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A Systematic Literature Review of Climate Change Impacts and Adaptation among Older Adults in Malaysia

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Abstract: The health of the population is increasingly threatened by climate change, with older adults being particularly vulnerable due to changes in their physiological, social, and economic circumstances. In Malaysia, older adults are disproportionately affected by aging, environmental degradation, and extreme temperatures, yet little is known about how these factors interact to impact the country's aging population. This study aims to conduct a comprehensive assessment of the literature on climate change and the circumstances of older adults in Malaysia, focusing on vulnerabilities, adaptation strategies, and governmental responses. In compliance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, a comprehensive literature search was conducted across relevant databases and grey literature. Research suggests that, in the context of climate change, older adults are particularly susceptible to social, economic, and health-related challenges. Despite the presence of informal coping strategies and community-based efforts, there is currently no adequate adaptation strategy in place. Furthermore, existing policies, such as the National Policy on Climate Change and the National Policy on Older Persons, are not consistently aligned to address the combined challenges of aging and environmental degradation. Gaps remain in research and policy development, particularly in the areas of health system resilience, disaster preparedness, and older adults' involvement in climate policy. To ensure that Malaysia's aging population is not left behind in the government's sustainable development objectives, this review underscores the need for age-specific and climate-resilient measures.

Keywords: Climate change; Older adults; Vulnerability; Adaptation; Malaysia

1.0 Introduction

Climate change has significant impacts on human health, social well-being, and economic stability, making it a critical issue in the 21st century. According to the Intergovernmental Panel on Climate Change (IPCC, 2022), vulnerable populations are disproportionately affected by rising temperatures, extreme weather, and changing precipitation patterns, which exacerbate health disparities and challenge sustainable development (Boudreau et al., 2022). Older adults are particularly susceptible due to their biological sensitivity, limited adaptive capacity, and social and economic marginalization (Fineman, 2012). Vulnerability is commonly conceptualized through three dimensions: exposure, sensitivity, and adaptive capacity, all of which are closely associated with aging (Swami & Parthasarathy, 2021). As people age, physiological changes reduce resilience to climate risks such as heat waves, air pollution, vector-borne illnesses, and food insecurity due to decreased mobility and impaired thermoregulation (Kim, 2024). Social factors, including low income, restricted access to healthcare, and limited participation in decision-making processes, further reduce adaptive capacity and increase the risks faced by older adults (Preston et al., 2011).

The intersectionality perspective emphasizes that older adults' vulnerability is not uniform but depends on intersecting factors such as living arrangements, gender, socioeconomic status, ethnicity, and rural–urban differences (Shen et al., 2023). For example, older women in low-income households may face heightened risks due to challenging caregiving responsibilities and limited access to financial or cultural support networks. Equitable adaptation strategies must account for these intersecting axes of disadvantage rather than treating vulnerability as a single, homogeneous category. A climate justice perspective further highlights the ethical and governance dimensions of the disproportionate burdens faced by older adults. Climate justice aims to ensure that all members of society, particularly older adults, have the right to live in safety, health, and dignity amid climate change (Roy et al., 2024). Yet, older adults are often excluded from disaster preparedness and climate adaptation planning, reflecting structural neglect that perpetuates systemic inequities.

Malaysia reflects these complex challenges. The country is increasingly exposed to flooding, heat waves, erratic rainfall, and haze from transboundary pollution, intensifying vulnerability to climate hazards (Stroud & Green, 2022). Simultaneously, Malaysia is undergoing a rapid demographic transition. When the proportion of Malaysians aged 60 and over reaches 15 percent, the country will officially become an aging society (Abdul Karim et al., 2021). The convergence of climate risks and demographic aging creates an urgent need to examine their combined effects on older adults. However, research on Malaysia remains fragmented, and older adults are insufficiently recognized as a vulnerable population despite growing awareness of climate change impacts (Emelyanova & Rautio, 2016). This study employs a systematic literature review (SLR) to assess the relationship between climate change and the health of Malaysian older adults, identify existing adaptation strategies, and highlight research and policy gaps. This theoretically grounded approach provides a comprehensive understanding of older adults' vulnerabilities to climate change and informs equity-based adaptation policies.

Climatic hazards and population vulnerabilities in Malaysia are unevenly distributed. Peninsular Malaysia, particularly Kuala Lumpur and Penang, experiences more severe urban heat island effects than East Malaysia (Sarawak and Sabah), due to topography and river dependency (Istihar & Noordin, 2024). Urbanization and traffic in major cities increase older adults' susceptibility to heat waves and air pollution, while rural and coastal areas face flooding, storm surges, and agricultural disruption. Coastal states such as Kelantan, Terengganu, and Sarawak are climate hotspots due to storm intensity and sea-level rise, which threaten older adults in low-lying and fishing communities. Interior regions like Pahang and Perak are vulnerable to landslides and riverine floods, disproportionately affecting older adults in isolated areas with limited healthcare access (Rahman, 2018). These variations underscore the need for context-specific adaptation strategies. Integrating maps of hazard exposure with demographic projections of aging populations into land-use planning can guide resource allocation, support age-friendly communities, and enhance localized adaptation measures.

Heat waves are increasingly frequent and severe in Peninsular Malaysia, often lasting more than a week during El Niño and Southwest monsoon seasons (Suparta & Norazhar, 2019). Prolonged intense heat has two primary consequences: first, it threatens human health, disproportionately affecting vulnerable groups, including older adults, who are more prone to heat-related illnesses and mortality; second, it jeopardizes agricultural production, as temperatures between 29.4 and 33°C exceed the tolerance of many crops (Figure 1). These conditions exacerbate water scarcity in irrigation systems and accelerate evapotranspiration, leading to significant yield losses. Examining the interplay

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between climate and demographic trends is crucial in Malaysia, where such interactions have significant implications for public health and economic stability.

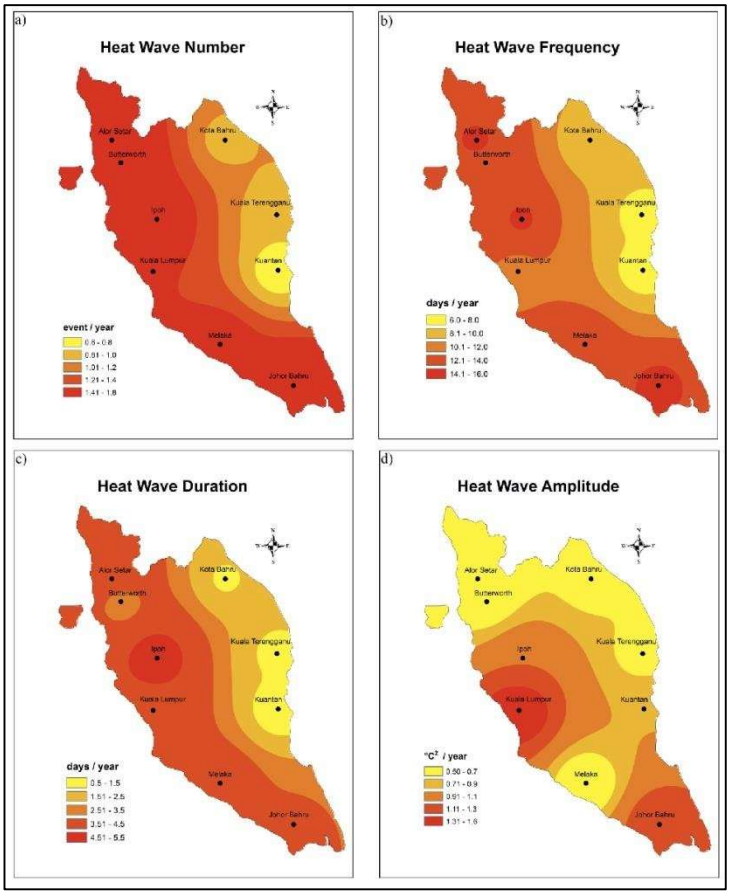

Figure 1: Spatial distribution of heat wave feature in Peninsular Malaysia (a) heat wave numbers (b) heat wave frequency (c) heat wave duration and (d) heat wave amplitude (Suparta & Norazhar (2019).

Researchers have also highlighted the simultaneous challenges of climate change and aging on a global scale, as older adults face increasing exposure to climatic risks (Roy et al., 2024). This convergence is particularly important in Malaysia, where many older adults still reside in rural or semi-urban areas with inadequate infrastructure, limited access to healthcare, and weak social safety nets. Climate-sensitive sectors that directly or indirectly involve older adults, such as farming and fishing, are especially vulnerable to fluctuations in precipitation and extreme weather events (Emelyanova & Rautio, 2016). These ecological constraints on social development suggest that integrated approaches combining environmental, social welfare, and health policies are urgently needed.

Moreover, the discussion of climate change and aging in Malaysia has been highly fragmented, with older adults often excluded from resilience planning or treated as a uniform population. Despite the existence of government programs such as the National Policy on Older Persons (2011) and the National Policy on Climate Change (2009), little has been done to connect the two. This policy gap leads to deficiencies in community-level adaptation, healthcare capacity, and disaster preparedness. In practice, this means that during climate-related disasters, older adults often lack access to early warning systems, accessible evacuation facilities, and continuity of care for chronic illnesses (Abdul Karim et al., 2021). Strengthening the policy link between climate change and aging is therefore essential to enhance societal resilience and protect the well-being of older populations.

2.0 Study Area

The South China Sea separates Peninsular Malaysia from East Malaysia (Sabah and Sarawak on Borneo), the two main regions of Malaysia, which is located in Southeast Asia (Figure 2). Covering a total land area of approximately 330,803 km², the country lies between latitudes 1° and 7° North and longitudes 100° and 119° East (Department of Information Malaysia, 2016). Malaysia has a tropical climate characterized by high humidity, abundant rainfall, and warm temperatures throughout the year. The country is influenced by two monsoon systems: the Southwest Monsoon (May to September) and the Northeast Monsoon (November to March), which significantly affect weather patterns and climate-related hazards, including floods, droughts, and heat stress.

Malaysia's demographics are rapidly changing, with the population aging. In 2020, 7.0 percent of the population was over 65 years old, and this figure is projected to rise to 14.5 percent by 2040, transitioning the country into an aging society (Abdul Karim et al., 2021). Older adults are particularly vulnerable to the impacts of climate change due to poorer health, limited mobility, and lower socioeconomic status.

There are three main reasons why Malaysia was chosen as the study area. First, the country is already experiencing high climate variability, making it highly relevant for examining the intersection of environmental change and vulnerable populations. Second, Malaysia is undergoing a rapid demographic transition, with the proportion of older adults expected to double between 2020 and 2040 (Abdul Karim et al.,

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2021), posing immediate health, mobility, and socioeconomic challenges in the context of climate risks. Third, there has been limited research on older adults' vulnerability, adaptive capacity, and well-being in Malaysia in relation to climate change. Studying Malaysia therefore contributes not only to local discussions but also to regional and global debates on aging and climate resilience in the Global South.

Furthermore, Malaysia is representative of many ASEAN countries that share similar tropical climates, rapid demographic aging, and high exposure to climate-related risks. Insights from Malaysia can provide lessons for other Southeast Asian countries facing the combined challenges of climate change and population aging. These factors collectively motivated the author to select Malaysia as the focus of this review study.

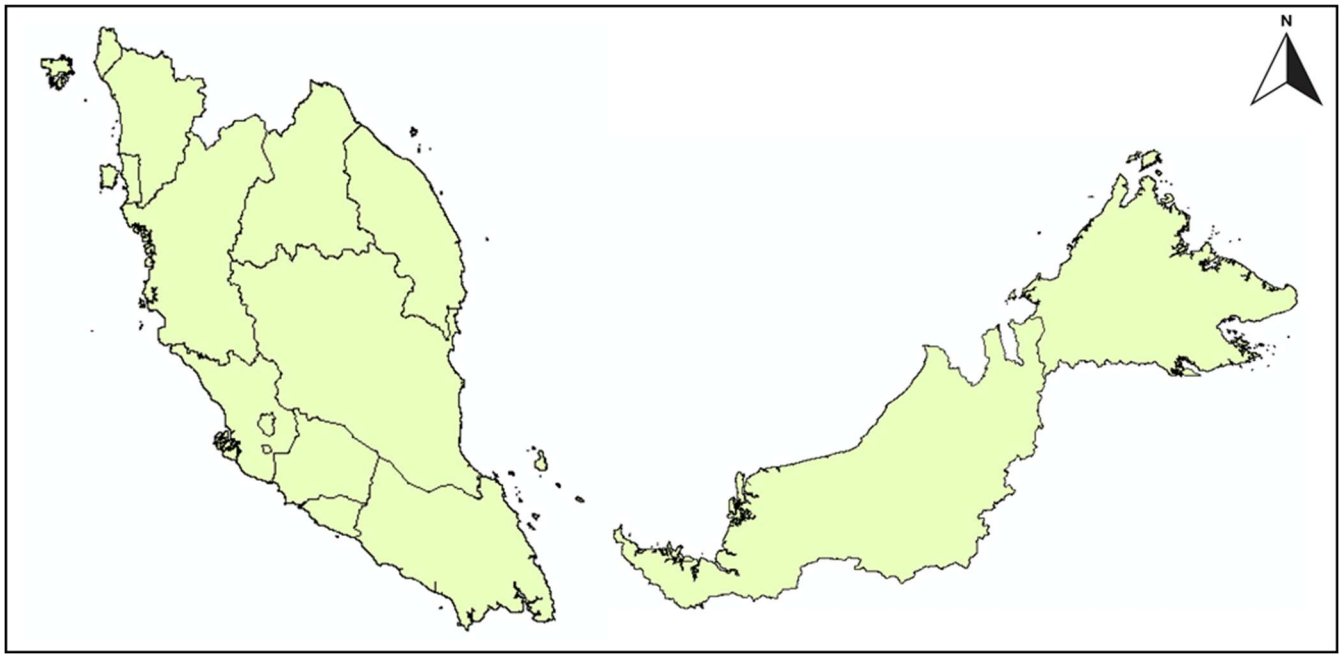

Figure 2: Peninsular and East Malaysia.

3.0 Materials and Methodology

3.1 Study Design

The literature on the impacts of climate change on older adults in Malaysia was reviewed using the Systematic Literature Review (SLR) method. This approach is methodologically transparent, reliable, and scientifically rigorous. The review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 framework, which includes a checklist and flow diagram to ensure transparency and accuracy at all stages of the review process. These stages include searching, screening, eligibility assessment, data extraction, and synthesis. The PRISMA framework provides a structured and up-to-date methodology suitable for this study (Sohrabi et al., 2021).

PRISMA 2020 has been specifically revised to accommodate a wide range of evidence types, including mixed-method, qualitative, and observational research, in addition to randomized studies. This flexibility is particularly suitable for our interdisciplinary approach, which integrates health, social, and economic perspectives on older adults. The framework also reduces the risk of selective reporting and other biases. A key aspect of PRISMA that required special attention was the explicit documentation of study selection and clear justification for the exclusion of studies.

Structured study selection is critical, as the PRISMA flow diagram effectively presents data across disciplines and methodological approaches. Revisions in the framework strengthened our methodology by providing comprehensive guidance on setting eligibility criteria, developing search strategies, removing duplicates, reducing risk of bias, and conducting narrative synthesis when meta-analysis is not feasible (Sohrabi et al., 2021). The framework was further customized to enhance contextual relevance, considering the focus on a vulnerable and growing older adult population in Malaysia.

While other environmental evidence standards, such as ROSES and the Collaboration for Environmental Evidence guidelines (Haddaway et al., 2018), were considered, PRISMA 2020 was selected as the most suitable framework. Its rigorous methodology, broad adoption in health and social sciences, and adaptability for multidisciplinary searches made it the optimal choice for this study.

3.2 Research Questions

The PICO framework (Population, Intervention, Comparison, Outcome), commonly used to structure research questions in evidence-based reviews, provided the foundation for this systematic literature review (SLR).

- Population (P): Malaysian older adults directly or indirectly impacted by climate change.
- Intervention (I): Adaptation, resilience and policy interventions to the effects of climate change in older adults.
- Comparison (C): Compare between older adults and other groups in the population or between the various strategies of adaptation to policy are drawn where appropriate. In other instances, lack of adaptation measures acts as an implicit comparator.
- Outcome (O): The effects of climate change on the health, social and economic well-being of older adults, research and policy gap.

Based on the PICO framework, this study formulated three key research questions:

1. What are the impacts of climate change on the health, social and economic well-being of older adults in Malaysia?
2. What adaptation strategies have been proposed and implemented to enhance the resilience of older adults to the climate change in Malaysia?
3. What are the existing gaps in research and policy that concerning climate change and older adults in Malaysia?

3.3 Search Strategy

To identify peer-reviewed publications and grey literature related to the review's objectives, a thorough search method was developed. From January 2015 to July 2025, the following electronic databases were thoroughly searched (Table 1):

Table 1: Four Electronic databases used in the SLR

Databases	Selected articles	Strength	Reason for inclusion
Scopus	11	Highly comprehensive and encompassing social sciences, health and environmental research	Interdisciplinary studies and regional journals pertinent to ASEAN
ScienceDirect	6	Rigorous indexing with citation tracking	Ensures reliability that includes high-quality studies
Google Scholar	14	Wide inclusivity that covers non-indexed/local publications	Gets local and grey literature and reduces publication bias
PubMed	2	Accurate, peer-reviewed papers for health and biological sciences.	Covers gerontology, public health and climate-health intersection research

The search combined keywords and Boolean operators related to climate change, aging population and Malaysia as shown in Table 2:

Table 2: Boolean operators used in this study according to databases

Databases	Boolean operator
Scopus	("climate change" OR "global warming" OR "extreme weather" OR "heat wave*" OR flood* OR "air pollution") AND ("older adults" OR elderly OR "senior citizens" OR "ageing population" OR "aging population") AND (Malaysia OR "Southeast Asia" OR Brunei OR Cambodia OR Indonesia OR Laos OR Myanmar OR Philippines OR Singapore OR Thailand OR Vietnam)
ScienceDirect	("climate change" OR "global warming" OR "extreme weather" OR "heat wave*" OR flood* OR "air pollution") AND ("older adults" OR elderly OR "senior citizens" OR "ageing population" OR "aging population") AND (Malaysia OR "Southeast Asia" OR Brunei OR Cambodia OR Indonesia OR Laos OR Myanmar OR Philippines OR Singapore OR Thailand OR Vietnam)
PubMed	("climate change"[MeSH Terms] OR "global warming"[MeSH Terms] OR "extreme weather" OR "heat wave" OR floods OR "air pollution"[MeSH Terms]) AND ("Aged"[MeSH Terms] OR "older adults" OR elderly OR "senior citizens" OR "ageing population" OR "aging population") AND (Malaysia OR "Southeast Asia" OR Brunei OR Cambodia OR Indonesia OR Laos OR Myanmar OR Philippines OR Singapore OR Thailand OR Vietnam)
Google scholar	("climate change" OR "global warming" OR "extreme weather" OR "heat wave" OR flood OR "air pollution") AND ("older adults" OR elderly OR "senior citizens" OR "ageing population" OR "aging population") AND (Malaysia OR "Southeast Asia" OR Brunei OR Cambodia OR Indonesia OR Laos OR Myanmar OR Philippines OR Singapore OR Thailand OR Vietnam)

The searches were conducted up to July 10, 2025, and were consistent across all databases. Only materials in English and Malay were considered during the screening process; articles in other languages were excluded. In addition, government policy documents, relevant organizational reports, and grey literature on aging and climate change in ASEAN—including sources identified via Google Scholar—were reviewed by the author to minimize publication bias.

3.4 Eligibility Criteria

Studies were selected based on predefined inclusion and exclusion criteria to ensure relevance and rigor, as listed in Table 3. Inclusion criteria comprised publications from 2015 to 2025, peer-reviewed articles, government reports, or policy papers, with a focus on older adults (⩾60 years) in Malaysia or other ASEAN countries and written in English or Malay. Exclusion criteria included studies not related to climate change, editorials, commentaries, and opinion pieces lacking empirical or theoretical contribution, research not focused on older adults or the ASEAN region, and publications in languages other than English or Malay

Table 3: Inclusion and exclusion criteria

Inclusion	**Exclusion**
Published between 2015-2025	Studies that not related to climate change.
Peer-reviewed articles, government reports or policy papers	Editorials, commentaries and opinion pieces without empirical or theoretical contribution
Focused on older adults (≥60 years) in Malaysia and ASEAN countries	Studies not focused on older adults and ASEAN countries
English or Malay language only	Other language articles

3.5 Selection and Screening Process

A systematic screening and selection approach was employed in this systematic literature review (SLR) to ensure that only the most relevant and high-quality studies were included. A total of 236 articles were initially retrieved from Scopus, ScienceDirect, PubMed, and Google Scholar. After duplicates were removed, the records were screened based on titles and abstracts. Full-text evaluations were then conducted using predefined inclusion and exclusion criteria. Studies were required to address vulnerabilities, adaptation strategies, and well-being outcomes of older adults in Malaysia. Only peer-reviewed journal articles, empirical research, and reviews were considered, while conference papers, opinion pieces, and non-scholarly sources were excluded. To maintain consistency, only publications in English or Malay were included. Both open-access and subscription-based articles were considered. The review period was limited to the past 10 years (2015–2025) to ensure relevance to current concerns and policy. Following this rigorous screening process, 33 articles were deemed eligible for inclusion. This comprehensive approach enhanced academic rigor, minimized bias, and strengthened the validity of the findings, providing a robust foundation for understanding the relationship between Malaysia's aging population and climate change.

3.6 Eligibility

A comprehensive full-text analysis of 33 articles was conducted in the final stage of this systematic literature review (SLR) on climate change and older adults in Malaysia, resulting in the final selection of papers. Each article was thoroughly examined to extract data directly aligned with the study objectives, particularly regarding older adults' vulnerabilities, adaptation strategies, and well-being outcomes related to climate change in Malaysia. A total of 80 articles were excluded based on the inclusion and exclusion criteria after careful review. Articles were removed for three primary reasons to ensure compliance with the PRISMA framework. First, studies that did not meet the review criteria were excluded. This included research focusing on climate change impacts on energy, agriculture, or biodiversity without addressing older adults, as well as studies on aging populations that did not consider climate change vulnerabilities or adaptation. Second, studies that did not meet the predetermined inclusion criteria for study type or quality were removed. For example, non-peer-reviewed materials such as conference abstracts, reports, editorials, or opinion pieces, as well as papers lacking empirical or conceptual foundations, were excluded. Third, studies with weak or missing data were omitted. This included articles for which full texts were unavailable and narratives that lacked sufficient detail on older adults' vulnerability, coping mechanisms, or overall well-being in relation to climate change.

The validity, reliability, and comprehensiveness of the findings were strengthened by this rigorous approach, which prevented the inclusion of irrelevant or low-quality studies. Screening was conducted independently by three authors. Initially, all retrieved records were screened for titles and abstracts according to the specified eligibility criteria. Studies meeting the preliminary requirements then underwent full-text screening. Two authors independently assessed the titles, abstracts, and full texts, while the third author provided justification for inclusion. Any disagreements were resolved through discussion and consensus. This multi-reviewer process enhanced the quality of the review, increased transparency, and minimized bias in accordance with PRISMA guidelines.

3.7 Quality Appraisal

The Joanna Briggs Institute (JBI) Critical Appraisal Checklists, which include design-specific criteria for cross-sectional studies, systematic reviews, and qualitative research, were used to assess the methodological quality of the included articles. To minimize bias and ensure fairness, each article was independently evaluated by all three authors. Table 4 highlights the key methodological strengths and weaknesses was created to clearly present the appraisal findings.

Table 4: Summary of the appraisal results in this study.

Author(s), Year	Study Design	JBI Checklist Used	Key Appraisal Notes	Overall Quality
Abdul Karim et al., 2021	Quantitative	JBI Cross-Sectional	Clear inclusion criteria	High
Alhoot et al., 2016	Systematic Review	JBI Cross-Sectional	Clear inclusion criteria	Moderate
Aziz, 2015	Policy Analysis	NA	Not appraised (contextual)	NA
Darus et al., 2020	Quantitative	JBI Quantitative	Appropriate analysis	High
Ebi & Bowen, 2016	Conceptual analysis	NA	Clear analysis	Moderate
Haddaway et al., 2018	Systematic Review	JBI Cross-Sectional	Clear inclusion criteria	High
Junlapeeya et al., 2023	Qualitative	JBI Qualitative	Rigorous data collection	High
Kim et al., 2024	Quasi-experimental	JBI Cross-Sectional	Rigorous data collection	High
Kim et al., 2022	Systematic Review	JBI Cross-Sectional	Clear inclusion criteria	High
Latif et al., 2021	Observational	JBI Cross-Sectional	Appropriate analysis	High
Martinez et al., 2018	Quantitative	JBI Quantitative	Appropriate analysis	High
Murphy et al. (2021)	Systematic Review	JBI Cross-Sectional	Clear inclusion criteria	Moderate
Ngcamu, 2023	Systematic Review	JBI Cross-Sectional	Clear inclusion criteria	Moderate
Preston et al., 2011	Systematic Review	JBI Cross-Sectional	Good inclusion criteria	Moderate
Roy et al., 2024	Qualitative	JBI Qualitative	Rigorous data collection	High
Sasaki et al., 2020	Longitudinal cohort study	JBI Cohort Studies	Good inclusion criteria	Moderate
Shahid et al., 2017	Mixed-Methods Review	NA	Not appraised (contextual)	Low
Shen et al., 2023	Quantitative	JBI Cross-Sectional	Rigorous data collection	High
Stroud & Green, 2022	Qualitative	JBI Qualitative	Rigorous data collection	High
Sun et al., 2025	Observational case study/ secondary data analysis	JBI Cross-Sectional	Appropriate analysis	High
Swami & Parthasarathy, 2021	Descriptive/ Observational Geospatial Study	JBI Cross-Sectional	Appropriate analysis	High
Tang, 2019	Cross-sectional	JBI Cross-Sectional	Rigorous data collection	High
Usmani et al., 2020	Descriptive Review/ Secondary Data Study	JBI Cross-Sectional	Data variability	Moderate
Yau & Hasbi, 2017	Simulation / Modelling Study	JBI Cross-Sectional	Good inclusion criteria	Moderate

Based on the number of criteria met, the quality of the studies was categorized as high, moderate, or low. Policy papers and reports, such as government or international guidelines, were not assessed using the JBI checklists; instead, they were retained for contextual relevance.

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The review clearly reflected the aim, selected study designs, and appropriate data collection and analysis techniques, and the methodologies used in the majority of included studies were generally of good quality. A few studies were rated as moderate in quality, primarily because their descriptions of sampling or data processing techniques were insufficient. The assessment results were considered when interpreting the overall findings, but no study was excluded based on quality (Figure 3).

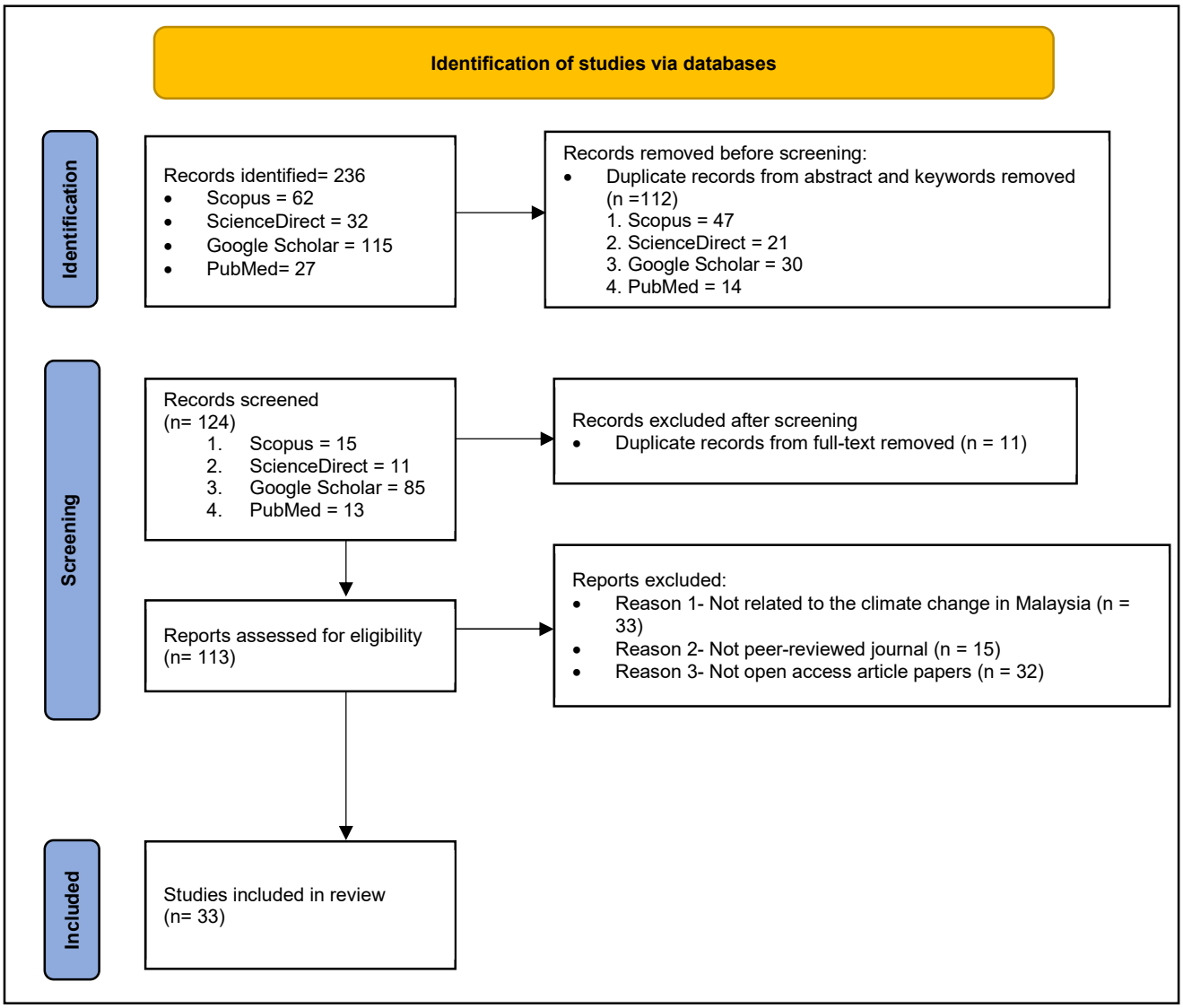

Figure 3: Preferred reporting items for systematic reviews framework

4.0 Result

To provide an overall description of the studies included in this review, a systematic table of evidence was prepared. Table 5 summarizes key information for each of the 33 selected research studies, including the year of study, country, research design, sample characteristics, risks examined, main findings, and limitations. This systematic arrangement allows readers to understand the scope, methodology, and primary conclusions of the available literature on the impacts of climate change on older adults. The table of evidence also provides a foundation for further analysis and enables clear organization of data according to the type of risk (e.g., air pollution, floods, heat waves) and conceptual frameworks of vulnerability, such as exposure, sensitivity, and adaptive capacity.

Table 5: Summary of the selected studies.

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No.	Author, Year	Country	Study Design	Participants	Key Findings	Limitation
1.	Abdul Karim et al., 2021	Malaysia	Quantitative	Aged 60+, fertility rates, capital stocks	Aging population effects the economic growth in long term; less fertility rate in long-run economic growth; integration exists between aging, fertility, capital, employment and GDP	Secondary data used; it does not measure individual health and social determinants. It assumes that the trend remain constant in the long term
2.	Alhoot et al., 2016	Malaysia	Systematic Literature Review	All population	Climate variability threatens outbreaks of water- and vector-borne diseases; heavy monsoons are a contributor to contamination and breeding habitats.	Lacks primary quantitative analysis; descriptive trend-oriented; confined to Malaysia; does not examine effectiveness of interventions in detail.
3.	Aziz, 2015	Malaysia	Policy Analysis	NA	Malaysia has advanced in its climate commitments whereby it aims to be carbon neutral by the year 2050. Despite the change in politics, investment in rhetoric about the green agenda remains constant. Policies however seem to be disjointed and disconnected in agencies. Alleged under-reporting of emissions (denied by government) became the subject of international scrutiny of Malaysia.	Analysis is descriptive; fails to provide empirical evaluation of emission trends; fails to assess real effectiveness of policies; is concerned with rhetoric vs reality gap especially for aging population.
4.	Boudreau et al., 2022	International	Assessment Report	NA	Underlines the importance of the effects of climate change to Canada. Highlights the contribution of scientists in Canada in the IPCC report. Gives synthesized policy-relevant information to emergency management practitioners as a preview of future disaster planning directions.	Not especially focus on aging population; Overall report
5.	Caballero-Anthony et al., 2015	Case study	Policy analysis	NA	Determines the strengths and weaknesses of the ASEAN in the governance of the diseases transmitted by vectors. Dengue represents a leading economic and health problem. Focus shift on preventive and long term solutions. Gives regional suggestions on how to enhance integration between the systems of governance and policies.	According to secondary policy review; no primary data; dengue only; generalizable to ASEAN but detailed analysis of Indonesia and Malaysia only.
6.	CFE, 2022	ASEAN	Policy Analysis	NA	Disaster management has been institutionalized in ASEAN through AADMER (2005/2009), AHA Centre and DELSA system, 85 percent of disasters are hydro meteorological. Floods are the most common occurrence; wind damage the most expensive. There was enhanced regional solidarity and coordination, although COVID-19 revealed shortcomings in health emergency preparedness. The	Mostly descriptive and policy-based; no or minimal quantitative outcome measures; coordination issues persist; the reliance on bilateral aid during COVID-19 shows that the institution is vulnerable.

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					efforts of the ASEAN were supplemented by outside help (China, Singapore, US, and Vietnam).	
7.	Darus et al., 2020	International	Quantitative	NA	Carbon emissions accounting had the most disclosure and risks/opportunities had the least disclosure. Profitability was a positive determinant of the disclosure; leverage was a negative determinant of the disclosure. There was no important impact of governance structure.	Only largest 100 companies; cross-sectional data within 1 year; the results are not necessarily applicable to small firms or longitudinal effects.
8.	Department of Environmental Affairs and Tourism, 2004	Malaysia	Policy review and descriptive analysis of government climate strategies	NA	Although a non-Annex I nation, Malaysia has promised to respond to global climate problems. The focus of government efforts on sustainable development is on leadership, energy efficiency, and renewable energy.	Paper is mostly descriptive; no empirical/quantitative analysis of results; is concerned only with government point of view, but not with private/grassroots activities.
9.	Ebi & Bowen, 2016	Global	Conceptual review	NA	Extreme events (such as droughts) are both a hazard and vulnerability source by influencing future exposure and vulnerability. Management of health risks in the context of climate change requires a better understanding of changing patterns of risks, health effects, and long-term outcomes.	Lacks empirical data; more of conceptual framing paper than case study or quantitative analysis.
10.	Economic Planning Unit, 2015	Malaysia	Policy/ Strategic plan	NA	The plan is anchored around the idea of growth on people, and it focuses on the capital economy (GDP, big projects) as well as the people economy (jobs, cost of living, wellbeing). Six game changers and six strategic thrusts to spearhead Vision 2020.	No scientific study; policy framework not subjected to empirical testing; little explicit attention to climate change or environmental health.
11.	Emelyanova & Rautio, 2016	International	Review/ secondary data analysis (demography, health, environment)	All population (gender, age, ethnicity)	Determined depopulation, aging housing and health impacts of environmental stressors. Human capital (level of education) necessary to adapt. Significant regional disparities on demographic and education.	Regional emphasis reduces generalizability; high degree of description; causal relationships between the environment and health are not highly quantified.
12.	Fineman, 2012	International	Theoretical Study	NA	Vulnerability and is not adverse; is generative (growth, creativity, relationships); emphasizes interdependence and a responsive, just state.	Not empirical; no population data; inapplicable conceptually to climate/aging but relevant to the concept.
13.	Haddaway et al., 2018	International	Methodological/ guideline development	NA	PRISMA (health-based) also has shortcomings of environmental reviews (e.g., meta-analysis is the focus, no flexibility). ROSES evolved to enhance transparency, description and usability of environmental systematic	Early stage of development; little field testing; applicability can change as wider used.

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					reviews and maps. The first road-testing proved viable and useful.	
14.	IPCC, 2022	International	Assessment Report	NA	Underlines the importance of the effects of climate change to Canada. Highlights the contribution of scientists in Canada in the IPCC report. Gives synthesized policy-relevant information to emergency management practitioners as a preview of future disaster planning directions.	Not especially focus on aging population; Overall report
15.	Junlapeeya et al., 2023	Thailand	Qualitative	30 participants (15 older adults, 15 family members)	The themes identified were (1) local measures to counter weather changes, (2) doubling efforts, (3) awareness and response, (4) comfortable and secure living conditions, (5) mitigation measures. Older adults relied on seasonal adaptability and predictive/ adaptive coping mechanisms as the key to their safety, health and daily living habits.	Small, localized sample; limited generalizability; qualitative findings context-specific.
16.	Kim et al., 2024	Southeast Asian communities	Quantitative	Communities with varying ageing demographics (elderly population concentration)	Green space loss was more vulnerable to the ageing communities in socio-economically disadvantaged and fast ageing cities. Cities that were at risk due to their location along the coast kept providing the green space. Gives emphasis on socio-demographic changes as a determinant of adaptation strategies.	Observational study; can only measure satellite-based measures (no health/individual-level outcome); not able to measure qualitative elements of adaptation.
17.	Kim et al., 2022	South Korea	Quantitative	Population projections 2010–2060; age-specific groups (older adults emphasized)	There is more national exposure to EHE; highest in 20302040; EHE vulnerable to Seoul because of super aging, vulnerable in Daegu because of extreme EHE; older adults will be up to 4 times more exposed than they are now.	On basis of BAU scenarios alone; predicted on the basis of climate and demographic assumptions; no adaptation/mitigation model used.
18.	Latif et al., 2021	Malaysia	Observational study	Not human sample; monitoring station air quality data	Major PM_0, PM 2.5, NO 2, and CO decreases during MCO compared with 2018/2019; NO 2 declined by 55 to 72 percent; O 3 rose because of fewer precursors (NO); diurnal analysis revealed steep PM reductions during rush hours because of reduced traffic.	Only Klang Valley; short-term analysis; only air quality indicators; did not measure direct health outcome.
19.	Martinez et al., 2018	International	Cross-sectional survey	Quota sample of residents ≥18 years old	Nearly all respondents had heard of climate change and thought it was a reality; perceived primary effects include droughts and floods due to its effects on health, water, energy and food; respondents linked the	It was based on self-reported perceptions; it has limited generalizability outside of Bogotá; it lacks a longitudinal follow-up; it does not directly measure the effects of behaviour or policy.

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					necessity of adaptation and mitigation efforts.	
20.	Murphy et al. (2021)	Global	Narrative review	NA	Oil palm produces approximately 40% of world vegetable oil (81 Mt/19 Mha) using much less land area than soybean/rapeseed; industry has some exposure to climate change (heat, rainfall variability), pest/disease risks and market pressures; breeding and management innovations (higher yield, oil quality, resilience) have an opportunity to adjust with climate change.	In review, not empirical study; no quantitative model; restricted to what is known in 2020s; not elderly economic study
21.	Ngcamu, 2023	Global	Systematic Literature Review	23 articles (2018–2023) Vulnerable populations	Climate change affects vulnerable people, unaware of adaptation/ mitigation measures; vulnerable populations are discriminated and ignored in the disaster response; failure in providing protection to victims of gender-based violence; the actions of governments are not in tandem with the international system.	Small number of studies (23 only); inadequacy of empirical intervention evidence; insufficient evidence of effectiveness of adaptation mechanisms; heterogeneity of regions/ contexts.
22.	Preston et al., 2011	Global	Systematic Literature Review	45 studies reviewed	Four design questions that are considered critical: (1) goals (problem-solving vs. decision support), (2) framing (vulnerability of what and to what), (3) technical methods (integration challenges), (4) stakeholder participation (often lacking). Gives avenues to enhance mapping.	Absence of consistency in studies; determining of determinants is subjective; no stakeholder has been involved; results are not empirically tested.
23.	Roy et al., 2024	South-western Bangladesh	Qualitative	12 in-depth interviews; 4 FGDs (27 participants); 4 key informant interviews; mixed ages including older adults	Climate change indirectly worsened intergroup and intragroup conflicts, livelihood vulnerabilities and social tensions. Respect towards older adult is said to have decreased leading to loosening of kinship and less cooperation in collectivist society. Inequitably impacted disadvantaged populations; environmental justice problem.	Localized scope; limited sample size; qualitative nature limits generalizability; causality inferred indirectly rather than measured
24.	Sasaki et al., 2020	Iwanuma City, Japan	Longitudinal cohort (pre- and post-disaster surveys from Japan Gerontological Evaluation Study)	Older adults ≥65 years; 3,111 older survivors (out of 3,567 baseline); mean follow-up 2.5 years after 2011 Great East Japan Earthquake & Tsunami	The proportion of GDS increased after disaster was 34.5%. Neighbourhood tie loss associated with increased depression; establishment of ties after the disaster hedged against exacerbation of symptoms (= -0.39, 95% CI: -0.72, -0.06). The resilience factor was social capital.	Observational study; self-reported measures; there may be unmeasured confounding factors; low external generalizability to older Japanese survivors.

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25.	Shahid et al., 2017	Malaysia	Narrative review & secondary data analysis	NA	Projected increase in temp 1.1-3.6 C and change in rainfall 150mm by 2100; river discharge up to 43% NE monsoon; and some consequences of these changes are property damage, increasing costs of lifecycle, decreasing sector growth. Short run: GHG reduction policy (45% by 2030) can also affect property prices; long run: physical climate risks take the centre stage.	All secondary data; model-based projections; little primary empirical validation of Malaysia-specific real estate results.
26.	Shen et al., 2023	Bangkok, Thailand	Case study with panel data analysis	HART survey waves 2017, 2020, 2022 (middle-aged and older adults)	Over time, memory and orientation to time became worse because of flooding. RCP counteracted the adverse outcomes on memory & calculation scores and risks of diabetes and depression, and indirectly guarded cognition. Includes the suggestion that RCP (structural systems, preparedness, healthcare) can have a buffering effect on flooding-related cognitive decline.	No specified sample size; observational study (causal inference is constrained); possible mechanisms by which RCP is associated with cognition are not completely unravelled; sample may not be fully generalizable to Thailand.
27.	Sohrabi ET AL., 2021	NA	Systematic Literature Review and meta-analysis reporting	Guideline update & interpretive analysis	PRISMA 2020 reflects recent evolution in identification, selection, appraisal, and synthesis of research; provides clearer guidance with updated 27-item checklist and 4-phase flow diagram; encourages adoption to advance evidence-based medicine	NA
28.	Stroud & Green, 2022	International	Qualitative	175 practitioners from 12 countries	Griffiths III offers useful diagnostic knowledge about developmental disorders within various settings; assists practitioners in reducing climate and environment-induced stress on child growth; emphasizes the importance of practitioner community in using ecological and holistic methods.	Not specified; restricted to practitioners who had already registered with Griffiths III (selection bias); results were based on self-report using questionnaire; no measurement of direct child developmental outcomes.
29.	Sun et al., 2025	Hawaii	Quantitative	Older adults	By 2050, the number of older adult without timely emergency/ healthcare access would double under SLR; relocation/ redevelopment strategies improve access; prioritizing land use, housing and transport planning supports age-friendly living	Projections, not observed outcomes; uncertainty in sea level rise and demographic forecasts; limited to Honolulu context
30.	Swami & Parthasarathy, 2021	India	Longitudinal indicator-based vulnerability assessment	NA	There were patterns of vulnerability increased to 0.065 because there is less adaptive capacity and more land sensitivity; Chandrapur decrease 0.025 because there is less exposure/ sensitivity	The indicator-based approach that weights the indicators equally can be over-simplifying; the projection relies on the selected variables; it cannot be generalized outside Maharashtra.

					and more adaptive capacity. Vulnerability is driven by sensitivity and adaptive capacity and not by exposure alone. District variability shows that local policy is needed.	
31.	Tang, 2019	Malaysia	Questionnaire survey (cross-sectional, correlational)	Young adults	There was low-to-median agreement on sustainability-related beliefs/ attitudes/ intentions among the students. Greater awareness, willingness and responsibility were associated with moral obligation. Course had favourable effects providing students with rudimentary knowledge of sustainability.	Survey self-reporting can be biased. Causal inference is constrained by correlational design.
32.	Usmani et al., 2020	Malaysia	Narrative review/ descriptive study	All ages	The problem of air pollution is significant in Malaysia and the consequences of this problem are important. The Malaysian air quality standards were compared with the global standards. Research gaps detected: lack of local health impact research, lack of predictive/engineering models and stronger government action.	No age-specific effects were analysed; no health risks were quantified in general conclusions.
33.	Yau et al., 2017	Malaysia	Simulation study using TRNSYS	NA	Cooling loads projected to rise with temperature increases: +2.96% (2020), +8.08% (2050), +11.7% (2080) compared to 2000 baseline. Existing systems' efficiency and durability expected to decline over 70 years.	Simulation-based only (no empirical field data); limited to cooling load projections (ignores other building services); focused on commercial buildings in tropics generally, not site-specific.

4.1 Impacts of climate change on older adults in Malaysia

When studying the effects of climate change on older adults, it is important to adopt a systematic approach that captures both the direct and indirect aspects of vulnerability. The Intergovernmental Panel on Climate Change (IPCC) defines vulnerability as a process determined by three interdependent variables: exposure, sensitivity, and adaptive capacity. Exposure refers to the extent to which individuals or populations face climate-related hazards, such as extreme heat, flooding, or air pollution. Sensitivity describes how these exposures affect people differently, depending on factors such as health status, socioeconomic conditions, and demographic characteristics. Adaptive capacity, in turn, refers to the ability of individuals, groups, or organizations to prepare for, cope with, and recover from these hazards. This review arranges its findings according to the IPCC Vulnerability Framework to provide a clearer understanding of how climate change uniquely affects older adults in ASEAN countries, particularly Malaysia. The framework also highlights the multidimensional nature of vulnerability by integrating health, social, and economic outcomes throughout the analysis. Accordingly, the evidence in the following section is discussed under the categories of exposure, sensitivity, and adaptive capacity, offering a comprehensive view of the risks and responses associated with climate change for Malaysia's older population (Figure 4).

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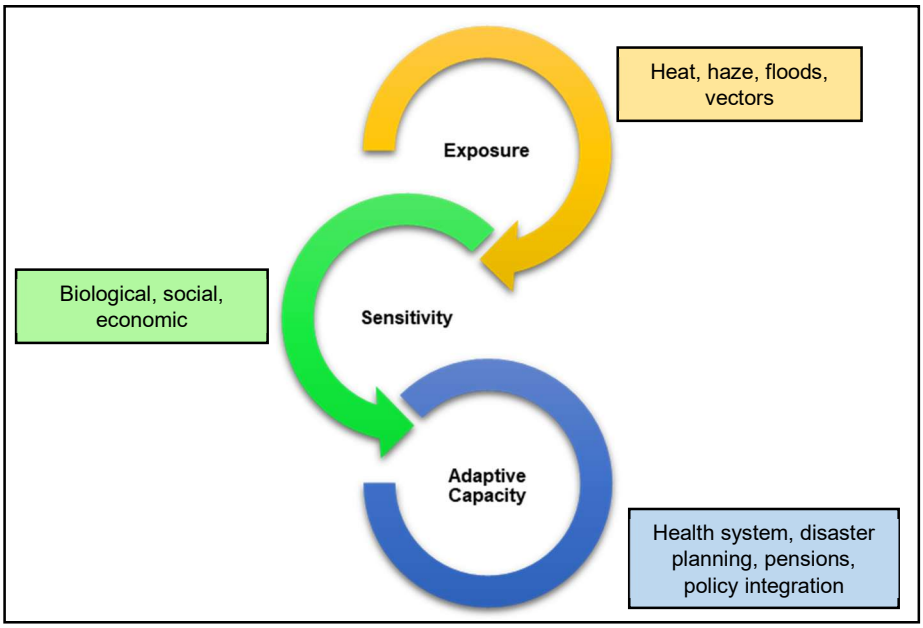

Figure 4: Conceptual framework of climate change vulnerability among older adults in Malaysia that adapted from the IPCC Vulnerability Framework (IPCC, 2007).

4.1.1 Exposure

In Malaysia, older adults are becoming increasingly vulnerable to various climate-related hazards that directly influence their vulnerability profile. In scientific terms, exposure within the IPCC framework refers to the degree to which individuals or groups are subjected to climate stresses or extreme events. For older adults, this exposure is particularly consequential, as it often coincides with biological vulnerability, chronic health conditions, and social marginalization. Four key climate hazards are of particular concern in Malaysia: heat stress, air pollution, floods and rainfall extremes, and vector-borne diseases.

Heat stress and extreme temperatures are among the greatest risks. Malaysia's hot and humid climate is expected to experience more frequent and prolonged heat waves, especially during El Niño years and the Southwest Monsoon. In Selangor, even a slight rise in apparent temperature of 1°C was associated with a 12.9% increase in hospital admissions among older adults (CFE-DM, 2016). Chronic exposure to heat exacerbates health problems, leading to dehydration, impaired thermoregulation, cardiovascular stress, and respiratory illnesses. Urbanized areas amplify these risks due to the urban heat island effect, which further increases local temperatures. For older adults, whose thermoregulatory capacity decreases with age, these exposures can be life-threatening, especially when combined with underlying non-communicable conditions such as hypertension, diabetes, or chronic respiratory diseases.

Air pollution and transboundary haze present another major risk factor. Haze events, often originating from biomass burning in neighboring countries, contribute significantly to respiratory morbidity and mortality. Studies have shown that hospital admissions for chronic respiratory conditions such as asthma, pneumonia, and chronic obstructive pulmonary disease rise significantly during haze events (Usmani et al., 2020). Fine particulate matter (PM2.5) penetrates deeply into the respiratory system, increasing inflammation and the risk of mortality. Seasonal haze events impose cumulative stress on older populations, particularly those with limited access to clean indoor air or protective equipment such as air purifiers.

Floods and excessive rainfall further increase exposure risks, particularly in low-lying and riverine regions of Malaysia. Flooding disrupts essential services, including access to clean water and healthcare. For older adults with chronic conditions like hypertension, diabetes, or heart disease, any disruption to medication or medical care can be life-threatening. Floods also have mental health impacts; follow-up surveys in Kelantan indicate that older adults are more likely than younger populations to experience depression, anxiety, and post-traumatic stress disorder (PTSD) following flood events (Shahid et al., 2017). Additionally, rainfall-induced landslides in hilly areas pose physical risks, disproportionately affecting older adults with limited mobility and slower evacuation capacity.

Climate change also exacerbates vector-borne diseases by increasing temperatures and altering rainfall patterns. Higher temperatures accelerate mosquito breeding cycles and expand the geographical distribution of vectors. It is estimated that a 1.5°C rise in ambient temperature by 2050 could lead to a 15% increase in malaria cases (Alhoot et al., 2016). Dengue is the most prevalent vector-borne disease in Malaysia, and national data indicate that mortality rates rise sharply with age, peaking among those over 75 years old (Caballero-Anthony et al., 2015). Older adults are disproportionately affected not only because of their biological susceptibility but also due to comorbidities that hinder recovery.

The cumulative effect of heat, haze, floods, and vector-borne diseases places older adults in Malaysia on the frontline of climate-related hazards. These exposures often overlap and compound one another rather than occurring in isolation. Notably, vulnerability is not uniform across the country; urban-dwelling older adults face greater risks from heat stress, haze, flooding, excessive rainfall, and vector-borne diseases compared with those in rural regions. This uneven geographic distribution of hazards highlights the need for place-based adaptation strategies. While exposure measures the risk to which older adults are subjected, vulnerability captures how sensitive they are to these hazards. The next section (4.1.2 Sensitivity) explores how biological aging, chronic health conditions, and social factors, including poverty and isolation, amplify the impacts of climate exposures on older adults.

4.1.2 Sensitivity

According to the IPCC vulnerability framework, sensitivity refers to the degree to which a system, in this case, older adults, is affected by climate stressors when exposed. Sensitivity measures the extent to which a population is susceptible to harm during a hazard event. Older adults in Malaysia are particularly vulnerable to climate hazards due to biological aging, social dependence, and limited economic resources. The same climatic event may have a more severe impact on older, less healthy, or economically disadvantaged individuals (IPCC, 2022; Fineman, 2012).

The main physiological, social, and economic factors that increase older adults' sensitivity in the Malaysian context are briefly described below. Biological aging is a fundamental factor underlying climate risks. Thermoregulatory systems lose efficiency, immune function declines, and the prevalence of chronic non-communicable diseases, including cardiovascular disease, diabetes, and chronic respiratory illnesses, increases with age. These factors contribute not only to the likelihood of acute illness during climate events but also to the severity of outcomes and recovery periods (Fineman, 2012; Ebi & Bowen, 2016). Malaysian evidence supports these findings: heat exposure is closely linked to increased hospitalizations among older adults (time-series analyses in Selangor showed significant rises in hospital admissions with small increases in apparent temperature), and haze events caused by cross-border biomass burning result in substantial respiratory hospitalizations and mortality (CFE-DM, 2020; Usmani et al., 2020). Biological vulnerability is further compounded by vector-borne diseases. National surveillance and synthesis studies indicate age-related increases in severe outcomes, such as the dramatic rise in dengue mortality with age, and modeling predicts climate-related increases in malaria and dengue cases with warming (Caballero-Anthony et al., 2015; Alhoot et al., 2016). Physical vulnerabilities, combined with multiple illnesses, medication use, decreased mobility, and weakened immunity, make even moderate climatic stresses disproportionately harmful for most older Malaysians.

Everyday routines and social structures also shape the translation of climate change impacts into harm. In Malaysia, older adults rely heavily on dense local social networks for emotional support and secondary assistance (care, transportation, and access to medication); disruptions to these networks heighten vulnerability. Floods and displacement weaken neighborhood ties and hinder access to social and religious activities that support well-being, causing both immediate care gaps and long-term mental health consequences (Tang, 2018; Shahid et al., 2017). Heat waves and haze events also increase social isolation, as frail older adults are often unable to travel to community centers, places of worship, or social gatherings. Reduced social participation diminishes stress-buffering capacity and overall resilience. Conversely, strong neighborhood networks can mitigate depressive symptoms following unexpected events (Sasaki et al., 2020). In many rural and semi-urban areas, older adults serve as informal caregivers (e.g., for grandchildren) or manage small home enterprises, adding to their social burden during disasters and limiting their ability to seek assistance, which further increases sensitivity (CFE-DM, 2020).

Economic constraints further exacerbate sensitivity. Limited financial resources restrict older adults' ability to protect themselves from extreme weather. Climate-related events such as droughts, floods, and reduced fishing days quickly translate into income and savings losses, as many older Malaysians work in the informal economy (smallholder agriculture, fisheries, casual labor) or depend on family support rather than full-scale pensions (Shahid et al., 2017). Retirees are often unable to diversify income or purchase insurance, meaning that additional health costs due to heat, pollution, or sector-specific illnesses disproportionately affect them (Ebi & Bowen, 2016). Seasonally predicted temperature increases may lead to higher utility bills or unaffordable living conditions for low-income older adults. Climate-driven increases in energy demand (e.g., for cooling) further raise household expenditures (Yau & Hasbi, 2017). Gender differences also shape economic vulnerability: older women are particularly susceptible because they are more likely to engage in unpaid caregiving and informal microbusinesses, limiting their recovery capacity (Tang, 2018). At the macroeconomic level, rising disaster preparedness and adaptation costs could constrain the expansion of social protection, reducing the scope and stability of welfare support during critical periods (Economic Planning Unit, 2015; Shahid et al., 2017).

Overall, older adults in Malaysia exhibit multidimensional sensitivity. Biological aging increases direct health vulnerability, breakdowns in social networks exacerbate psychosocial harm, and limited access to support and financial resources constrain recovery. Sensitivity also varies spatially and socially: urban older adults are more vulnerable to heat and haze (due to urban heat islands and air pollution), while rural or coastal older adults face greater livelihood disruptions and displacement risks. This pattern underscores the need for place-based, age-sensitive adaptation strategies. Section 4.1.3 Adaptive Capacity examines the role of personal, household, and institutional resources in mitigating these sensitivities, thereby influencing overall vulnerability trajectories.

4.1.3 Adaptive Capacity

Malaysia has already developed several policies addressing climate change and aging, but these remain incomplete. The National Policy on Climate Change (NPCC, 2009) provides the country's strategic framework for low-carbon development and climate resilience, while the National Policy on Older Persons (2011) outlines goals for social protection against aging. Despite the potential synergy between these two frameworks, older adults are routinely excluded from climate adaptation and resilience planning, as the policies do not cross-reference one another (Rosenzweig, 2016). The institutional structures of the National Disaster Management Agency (NADMA) also influence adaptive capacity. Post-disaster assessments such as those conducted after floods in Kelantan have shown that shelters rarely meet older adults' needs, including mobility assistance, continuity of chronic medications, and culturally supportive facilities. NADMA coordinates disaster response, including evacuation and shelter management, and could work with the Ministry of Women, Family and Community Development (KPWKM) and the Social Welfare Department (JKM) to implement age-responsive measures, such as age-disaggregated evacuation planning and shelter requirements, to close this gap.

Health surveillance and disaster preparedness are key aspects of the Ministry of Health's (MoH) adaptive capacity. However, targeted interventions are constrained by a lack of longitudinal research on environmental-health interactions and insufficient age-disaggregated health data. To ensure that early warning systems are risk-specific for older adults, the MoH, in collaboration with MetMalaysia, is developing heat-health action plans, which may include cooling centers, SMS alerts, and continuity plans for patients with chronic conditions. Economic safety nets are also limited. In times of disaster, older adults often rely on family support or government assistance, as many are not covered by pensions or formal employment benefits. Although the Social Security Organization (SOCSO) and the Employees Provident Fund (EPF) provide some protection, many older adults in Malaysia work in the informal sector, particularly in agriculture and fishing. Linking adaptation support such as emergency cash transfers to EPF and SOCSO frameworks could help strengthen household resilience after floods or prolonged heat events.

At a broader level, Malaysia's climate governance is evolving through the National Adaptation Plan (NAP) of the Ministry of Natural Resources, Environment and Climate Change (NRECC) and the 12th Malaysia Plan (2021–2025), which mainstream disaster preparedness and climate resilience. However, older adults are not explicitly recognized as a vulnerable population. Incorporating age-sensitive risk assessments, healthcare preparedness, and local adaptation planning into the NAP would better align it with Malaysia's demographic realities and international commitments under the Paris Agreement and Sendai Framework. In summary, Malaysia's aging policies and climate resilience

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initiatives remain largely disconnected, limiting the country's adaptive capacity. Current authorities including the MoH, NADMA, KPWKM, JKM, MetMalaysia, EPF, and SOCSO could operationalize age-specific early warning systems, design shelters that accommodate older adults, and ensure continuity of chronic-care medications. These steps can then be translated into practical resilience strategies (Hussain & Ibrahim, 2021).

5.0 Discussion

The results of this review indicate that climate change poses a serious challenge to older adults in Malaysia, particularly in terms of health risks, social well-being, and economic vulnerability. It is evident that these issues are not adequately addressed by existing policy frameworks, despite significant attention to risk factors in the literature. This aligns with broader research showing that older adults are disproportionately vulnerable to climate hazards due to comorbidities, limited mobility, low adaptive capacity, and fixed incomes (Latif et al., 2021; IPCC, 2022). In Malaysia, although both climate change and population aging are recognized as national priorities, their intersection is rarely addressed in practice. Most Malaysian studies on climate change do not analyze data by age, leaving a gap in understanding the specific needs of older adults. Empirical research examining the diverse experiences of this demographic is even more limited, and specialized adaptation strategies are seldom developed. Age-disaggregated data remain scarce, reflecting broader challenges in research and policy design in climate-health studies across the Global South, where vulnerable groups are often discussed rhetorically but not systematically addressed (Ngcamu, 2023).

The National Policy on Climate Change (2009) and the National Policy on Older Persons (2011) are examples of policy structures in Malaysia, alongside the proposed Climate Change Act. However, these domains largely operate in silos. Policies targeting older adults rarely consider climate sensitivity, while climate policies frequently overlook the older population. This lack of integration leads to fragmented initiatives: social protection programs often ignore environmental risks, while climate resilience programs fail to account for demographic realities. Without institutional safeguards, older adults are more vulnerable to illness, mortality, and social isolation during extreme weather events or socioeconomic shocks. The review also identified significant gaps in community-level adaptation strategies for older adults. Their perspectives and experiences are rarely included in Malaysian research, despite the recognized value of participatory approaches for climate adaptation. This underrepresentation suggests that older adults, who are among the most vulnerable, are not adequately considered in urban planning or disaster preparedness. For instance, Malaysia has implemented age-friendly city concepts to enhance health and access to services, but these initiatives are not clearly integrated with climate resilience efforts, limiting inclusive and sustainable urban adaptation.

From a broader Asian perspective, Malaysia's challenges are similar to those faced by other regional countries, offering opportunities for policy learning. In Thailand, for example, both demographic and environmental pressures are rising, with older adults increasingly exposed to flooding, heat stress, and air pollution. Recent studies indicate that post-flood outcomes in Bangkok negatively affected older adults' cognitive function, memory, and arithmetic, though these effects were mitigated when resilient city policies (RCPs) such as structural adaptation, community preparedness, and healthcare access—were implemented (Sun et al., 2025). Ethnographic studies in Northern Thailand further show that family structures and coping mechanisms help older adults manage seasonal extremes, but structural policy support remains uneven (Junlapeeya et al., 2023). These lessons suggest that Thailand is ahead in integrating aging into disaster risk management, though implementation and equity challenges persist lessons equally relevant for Malaysia.

Japan provides another reference point, demonstrating how disaster resilience can be integrated with aging policy. As one of the fastest-aging societies globally, Japan has faced compounded climate hazards for its older population. The longitudinal Iwanuma Study following the Great East Japan Earthquake found that social capital strong neighborhood ties and community support was a critical predictor of recovery for older adults, often more influential than physical infrastructure alone (Sasaki et al., 2020). Interventions in Tokyo to prevent heat-related illness among older adults highlight the importance of targeting at-risk households, addressing isolation, and ensuring access to air conditioning. Japan illustrates that integrating older adults' care with disaster preparedness is both cost-effective and humane.

South Korea offers insights into a demographic and environmental trajectory Malaysia may soon face. By 2060, projections suggest that aging combined with urban heat patterns could expose older adults in Korea to up to four times the current incidence of extreme heat events (Kim et al., 2022). In response, Korean urban planning increasingly incorporates age-friendly, climate-oriented practices, including heat shelters and community cooling centers for older adults. These preventive measures underscore the importance of proactive planning in highly urbanized societies vulnerable to climate change.

Collectively, these regional and East Asian comparisons indicate that Malaysia is not unique in facing the dual realities of climate change and population aging, but it lags in integrating the two policy areas. Thailand illustrates the utility of localized, community-based resilience frameworks, Japan demonstrates the role of social capital and eldercare in disaster preparedness, and South Korea emphasizes the importance of pre-emptive planning based on demographic and climate projections. For Malaysia, the key actions include developing age-disaggregated data on climate vulnerability, explicitly linking aging and climate policies, and incorporating older adults' perspectives into adaptation planning.

In conclusion, Malaysia's current policy framework is insufficient to address older adults' climate vulnerabilities, increasing their risk of being left behind and unprepared. Nevertheless, by learning from regional peers and adopting more inclusive, evidence-based, and proactive strategies, Malaysia can advance toward a more integrated and sustainable approach that ensures the safety of its aging population and strengthens climate resilience in the decades to come.

6.0 Conclusions

This review shows that Malaysia's aging population faces significant health, social, and economic challenges, as well as environmental exposures resulting from climate change. Extreme weather events, air and water quality issues, and food security are key concerns for older adults, yet their basic needs are often overlooked in research and policy interventions. Although the impacts of climate change are increasingly evident, Malaysia has yet to implement age-specific adaptation strategies that address the vulnerabilities of its older population. Current policies, such as the National Policy on Climate Change, operate largely independently from aging-focused agendas like the National Policy on Older Persons, creating gaps in effectively protecting older adults.

Future approaches must emphasize community-based adaptation efforts that involve older adults as active stakeholders rather than passive beneficiaries. Inclusive disaster preparedness systems should prioritize older adults in early warning mechanisms, evacuation plans, and resilience training. Strengthening health systems is also critical, with attention to climate-sensitive disease surveillance, access to healthcare infrastructure, and targeted health services. Beyond health, intergenerational programs, social support networks, and local adaptation initiatives should be harmonized to reduce disparities that climate change may exacerbate.

In summary, there are both moral and practical imperatives to bridge the gap between climate action and aging policy, enhancing sustainable development and resilience in Malaysia. Mainstreaming the needs of older adults into national adaptation planning would move the country toward an inclusive model of climate governance, where the most vulnerable groups are not only protected but also empowered to maintain their resilience, equity, and dignity amid environmental change.

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