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Mental Health and Cognitive Outcomes in Older Adults After Disasters: Epidemiological Evidence, Determinants, Interventions, and Tiered Service Models for Policy and Education

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Abstract

Background: Natural and human-made disasters disproportionately increase the risk of mental health disorders and cognitive decline among older adults through trauma exposure, displacement, social isolation, and disrupted health services. Despite expanding literature, a synthesized evidence base linking epidemiology, determinants, interventions, and scalable service models for policy and educational use remains limited. **Objective:** This study aims to synthesize epidemiological evidence, identify key determinants, map effective interventions, and develop policy-ready tiered service models to support mental health and cognitive recovery in older adults following disasters. **Methods:** This narrative review, enhanced by evidence mapping, employs a bio-psychosocial framework aligned with the Inter-Agency Standing Committee (IASC) tiered MHPSS pyramid. Literature was retrieved from scientific databases (PubMed, Scopus, Web of Science), international clinical and policy guidelines (WHO, IASC, NICE, VA/DoD), and Indonesian context-specific sources. Data were narratively synthesized across epidemiological trends, risk/protective factors, intervention efficacy, and service pathway implementation. **Results:** Post-disaster epidemiological burden varies widely; meta-analyses of older earthquake survivors report pooled prevalences of 19.3% for PTSD, 23.5% for depression, and 10.9% for anxiety. Indonesian evidence (North Lombok) indicates 59.9% PTSD prevalence, strongly associated with chronic comorbidities (OR 2.49). Prospective Japanese cohorts demonstrate that severe housing damage accelerates cognitive decline, an effect moderated by social connectivity. Effective interventions include Psychological First Aid (PFA), task-sharing models (e.g., PM+), trauma-focused psychotherapy, cautious pharmacotherapy, and telehealth adaptations. Implementation requires age-friendly, tiered pathways with standardized screening and referral protocols. **Conclusion:** Post-disaster responses must integrate geriatric-sensitive, tiered MHPSS frameworks that ensure continuity of chronic care, preserve social networks, and establish clear, age-disaggregated monitoring systems. These findings provide a structured evidence base for emergency health policy, community response planning, and public health curriculum development.

Keywords
Older adults, Disasters; Mental health, Post-traumatic stress disorder

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1. BACKGROUND

Natural and human-made disasters act as acute psychosocial stressors that disproportionately threaten the mental health and cognitive well-being of older adults. Individuals aged ≥60 or ≥65 years face heightened vulnerability due to accumulated comorbidities, functional limitations, and reliance on routine health and social services. The psychological toll of disasters extends beyond acute trauma, frequently manifesting as post-traumatic stress disorder (PTSD), depression, and anxiety, while concurrently intersecting with accelerated cognitive decline, disrupted social roles, and a profound loss of security and autonomy (Inter-Agency Standing Committee, 2007; Hikichi et al., 2016).

Post-disaster psychosocial stressors, including bereavement, forced displacement, erosion of social support networks, and prolonged isolation, compound this vulnerability. Concurrently, the disruption of health systems characterized by interrupted access to chronic medications, fragmented primary care, and suspended mental health services prolongs physiological and psychological stress, thereby impeding recovery. Consequently, post-disaster mental health risks in older populations must be conceptualized through an integrated bio-psychosocial-ecological lens that accounts for individual health status, social determinants, and systemic service capacity (World Health Organization, 2015).

Globally, the Inter-Agency Standing Committee (IASC) guidelines on Mental Health and Psychosocial Support (MHPSS) provide a foundational, multi-layered framework for emergency response, emphasizing tiered interventions ranging from basic safety and community support to specialized clinical care. Despite the growing body of literature on disaster-related mental health, there remains a critical need for a synthesized, policy- and education-oriented resource that specifically integrates epidemiological burden, risk and protective determinants, evidence-based interventions, and scalable tiered service models tailored to older adults. Existing reviews often overlook the cognitive dimensions of disaster recovery or fail to translate epidemiological findings into actionable, age-sensitive service pathways.

The epidemiological burden among older disaster survivors is highly heterogeneous. A recent meta-analysis of post-earthquake populations across Asia and Latin America reported pooled prevalences of 19.3% for PTSD, 23.5% for depression, and 10.9% for anxiety, though

with high statistical heterogeneity ($I^2 \approx 99\%$), underscoring the context-dependent nature of these estimates (Peng et al., 2024). Context-specific data from Indonesia reveal even higher PTSD prevalence (59.9%) among older earthquake survivors in North Lombok, strongly associated with chronic comorbidities (OR = 2.49) and primary care utilization (Aurizki et al., 2019). Importantly, cognitive outcomes that are frequently underrepresented in disaster mental health literature are significantly impacted by housing destruction and displacement. Prospective Japanese cohort studies demonstrate that severe housing damage is associated with accelerated dementia symptom progression and increased risk of cognitive impairment, effects that are substantially moderated by social connectivity and community participation (Hikichi et al., 2016, 2017).

While evidence-based trauma-focused psychotherapies and cautious pharmacological management remain the cornerstone of PTSD treatment, their implementation in resource-constrained post-disaster settings requires adaptation. Scalable, task-sharing interventions such as Problem Management Plus (PM+) and Psychological First Aid (PFA) offer viable alternatives for mild-to-moderate distress, while telehealth modalities enhance accessibility for mobility-impaired older adults (VA/DoD, 2023; de Graaff et al., 2020). However, translating these interventions into coherent, tiered service models within national and local emergency health architectures remains a persistent challenge, particularly in settings like Indonesia, where coordination, funding continuity, and age-disaggregated monitoring systems are often fragmented (Trinidad & Protacio-De Castro, 2020; Efendi et al., 2022).

To address this gap, this narrative review, enhanced by evidence mapping, synthesizes current epidemiological data, identifies key bio-psychosocial and systemic determinants, evaluates intervention efficacy, and proposes policy-ready, tiered MHPSS service pathways for older adults following disasters. By aligning global guidelines (IASC, WHO, NICE, VA/DoD) with context-specific evidence, this manuscript aims to provide a structured knowledge base for emergency health policy formulation, community health worker training, and public health curriculum development. The review proceeds by mapping epidemiological and cognitive outcomes, delineating risk and protective determinants, appraising scalable interventions, and operationalizing tiered service delivery and monitoring frameworks.

2. METHODS

This manuscript employs a narrative review design, enhanced by evidence-mapping principles, to synthesize current knowledge on mental health and cognitive outcomes among older adults following disasters. The review integrates epidemiological evidence, bio-psychosocial determinants, intervention options, and service delivery models structured around the Inter-Agency Standing Committee (IASC) tiered Mental Health and Psychosocial Support (MHPSS) framework. This design was selected to provide a comprehensive, policy- and education-oriented synthesis that bridges epidemiology, behavioral science, public health, and health systems research, with particular relevance to Indonesian community health contexts.

The review is guided by an expanded bio-psychosocial-ecological framework incorporating environmental and health system dimensions. Operational definitions were established to ensure conceptual clarity: older adults were defined as individuals aged ≥60 or ≥65 years, consistent with definitions used in primary studies; disasters encompassed both natural and human-made events (e.g., earthquakes, tsunamis, floods, storms, fires, conflicts, and other emergencies) causing social disruption and service interruption; primary outcomes included mental health indicators (PTSD, acute stress disorder, depression, anxiety, psychological distress, sleep disturbances, and psychosocial functioning) and cognitive outcomes (cognitive impairment, cognitive decline, dementia, or changes in dementia symptoms); determinants were categorized into individual-level factors (comorbidities, disabilities, mental health history, trauma exposure), social factors (social support, social participation, bereavement, displacement), and health system factors (primary care access, chronic medication continuity, referral mechanisms, workforce availability); and interventions and policy recommendations were organized using the IASC MHPSS tiered pyramid, ranging from basic safe and dignified services to specialized clinical care.

A structured literature search across multiple sources was conducted to identify relevant publications. Electronic databases included PubMed/MEDLINE, Scopus, and Web of Science, supplemented by policy and guideline sources from WHO (including mhGAP and mhGAP-HIG), IASC, NICE, VA/DoD, and documents from international agencies and NGOs such as HelpAge International. Indonesian and regional literature were captured through supplementary searches on Google

Scholar and by tracking references from key articles. Search terms were combined using Boolean operators across three conceptual domains: population ("older adults" OR elderly OR aged OR "older people" OR geriatric OR "lansia"), exposure (disaster OR earthquake OR tsunami OR flood OR hurricane OR "post-disaster" OR emergency OR "bencana"), and outcomes (PTSD OR "posttraumatic stress" OR depression OR anxiety OR "psychological distress" OR "mental health" OR cognition OR dementia OR "cognitive decline"). Search strategies were tailored to each database, and the reference lists of included studies and key reviews were manually screened to identify additional relevant studies.

Inclusion criteria required that studies involve older adults (≥60/≥65 years) as the primary analytical group or provide disaggregated results for older adult subgroups; address post-disaster contexts across acute, subacute, or long-term recovery phases; report on mental health and/or cognitive outcomes, determinants, interventions, or service models; and represent credible publication types including observational studies, trials, qualitative studies, mixed-methods research, systematic reviews, meta-analyses, and policy documents. Publications in English or Indonesian were eligible. Exclusion criteria eliminated studies covering general populations without age-disaggregated results for older adults, opinion pieces without clear methodology (except official policy documents from recognized institutions), and studies using "disaster" as a metaphor or focusing on non-disaster stressors.

Study selection proceeded through three sequential stages: deduplication of search results using reference management software; title and abstract screening for relevance to population, disaster context, and outcomes; and full-text review to confirm eligibility and categorize evidence type. To ensure consistency, inclusion decisions utilized a standardized screening form with operational definitions for population, disaster exposure, outcomes, and evidence type, with discrepancies resolved through discussion and re-examination of full texts. From each included source, data were extracted using a standardized form capturing study identification (authors, year, country/setting, disaster type, post-disaster timeframe), design and sample characteristics, outcome measurement instruments, key findings (prevalence, effect sizes, risk/protective factors), intervention or service model components, and policy-relevant information including

governance issues and system prerequisites.

Given the narrative review design incorporating diverse study types, quality appraisal was conducted proportionally rather than through formal risk-of-bias scoring. Observational studies were evaluated for measurement validity, sample representativeness, confounder control, and temporal clarity; trials and interventions were assessed for design rigor, attrition, group comparability, and implementation relevance to emergency settings; and guidelines or policy documents were appraised for evidence transparency, recommendation clarity, and contextual appropriateness. Quality assessments informed interpretive weighting, such as flagging findings that were heavily dependent on cross-sectional designs, had high heterogeneity, or used unvalidated instruments for older adult populations.

Data synthesis followed a structured narrative mapping approach. Prevalence variations and effect sizes across disaster types, locations, time phases, and measurement instruments were summarized to summarize epidemiological evidence. Determinants were classified and organized across individual, social, and health system levels. Interventions and service models were categorized according to IASC MHPSS tiers, including task-sharing strategies and referral mechanisms. Finally, policy implications were extracted and formulated into actionable recommendations for Indonesian contexts across the disaster response-recovery continuum, encompassing preparedness, the acute phase, and recovery. This synthesis approach aligns with narrative review reporting standards while providing structured evidence mapping to support policy translation and educational application.

3. RESULTS

Overview of Included Studies

The evidence mapping identified eight key studies providing epidemiological data, determinant analysis, and intervention outcomes relevant to older adults following disasters. These included two multi-country systematic reviews/meta-analyses, two prospective cohort studies from Japan with pre-disaster baselines, one cross-sectional study from Indonesia, one longitudinal study from Taiwan, one cohort study on mortality outcomes, and one quasi-experimental intervention study from Indonesia. Study settings encompassed earthquakes, tsunamis, and other natural disasters across Asia and Latin America, with follow-up periods ranging from acute

phases to long-term recovery (6 months to 2.5 years post-disaster).

Epidemiological Burden: Prevalence and Risk Comparisons

Table 1 summarizes the key characteristics and findings of included studies. Meta-analytic evidence from 33 studies of older earthquake survivors across Asia and Latin America estimated pooled prevalences of 19.3% for PTSD, 23.5% for depression, and 10.9% for anxiety, though with very high statistical heterogeneity ($I^2 \approx 99\%$ for all outcomes), indicating substantial context-dependent variation (Peng et al., 2024). Comparative meta-analysis demonstrated that older adults were more than twice as likely to experience PTSD symptoms following natural disasters compared to younger populations (RR 2.11), underscoring the need for age-specific detection and management protocols (Parker et al., 2016).

Context-specific data from Indonesia revealed considerably higher PTSD prevalence (59.9%) among older earthquake survivors in North Lombok, with significant associations identified for chronic comorbidities (OR 2.49), primary health center utilization (OR 2.20), and pre-disaster employment status (OR 2.73) (Aurizki et al., 2020). In Japanese post-tsunami cohorts, depression prevalence reached 32.8% and PTSD 25.2%, with depression significantly associated with increased all-cause mortality (HR 2.29) in adjusted models, whereas PTSD did not show significant mortality association after controlling for confounders (Li et al., 2019).

Cognitive Outcomes and Social Moderators

Prospective evidence from the Japanese Iwanuma cohort, which benefited from pre-disaster baseline data, demonstrated that severe housing damage and complete home destruction were associated with worsening dementia symptoms (coefficients 0.12 and 0.29, respectively), with the effect size of "home destruction" comparable to incident stroke in the same analytical models (Hikichi et al., 2016). Follow-up analyses from the same cohort revealed that housing damage was associated with increased risk of cognitive impairment, while informal socializing and social participation exhibited protective effects and significantly moderated the adverse impact of housing damage on cognitive trajectories (Hikichi et al., 2017). These findings identified partial mediation pathways through depression and loss of neighbor interactions, suggesting that social capital preservation may buffer cognitive decline following disaster-induced displacement.

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Psychosocial Determinants and Longitudinal Trajectories

Longitudinal evidence from displaced older adults in Taiwan indicated that depression scores remained elevated between 6–12 months post-disaster, with substantial variation in depression symptoms strongly associated with the availability and quality of family/children support (Watanabe et al., 2004). This finding reinforces the critical role of familial and social support systems in long-term psychological recovery among older disaster survivors.

Intervention Evidence

A quasi-experimental study from post-earthquake Lombok, Indonesia, demonstrated that Motivational Interviewing-based counseling significantly reduced depression scores among older adults in evacuation settings compared to an active control group receiving music therapy (Idris et al., 2020). While limited in scale (n=60), this study provides preliminary evidence for the feasibility and potential effectiveness of structured psychosocial interventions delivered by non-specialist providers in Indonesian disaster contexts.

Table 1. Key Studies on Mental Health and Cognitive Outcomes Among Older Adults Following Disasters *(*Continue to page 99)*

Author /Year	Country/Setting	Design & Sample	Outcome Focus	Key Findings for Older Adults Post-Disaster
Peng et al. (2024)	Multi-country (primarily Asia; post-earthquake)	Systematic review & meta-analysis; 33 studies; older earthquake survivors	PTSD, depression, anxiety	Pooled prevalence: PTSD 19.3%; depression 23.5%; anxiety 10.9% (very high I^2). Risk factors categorized: demographic/chronic disease, disaster exposure, post-disaster support.
Parker et al. (2016)	Multi-country (natural disasters)	Systematic review & meta-analysis; comparing older vs. younger adults	PTSD, adjustment disorders	Older adults more likely to experience PTSD symptoms after natural disasters (RR 2.11); highlights need for early detection and PTSD management in older populations.
Aurizki et al. (2020)	Indonesia (North Lombok; post-earthquake)	Cross-sectional; n=152 older adults; modified CAPS-5	PTSD	59.9% PTSD prevalence; associated factors: chronic disease (OR 2.49), primary health center utilization (OR 2.20), pre-disaster employment (OR 2.73).
Hikichi et al. (2016)	Japan (Iwanuma; 2011 earthquake+tsunami)	Natural experiment; pre-disaster baseline; follow-up ~2.5 years; n=3,566 (≥65 years)	Dementia symptoms	Severe house damage/home destruction associated with worsening dementia symptoms (coefficients 0.12 and 0.29); mechanisms tested include depression & loss of neighbor interaction as partial mediators.
Hikichi et al. (2017)	Japan (Iwanuma; 2011 earthquake+tsunami)	Natural experiment; n=3,566 (≥65 years)	Cognitive impairment & social capital	Housing damage associated with increased cognitive impairment; informal socializing/social participation protective and moderated housing damage impact.

Author /Year	Country/Setting	Design & Sample	Outcome Focus	Key Findings for Older Adults Post-Disaster
Li et al. (2019)	Japan (post-2011 disaster)	Cohort; older adults; n=2,965	Depression, PTSD & mortality	Post-disaster depression 32.8% and PTSD 25.2%; depression associated with increased mortality (HR 2.29); PTSD not significant for mortality in adjusted model.
Watanabe et al. (2004)	Taiwan (1999 earthquake; displaced)	Longitudinal; n=54 (mean age 68)	Depression symptoms & social support	Depression scores remained elevated 6–12 months post-disaster; variation in children/family support strongly associated with depression symptoms.
Idris et al. (2024)	Indonesia (North Lombok; evacuation setting)	Quasi-experimental control; n=60 older adults	Depression	Motivational Interviewing-based counseling significantly reduced depression in intervention group compared to control (music therapy).

4. DISCUSSION

The determinants of mental health and cognitive outcomes among older disaster survivors are best understood through an expanded bio-psycho-social-ecological framework that incorporates environmental displacement and health system dynamics. Disaster impacts on older adults extend beyond direct traumatic exposure, encompassing housing dislocation, material losses, economic instability, severed social networks, and disrupted chronic disease management. These interconnected factors function as core determinants within the tiered Mental Health and Psychosocial Support (MHPSS) framework, necessitating integrated policy and educational approaches that address multidimensional vulnerabilities rather than isolated clinical symptoms (Inter-Agency Standing Committee, 2007; Hikichi et al., 2016). Biological and medical vulnerabilities, particularly chronic comorbidities and functional limitations, consistently emerge as significant risk determinants in post-disaster geriatric populations. Meta-analytic evidence identifies chronic disease as a prominent risk factor for post-traumatic stress disorder (PTSD), depression, and anxiety among older earthquake survivors (Peng et al., 2024). Indonesian data further substantiate this interaction, demonstrating a strong association between chronic comorbidities and PTSD prevalence (OR = 2.49), highlighting the synergistic burden of physiological stress and post-traumatic psychological strain (Aurizki et al., 2019). Concurrently, psychosocial stressors such as housing damage, forced relocation, and social isolation disrupt daily routines, diminish perceived safety, and erode community support structures. Prospective Japanese cohort studies confirm that residential

destruction is directly linked to adverse cognitive trajectories, with diminished social interaction amplifying these detrimental effects (Hikichi et al., 2016). Within the MHPSS paradigm, restoring family and community support networks is therefore positioned as a foundational protective layer that must be prioritized during the earliest phases of emergency response.

Material and structural losses function as profound psychological stressors that extend beyond economic deprivation, fundamentally altering living environments, compromising security, and restricting access to essential services. Severe housing damage and complete home destruction have been quantitatively associated with the exacerbation of dementia symptoms (coefficients = 0.12 and 0.29), with the magnitude of this effect comparable to incident stroke in longitudinal analyses (Hikichi et al., 2016). These findings underscore the need to integrate housing and relocation policies into broader mental health and cognitive preservation strategies. Furthermore, the observed association between primary healthcare utilization and elevated PTSD rates in Indonesian settings (OR = 2.20) should be interpreted as an indicator of heightened service need or confounding by indication rather than a causal relationship (Aurizki et al., 2019). Nevertheless, this pattern reinforces the strategic role of primary care facilities as critical entry points for early screening, basic psychosocial support, and tiered referrals, provided that cross-sectoral coordination and "do no harm" principles are strictly maintained (Inter-Agency Standing Committee, 2007; World Health Organization, 2015). Several interconnected mechanisms directly inform policy formulation and service architecture for post-disaster geriatric care. Prolonged exposure to life-threatening conditions, bereavement, and sustained uncertainty frequently precipitate PTSD, depression, and anxiety, necessitating early provision of basic needs and targeted clinical interventions as minimum response standards (Inter-Agency Standing Committee, 2007). While bereavement constitutes a significant stressor, its psychological impact varies considerably based on relational intensity, available social support, and recovery context, emphasizing the need for individualized and culturally sensitive assessments within MHPSS delivery (Inter-Agency Standing Committee, 2007; Hikichi et al., 2016). Similarly, community displacement and reduced social participation represent plausible pathways to depression and cognitive decline,

positioning social reintegration as a primary intervention target at the community support tier. Disruptions to chronic disease management and routine healthcare access further compound physiological stress and diminish coping capacity, warranting strengthened non-specialist services for early identification and management of emerging mental health conditions among medically complex populations (World Health Organization, 2015). Finally, relocation policies that fragment established communities risk depleting social capital, whereas strategies that preserve neighborhood cohesion can sustain daily social engagement and foster psychological and cognitive resilience (Hikichi et al., 2016).

Given the limited evidence base specifically targeting older adults in post-disaster settings, intervention synthesis draws upon established guidelines for trauma-affected adult populations while explicitly outlining necessary geriatric adaptations. These adaptations account for multimorbidity, sensory impairments, cognitive deficits, and the essential involvement of caregivers. All recommended interventions are systematically positioned within the layered, multi-sectoral IASC-MHPSS framework to ensure contextual appropriateness and service integration (Inter-Agency Standing Committee, 2007). Initial and community-level support relies heavily on Psychological First Aid (PFA). This humane, supportive, and practical intervention respects individual dignity, cultural values, and coping capacities while connecting survivors to basic needs and accurate information (World Health Organization et al., 2011). For clinically indicated cases, evidence-based trauma-focused psychotherapies such as trauma-focused cognitive behavioral therapy (TF-CBT) and eye movement desensitization and reprocessing (EMDR) remain the gold standard, requiring careful capacity mapping and prioritization for moderate-to-severe presentations alongside geriatric-specific modifications to minimize harm (National Institute for Health and Care Excellence, 2018). Pharmacological management for PTSD should adhere to guideline-recommended selective serotonin reuptake inhibitors or serotonin-norepinephrine reuptake inhibitors, with explicit avoidance of benzodiazepines due to risks of falls, polypharmacy interactions, and cognitive suppression in older populations (VA/DoD, 2023). To address workforce shortages, scalable task-sharing models like Problem Management Plus (PM+) deliver transdiagnostic psychological support through trained

non-specialists, demonstrating promising effectiveness in refugee settings and supporting a stepped-care approach where community health workers manage mild-to-moderate distress while complex cases are escalated to specialized services (World Health Organization, 2015; de Graaff et al., 2020). Additionally, secure video teleconferencing offers a viable delivery modality for continuity of care and specialist supervision when transportation or facility access is compromised, provided that digital literacy barriers and caregiver support needs are adequately addressed (VA/DoD, 2023). Successful implementation in Indonesia requires embedding these structured yet scalable interventions within primary care networks and community systems, supported by robust supervision mechanisms and cross-sectoral coordination to ensure sustainability (Trinidad & Protacio-De Castro, 2020; Efendi et al., 2022).

Developing policy-ready service models necessitates clear operational protocols addressing case identification, initial intervention delivery, referral triggers, and continuity of care. The IASC framework emphasizes integrated, cross-sectoral coordination and defines referral as a structured process for directing clients to appropriate services when needs exceed current provider competencies (Inter-Agency Standing Committee, 2007; Inter-Agency Standing Committee, n.d.). In Indonesia, these pathways must align with national health crisis governance structures, including the Health Cluster and Health Emergency Operations Centers (HEOC), which mandate comprehensive technical standards across pre-crisis, emergency, and recovery phases (Kementerian Kesehatan RI, n.d.). Minimum standard operating procedures should incorporate systematic need identification, service mapping, eligibility verification, informed consent documentation, secure execution of referrals, and rigorous follow-up protocols. Geriatric-specific adaptations must explicitly integrate caregiver involvement for functionally impaired individuals, mobility barrier assessments, transportation assistance, and coordinated management of chronic medications and assistive devices to prevent service fragmentation during the transition from acute response to long-term recovery. Post-disaster monitoring and evaluation systems frequently suffer from indicator overload, poor verifiability, and a critical lack of age-disaggregated data, rendering older adults invisible in official reporting. The IASC Common Monitoring and Evaluation Framework for MHPSS in Emergency Settings establishes the

overarching goal of reducing suffering and enhancing psychological well-being, with outcome domains emphasizing functional status and subjective well-being (Inter-Agency Standing Committee, n.d.). To address existing gaps, programs should implement streamlined, age-disaggregated indicators that cover coverage, processes, outcomes, and quality. Process metrics should track the proportion of identified older survivors who receive initial PFA contact, the rate of standardized distress screening, and referral completion rates, with documented time-to-care intervals. Outcome indicators must capture functional changes using validated tools like the WHODAS, shifts in subjective well-being domains, and early detection rates of cognitive decline requiring caregiver support or clinical referral. Quality and acceptability measures should incorporate beneficiary satisfaction surveys and routine audits, ensuring strict adherence to the "do no harm" principles and enabling continuous program refinement and equitable service delivery for older populations.

Translating these findings into actionable policy for Indonesia requires strategic integration across governance, service delivery, and community infrastructure. Older adults' mental health must be formally designated as a core outcome indicator within Health Cluster and HEOC frameworks, mandating the inclusion of MHPSS service mapping, geriatric service points, and cross-sectoral referral SOPs in regional emergency and recovery plans. Policies should prioritize the continuity of chronic disease management and the preservation of social connectivity as upstream interventions, recognizing that temporary housing and relocation strategies must actively maintain community cohesion through grouped resettlement and dedicated spaces for routine social engagement. Primary healthcare facilities should be repositioned as central screening and referral hubs rather than solely physical health providers, ensuring that every post-disaster geriatric consultation includes brief distress screening, sleep and fear assessments, functional evaluations, and family support mapping, followed by tiered referrals when indicated. Cross-sectoral referral systems must adopt standardized documentation, informed consent protocols, and closed-loop feedback mechanisms across health, social, and protection agencies. Healthcare authorities should deploy realistic stepped-care intervention packages aligned with workforce capacities, encompassing community-based PFA and basic needs provision at the foundational tier,

structured non-specialist counseling for mild-to-moderate distress, and specialized trauma-focused therapy or pharmaco-therapy for severe cases. Telehealth platforms should be leveraged for follow-up monitoring, medication adherence support, caregiver guidance, and non-specialist supervision, contingent upon robust data security protocols and targeted digital literacy interventions. Despite growing international evidence, critical knowledge gaps persist in the Indonesian context, particularly regarding the differentiation between acute and recovery-phase impacts, the use of prospective pre- and post-disaster designs, and the systematic measurement of cognitive outcomes. Japanese cohort studies demonstrate the methodological superiority of pre-disaster baselines in minimizing recall bias and strengthening causal inference. Consequently, priority research agendas for Indonesia should encompass community-based geriatric cohorts in disaster-prone regions, establishing pre-event baselines for functional status, social support, and comorbidities to enable valid impact assessment when disasters occur. Pragmatic trials or cluster-randomized controlled trials are needed to evaluate the feasibility and effectiveness of scalable interventions, such as task-shared PM+, brief counseling protocols, and telehealth follow-up models tailored for older survivors.

Furthermore, policy evaluations must examine temporary housing and relocation initiatives as determinants of mental and cognitive health rather than purely infrastructural projects. They should utilize social capital and cognitive function metrics. Implementation research should investigate the operationalization of functional cross-sectoral referral systems, tracking completion rates, time-to-care, and user satisfaction through standardized MHPSS evaluation frameworks. Finally, studies must focus on cultural adaptation and accessibility, develop low-literacy, locally translated psychoeducational materials, engage community leaders to mitigate stigma, and rigorously evaluate how these contextual modifications influence service engagement and clinical outcomes among older disaster survivors.

5. CONCLUSION

The integration of warm-water foot soaks and slow, deep breathing therapy demonstrated a consistent reduction in blood pressure among elderly individuals with Stage 2 hypertension, with mean decreases of 5.25 mmHg (systolic) and 1.75 mmHg (diastolic). Although the paired t-

test analysis did not reach statistical significance at the conventional α=0.05 level (systolic: p=0.054; diastolic: p=0.069), the sustained downward trend across intervention sessions suggests a clinically meaningful effect. These findings support the potential of combining these two low-cost, non-pharmacological interventions as a complementary to hypertension management in older adults.

Given the chronic and age-related nature of vascular stiffness in elderly, consistent and prolonged application of this combined intervention is recommended to achieve more substantial and sustained blood pressure control. Healthcare practitioners may consider incorporating warm-water foot soaks and slow deep breathing exercises into routine geriatric care protocols, particularly as adjunctive therapies for patients seeking safe, non-pharmacological options.

AUTHOR CONTRIBUTIONS

All authors contributed to the conception and design of the study, data collection, data analysis, and manuscript preparation. All authors have read and approved the final manuscript.

DATA AVAILABILITY STATEMENT

The data data can be accessed from the corresponding author upon reasonable request.

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