

Bibliometric Analysis on Horticultural Activities for Older Adults: A Global Perspective

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Abstract: *This bibliometric analysis elucidates global research trends on horticultural activities among older adults over the past decades. Publications were retrieved from Scopus and Web of Science using keywords "horticultural*" OR "garden*" AND "older adult*" OR "elderly*" with no date restrictions. Data cleaning and analysis utilized ScientoPy, VOSviewer, and Biblioshiny to examine publication trends, contributors, citations, keywords, and concepts. Findings reveal 168 papers published from 1953-2023, with the United States (46) and Australia (20) dominating contributions. Geriatrics, agriculture, public health, and psychology were top contributing fields. Influential works explored the physical, psychological, and cognitive benefits of gardening for older adults. Frequently occurring keywords represented themes of horticultural therapy, health, wellbeing, dementia, and aging. Growth trends demonstrate increasing research over time, with enduring knowledge gaps. This novel bibliometric analysis provides the first holistic literature mapping in horticulture and aging. It identifies research foci and frontiers to inform priority-setting and knowledge generation. Findings confirm the multifaceted benefits of gardening for older adults. Continued growth in interdisciplinary collaboration is vital to advancing evidence-based nature-based practices to enhance healthy aging. Researchers and practitioners can leverage these insights to catalyze future research, policy, and translation of horticultural activities for diverse older populations.*

Keywords: Bibliometric, Horticultural, Older, Scopus, Web of Science

1. Introduction

The United Nations predicts that the world's population of people 65 and over would rise from 703 million in 2019 to 1.5 billion in 2050 (United Nations, 2019). There will be serious political, social, and economic consequences if we ignore the ageing trend. Because of healthcare advancements, death rates have dropped, resulting in a longer average lifespan (Rowe & Kahn, 2015). An ageing population is the result of a combination of causes, including improved access to contraception, higher levels of education, and shifting societal mores (Mason et al, 2014). In addition, changes in lifestyle brought about by globalization and urbanization—such as an increase in the prevalence of sedentary behaviour and poor diets among the aged (WHO, 2018), contribute to the rise in the incidence of chronic diseases.

Aging is accompanied by a decline in quality of life, and horticulture is one of the activities that most elderly enjoy and can help preserve their physical and mental activity (Azizan et al., 2024). The potential of horticultural activities to improve older individuals' wellbeing has been widely investigated. Horticultural activities can enhance physical functioning and mental health in older persons, including those with cancer, according to a systematic review and meta-analysis (Lin. Et al, 2021). Additionally, elderly loneliness can be reduced therapeutically by engaging in gardening activities, which have been shown to promote well-being and healthy ageing (Khadka & Dangal, 2021). A bibliometric analysis on COVID-19 and older adults revealed that social isolation, dementia, mortality, and loneliness were key themes related to the impact of the pandemic on older adults, highlighting the importance of social and psychological support (Soytas, 2021). Horticultural activities can greatly enhance the quality of life for older individuals residing in daily care facilities, according to a quasi-experimental study (Alipour et al., 2020). Significant gains in quality of life, anxiety, depression, social relationships, physical impacts, and cognitive effects were discovered among older persons who participated in horticulture therapies, according to a comprehensive evaluation of quantitative studies (Nicholas et al., 2019).

Research on horticultural activities for older adults has revealed several significant trends and notable gaps. The first paper published on horticulture for older adults was in 1954 by Ikin A. Graham discussed the psychological problems of maturity and also elaborated the major task for the middle-aged in deepening of their own inner life, the cultivation of the garden of the spirit. Research has consistently shown that gardening and related activities have a significant impact on older people's health and well-being. These benefits include improvements in social interaction, physical fitness, cognitive function, and emotional well-being. Additionally, horticultural therapy is being recognized as a valuable intervention in healthcare settings (Hunter et al., 2023; Gerodetti & Foster, 2023; Andzaurova et al. 2023). However, there are gaps in the field, including a need for more research on the long-term effects of horticultural engagement, a focus on diverse and inclusive populations, standardization of interventions and outcome measures, economic considerations, cultural sensitivity, technology integration, and the refinement of interventions for specific conditions. As the field continues to evolve, further research is essential to maximize the benefits and inclusivity of horticultural activities for older adults.

There are several uses for bibliometric analysis among researchers. By providing quantitative proof of the reach and effect of their articles, measures like citation counts, the h-index, and impact factors aid in assessing the impact and visibility of their work (Wider, Jiang, Li, Tanucan, & Fauzi, 2023). It provides helpful perspective for their own research attempts by assisting in the identification of significant publications and writers in their subject. Researchers can select topics and develop research agendas by closely examining the literature to identify new trends and directions in the field.

The present study aims to conduct a bibliometric analysis on horticultural activities for older adults. Quantitative evaluation and mapping of the literature will shed light on the evolution, structure, and frontiers of this field. The findings can aid future research planning and knowledge generation by identifying publications, trends, and knowledge gaps. The following research questions will be discussed in this article.

- i. How has the volume of publications related to horticultural research in aging populations evolved over time?
- ii. Which countries and subject areas have been the most prolific in producing research on horticultural activities for older adults?

- iii. What are the most influential and highly cited papers in the domain of horticultural activities and aging populations?
- iv. What are the most frequently occurring keywords or phrases in the titles and abstracts of publications in this field?

2. Methodology

Data Collection

Relevant publications on horticulture activities among older adults were retrieved from the Scopus and Web of Science (WoS) databases on () using a keyword search strategy. The search terms included "horticultural*" OR "garden*" AND TITLE "elderly*" OR "older adult*" OR "older person*" OR "aged*" OR "pensioner*" based on recommendations from prior studies (Malik, 2022; Bergman & Bodner, 2020). No date restrictions were applied. All records containing cited references were exported and preprocessed using ScientoPy (version 0.05.6) software for cleaning and deduplication.

Data Analysis

Figure 1 presents the study process gained and was refined dataset using the bibliometric tools ScientoPy, VOSviewer (version 1.6.17), and Biblioshiny (version 0.9.0) (Aria & Cuccurullo, 2017).

ScientoPy provided summary statistics on the loaded papers, omitted papers, duplicated papers, and final dataset composition. VOSviewer was used to visualize collaboration networks, create maps based on co-occurrence, and analyze trends in keywords. Maps were generated for country collaboration, institutional collaboration, co-authorship, keyword co-occurrence, and temporal keyword trends. Biblioshiny offered a web interface to visualize maps and charts for publication growth trends, productive countries/institutions/authors, journal analysis, subject area analysis, citation analysis, and keyword co-occurrence clustering.

Key preprocessing results from ScientoPy indicated 293 original papers loaded, with 28 omitted and 97 duplicates removed, leaving a final dataset of 168 papers (64.9% from WoS, 35.1% from Scopus). The integration of data mining, information visualization, and contextual interpretation enabled a comprehensive bibliometric analysis to address the stated research questions on publication trends, leading contributors, influential works/journals, and conceptual themes and evolutions based on keyword analysis. Both quantitative metrics and qualitative visualizations were leveraged to synthesize a holistic overview of the frailty literature focused on older populations.

3. Results and Discussion

How has the volume of publications related to horticultural research in aging populations evolved over time?

For each year within the year 1953 to 2023, the dataset comprises the total number of publications concerning horticulture research in aging populations. To address the research question regarding the evolution of publication volumes in this field over time, a comprehensive analysis is required.

The dataset provided in figure 2 offers valuable insights into the evolution of publications related to horticultural research within aging populations over time. Both Web of Science (WoS) and Scopus have documented this research area since the 1950s, signifying its enduring

relevance. Notably, there has been a substantial increase in publication volume, reflecting a growing interest in this field. Annual Growth Rate (AGR) data reveals fluctuations in WoS, with periods of growth and decline, while Scopus consistently reports positive AGR values, indicating more consistent growth. The Average Daily Yield (ADY) figures, representing the average publications per day per library, have remained positive in both databases, signifying a sustained flow of research output. The hIndex, an indicator of research impact, demonstrates a steady rise over the years in both sources, underscoring the increasing influence and productivity of research in horticulture and aging populations.

Comparatively, Scopus consistently reports higher publication counts and more positive AGR values than WoS, suggesting variations in data coverage or reporting methodologies between the two sources. Key years, such as 2018 with 12 publications in WoS, stand out as potential periods of significant advancements or emerging research trends in this domain. To fully understand these trends, it is crucial to consider external factors such as advances in horticultural science, demographic shifts, and the impact of policies and funding initiatives on research priorities. In summary, this dataset indicates a growing body of research in horticulture and aging populations, with nuanced patterns and opportunities for further exploration of the factors driving this evolution.

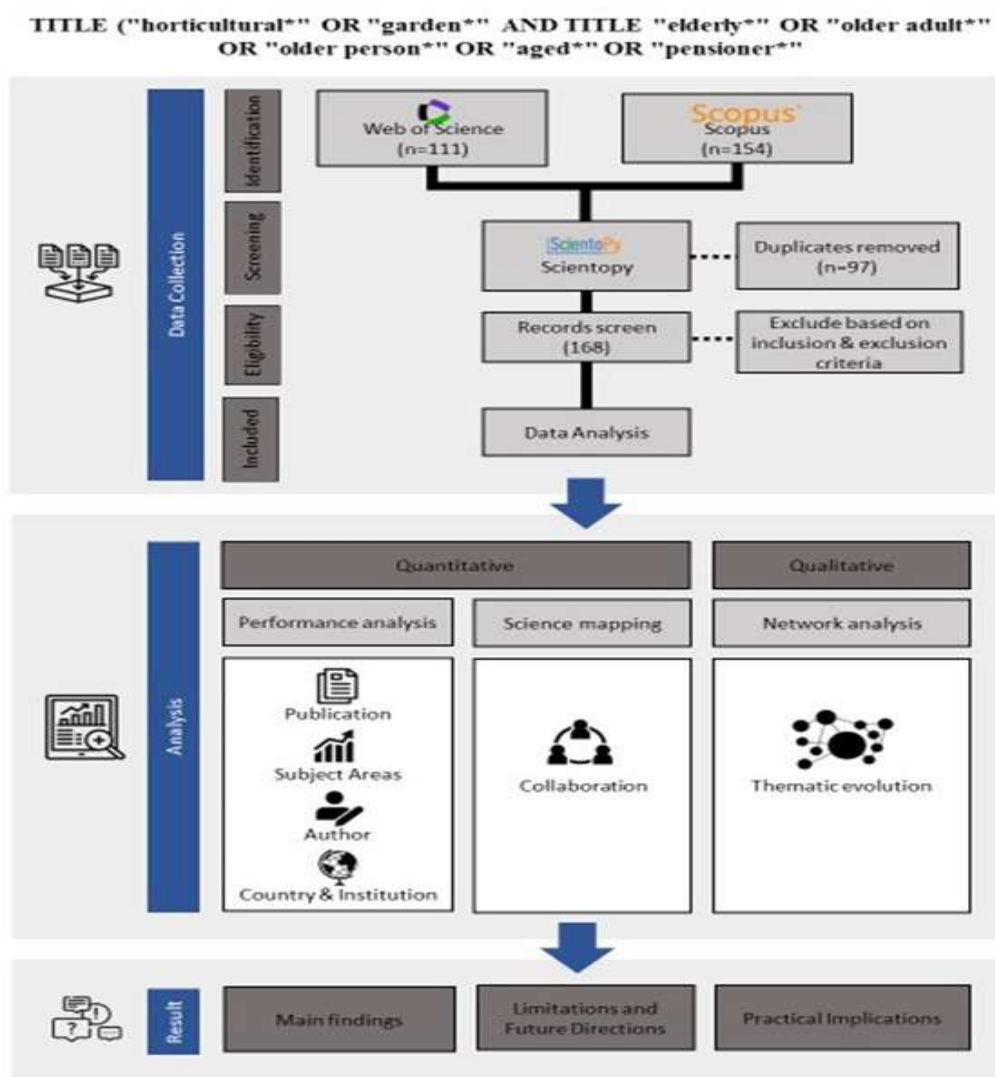


Figure 1: The Study Process Diagram of the search process adapted from previous study (Azizan et al.,2023)

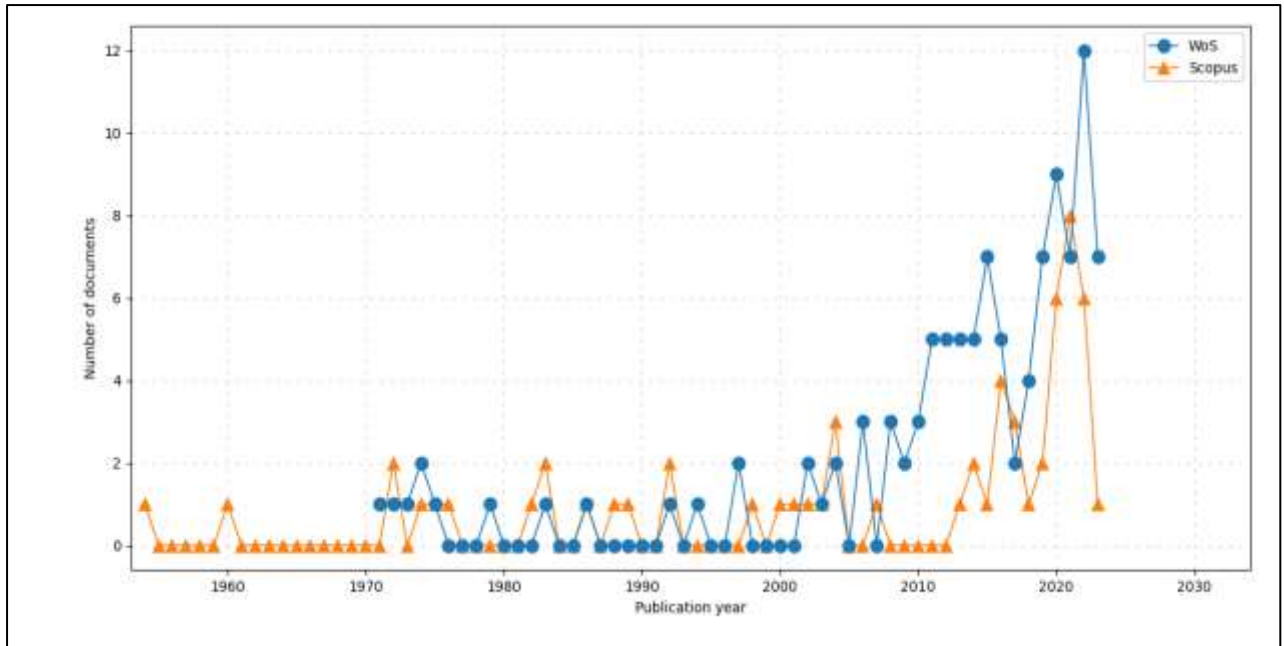


Figure 2: The dataset from the years 1953 through 2023 from the databases Web of Science (WoS) and Scopus.

Which countries and subject areas have been the most prolific in producing research on horticultural activities for older adults?

The trends in producing research on horticultural activities for older adults vary among countries based on the provided data in Table 1. The United States emerges as the frontrunner with the highest total number of research papers at 46, and it demonstrates a consistent growth trend with a positive average growth rate (AGR) of 1.0, reflecting a sustained commitment to this field.

Australia closely follows with 20 research papers and a similar positive AGR of 1.0, indicating ongoing research development. China, although contributing 18 research papers, shows a slight decline in research output over time (AGR -0.5), yet maintains an impactful presence with an h-index of 5. India, with 13 research papers and an AGR of 0.0, emphasizes collaboration (ADY 3.0) but exhibits a moderate impact with an h-index of 5. The United Kingdom, despite 9 research papers, faces a declining trend (AGR -1.5) but maintains a notable h-index of 7. Other countries like Japan, Italy, Taiwan, France, and Germany also contribute to the field, with varying trends in research output and impact, highlighting the dynamic nature of horticultural research for older adults globally.

The trends in producing research on horticultural activities for older adults vary among countries. While some countries like the United States and Australia exhibit consistent growth and high impact, others may experience fluctuations or decreases in research output while still making meaningful contributions. Collaborative efforts are evident across several countries, emphasizing the importance of international cooperation in advancing this research field.

Research on horticultural activities for older adults has seen significant contributions from various subject areas. Figure 3 shows subject areas and research productivity in horticultural activity for older adults. Notably, Geriatrics & Gerontology emerges as the most prolific field, reflecting the direct relevance of horticultural activities to the well-being and quality of life of older individuals. Agriculture, as the second most productive subject area, encompasses studies on horticultural techniques and practices, focusing on their impact on older adults. Public,

Environmental & Occupational Health and Environmental Sciences & Ecology play crucial roles in exploring the health and environmental aspects of gardening for older adults. Psychology contributes by investigating the psychological benefits, such as stress reduction and cognitive stimulation, associated with gardening. Additionally, Nursing, Engineering, Orthopedics, Psychiatry, and Sport Sciences provide valuable insights into the various dimensions of horticultural activities for older adults, ranging from healthcare considerations to physical fitness and mental health impacts. These diverse subject areas collectively enrich our understanding of the benefits and implications of engaging older adults in horticultural pursuits.

Table 1: Top 10 contributing countries

No.	Country	Total of Publication	AGR	ADY	PDLY	h-Index
1	United States	46	1	2	8.7	21
2	Australia	20	1	3	30	10
3	China	18	-0.5	3	33.3	5
4	India	13	0	0	0	5
5	United Kingdom	9	-1.5	0	0	7
6	Japan	8	-0.5	0.5	12.5	4
7	Italy	7	-0.5	1	28.6	3
8	Taiwan	7	-0.5	1	28.6	5
9	France	6	0	0.5	16.7	5
10	Germany	5	0	0	0	3

Notes: TP= Total of Publication, Average Growth Rate (AGR), Average Numbers per Authors per Paper (ADY), Average Publications per Year (PDLY) and h-Index based on Top Countries

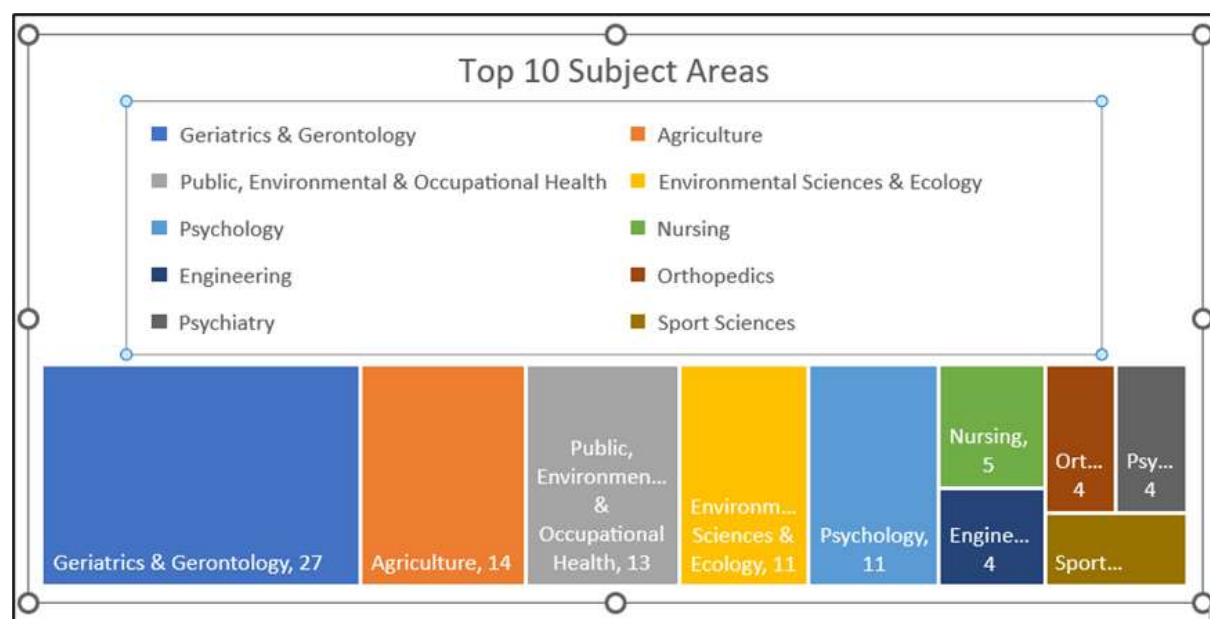


Figure 3: Top 10 Subject Areas and Research Productivity in related areas

What are the most influential and highly cited papers in the domain of horticultural activities and aging populations?

In the field of horticultural activities and aging populations, several highly influential and widely cited papers have made significant contributions to our understanding of the benefits and effects of gardening and related activities (See Table 2). Wang and Macmillan's 2013 paper, titled "The Benefits of Gardening for Older Adults: A Systematic Review of the Literature," published in *Activities Adaptation & Aging*, systematically explores the

advantages of gardening for older adults, citing 143 times. Similarly, Ratcliffe, Merrigan, Rogers, and Goldberg's 2011 study, "The Effects of School Garden Experiences on Middle School-Aged Students' Knowledge, Attitudes, and Behaviors Associated with Vegetable Consumption," featured in *Health Promotion Practice*, has garnered 141 citations. Additionally, Christianson, Williams, Zacks, and Ferreira's 2006 research on language processing in garden-related contexts, published in *DISCOURSE PROCESSES*, has been cited 122 times. Moreover, Corley, Okely, Taylor, and colleagues' 2021 paper, "Home Garden use during COVID-19: Associations with physical and mental wellbeing in older adults," in the *Journal of Environmental Psychology*, has gained 110 citations, highlighting the relevance of gardening during the pandemic. Kemper, Crow, and Kemtes' 2004 investigation into eye-fixation patterns among young and older adults, featured in *Psychology and Aging*, is another influential work with 85 citations. Lastly, Detweiler, Sharma, Detweiler, and others' 2012 paper, "What Is the Evidence to Support the Use of Therapeutic Gardens for the Elderly?" published in *Psychiatry Investigation*, has received 81 citations. These papers collectively cover a wide range of topics, offering valuable insights into the physical, psychological, and cognitive benefits of engaging in horticultural activities for individuals of various age groups.

These top-cited papers in the realm of horticultural activities and aging populations share several common themes and topics. A prominent theme revolves around the benefits of gardening for older adults, highlighting its positive impact on physical health, mental well-being, and overall quality of life. Additionally, some papers delve into school garden experiences, exploring how such programs can influence students' knowledge, attitudes, and behaviors concerning vegetable consumption. Another theme delves into the cognitive aspects of gardening-related language processing, investigating linguistic and cognitive challenges across different age groups. Therapeutic gardens for the elderly emerge as another recurring theme, examining the evidence supporting the use of gardens as therapeutic spaces. The COVID-19 pandemic also introduced a new dimension, with research exploring the role of home gardening during times of crisis and its associations with well-being among older adults. Furthermore, these studies touch upon the promotion of vegetable consumption, stress reduction, and healthy aging, emphasizing the multifaceted benefits of horticultural activities for individuals of varying age groups. Collectively, these papers enrich our understanding of the diverse and positive effects of engagement with nature and gardening.

What are the most frequently occurring keywords or phrases in the titles and abstracts of publications in this field?

In the field of horticultural activities and older adults, several keywords and phrases frequently appear in the titles and abstracts of publications, reflecting the core themes and topics of research (See Figure 4). "Aging" is a central keyword, indicating a primary focus on the challenges and opportunities associated with the aging population. "Dementia" is another key term, highlighting the exploration of horticultural activities as potential interventions for cognitive health, especially among individuals with dementia.

Table 2: Top 10 most influential and highly cited papers in the domain of horticultural activities and aging populations

Article Title	Cited by	Authors (Year)	Journal
The Benefits of Gardening for Older Adults: A Systematic Review of the Literature	143	Wang, D., Macmillan, T. (2013)	Activities Adaptation & Aging
The Effects of School Garden Experiences on Middle School-Aged Students' Knowledge, Attitudes, and Behaviors Associated With Vegetable Consumption	141	Ratcliffe, M.M., Merrigan, K.A., Rogers, B.L., Goldberg, J.P. (2011)	Health Promotion Practice
Younger and older adults' "good-enough" interpretations of garden-path sentences	122	Christianson, K., Williams, C.C., Zacks, R.T., Ferreira, F. (2006)	Discourse Processes
Home garden use during COVID-19: Associations with physical and mental wellbeing in older adults	110	Corley, J., Okely, J.A., Taylor, A.M., Page, D., Welstead, M., Skarabela, B., Redmond, P., Cox, S.R., Russ, T.C.	Journal Of Environmental Psychology
Eye-fixation patterns of high- and low-span young and older adults: Down the garden path and back again	85	Kemper, S., Crow, A., Kentes, K. (2021)	Psychology And Aging
What Is the Evidence to Support the Use of Therapeutic Gardens for the Elderly?	81	Detweiler, M.B., Sharma, T., Detweiler, J.G., Murphy, P.F., Lane, S., Carman, J., Chudhary, A.S., Halling, M.H., Kim, K.Y. (2012)	Psychiatry Investigation
Gardening Increases Vegetable Consumption in School-aged Children: A Meta-analytical Synthesis	72	Langellotto, G.A., Gupta, A. (2012)	Horttechnology
Allotment Gardening and Other Leisure Activities for Stress Reduction and Healthy Aging	70	Hawkins, J.L., Thirlaway, K.J., Backx, K., Clayton, D.A. (2011)	Horttechnology
Physical and Psychological Health Conditions of Older Adults Classified as Gardeners or Nongardeners	70	Park, S.A., Shoemaker, C.A., Haub, M.D. (2009)	Hortscience
"Doing" gardening and "being" at the allotment site: Exploring the benefits of allotment gardening for stress reduction and healthy aging	63	Hawkins J.L., Mercer J., Thirlaway K.J., Clayton D.A. (2013)	Ecopsychology

Synonymous with "older adults," the term "elderly" describes the primary demographic under study. "Garden," "gardening," and "gardens" are fundamental keywords that represent the core activities investigated in this field. "Health" is a frequent theme, reflecting the emphasis on understanding the health benefits of engaging in horticultural activities, including physical exercise and mental well-being. "Horticultural therapy" underscores the significance of horticulture as a therapeutic tool for addressing various health-related issues in aging populations. "Human issues in horticulture" suggests an exploration of the social and psychological aspects of gardening. "Physical activity" highlights the importance of movement and exercise, while "well-being" indicates research into the impact of horticultural activities on individuals' quality of life and mental health. Collectively, these keywords and phrases define the research landscape, with a particular focus on how gardening and related activities can promote the well-being and health of older adults.

These keywords are divided into 3 main clusters. Refer Figure 4. The first cluster of keywords identified by VOSviewer, encompassing "horticultural therapy," "gardening," "human issues in horticulture," and "physical activity," represents a cohesive set of concepts at the intersection

of horticultural activities and aging populations. "Horticultural therapy" stands out as a specialized field, focusing on the use of gardening for therapeutic purposes, especially among older adults. Research often delves into how horticultural therapy can enhance cognitive, emotional, and physical well-being for seniors. "Gardening" itself is a central theme, with studies investigating its potential to positively impact the physical and mental health of the elderly, including its effects on physical fitness, relaxation, and stress reduction. "Human issues in horticulture" suggests a social and psychological angle, examining how gardening and related practices foster community, social interactions, and psychological well-being among older individuals. Lastly, "physical activity" underscores the importance of movement in gardening, and research often explores how gardening contributes to cardiovascular health, strength, balance, and overall fitness in the aging population. This cluster of keywords underscores a comprehensive approach to understanding how horticultural activities can promote the well-being of older adults, encompassing both physical and psychological dimensions.

The second cluster of keywords, encompassing "well-being," "aging," "older adults," and "health," represents a focused and vital area of research within the realm of horticultural activities and aging populations. "Well-being" takes center stage in this cluster, emphasizing a primary interest in the overall quality of life and emotional contentment among older adults. Studies within this theme delve into how horticultural activities can contribute to enhancing the well-being and life satisfaction of individuals in the aging demographic. "Aging" is a foundational keyword, spotlighting the central focus on the aging process, exploring the challenges and opportunities it presents, and how horticultural activities can improve the aging experience. "Older adults" serves as a synonymous term, describing the specific demographic group in question, and research aims to grasp the distinct needs and attributes of older individuals in the context of horticultural activities and their influence on overall health and well-being. The keyword "health" plays a pivotal role, underlining the significance of physical and mental health, as research investigates the connection between horticultural activities and various health aspects, including physical fitness, cognitive health, and emotional well-being. In summary, this cluster delineates a critical area of inquiry that seeks to comprehend how horticultural activities can have a positive impact on the well-being and health of older adults. It delves into the multi-dimensional aspects of aging, encompassing physical, psychological, and emotional dimensions, with the ultimate goal of enhancing the quality of life for this aging demographic through engagement in horticultural practices.

The third cluster of keywords, "dementia" and "garden," represents a highly specialized and focused research area within the broader field of horticultural activities and aging populations. "Dementia" stands out as a central concept in this cluster, indicating a primary research interest in understanding and addressing cognitive health challenges in older adults. Studies within this theme are likely to explore how horticultural activities, particularly gardening, can potentially offer significant benefits to individuals living with dementia. Researchers may investigate the impact of garden engagement on cognitive function, memory, and overall well-being, with the ultimate goal of developing interventions and therapies to support those with dementia.

Complementing "dementia," the keyword "garden" underlines the specific environment and activities that are being studied within the context of dementia care. This suggests that researchers may examine how various types of gardens, garden design, and garden-related interventions can have a positive influence on individuals with dementia. The aim of this specialized research cluster is to harness the therapeutic potential of garden settings and

activities to enhance the cognitive and emotional well-being of individuals living with dementia, ultimately improving their quality of life and the quality of care they receive.

4. Conclusion

This bibliometric analysis offers valuable insights into the evolution and current state of research on horticultural activities for older adults. Key findings reveal a growing body of literature, with the United States and Australia leading production. Geriatrics, gerontology, agriculture, public health, and psychology are major contributing fields. Influential works have explored the multidimensional benefits of gardening for seniors. Frequently occurring keywords highlight themes of horticultural therapy, health, well-being, and dementia care. The research landscape continues to expand, but gaps persist concerning diverse populations, economic factors, cultural contexts, and standardized interventions.

This study represents the first known bibliometric analysis focused specifically on horticultural activities for older adults. It provides an original quantitative evaluation and visual mapping of the literature from 1953-2023. The breadth of data sources, inclusion of cited references, and incorporation of data mining and information visualization techniques offer new insights not afforded by traditional reviews. This novel approach elucidates the structure and evolution of this domain, identifying leading contributors, impactful publications, collaboration networks, and knowledge clusters. The findings can guide future research to address gaps and extend frontiers.

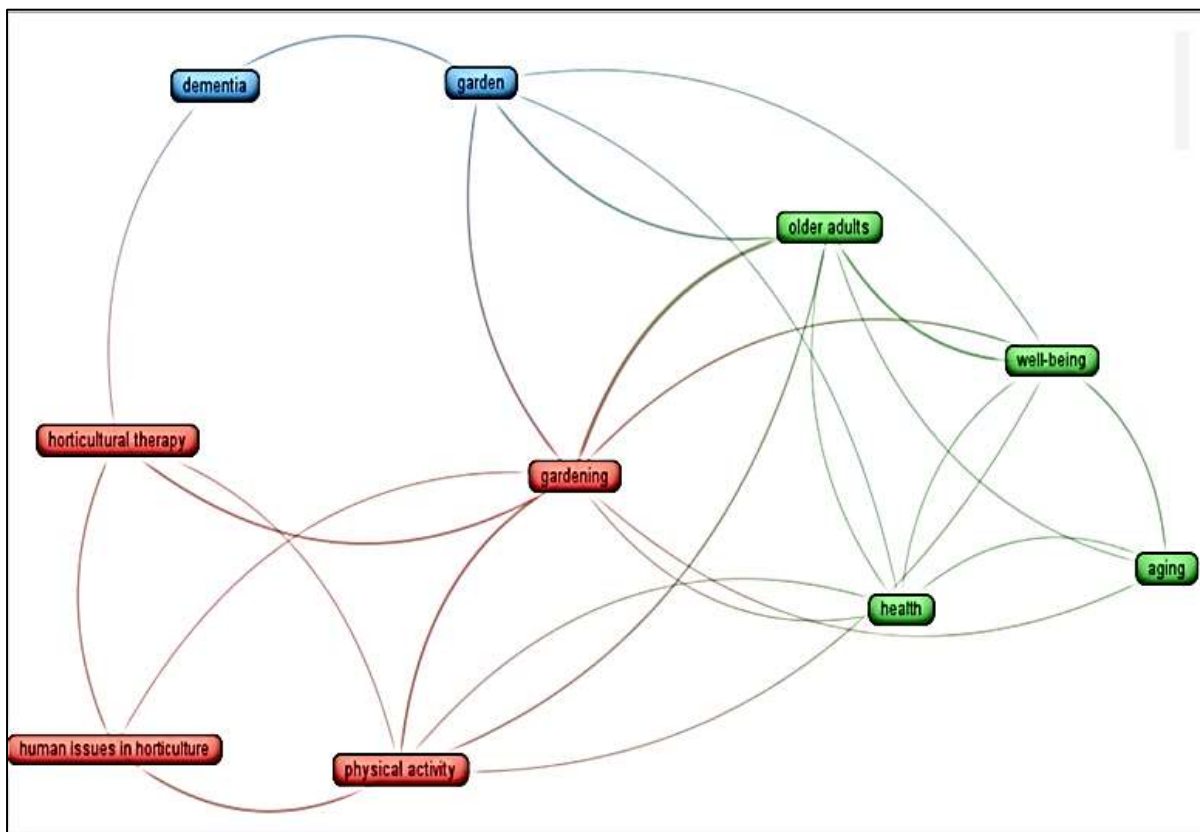


Figure 4: Frequent occurring keywords and Phrases

These findings have important practical implications. They can aid research planning, priority setting, and policymaking to advance the science and practice of horticultural activities for healthy aging. Researchers can identify impactful studies, core contributors, and promising

areas to advance knowledge. Practitioners can discern key intervention research to inform programs supporting active engagement among diverse older adults. The analysis indicates growing recognition of gardening and horticultural therapy in gerontology and healthcare. continued multidisciplinary collaboration is vital to maximizing reach across settings. This study provides a knowledge foundation to catalyze future growth and translation of evidence-based nature-based practices for older adults.

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