Griffith University	22731.8	University of Queensland
23	Monash University	34	University of Sydney	22675.1	Sichuan University
21	La Trobe University	31	University of Auckland	19275.2	Chinese Academy Science
21	Griffith University	29	Monash University	19084.7	Kyoto University
20	Natl University	27	University of Ghana	18523.6	University of Western Australia
19	University of Queensland	27	Human Social Research Council	18264.3	University of Auckland

# 3.4.4 Co-category Network

Figure 31 shows a network of WoS scientific disciplines, including 162 disciplines and 1,164 cross- or inter-disciplinary publications. The network density is 0.0893, demonstrating cross- or inter-disciplinary research to be relatively intensive. The largest network component comprises 157 WoS disciplines, accounting for 96% of the network.



Figure 31. Co-category Network

# 3.4.5 Co-keyword Network

From Figure 32 below, we can see a network of keywords used in publications, including 427 keywords and 1,826 co-occurrence relationships. The network density is 0.0201, indicating that the keyword relationships are intensive. The largest network cluster consists of 323 keywords, accounting for 75% of the network.



Figure 32. Co-keyword Network

# 3.4.6 Co-citation Network

Figure 33 shows a network of co-citation relationships, indicating the frequency with which two publications are cited together by other publications. This network contains 12,050 documents and 37,230 times of co-citations. The network density is only 0.0005, demonstrating that the citation relationships are scattered. The modularity value is 0.9915 and the silhouette value is 0.9896, indicating that the clustering effect is significant and reliable. The largest network cluster is composed of 1,746 publications, accounting for 14% of the network.



Figure 33. Co-citation Network<sup>11</sup>

Table 31 shows top 5 clusters of co-citation network.

Cluster ID	Size	Silhouette	Mean (Year)	Cluster Label	Top Cited Publications
0	303	0.957	2015	South Africa	Vosner HB (2016) Moyle W (2017) Li Q (2020) Khosravi P (2016) Prince M (2015)
1	181	0.998	2013	service innovation	Cummings J (2015) Goodall Ken (2010) Klapwijk MS (2016)

Table 31. Top 5 Co-citation Network Clusters

<sup>11</sup> The literatures related to WHO are marked with a blue box in Figure 33.

					Wilson EV (2014)
					Valembois L (2015)
					Anderson ND (2014)
				1	Kishimoto Y (2013)
2	160	0.985	2012	social participation	Levasseur M (2015)
					Takeuchi K (2013)
					Aida J (2013)
	150	1	2014	diabetes self- management	Deng ZH (2014)
					Wang ZH (2017)
3					Braun MT (2013)
					Matthew-Maich N (2016)
					Arnhold M (2014)
					Takagi D (2013)
4	143	0.997	2011	China Ghana	Kanamori S (2014)
				India Mexico	Kowal P (2012)
				Russia	Murayama H (2012)
					Chiao C (2011)

Table 32 provides top 10 cited documents in the co-citation network, which can be seen as the most significant documents.

# Table 32. Top 10 Most Cited Documents

Document	Frequency	
Takagi, D., Kondo, K., & Kawachi, I. (2013). Social participation and mental		
health: moderating effects of gender, social role and rurality. BMC public	9	
<i>health</i> , <i>13</i> (1), 1-8.		
Kanamori, S., Kai, Y., Aida, J., Kondo, K., Kawachi, I., Hirai, H., & JAGES		
Group. (2014). Social participation and the prevention of functional disability in	9	
older Japanese: the JAGES cohort study. <i>PloS one</i> , 9(6), e99638.		
Vošner, H. B., Bobek, S., Kokol, P., & Krečič, M. J. (2016). Attitudes of active		
older Internet users towards online social networking. Computers in Human	7	
Behavior, 55, 230-241.		
Moyle, W., Jones, C. J., Murfield, J. E., Thalib, L., Beattie, E. R., Shum, D. K., &		
Draper, B. M. (2017). Use of a robotic seal as a therapeutic tool to improve	-	
dementia symptoms: a cluster-randomized controlled trial. Journal of the American	/	
Medical Directors Association, 18(9), 766-773.		
Li, Q., Guan, X., Wu, P., Wang, X., Zhou, L., Tong, Y., & Feng, Z. (2020). Early		
transmission dynamics in Wuhan, China, of novel coronavirus-infected	6	
pneumonia. New England journal of medicine.		
Anderson, N. D., Damianakis, T., Kröger, E., Wagner, L. M., Dawson, D. R., Binns,		
M. A., & Cook, S. L. (2014). The benefits associated with volunteering among	6	
seniors: a critical review and recommendations for future research. Psychological	U	
<i>bulletin</i> , <i>140</i> (6), 1505.		

Khosravi, P., Rezvani, A., & Wiewiora, A. (2016). The impact of technology on older adults' social isolation. <i>Computers in Human Behavior</i> , <i>63</i> , 594-603.	6	
Kishimoto, Y., Suzuki, E., Iwase, T., Doi, H., & Takao, S. (2013). Group		
involvement and self-rated health among the Japanese elderly: an examination of	5	
bonding and bridging social capital. BMC public health, 13(1), 1-10.		
Levasseur, M., Généreux, M., Bruneau, J. F., Vanasse, A., Chabot, É., Beaulac, C.,		
& Bédard, M. M. (2015). Importance of proximity to resources, social support,	5	
transportation and neighborhood security for mobility and social participation in		
older adults: results from a scoping study. BMC public health, 15(1), 1-19.		
Frennert, S., & Östlund, B. (2014). Seven matters of concern of social robots and	5	
older people. International Journal of Social Robotics, 6(2), 299-310.	3	

# 3.5 Results Related to Objective 5

### 3.5.1 Publications by Year and Country

Figure 34 shows the distribution of publications by year since 1991. Figure 35 displays the top 10 publishing countries/areas. 69 publishing countries/areas are identified in the ageing studies involving the WPR.



Figure 34. Number of Publications Over Time<sup>12</sup>



Figure 35. Top 10 Publishing Countries/Areas

<sup>&</sup>lt;sup>12</sup> The number of publications in 2021 is not accurate, as the data was collected on 26 November 2021.

# 3.5.2 Co-author Network

Figure 36 shows a network of co-authors, including 2,764 authors and 8,707 coauthorships. The network density is 0.0023, which demonstrates the co-authorship network is sparse and disconnected. The modularity value is 0.9506 and the silhouette value is 0.991 through the cluster analysis, indicating the clustering effect is statistically significant and reliable. The largest network cluster is composed of 212 authors, accounting for 7% of the network. Five main clusters are presented in Figure 37.



#### Figure 36. Co-author Network





ROBYN WOODS



Figure 37. Main Network Clusters of Co-authorships

Table 33 lists co-authorship details of the top 2 clusters. The topic of each cluster is automatically generated by CiteSpace and are displayed as red labels in Figure 37. The representative publications of top authors are provided in Table 34.

Cluster ID	Size	Silhouette	Mean (Year)	Cluster Label	Top Authors (by frequency)
		0.991	2019		Richard Ofori-Asenso
					Adam Belay Wondmieneh
0	201			reducing	Afshin Zarghi
0	201			event	Adrian Pana
					Abdollah Mohammadian-
					Hafshejani
	11	0.999	2017		Sophia Zoungas
					ASPREE Healthy Ageing
41				genomic	Biobank
41	11			potential	STAREE Investigator Group
					ASPREE Investigator Group
					Andrea J Curtis

Table 33. Top 2 Clusters of Co-authorship

	Top author	Affiliation	Publication Example	
			Ofori-Asenso, R., Chin, K. L., Mazidi, M., Zomer,	
			E., Ilomaki, J., Zullo, A. R., & Liew, D. (2019).	
	Richard Ofori-	University of	Global incidence of frailty and prefrailty among	
Cluster 0	Asenso	Copenhagen	community-dwelling older adults: a systematic	
			review and meta-analysis. JAMA network	
			open, 2(8), e198398.	
			Dirac, M. A., Safiri, S., Tsoi, D., Adedoyin, R. A.,	
	Adam Belay Wondmieneh	Mediacal	Afshin, A., Akhlaghi, N., & Naghavi, M. (2020).	
		University of	The global, regional, and national burden of gastro-	
		Lodz	oesophageal reflux disease in 195 countries and	
			territories, 1990-2017: a systematic analysis for the	

			Global Burden of Disease Study 2017. <i>The Lancet</i>
	Afshin Zarghi Shahid Medical Sciences		Zarghi, A., & Arfaei, S. (2011). Selective COX-2 inhibitors: a review of their structure-activity relationships. <i>Iranian journal of pharmaceutical</i> <i>research: IJPR</i> , <i>10</i> (4), 655-683.
	Adrian Pana	Center for Health Outcomes and Evaluation, Romania	<ul> <li>Reitsma, M. B., Fullman, N., Ng, M., Salama, J. S.,</li> <li>Abajobir, A., Abate, K. H., &amp; Patton, G. C.</li> <li>(2017). Smoking prevalence and attributable disease</li> <li>burden in 195 countries and territories, 1990–2015:</li> <li>a systematic analysis from the Global Burden of</li> <li>Disease Study 2015. <i>The Lancet</i>, 389(10082), 1885-</li> <li>1906.</li> </ul>
	Abdollah Mohammadian- Hafshejani	Shahrekord University of Medical Science	<ul> <li>Haile, L. M., Kamenov, K., Briant, P. S., Orji, A.</li> <li>U., Steinmetz, J. D., Abdoli, A., &amp; Rao, C. R.</li> <li>(2021). Hearing loss prevalence and years lived with disability, 1990–2019: findings from the Global Burden of Disease Study 2019. <i>The Lancet</i>, 397(10278), 996-1009.</li> </ul>
Cluster 41	Sophia Zoungas	Monash University	Zoungas, S., Patel, A., Chalmers, J., De Galan, B. E., Li, Q., Billot, L., & Heller, S. (2010). Severe hypoglycemia and risks of vascular events and death. <i>New England Journal of Medicine</i> , <i>363</i> (15), 1410-1418.
	ASPREE Healthy Ageing Biobank	Monash University	Lacaze, P., Woods, R., Zoungas, S., McNeil, J., ASPREE Investigator Group, ASPREE Healthy Ageing Biobank, & STAREE Investigator Group. (2017). The genomic potential of the Aspirin in Reducing Events in the Elderly and Statins in Reducing Events in the Elderly studies. <i>Internal</i> <i>medicine journal</i> , 47(4), 461-463.
	STAREE Investigator Group Monash University		Lacaze, P., Woods, R., Zoungas, S., McNeil, J., ASPREE Investigator Group, ASPREE Healthy Ageing Biobank, & STAREE Investigator Group. (2017). The genomic potential of the Aspirin in Reducing Events in the Elderly and Statins in Reducing Events in the Elderly studies. <i>Internal</i> <i>medicine journal</i> , 47(4), 461-463.
	ASPREE Investigator Group		Group, A. I. (2013). Study design of ASPirin in Reducing Events in the Elderly (ASPREE): a randomized, controlled trial. <i>Contemporary clinical</i> <i>trials</i> , <i>36</i> (2), 555-564.
	Andrea J Curtis	Monash	Zhou, Z., Curtis, A. J., Ernst, M. E., Ryan, J.,

	University	Zoungas, S., Wolfe, R., & Nelson, M. R. (2021).
		Comparison of statins for primary prevention of
		cardiovascular disease and persistent physical
		disability in older adults. European Journal of
		Clinical Pharmacology, 1-10.
		https://doi.org/10.1007/s00228-021-03239-1

Table 35 shows the top 10 authors identified as the most productive authors' number, collaborators or mediators, respectively. Examples of representative publications by top authors are displayed in Table 36.

Frequency	Author	Degree Centrality	Author	Betweenness Centrality	Author
15	Rahul Malhotra	200	Adam Belay Wondmieneh	9441.2	Kaarin J Anstey
14	Angelique Chan	200	Afshin Zarghi	8255.6	Yasuhiko Saito
10	Tengku Aizan Hamid	200	Adrian Pana	7421.8	Gavin Andrews
10	Katsunori Kondo	200	Abdollah Mohammadian- Hafshejani	6776.0	Perminder Sachdev
10	Danan Gu	200	Abdallah M Samy	5877.5	Brian Draper
8	Nanako Tamiya	200	Adane Teshome Kefale	4502.8	Blossom C M Stephan
7	Yadollah Abolfathi Momtaz	200	Abdulaziz M Almulhim	3594.3	David B Matchar
7	Rahimah Ibrahim	164	Ahmad Daryani	2704.4	Adam Belay Wondmieneh
7	Yasuhiko Saito	60	Blossom C M Stephan	2704.4	Afshin Zarghi
7	Erika Kobayashi	47	Atsushi Hozawa	2704.4	Adrian Pana
7	Taro Fukaya			2704.4	Abdollah Mohammadian- Hafshejani
7	Jersey Liang			2704.4	Abdallah M Samy

Table 35. Top 10 Authors (as productive authors, collaborators or mediators)<sup>13</sup>

<sup>&</sup>lt;sup>13</sup> There are 6 authors rank 7th in the frequency ranking, so 12 authors are listed. There are 7 authors rank 8th in the betweenness centrality ranking, so 14 authors are listed.

		2704.4	Adane Teshome Kefale
		2704.4	Abdulaziz M
			Almulhim

Influence Indicator	Author	Affiliation	Publication Example
	Rahul Malhotra	Duke-NUS Medical School	Chan, A., Malhotra, C., Malhotra, R., & Østbye, T. (2011). Living arrangements, social networks and depressive symptoms among older men and women in Singapore. <i>International journal of</i> <i>geriatric psychiatry</i> , <i>26</i> (6), 630-639.
Number of Publications	Angelique Chan	Duke-NUS Medical School	Teo, P., Mehta, K., Thang, L. L., & Chan, A. (2006). <i>Ageing in Singapore: Service needs and the state</i> . Routledge.
	Tengku Aizan Hamid	University of Putra Malaysia	Eshkoor, S. A., Hamid, T. A., Mun, C. Y., & Ng, C. K. (2015). Mild cognitive impairment and its management in older people. <i>Clinical interventions in aging</i> , <i>10</i> , 687-693.
Degree Centrality	Adam Belay Wondmieneh	Mediacal University of Lodz	<ul> <li>Dirac, M. A., Safiri, S., Tsoi, D., Adedoyin, R.</li> <li>A., Afshin, A., Akhlaghi, N., &amp; Naghavi, M.</li> <li>(2020). The global, regional, and national burden of gastro-oesophageal reflux disease in 195 countries and territories, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. <i>The Lancet</i> <i>Gastroenterology &amp; Hepatology</i>, 5(6), 561-581.</li> </ul>
	Afshin Zarghi	Shahid Beheshti University of Medical Sciences	Zarghi, A., & Arfaei, S. (2011). Selective COX- 2 inhibitors: a review of their structure-activity relationships. <i>Iranian journal of pharmaceutical</i> <i>research: IJPR</i> , <i>10</i> (4), 655-683.
	Adrian Pana	Center for Health Outcomes and Evaluation, Romania	<ul> <li>Reitsma, M. B., Fullman, N., Ng, M., Salama, J.</li> <li>S., Abajobir, A., Abate, K. H., &amp; Patton, G.</li> <li>C. (2017). Smoking prevalence and attributable disease burden in 195 countries and territories, 1990–2015: a systematic analysis from the Global Burden of Disease Study 2015. <i>The Lancet</i>, 389(10082), 1885-1906.</li> </ul>
Betweenness Centrality	Kaarin J Anstey	The University of New South Wales, Sydney	Lord, S. R., Ward, J. A., Williams, P., & Anstey, K. J. (1994). Physiological factors associated with falls in older community- dwelling women. <i>Journal of the American</i> <i>Geriatrics Society</i> , <i>42</i> (10), 1110-1117.

# Table 36. Top Authors and Publication Examples

			Crimmins, E. M., Hayward, M. D., & Saito, Y.		
	Yasuhiko	Nihon	(1994). Changing mortality and morbidity rates		
	Saito	University	and the health status and life expectancy of the		
			older population. Demography, 31(1), 159-175.		
			Andrews, G., Cuijpers, P., Craske, M. G.,		
	Gavin Andrews	The University	McEvoy, P., & Titov, N. (2010). Computer		
		of New South	therapy for the anxiety and depressive disorders		
		Wales, Sydney	is effective, acceptable and practical health care:		
			a meta-analysis. PloS one, 5(10), e13196.		

# 3.5.3 Co-institution Network

As shown in Figure 38, the co-institution network contains 969 institutions and 3,496 collaborations between or among institutions. The network density is 0.0075, indicating that institutional collaboration network is relatively intensive. The modularity value of 0.7816 and the silhouette value of 0.9381 implies that the clustering effect is statistically significant and reliable. The largest network cluster consists of 766 institutions, accounting for 79% of the entire network.



Figure 38. Main Network Clusters

Table 37 provides five substantial clusters in the co-institution network.

 Table 37. Top 5 clusters of institutions

Cluster ID	Size	Silhouette	Mean	Cluster Label	Top Institutions

			(Year)		(by frequency)	
		0.982	2019	decision process	The University of Birmingham	
					The University of Toronto	
0	175				China Medical University	
					McMaster University	
					Imperical College London	
		0.862	2014	co-ordinated	The University of Sydney	
					The University of Queensland	
1	105				The University of Melbourne	
				allarysis	Monash University	
				decision process co-ordinated analysis cost-effective analysis depressive symptom	The Univerisyt of South Wales	
			2014		Duke University	
					National University of Singapore	
2	75	0.931		2014 cost-effective analysis	The University of Michigan	
2					Duke-NUS Medical School	
					Tokyo Metropolitan Institute of	
					Gerontol	
	71	0.883	2017	depressive symptom	The University of Hong Kong	
					Sun Tat-sen University	
2					Huazhong University of Science &	
3					Technology	
					Renmin University of China	
					Hong Kong Polytech University	
4	66	0.954	2015	total cholesterol level	The University of Tokyo	
					National Center for Geriatrics and	
					Gerontology	
-					Chiba University	
					University of Tsukuba	
					Waswda University	

Table 38 shows the top 10 institutions ranked by publications' number, degree centrality, and betweenness centrality.

Frequency	Institution	Degree Centrality	Institution	Betweenness Centrality	Institution
34	Peking University	178	Adigrat University	59053.33	Peking University
33	The University of Sydney	178	AT Still University	35861.08	The University of Newcastle, Autralia

 Table 38. Top 10 institutions<sup>14</sup>

<sup>&</sup>lt;sup>14</sup> Since there are 3 institutions ranked 10th in the frequency ranking, 12 institutions are listed. Since there are 3 institutions ranked 10th in the degree centrality ranking, 12 institutions are listed.

24	Duke	178	Addis Ababa	33519 54	The University of
	University	170	University	55517.54	Melbourne
23	National University of Singapore	178	Aga Khan University	25594.52	Adigrat University
19	The University of Otago	178	Afro-Asian Institute	25594.52	AT Still University
18	The University of Newcastle, Autralia	88	Ahmadu University	25594.52	Addis Ababa University
18	The University of Queensland	70	Peking University	25594.52	Aga Khan University
17	Australian National University	52	The University of Sydney	25594.52	Afro-Asian Institute
16	The University of Melbourne	48	Newcastle University	18884.08	Australian National University
15	The Chinses University of Hong Kong	47	The University of Newcastle, Australia	18805.33	The University of Queensland
15	Monash University	47	Australian National University		
15	The University of Hong Kong	47	Kyushu University		

# 3.5.4 Co-category Network

Figure 39 shows a network of WoS scientific disciplines, including 88 disciplines and 307 cross- or inter-disciplinary publications. The network density is 0.0802, demonstrating cross- or inter-disciplinary research to be relatively intensive. The largest network component comprises 84 WoS disciplines, accounting for 95% of the network.



Figure 39. Co-category Network

# 3.5.5 Co-keyword Network

From Figure 40 below, we can see a network of keywords used in publications, including 366 keywords and 1,783 co-occurrence relationships. The network density is 0.0267, indicating that the keyword relationships are intensive. The largest network cluster consists of 333 keywords, accounting for 90% of the network.



Figure 40. Co-keyword Network
# 3.5.6 Co-citation Network

Figure 41 shows a network of co-citation relationships, indicating the frequency with which two publications are cited together by other publications. This network contains 9,295 publications and 29,067 times of co-citations. The network density is only 0.0007, demonstrating that the citation relationships are scattered. The modularity value is 0.9913 and the silhouette value is 0.9925, indicating that the clustering effect is significant and reliable. The largest network cluster is composed of 2,314 publications, accounting for 24% of the network.



Figure 41. Co-citation Network<sup>15</sup>

Table 39 shows top 5 clusters of co-citation network.

Cluster ID	Size	Silhouette	Mean (Year)	Cluster Label	Top Cited Publications
					Li JX (2017)
	185 0.982 2			mbrusical	Tu RP (2018)
0		2015	functioning	Lei XY (2014)	
l				runctioning	Fu R (2017)
					Kanamori S (2014)
		0.987	2015		Hu B (2018)
1	161			medical	Zhou JS (2016)
				insurance	Gong CH (2016)
					Qi XY (2015)

Table 39. Top 5 Co-citation Network Clusters

<sup>15</sup> The literature related to WHO is marked with a blue box in Figure 41.

					Lu B (2015)
					Zhang CC (2017)
		0.992	2016	inpatient health	Meng QY (2015)
2	153			service	Guo N (2016)
				utilization	Li YN (2016)
					Yamada T (2015)
		1	2016	functional decline	Kondo K (2018)
					Fujihara S (2019)
3	144				Kondo K (2016)
					Douglas H (2017)
					Saito M (2017)
					Blakely T (2015)
	1340.9902015parametric g- formula	nomenatuia a	Vieria ER (2016)		
4		0.990	2015	formula	Hu HW (2018)
					Pega F (2016)
					Dobson AJ (2015)

Table 40 provides top 10 cited publications in the co-citation network, which can be seen as the most significant publications.

Table	<b>40.</b> 1	Гор 10	Most	Cited	<b>Publications</b>
-------	--------------	--------	------	-------	---------------------

Publication	Frequency	
Zhao, Y., Hu, Y., Smith, J. P., Strauss, J., & Yang, G. (2014). Cohort profile: the		
China health and retirement longitudinal study (CHARLS). International journal of	16	
<i>epidemiology</i> , <i>43</i> (1), 61-68.		
Li, J., Cacchione, P. Z., Hodgson, N., Riegel, B., Keenan, B. T., Scharf, M. T., &		
Gooneratne, N. S. (2017). Afternoon napping and cognition in Chinese older adults:	7	
findings from the China health and retirement longitudinal study baseline	/	
assessment. Journal of the American Geriatrics Society, 65(2), 373-380.		
Wang, L., Zhang, H., Ruan, Y., Chin, D. P., Xia, Y., Cheng, S., & Wang, Y.		
(2014). Tuberculosis prevalence in China, 1990–2010; a longitudinal analysis of	6	
national survey data. The Lancet, 383(9934), 2057-2064.		
Zhao, Y. H., Strauss, J., Yang, G. H., Giles, J., Hu, P. F., Hu, Y. S., & Wang, Y.		
(2013). China Health and Retirement Longitudinal Study: 2011-2012 national		
baseline users' guide.	6	
http://charls.pku.edu.cn/Public/ashelf/public/uploads/document/2011-charls-		
wave1/application/CHARLS_nationalbaseline_users_guide.pdf		
Kondo, K., Rosenberg, M. & World Health Organization. (2018). Advancing		
universal health coverage through knowledge translation for healthy ageing:	5	
lessons learnt from the Japan gerontological evaluation study. World Health	5	
Organization. https://apps.who.int/iris/handle/10665/279010.		
Slade, T., Johnston, A., Oakley Browne, M. A., Andrews, G., & Whiteford, H.		
(2009). 2007 National Survey of Mental Health and Wellbeing: methods and key	5	
findings. Australian & New Zealand Journal of Psychiatry, 43(7), 594-605.		

Fang, E. F., Scheibye-Knudsen, M., Jahn, H. J., Li, J., Ling, L., Guo, H., & Ng,	5
research reviews 24, 197,205	5
research reviews, 24, 197-203.	
Zhang, C., Lei, X., Strauss, J., & Zhao, Y. (2017). Health insurance and health care	
among the mid-aged and older Chinese: Evidence from the national baseline survey	5
of CHARLS. Health economics, 26(4), 431-449.	
Hu, B., & Ma, S. (2018). Receipt of informal care in the Chinese older	4
population. Ageing & Society, 38(4), 766-793.	4
Beard, J. R., Officer, A., De Carvalho, I. A., Sadana, R., Pot, A. M., Michel, J. P.,	
& Chatterji, S. (2016). The World report on ageing and health: a policy framework	4
for healthy ageing. The lancet, 387(10033), 2145-2154.	

#### 4. Conclusion

Based on the above analysis, we find that the population ageing in the WPR has increasingly become a research hotspot in academic circles, and the number of relevant studies is also increasing year by year. The topics of population aging in the Western Pacific Region are not only concerned by researchers from the countries/areas of the Western Pacific Region, such as the People's Republic of China and Japan, but also focused by researchers in the other countries of the Americas and Europe, such as the United States of America (USA) and the United Kingdom of Great Britain and Northern Ireland (UK).

By conducting network analysis, the researcher cooperation network, institutional cooperation network, discipline co-occurrence network, research keyword co-occurrence network and literature co-citation network of relevant academic literature based on five objectives are described. We mainly analyze the network from the overall and individual perspectives. From the angle of the overall network, we took two successive steps. Primarily, we describe the scale, density, modularity indicators of the five networks respectively and visualize them to clarify the structure of the networks. The second step is clustering the networks and finding subgroups with high homogeneity and large size and their components in each network. From the individual perspective, we identified the key nodes in each network, such as pivotal authors, crucial institutions and critical research literature, using three indicators-frequency, degree centrality and betweenness centrality to clarify the most significant individual components of the research field.

In conclusion, the population ageing in the WPR are attracting an increasing number of scholars worldwide to devote to the research field. However, there is still some space to be explored. The network analysis shows that it is relatively fragmented and lacks cross-regional and cross-disciplinary collaboration while academic research in the field is abundant. In addition, there are relatively few long-term national studies that can provide more basic data support and a broader perspective for population ageing

research. It is expected that there will be an increasing number of cutting-edge, longterm and large-scale academic studies in this research field in the future, so as to contribute to a good development of healthy population ageing in the WPR.

# 5. References

 United Nations. (2019a). World Population Ageing 2019 – Highlights (ST/ESA/SER.A/430). Department of Economic and Social Affairs, Population Division.
<a href="https://www.un.org/en/development/desa/population/publications/pdf/ageing/Wo">https://www.un.org/en/development/desa/population/publications/pdf/ageing/Wo</a>

rldPopulationAgeing2019-Highlights.pdf

United Nations. (2019b). *World Population Prospects 2019 – Highlights* (ST/ESA/SER.A/423). Department of Economic and Social Affairs, Population Division.

https://population.un.org/wpp/Publications/Files/WPP2019 Highlights.pdf

World Health Organization Regional Office for the Western Pacific. (2020). *Regional action plan on healthy ageing in the Western Pacific* (CC BY-NC-SA 3.0 IGO).

### 6. Appendices

### 6.1 Modularity Value

Modularity value is the evaluation index of network modularization. The larger the modularity value of a network, the better the clustering obtained by the network. Q takes the value interval [0,1] and Q>0.3 means that the community structure of the network is significant.

# 6.2 Silhouette Value

Silhouette value is a parameter that evaluates the clustering effect by measuring the homogeneity of the network. The closer the silhouette value is to 1, the higher the homogeneity of the network. Silhouette value above 0.7 indicates that the clustering effect has high reliability, and the clustering result can be considered reasonable above 0.5.

### 6.3 Selection of Different Databases

The database used in the research related to Objective 1 and Objective 5 was Web of Science (WoS) Core Collection from the Renmin University of China, including the following sub-databases: Science Citation Index Expanded (SCI-Expanded) – 1975 to present, Social Sciences Citation Index (SSCI) – 1975 to present, Arts & Humanities Citation Index (A&HCI) – 1975 to present, Conference Proceedings Citation Index—Social Science (CPCI-S) – 1990 to present, Conference Proceedings Citation Index—Social Science & Humanities (CPCI-SSH) – 1990 to present, Emerging Sources Citation Index (ESCI) – 2015 to present, Current Chemical Reactions (CCR-Expanded), and Index Chemicus (IC) – 1993 to present.

The database used in the research related to Objective 2 and Objective 4 was Web of Science (WoS) Core Collection from Beijing Normal University, including the following sub-databases: Science Citation Index Expanded (SCI-Expanded) – 1900 to present, Social Sciences Citation Index (SSCI) – 1900 to present, Arts & Humanities Citation Index (A&HCI) – 1975 to present, Conference Proceedings Citation IndexScience (CPCI-S) – 1997 to present, Conference Proceedings Citation Index—Social Science & Humanities (CPCI-SSH) – 1999 to present, Emerging Sources Citation Index (ESCI) – 2015 to present, Current Chemical Reactions (CCR-Expanded) – 1985 to present, and Index Chemicus (IC) – 1993 to present.

The database used in the research related to Objective 3 was Web of Science (WoS) Core Collection from Tsinghua University, including the following sub-databases: Science Citation Index Expanded (SCI-EXPANDED) – 1900 to present, Social Sciences Citation Index (SSCI) – 1998 to present, Arts & Humanities Citation Index (A&HCI) – 1998 to present, Conference Proceedings Citation Index—Science (CPCI-S) – 1998 to present, Conference Proceedings Citation Index—Social Science & Humanities (CPCI-SSH) – 1998 to present, Book Citation Index—Science (BKCI-S) – 2005 to present, Book Citation Index—Social Sciences & Humanities (BKCI-SSH) – 2005 to present, Emerging Sources Citation Index (ESCI) – 2015 to present, Current Chemical Reactions (CCR-Expanded) – 1985 to present, and Index Chemicus (IC) – 1993 to present.