



Disaster preparedness for persons with disabilities in flood-prone areas of East Jakarta: A multidimensional environmental perspective

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ABSTRACT

Background: The increasing frequency and intensity of hydrometeorological disasters driven by climate change have heightened the vulnerability of persons with disabilities, particularly in urban flood-prone areas. Flooding is the most common disaster in Jakarta and disproportionately affects persons with disabilities due to barriers to accessing disaster information, evacuation routes, emergency shelters, and recovery resources. Although research on disaster preparedness among persons with disabilities has expanded, limited attention has been given to how environmental conditions shape preparedness. This study examines flood preparedness among persons with disabilities in flood-prone areas of East Jakarta through a multidimensional environmental perspective encompassing physical, social, and economic dimensions. **Methods:** This study employed a qualitative approach using in-depth interviews, focus group discussions (FGDs), observations, and document review. Data were collected from persons with disabilities, family members, community representatives, and local stakeholders and analyzed using thematic analysis. **Findings:** Disaster preparedness is shaped by the interaction of physical, social, and economic environments. Inaccessible evacuation routes, emergency shelters, and early warning systems constrain preparedness and response capacities. Social support from families, communities, and disability organizations facilitates access to information, evacuation, and emergency assistance, while limited economic resources reduce households' capacity to prepare for, respond to, and recover from recurrent flooding. These dimensions are interconnected and collectively influence vulnerability and adaptive capacity. **Conclusion:** The study concludes that disaster preparedness among persons with disabilities is a multidimensional environmental phenomenon rather than solely an individual attribute. **Novelty/Originality of this article:** The novelty of this study lies in examining how the interactions among physical, social, and economic environmental dimensions shape disability-inclusive disaster preparedness in urban flood-prone communities.

KEYWORDS: disaster preparedness; disability-inclusive; environmental perspective; person with disabilities; urban resilience.

1. Introduction

Global climate change has contributed to the changes in the frequency, intensity, and patterns of hydrometeorological disasters worldwide (Coronese et al., 2019; Khurana et al., 2022; Rana et al., 2021; Utami et al., 2019; Zhao et al., 2025). These changes have heightened

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disaster risks and impacts, posing significant threats to human safety and sustainable development. Among hydrometeorological hazards, floods are among the most frequent disasters and account for approximately 31% of global economic losses caused by natural hazards (Bevere & Remondi, 2022). In Indonesia, flood vulnerability remains particularly high, placing the country among those facing the greatest flood risks worldwide (Frege et al., 2025). Data from the National Disaster Management Agency/*Badan Nasional Penanggulangan Bencana* (National Agency for Disaster Management, 2025) indicate that floods accounted for 50.85% of all disaster events recorded in Indonesia during the year.

Geographically, Jakarta is situated on low-lying alluvial terrain and surrounded by 13 rivers, making the city highly susceptible to flooding driven by rainfall and coastal processes, with risks further exacerbated by dense land-use development, an overburdened drainage system, excessive groundwater extraction, and land subsidence (Yang et al., 2018; Perdinan et al., 2023). As a result, flooding has become a chronic, recurrent hazard that significantly disrupts urban life. In densely populated urban neighborhoods, these flood impacts are closely intertwined with existing social and economic inequalities. Households with limited financial resources often have fewer opportunities to relocate to safer areas, improve housing conditions, or invest in disaster preparedness measures (Ssennoga et al., 2022). At the same time, residents who depend on local social networks for daily support may experience greater disruption when community functions are affected by flood events. These conditions create uneven capacities to anticipate, respond to, and recover from disasters. Therefore, understanding flood risk in Jakarta requires attention not only to the physical characteristics of the hazard but also to the social, economic, and physical environments that shape people's preparedness and capacity to cope with recurrent flooding.

Persons with disabilities are among the population groups most vulnerable to the impacts of disasters. Globally, approximately 16% of the world's population, or an estimated 1.3 billion people, live with some form of disability (World Health Organization, 2023). According to the United Nations Economic and Social Commission for Asia and the Pacific/UNESCAP (2017), persons with disabilities are two to four times more likely to be affected by disasters than their non-disabled counterparts. In addition to increasing the risks of mortality and injury, disasters may result in the emergence of new disabilities due to their physical and psychological impacts. Data from the 2020 National Socioeconomic Survey/*Survei Sosial Ekonomi Nasional* (SUSENAS), as reported by Nainggolan (2025), estimated that Indonesia had approximately 22.97 million persons with disabilities, representing around 8.5% of the total population, highlighting the growing importance of disaster risk reduction and protection efforts for this population group. In addition, increases in disability prevalence following major disasters have also been documented in Indonesia, including the 2006 Yogyakarta earthquake and the 2018 West Nusa Tenggara earthquake (Hanjarwati, 2023; Philona & Listyaningrum, 2021). These conditions highlight the need to better understand the factors that shape disaster preparedness among persons with disabilities.

The heightened vulnerability of persons with disabilities during disasters is not determined solely by individual functional limitations but is produced through their interaction with the physical, social, and institutional environments in which they live. Previous research has shown that environmental barriers can limit access to disaster information, early warning systems, evacuation processes, emergency shelters, and essential support services during and after disaster events (Chang et al., 2023; Kruger et al., 2018; Pyke & Wilton, 2020; Yıldırım, 2023). These limitations can exacerbate disaster risks for persons with disabilities (Crawford et al., 2021; Hunt et al., 2015). These interacting barriers may ultimately contribute to low levels of disaster preparedness among persons with disabilities (Dunn et al., 2017; Gaskin et al., 2017; Park et al., 2019).

Over the past decade, the concept of Disability-Inclusive Disaster Risk Reduction (DiDRR) has gained increasing attention, emphasizing equitable access, meaningful participation, and the active involvement of persons with disabilities throughout all phases of disaster risk reduction (Rofiah & Kawai, 2025; Twigg, 2015; Villeneuve et al., 2021). This

approach is grounded in the recognition that persons with disabilities are not merely recipients of protection and assistance but also possess valuable capacities, lived experiences, and knowledge that can contribute to strengthening disaster preparedness and community resilience (Kosanec et al., 2022; Park et al., 2019; Uddin et al., 2024). In Indonesia, studies have shown that organizations of persons with disabilities can play an active role in disaster preparedness and risk reduction initiatives when supported by adequate resources, organizational capacity, and cross-sectoral collaboration (Pertiwi et al., 2019). Nevertheless, disaster-related policies and practices continue to predominantly position persons with disabilities as passive beneficiaries of protection, limiting their meaningful participation in disaster risk reduction processes (Gartrell et al., 2020).

Although research on disaster preparedness among persons with disabilities has expanded considerably, previous studies have primarily focused on disaster knowledge, emergency planning, early warning systems, individual preparedness behaviors, and disaster risk reduction policy frameworks (Aslan & Şahinöz, 2023; Baker et al., 2017; Elisala et al., 2020; Ssennoga et al., 2022; Villeneuve et al., 2021). However, less attention has been given to how the environments in which persons with disabilities live collectively shape their preparedness, particularly in flood-prone urban areas of developing countries. Existing evidence indicates that physical accessibility, social support, and economic resources can influence vulnerability, adaptive capacity, and resilience among persons with disabilities in disaster contexts (Aslan & Sahinoz, 2023; Ssennoga et al., 2023; Villeneuve et al., 2021; Elisala et al., 2020; Baker et al., 2017).

These findings suggest that disaster preparedness should be understood not only as an individual behavior but also as a capacity shaped by the interaction of environmental conditions. This perspective is particularly relevant in flood-prone urban settings, where physical, social, and economic dimensions are closely interconnected. Examining these interactions can provide a more comprehensive understanding of how environmental conditions strengthen or constrain preparedness capacities.

To address this gap, this study examines flood disaster preparedness among persons with disabilities in flood-prone areas of East Jakarta through a multidimensional environmental perspective encompassing physical, social, and economic dimensions. Rather than examining these dimensions independently, the study considers how their interaction collectively shapes the preparedness capacities of persons with disabilities living in densely populated and recurrently flooded urban settlements. By doing so, this study contributes to the growing body of Disability-Inclusive Disaster Risk Reduction (DiDRR) research by advancing understanding of disability-inclusive preparedness in flood-prone urban communities. Accordingly, this study addresses the following research questions: 1) How do physical, social, and economic environmental dimensions influence disaster preparedness among persons with disabilities in flood-prone urban communities?; 2) How do interactions among these environmental dimensions shape disability-inclusive disaster preparedness in densely populated, recurrently flooded urban settlements?

2. Methods

2.1 Research design and study setting

This study adopted a qualitative case study design to explore flood preparedness among persons with disabilities in flood-prone urban communities in East Jakarta, using two urban villages as study sites. The study analyzed data from both sites collectively to develop an integrated understanding of the factors shaping their preparedness. A qualitative approach was appropriate because the study examined disaster preparedness as a complex, context-specific phenomenon shaped by interactions between individuals and their physical, social, and economic environments. By engaging directly with participants in their everyday settings, this approach enabled an in-depth understanding of the lived experiences, structural barriers, and adaptive capacities that influence disaster

preparedness among persons with disabilities, which quantitative methods alone may not adequately capture (Creswell & Poth, 2018).

The study was conducted in two urban villages in East Jakarta, Indonesia: Cililitan (Kramat Jati District) and Cipinang Melayu (Makasar District), both classified as highly flood-prone areas. The two study sites were purposively selected after identifying urban villages where external organizations facilitated disability-inclusive disaster risk reduction programs. Both sites are located in areas with recurrent flooding (Regional Disaster Management Agency DKI Jakarta, 2023a, 2023b) and have communities of persons with disabilities living within these flood-prone environments. We collected primary data over four months, from July to October 2025. Figure 1 shows the study area.

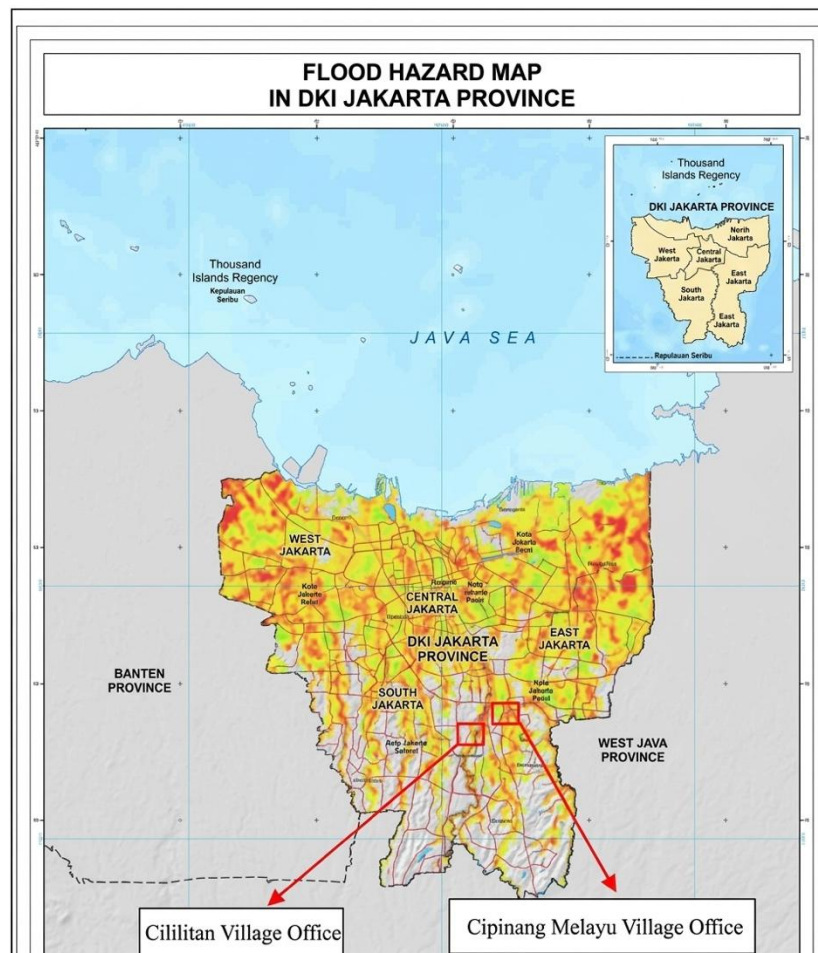


Fig. 1. Research location

2.2 Participants and data collection

Participants were recruited using purposive sampling, complemented by snowball sampling to identify individuals with relevant experiences and knowledge of flood preparedness and disability inclusion in the study areas. A total of 14 key participants were involved, comprising six persons with disabilities and eight persons without disabilities. The persons with disabilities included individuals with sensory disabilities (visual and hearing impairments) and intellectual disabilities who resided in the study areas and had firsthand experience of flood events. The other participants comprised four family members or caregivers, two community leaders, and two representatives from the local village administration. Data collection continued until thematic saturation was achieved. Participant characteristics are presented in Table 1.

The findings presented in this study are therefore limited to the experiences of participants with visual, hearing, and intellectual disabilities. References to other disability

groups, where included in the discussion, are based solely on field observations, document review, or relevant literature and are explicitly identified as such. Data collection employed methodological triangulation, with the researcher serving as the primary research instrument. Primary data were gathered through semi-structured, in-depth interviews designed to explore participants' experiences of disaster preparedness, environmental barriers, and socioeconomic conditions. Sign language interpreters were engaged when interviewing participants with hearing impairments to ensure effective communication and facilitate data collection. In addition, two focus group discussions (FGDs) were conducted, one at each study site, to capture collective perspectives and validate emerging findings.

Table 1. Participant Information

Participant code	Age	Gender	Disability status	Occupation status
P01	54	Male	Hearing impairment	Public Infrastructure and Facilities Maintenance Unit Worker
P02	48	Female	Hearing impairment	Shopkeeper
P03	46	Male	Visual impairment	Therapist
P04	61	Female	Visual impairment	Housewife
P05	24	Male	Intellectual disability	Unemployed
P06	21	Male	No	Unemployed
P07	18	Female	No	Student
P08	54	Male	No	Unemployed
P09	56	Female	No	Housewife
P10	57	Female	No	Housewife
P11	53	Male	No	Urban village officer
P12	61	Female	No	Urban village officer/Family Welfare and Empowerment
P13	36	Male	No	Urban village officer
P14	56	Female	No	Urban village officer/Community Disaster Preparedness Group

The FGDs involved 12 participants representing neighborhood associations, community groups, and local volunteers residing in flood-affected areas across the two study sites. These data were further complemented by field observations to assess the accessibility of evacuation routes, emergency shelters, and other disaster-related infrastructure within the study areas, as well as document reviews to corroborate the interview and FGD findings. Methodological and source triangulation were employed throughout the research by comparing evidence obtained from multiple data collection methods and participant groups, thereby strengthening the credibility and consistency of data interpretation.

Data were analyzed using the interactive model of Miles et al. (2014), which consists of three iterative stages: data condensation, data display, and conclusion drawing and verification. During the data condensation stage, interview and FGD recordings were transcribed verbatim and systematically coded according to three analytical themes: Physical Environment (PE), Social Environment (SE), and Economic Environment (EE). The researcher conducted the coding process using a predetermined framework based on these three themes. In the data display stage, the researcher organized coded data into structured narrative matrices to identify environmental factors influencing disaster preparedness among persons with disabilities and to illustrate interactions among environmental dimensions. Finally, conclusions were drawn and verified through source and method triangulation to enhance the credibility and trustworthiness of the findings before developing the final interpretations.

This research followed principles of research integrity, participant safety, and respect. All participants provided voluntary informed consent and retained the right to withdraw from the study at any time. The study strictly protected participant privacy and data

confidentiality, and the procedures were designed to minimize potential harm. All data and findings were reported honestly, accurately, and without intentional bias.

3. Results and Discussion

The analysis identified a range of factors across the physical, social, and economic environments that shape flood preparedness among persons with disabilities in Cililitan and Cipinang Melayu Urban Villages. Following the analytical framework described in the Methods, the findings were organized into three main dimensions: Physical Environment (PE), Social Environment (SE), and Economic Environment (EE). Each dimension was further divided into sub-themes based on recurring issues identified across interviews, focus group discussions, field observations, and document review. Table 2 summarizes the main findings.

Table 2. Classification of environmental factors influencing flood preparedness among persons with disabilities

Theme	Sub-theme	Findings
PE	PE-ACS (Evacuation Route Accessibility)	Narrow alleyways, uncovered drainage channels, stairways, and boundary fences restrict the mobility of persons with disabilities during evacuation.
	PE-GEO (Geographical Conditions and Flood Characteristics)	Proximity of residences to rivers, low-lying terrain, and the rapid onset and flow of floodwaters.
	PE-EWS (Early Warning Infrastructure)	The availability and effectiveness of automated sirens, flood-monitoring CCTV systems, and WhatsApp groups for disseminating flood warnings and emergency information.
	PE-INFR (Evacuation Shelter and Infrastructure Facilities)	Physical accessibility of evacuation shelters (e.g., mosques, universities, and schools), including the availability of ramps, accessible toilets, and other disability-friendly facilities.
SE	PE-PASC (Post-Disaster Physical Barriers)	Accumulated debris, thick mud deposits, and slippery roads hinder the safe return and mobility of persons with disabilities after flood events.
	SE-FAM (Family Dependence and Support)	Persons with disabilities show a high dependence on family members for mobility assistance and evacuation-related decision-making during flood events.
	SE-COM (Community Solidarity and Individualism)	Community response patterns during flooding include the tendency to prioritize individual or family safety versus providing assistance to vulnerable groups under high-risk and emergency conditions.
	SE-STG (Social Stigma and Participation Barriers)	Social perceptions, age-based restrictions, and structural barriers that limit the participation of persons with disabilities in disaster preparedness activities and training programs
	SE-VOL (Volunteer Capacity and Operational Challenges)	The role of community volunteers in disaster response and the challenges they encounter, particularly when residents delay evacuation despite escalating flood risks.
EE	SE-INST (Institutional Coordination and Inclusive Data Systems)	The existence of cross-sector disaster coordination mechanisms and the limitations of disability-disaggregated data for disaster preparedness and response planning.
	EE-LOSS (Economic Losses and Financial Impacts)	Financial losses resulting from damage to household assets, electronic appliances, housing structures, and additional recovery expenses such as laundry and cleaning costs.
	EE-ADAP (Household Financial Adaptation Strategies)	Economic decisions aimed at minimizing flood-related losses include avoiding expensive household assets, using plastic furniture, and protecting belongings with waterproof coverings.

Theme	Sub-theme	Findings
	EE-WORK (Economic Constraints and Employment Limitations)	Limited access to employment opportunities and income-generating activities among persons with disabilities.
	EE-GOV (Access to Social Protection and Economic Assistance)	Access to government social protection programs, such as the Family Hope Program, and other economic inclusion initiatives available to persons with disabilities.

Note. PE = Physical Environment; SE = Social Environment; EE = Economic Environment

3.1 Physical environment and accessibility barriers

The urban spatial configuration and high population density of the study areas, which are located in close proximity to the Ciliwung River Basin in Cililitan and the Sunter River Basin in Cipinang Melayu, contribute to the flood vulnerability of persons with disabilities. Interviews and field observations revealed that both communities are situated in low-lying areas, with the residences of persons with disabilities located at varying distances, ranging from approximately 200 meters to 1 kilometer from the nearest river. In addition, the river systems are affected by sedimentation, channel narrowing, and solid waste accumulation, which reduce their drainage capacity. These findings suggest that spatial and environmental constraints create cumulative barriers for persons with disabilities across multiple phases of disaster management, including preparedness, emergency evacuation, and post-disaster recovery.

The mobility of persons with disabilities is significantly constrained by the inadequate accessibility of evacuation routes during flood emergencies. Most participants resided in densely populated settlements characterized by narrow alleyways (approximately 1–2 meters wide), uneven terrain with multiple elevation changes, and roadways bordered by wide, open drainage channels. In Cililitan, evacuation routes also consisted of steep and narrow stairways, creating additional challenges for safe and timely evacuation. These disability-unfriendly physical conditions were further exacerbated by the presence of fences and barbed wire, which frequently obstructed the movement of inflatable rescue boats operated by community volunteers during evacuation efforts.

"If the floodwater is still shallow, someone usually helps me walk. I am afraid of falling into the drainage channel near my house because it is quite wide. Once I reach the mosque, however, I can move around independently because there are no open drainage channels there." (P03, participant with visual impairment)

"Barbed-wire fences also obstruct evacuation efforts using rescue boats..." (FGD participant, Cipinang Melayu).

The inadequacy of evacuation routes is closely intertwined with the functional limitations of conventional Early Warning System (EWS) infrastructure. In several locations near the river, water pumping stations were often activated only after floodwaters had already inundated residential areas. Likewise, automated flood warning sirens designed to signal rising water levels were frequently rendered ineffective because residents intentionally switched them off due to concerns about excessive noise. As a result, persons with disabilities often lost the critical window of opportunity for timely self-evacuation during the initial stages of flooding. In addition to sirens, flood monitoring and warning systems in Cipinang Melayu included CCTV (Closed-Circuit Television) cameras, neighborhood WhatsApp groups, and traditional warning devices such as kentongan. These findings indicate that the effectiveness of early warning depends not only on the availability of physical infrastructure but also on how warning information is communicated and acted upon within the community.



Fig. 2 (a) Narrow access roads within the residential area; (b) Narrow alleyway adjacent to the residence of a participant with an intellectual disability; (c) Wide open drainage channel near the residence of a participant with visual impairment.

"We receive flood warnings through neighborhood WhatsApp groups. There are also kentongan, warning sirens, and CCTV cameras used to monitor flooding around residents' homes." (P09, caregiver of a participant with an intellectual disability)

Even when evacuation was successfully undertaken, additional challenges emerged at evacuation shelters and public facilities, including mosque courtyards, school buildings, and university facilities, many of which lacked adequate accessibility features. Participants and field observations indicated that many evacuation sites lacked adequate accessibility features, such as portable ramps and other mobility-support facilities. During their stay in evacuation shelters, persons with disabilities also encountered limited access to inclusive sanitation facilities, often having to queue for narrow and slippery communal bathrooms that increased their risk of injury and compromised their safety.

Physical barriers persisted even after floodwaters receded. During the recovery phase, thick mud deposits and large accumulations of debris from damaged household belongings obstructed neighborhood pathways. These hazardous environmental conditions generated spatial insecurity and anxiety among participants, particularly those with visual disabilities, leading some to delay returning to their homes or to avoid doing so altogether. As one participant explained:

"I am not yet willing to return home because I am afraid of slipping on the muddy roads and navigating through piles of debris." (P03, participant with visual impairment)

The findings indicate that inaccessible physical environments remain a major barrier to strengthening flood preparedness among persons with disabilities. Barriers were not limited to evacuation routes but extended across the entire disaster process, including access to early warning systems, evacuation shelters, and post-flood mobility. These findings are consistent with Yıldırım (2023), who reported that persons with disabilities frequently encounter difficulties accessing assembly points, evacuation shelters, emergency assistance, and early warning systems due to environmental barriers that fail to accommodate their specific needs. Similarly, Chang et al. (2023) identified access to disaster-related information and evacuation support as critical determinants of disaster preparedness among persons with disabilities.

These findings further support the argument advanced by Crawford et al., (2021) within the Disability-Inclusive Disaster Risk Reduction (DiDRR) framework, which conceptualizes disaster risk as the outcome of interactions between individuals' support needs and the characteristics of the environments in which they live. In other words, the vulnerability of persons with disabilities is not solely attributable to individual functional

limitations but is also produced by physical environments that fail to provide adequate accessibility (Xu et al., 2025). Xu et al. (2025) further show that environmental factors significantly influence disaster preparedness, even after controlling for individual characteristics. Therefore, strengthening flood preparedness among persons with disabilities requires both individual capacity-building and improvements to the physical environment (Malpass et al., 2019). Practical measures should include improving the accessibility of evacuation routes and shelters, providing ramps and accessible sanitation facilities, maintaining clear evacuation pathways, and ensuring that early warning systems are accessible and effective for persons with different types of disabilities.

3.2 Social environment and community capacity

The social environment in East Jakarta reveals a notable paradox. On the one hand, persons with disabilities rely heavily on immediate family members for evacuation and emergency assistance. On the other hand, neighborhood solidarity tends to weaken during severe flood events, as residents prioritize the safety of their own households under conditions of uncertainty and panic. This situation is further compounded by bureaucratic challenges in the collection and management of disability-inclusive data at the urban village level, where information systems remain fragmented and poorly integrated.

During the initial emergency phase, family members function as the primary first responders for persons with disabilities, making evacuation decisions and providing immediate assistance when floodwaters begin to rise. This pattern reflects a form of family-protection dependency, in which the safety of persons with disabilities is largely determined by the preparedness and responsiveness of family members or caregivers. In the absence of organized external evacuation support during the critical early stages of flooding, family members are often required to make rapid decisions to ensure the safety of persons with disabilities. Evacuation is commonly carried out through physically demanding measures, such as carrying or guiding individuals to safer locations, frequently without sufficient time to secure important documents or household assets.

“MAR’s evacuation depends on me. His older sibling carries him, and then we walk together to a safer place.” (P10, caregiver of a participant with an intellectual disability)

This strong reliance on family support is further reinforced by the tendency of households to prioritize the safety and needs of their own family members during emergencies. Although local communities are often characterized by strong social cohesion and mutual support, field observations revealed that as floodwaters rise rapidly, residents tend to prioritize household safety and asset protection. This shift toward self-preservation during crisis situations increases the likelihood that persons with disabilities who live alone, or whose family members are absent at the time of flooding, may become socially isolated and overlooked during evacuation efforts.

These social challenges are further complicated by the prevalence of evacuation-delay behavior among residents, including some households caring for persons with disabilities. Local volunteers frequently encounter resistance from residents who refuse to evacuate when floodwaters remain at waist level, often because they are reluctant to leave their homes and possessions unattended. Emergency assistance is commonly requested only later in the night, when floodwaters have reached roof level and electricity has been shut down by the state power company. Such delays not only place persons with disabilities at greater risk due to mobility limitations and reduced visibility during power outages, but also endanger the safety of volunteers who must conduct rescue operations in fast-moving floodwaters within narrow residential alleyways.

“Residents usually refuse to evacuate until the floodwaters become extremely high. Then, late at night, they suddenly call and say, ‘I’m trapped by the flood.’ Meanwhile, we as

volunteers have limited resources and must repeatedly travel back and forth using rescue boats.” (FGD participant, Cipinang Melayu)

“The neighborhood head usually rides around on a motorcycle to warn residents, saying things like, ‘Be prepared, the water level has reached Alert Level 3.’ However, many residents tend to underestimate the situation and do not evacuate immediately.” (P07, family member of hearing impairment)

This account also highlights the importance of considering disability-specific accessibility within community-based warning systems. Although direct verbal warnings from neighborhood leaders can help disseminate flood information, such approaches may not be equally accessible to all residents, particularly persons with hearing impairments. Therefore, community warning mechanisms need to use multiple communication formats to ensure that information reaches persons with different sensory needs.

At the institutional level, the study identified critical gaps in disability-inclusive data management within local administrative systems. Although *Dasa Wisma (Dawis)*, a neighborhood-based community welfare group, routinely collects information on vulnerable populations, disability-disaggregated information was not systematically incorporated into evacuation planning or emergency relief distribution. Instead, evacuation shelter managers and local government officials continued to rely primarily on household-based registration systems organized at the family level. As a result, the presence and specific needs of persons with disabilities in evacuation shelters were often not identified by health personnel or aid providers. This gap was particularly evident among persons with disabilities who sought refuge outside formal evacuation shelters, such as in the homes of relatives or other informal locations. Because these individuals were not captured within official registration systems, they faced a greater risk of being excluded from emergency food assistance, relief supplies, and other forms of humanitarian support.

“As far as I know, there were no persons with disabilities in the evacuation shelters. Perhaps only their mothers were recorded in the household registration data.” (P14, Community Disaster Preparedness Group)

This statement illustrates how household-based registration can obscure the presence and specific needs of persons with disabilities when individual disability information is not separately recorded.

“We did not receive any assistance, not even food aid. We could not go to the evacuation shelter to request food assistance. There was absolutely no support during the last flood.” (P08, caregiver of a participant with hearing impairment)

This form of structural exclusion is also evident in pre-disaster participation processes. One participant reported that age restrictions limited access to disaster preparedness training, with individuals over the age of 45 perceived as having reduced capacity to learn and participate in such activities.

“There was an age limit for participating in the training. The local government considered people over the age of 45 to have reduced capacity. Because of this age restriction, I was unable to participate in Braille training, even though I needed to learn it.” (P03, participant with visual impairment)

As a result, persons with disabilities, older adults, and individuals perceived as having functional limitations are indirectly excluded from these activities. In addition, prevailing social stigma among community members and local disaster actors often reinforces the perception that persons with disabilities do not need to be involved in disaster preparedness training because their participation is considered burdensome or impractical.

"It is quite difficult because involving persons with disabilities in preparedness training can be challenging. Usually, only their family members participate. Sometimes, someone simply pretends to be a person with a disability during simulations or training exercises. However, family members should definitely be included." (FGD participant, Cipinang Melayu)

This statement from FGD illustrates a gap between training practices and disability-inclusive participation. Although family members play an important supporting role, replacing persons with disabilities with simulated participants may limit opportunities for persons with disabilities to directly participate in preparedness activities and communicate their own needs. Family involvement should therefore complement, rather than replace, the participation of persons with disabilities.

Despite these social barriers, community support emerged as a critical factor sustaining disaster preparedness among persons with disabilities. This solidarity was reflected in a range of collective actions, including the active dissemination of early warning information and emergency assistance, such as guiding persons with visual impairments and supporting older adults through flooded areas to reach safe locations. At the neighborhood level, community organizations and residents also mobilized independently to establish communal kitchens, ensuring the availability of emergency food supplies for affected households. Following the recession of floodwaters, this collective spirit continued through community clean-up activities involving residents and Public Infrastructure Maintenance Agency personnel, who worked together to remove thick mud deposits and clear debris from damaged household belongings that obstructed residential access routes.

These initiatives and strong expressions of mutual support have been shaped by the collective memory of communities that has adapted to recurrent flooding over many years. At the same time, the local practice of organizing community-based food assistance through communal kitchens was also influenced by external factors, particularly the frequent delays in the distribution of government relief supplies. To address these limitations, volunteers from the Disaster Preparedness Village Program and other local actors increasingly strengthened communication and collaboration with non-governmental organizations (NGOs) in the post-disaster period to secure direct assistance for affected communities.

"In 2002, relief assistance took a very long time to arrive. We had to find our own solutions and set up a communal kitchen. The aid only arrived about two weeks after the flooding occurred." (FGD participant, Cipinang Melayu)

This retrospective account suggests that previous experiences of delayed external assistance contributed to the development of community-based coping and preparedness practices.

"I posted a message in the group saying, 'We need drinking water,' and immediately 20 boxes were delivered. The next day, someone sent 150 meal boxes. During floods, assistance can be mobilized very quickly—it only takes communication, and everyone immediately takes action." (P14, Community Disaster Preparedness Group Cipinang Melayu)

The interview findings indicate that persons with disabilities should not always be viewed as passive recipients of assistance during disasters. One participant with a hearing impairment demonstrated both the capacity and willingness to take an active role in responding to flood events within his community. In addition to evacuating independently, he assisted neighbors who required support during flood emergencies. His involvement extended beyond the emergency response phase and continued into the post-disaster recovery period, where he participated in community clean-up activities, including removing mud from roads, helping to move damaged belongings, and restoring access within the neighborhood.

"Yes, I have helped older people and assisted in carrying their belongings. After the flood, there is usually a lot of debris and garbage on the roads, so I help clean it up." (P01, participant with hearing impairment)

Within the social dimension, the findings indicate that family members, neighbors, local communities, and organizations of persons with disabilities play a crucial role in supporting the safety and preparedness of persons with disabilities during flood events. These social support networks facilitate access to disaster-related information, evacuation assistance, emergency aid, and the maintenance of daily living needs throughout the disaster period. This finding is consistent with Aslan & Şahinöz (2023), who argued that persons with disabilities in disaster-prone areas often rely heavily on family and community support due to the limited integration of government-led preparedness systems. Similarly, Sennoga et al. (2022) identified social networks as a key component of resilience among persons with disabilities in disaster contexts. Cong et al. (2023) further demonstrated that social engagement and strong community connections contribute positively to individual levels of disaster preparedness.

Beyond serving as a source of support, the social environment also determines the extent to which persons with disabilities can participate in disaster risk reduction processes. Pertiwi et al. (2019) demonstrated that organizations of persons with disabilities possess the capacity to contribute to disaster preparedness activities, disaster education, and the strengthening of community resilience when provided with adequate institutional support. Other studies have similarly emphasized the importance of actively involving persons with disabilities in disaster risk reduction planning, needs identification, risk management, and preparedness activities to ensure that DRR measures are responsive to their needs, experiences, and capabilities (Stjernholm et al., 2026; Takahashi et al., 2025). Nevertheless, persistent social stigma, limited access to disaster-related activities, inadequate integration of disability data, and insufficient provision of reasonable accommodations indicate that meaningful participation among persons with disabilities continues to face substantial structural barriers (King et al., 2019). These conditions suggest that disaster risk reduction practices in Indonesia remain largely top-down in nature and continue to position persons with disabilities as passive recipients of assistance rather than as active contributors to community preparedness and resilience (Lee & Chen, 2019; Pertiwi et al., 2020).

The findings suggest that an inclusive social environment involves more than the availability of family and community assistance. It also requires participatory spaces where persons with disabilities can contribute to decision-making and disaster-related activities. Previous research emphasizes the importance of collaboration between community leaders who understand disability-related needs and disability leaders who have knowledge of disaster risk reduction (Lerner & Praag, 2024; Villeneuve et al., 2021). Consequently, gaps in disability data management at the urban village level and the limited involvement of persons with disabilities in pre-disaster activities can be understood as manifestations of ongoing social exclusion within both bureaucratic systems and local communities.

These findings are consistent with the critique advanced by Villeneuve et al. (2021), who argued that the absence of standardized disability data systems and weak cross-sectoral coordination can increase the vulnerability of persons with disabilities and their caregivers during disasters. Such conditions are inconsistent with the principles of Disability-Inclusive Disaster Risk Reduction (DiDRR), which recognize persons with disabilities as capable actors who can contribute meaningfully to disaster risk reduction when supported by enabling environments. Strengthening disaster preparedness among persons with disabilities therefore requires integrated disability data systems, active participation in disaster simulations and pre-disaster activities, the removal of participation barriers, and stronger cross-sectoral communication and coordination mechanisms (Villeneuve, 2021). In the context of Jakarta, the importance of collaboration among communities, civil society organizations, and government institutions in enhancing

community resilience has also been highlighted by (Sunarharum, 2021) Furthermore, emphasized the critical role of institutional support, policy commitment, and adequate resource allocation in strengthening disaster resilience among persons with disabilities ((Cooper et al., 2021; Pamungkas et al., 2024) . Taken together, these findings suggest that strengthening the social environment requires not only protective forms of support but also participatory, inclusive, and empowerment-oriented approaches that promote both disability inclusion and institutional capacity-building.

3.3 Economic environment and financial vulnerability

Household economic conditions form a foundation that shapes how well families can manage risk and recover from the material losses associated with recurrent flood events. This finding reflects the disability-poverty-disaster cycle, which suggests that limited economic resources increase the vulnerability of persons with disabilities by restricting access to safer housing, protective measures, transportation, and other resources needed for disaster preparedness and recovery. At the same time, recurrent disasters can further erode household economic resources, creating a cycle that constrains preparedness and adaptive capacity (Aslan & Şahinöz, 2023).

Empirical evidence from East Jakarta indicates that recurrent flooding generates substantial and persistent financial shocks that undermine household economic stability. Based on participants' self-reported estimates, several households with family members with disabilities reported material losses ranging from approximately IDR 5 million to IDR 15 million following major flood events. These losses include damage to housing structures (e.g., doors, ceilings, and wall finishes), household appliances (e.g., water pumps, refrigerators, and televisions), and bedding, as well as additional post-disaster expenditures such as large-scale laundry costs required to clean clothing contaminated by floodwater and river sediment.

"The losses caused by flooding can reach around IDR 5 million. Mattresses, household appliances, and water pumps are often damaged." (P04, participant with visual impairment)

"We can spend around IDR 10–15 million when the flooding is severe, especially for repairing damaged parts of the house." (P03, participant with visual impairment)

Flood events also disrupt local livelihoods and income-generating activities. Many households with family members with disabilities depend on informal-sector employment within their communities as their primary source of income. Among the six participants with disabilities, only one held a permanent position as a Public Infrastructure Maintenance Agency worker, while the remaining participants were engaged in small-scale informal activities, such as operating neighborhood convenience stores, providing therapy services, or were unemployed and had no regular source of income. Likewise, family members of persons with disabilities were predominantly employed in micro-enterprises and other low-income occupations. This economic vulnerability is further compounded by the discontinuation of business capital assistance previously provided by the Social Affairs Office, as well as the absence of alternative economic support programs specifically targeting persons with disabilities.

In response to persistent economic pressures and recurrent flooding, households with family members with disabilities have developed various material adaptation strategies to cope with economic constraints and reduce the impacts of flood events. As a pragmatic effort to reduce future financial losses, these households consciously avoid purchasing expensive furniture, wooden furnishings, and upholstered household items that are highly susceptible to flood damage. Instead, they prefer inexpensive, lightweight plastic furniture that can be moved quickly to upper floors or to the homes of relatives located in safer areas. Many households also choose to leave ground-floor spaces largely unfurnished to minimize

potential losses during future flood events. Similarly, conventional mattresses—among the household items most frequently damaged by flooding—have been replaced with portable folding mattresses that can be relocated more easily during emergencies.

“The solution is simply not to buy too much furniture. When the floods come, it will only be damaged and thrown away. Nowadays, we use plastic furniture instead.” (P04, participant with visual impairment)

“The mattress was damaged by the flood and became dirty and foul-smelling. Our clothes were soaked, and the television and other household items were ruined. The experience was exhausting and stressful—it was mentally draining.” (P01, participant with hearing impairment)

This account shows that the economic consequences of flooding extend beyond direct financial losses and can also contribute to emotional stress from repeated damage and replacing household belongings.

“Our house used to be full of furniture, but now it is almost empty. We hardly have any furniture left. We no longer want to buy new furniture, and even if we do, we often cannot afford it. Whenever we consider buying something, we end up saying, ‘What’s the point? It will only be damaged by the next flood anyway.’” (FGD participant, Cililitan)

From a disaster economics perspective, the use of plastic furniture and foldable mattresses, and the practice of covering household belongings with large plastic sheets, represent coping mechanisms that emerge at the intersection of urban poverty and repeated flood experiences (Elisala et al., 2020). These strategies illustrate how households with persons with disabilities seek to minimize potential material losses despite their limited economic resources. Moreover, the constrained economic well-being of these households limits their ability to relocate to safer areas with lower flood risk, thereby reinforcing their continued exposure to recurrent flooding.

“As permanent residents, we have no choice but to adapt to these conditions because this is our own home. Tenants may have the flexibility to relocate, but we do not have that option. We simply have to remain here and cope with the situation.” (FGD participant, Cililitan)

These findings suggest that economic capacity is an important dimension shaping flood preparedness among persons with disabilities. Participants' accounts highlighted how limited income, unstable livelihoods, and recurring economic losses associated with flooding created constraints on households' ability to invest in preparedness and cope with disaster impacts. The deliberate minimization of household assets can be understood as a rational coping strategy aimed at preventing household poverty from being further exacerbated by the high costs of post-disaster recovery. These findings are consistent with Ssenoga et al. (2022), who identified economic capacity as one of the primary determinants of resilience among persons with disabilities in disaster contexts. Economic vulnerability affects not only the ability to meet basic needs during disasters but also access to resources that support preparedness, including transportation, communication, emergency supplies, assistive devices, and safer housing options.

These findings are further supported by Cong et al. (2023), who demonstrated that various forms of socioeconomic vulnerability at the community level contribute to lower levels of disaster preparedness. Similarly, Morshed et al. (2025) found that household economic instability represents a major barrier to adaptation to disaster risks, while Kundo et al. (2023) argued that reducing disaster vulnerability requires the integration of disaster risk reduction, climate change adaptation, and social protection systems capable of strengthening the capacities of vulnerable populations. Taken together, these findings

suggest that the economic needs of persons with disabilities cannot be addressed through post-disaster emergency assistance alone. Longer-term measures, including accessible employment opportunities, livelihood support, economic empowerment, adaptive social protection, and sustained recovery assistance, are also needed. In the Indonesian context, these objectives may be achieved by strengthening existing social protection programs based on the Integrated Social Welfare Database, and the Family Hope Program, and by expanding inclusive business capital assistance for households with family members with disabilities affected by disasters (Fitrinitia & Matsuyuki, 2023).

3.4 Interactions among environmental dimensions shaping disaster preparedness capacity among persons with disabilities

The findings indicate that flood preparedness among persons with disabilities is not shaped by any single environmental factor in isolation, but rather by the dynamic interaction of physical, social, and economic dimensions. Although all three environmental dimensions influenced disaster preparedness across disability groups, the relative importance of each dimension varied with participants' functional characteristics and support needs. This interaction was evident across all disability groups included in this study, although the specific forms of support required differed according to participants' functional needs. Participants with visual impairments depended primarily on accessible physical environments to facilitate safe mobility and independent evacuation; participants with hearing impairments relied on inclusive social support and accessible communication to enable meaningful participation in disaster preparedness and response; while participants with intellectual disabilities required continuous assistance from family members and community networks during evacuation and decision-making. These patterns should be understood as context-specific findings rather than fixed characteristics of particular disability groups. Across participants, however, economic resources served as a cross-cutting factor that shaped households' ability to reduce flood risks through measures such as improving housing conditions, protecting essential assets, making housing modifications, or relocating to safer areas.

This finding is consistent with Ton et al. (2019) who argued that disaster risk is influenced not only by the resources available to individuals but also by their ability to convert those resources into meaningful preparedness and response actions. Inaccessible physical environments increase the dependence of persons with disabilities on family members, neighbors, and local communities for evacuation assistance and access to disaster-related information. At the same time, families' and communities' ability to provide this support depends on their economic capacity. However, the effectiveness of this social support depended on the availability and capacity of the people providing assistance. Thus, physical barriers could increase social dependence, while limitations within social support systems could further increase the vulnerability created by those physical barriers.

These interactions were consistently observed across the study findings. For example, inaccessible evacuation routes and inaccessible shelter facilities (physical environment) increased reliance on family members and community volunteers (social environment) during emergency evacuation. However, delayed evacuation decisions, limited volunteer capacity, fragmented disability data, and social stigma often reduced the effectiveness of this social support. These challenges became even more pronounced among economically disadvantaged households that lacked private transportation, financial resources to relocate temporarily, or the means to repair damaged assistive devices and household assets. Consequently, physical, social, and economic constraints reinforced one another, creating cumulative barriers to disaster preparedness among persons with disabilities. For the detailed description, please refer to Figure 3 below.

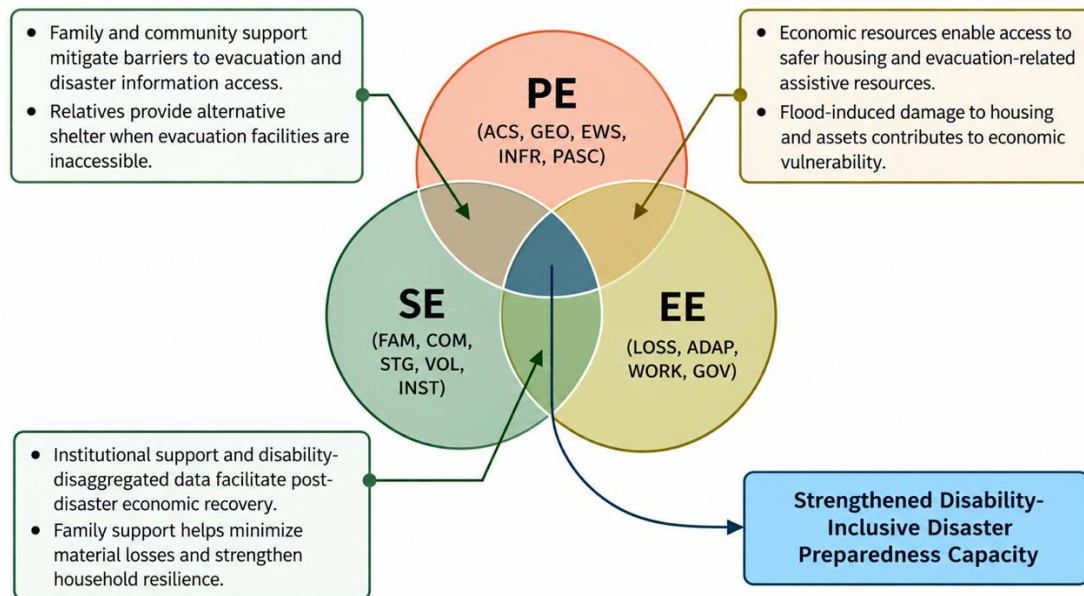


Fig. 3. Conceptual model of the physical, social, and economic dimensions shaping disability-inclusive disaster preparedness capacity

Conversely, improvements in one environmental dimension may strengthen preparedness through positive spillover effects across other dimensions. For instance, accessible evacuation infrastructure can reduce dependence on family members during evacuation, while stronger community networks facilitate the dissemination of accessible early warning information and collective evacuation support. Likewise, improved household economic conditions enable families to invest in preparedness measures, protect essential assets, maintain assistive devices, and access safer temporary accommodation during flood events. These findings demonstrate that preparedness capacity emerges from the dynamic interaction among environmental dimensions rather than from improvements within a single dimension alone.

These findings are consistent with the Disability-Inclusive Disaster Risk Reduction (DiDRR) framework, which conceptualizes disaster risk and preparedness as outcomes of the interaction between individual characteristics, support needs, and the environmental conditions in which individuals live (Crawford et al., 2021). The results further reinforce the findings of Ssennoga et al. (2022), Barker et al. (2022) and who demonstrated that the adaptive capacity of persons with disabilities is shaped by the interconnected relationships among environmental accessibility, social networks, and economic resources. Therefore, strengthening disaster preparedness among persons with disabilities requires a multidimensional approach that goes beyond providing accessible infrastructure to include simultaneous improvements in social capital and household economic resilience.

In East Jakarta, this interaction suggests that disability-inclusive preparedness cannot be strengthened through infrastructure improvements alone. Effective preparedness requires coordinated improvements in physical accessibility, social inclusion and community support, and household economic capacity. A multidimensional approach is therefore needed to reduce the cumulative barriers that persons with disabilities experience before, during, and after recurrent flood events.

4. Conclusions

This study demonstrates that flood preparedness among persons with disabilities in disaster-prone urban areas cannot be adequately explained solely by individual characteristics or disability types. Rather, preparedness is shaped by interactions among physical, social, and economic environmental conditions that can enable or constrain

preparedness, evacuation, and recovery. The findings indicate that inaccessible physical environments, limited social inclusion, and constrained household economic capacity reinforce one another, shaping both vulnerability and adaptive capacity among persons with disabilities.

This study has several limitations. The findings are based on a qualitative study involving a relatively small sample from two purposively selected flood-prone urban villages in East Jakarta, and the participants with disabilities included only those with visual, hearing, or intellectual disabilities. Participants also self-reported their experiences, which may have been influenced by recall bias or social desirability. In addition, both study sites had previously implemented disability-inclusive disaster management training, which may have influenced participants' preparedness experiences. These contextual characteristics may limit the transferability of the findings to other urban communities with different disaster preparedness contexts. Future research should compare communities with varying levels of disaster preparedness and examine how persons with other types of disabilities experience environmental barriers and preparedness needs across diverse urban flood settings.

Despite these limitations, the findings provide practical implications for disability-inclusive disaster risk reduction in flood-prone urban areas. Strengthening preparedness should integrate accessible physical environments, meaningful participation of persons with disabilities, stronger community networks, inclusive data systems, and adaptive social protection to reduce disaster risk and enhance urban resilience. Ultimately, disability-inclusive flood preparedness should not be treated solely as the responsibility of individuals, families, or local governments. It requires sustained collaboration among persons with disabilities, communities, civil society organizations, and government institutions to create accessible physical environments, inclusive social systems, and economic conditions that support long-term adaptive capacity.

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Author Contribution

Conceptualization, MA and RP; Methodology, BP; Software, MA; Validation, MA, RP, and BP; Formal Analysis, RP; Investigation, BP; Resources, RP; Data Curation, RP; Writing – Original Draft Preparation, MA; Writing – Review & Editing, RP; Visualization, RP; Supervision, RP; Project Administration, MA; and Funding Acquisition, BP.

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Ethical Review Board Statement

This study was approved by the Ethics Committee of the School of Environmental Sciences, Universitas Indonesia (Approval Number: KET-058/UN2.F13.D1.KE1/PPM.00/2025; Approval Date: August 27, 2025).

Informed Consent Statement

We obtained informed consent from all study participants.

Data Availability Statement

Not available.

Conflicts of Interest

The authors declare no conflicts of interest.

Declaration of Generative AI Use

During the preparation of this work, the author used ChatGPT-OpenAI and Gemini to help improve the academic tone, English structure, and clarity of the manuscript. After using these tools, the author thoroughly reviewed and edited the content as needed and takes full responsibility for the final version of the publication.

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