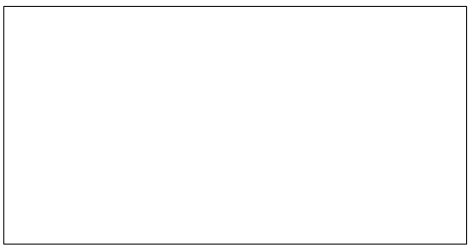

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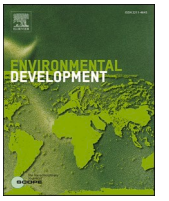

Living on top of water: Public attitude toward floating houses in North Jakarta, Indonesia

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1. Introduction

A strong historical connection between the sea and its people is key to understanding the growth and complexity of coastal cities. The sea pollinates culture, provides livelihoods and other opportunities which attract people to live, work and visit. Today, sea level rises (SLR) driven by climate change present a major threat to over 4285 coastal cities and agglomerations across the world (Barragán and Andrés, 2015) since the IPCC's most recent projection (2021) shows that by 2100, depending on the scenario, global mean sea level will rise by 0.28–1.01 m, and by 2150, it will rise by 0.37–1.88 m. One possible transformative solution is to bring urban developments onto the sea by building floating structures (Baumeister et al., 2021; Setiadi et al., 2020; Umar, 2020; Wang and Wang, 2020; Wang and Tay, 2011). This strategy does not involve land reclamation which often environmentally harmful nor use column to support space advancement. This innovative strategy, however, has received less attention from policymakers and the public than the other conventional strategies, such as protecting, adapting, and retreat. There are various political and commercial barriers, leading to the demise of many floating city proposals put forward since the 1950s (Wang, 2019). It is important, therefore, to understand why such a potentially transformative solution has often met with resistance.

A floating strategy refers to advancing space in terms of building, production area, infrastructure and natural environment which allow people or community to live on top of water (Baumeister et al., 2021). Wang and Wang (2020) suggest that it can help address the risks of sea level rise and other global challenges in energy, water and food securities. In this paper, we refer this strategy as *living on top of water*. The study does not include living in traditional stilt houses, as this represents an accommodating strategy, not a floating one.

Floating houses represent a manifestation of a floating strategy. They take the form of urban architectural and engineering innovations equipped with environmentally friendly infrastructure for generating energy, water, and food, as well as managing waste. These innovations have the potential to withstand sea-level rise. The principle for advancing in this space involves a range from simple pontoons to very large floating structures (VLFS), which can either be anchored to the seabed or moored to the land (Wang and Tay, 2011). More recently, the popularity of small modular floating (SMF) units, which can expand from a neighborhood to a city-wide scale, is increasing as an alternative to traditional engineering solutions (Wang et al., 2019). Floating houses come in various forms, from single-storey housing in neighborhoods to massive multi-storey infrastructure placed on the water's surface via floating platforms. Since floating houses adhere to the Archimedes principle, there is no weight limit, as long as the structure is properly calculated to ensure stability by considering buoyant force.

Drawing on the work of Bruyns and Hasdell (2017), we understand the sea not only as a threat but also an urban resource, and

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explore the role of the sea in advancing future urbanity. However, floating strategies are not well-known because many policymakers favor either reactive and incremental strategies to address SLR, such as building dykes, sea walls and other coastal protective infrastructures. Although hard-infrastructure approach can be effective in a particular area or context, it has technical and environmental limitations. For example, the development of hard-infrastructure may result in imbalance sediment transport or further accelerate land subsidence, which would then reduce the long-term performance of the infrastructure to protect against SLR and storm-surge (Takagi et al., 2016b; Slobbe et al., 2013; Andreas et al., 2018). In addition, the high costs of construction and maintenance pose a significant financial burden on local governments (Meng et al., 2020; Ekstrom and Moser, 2014) particularly in the Global South (Dijk, 2016; Garschagen et al., 2018).

Although the floating strategy is not the only solution, this strategy is important for two key reasons. First, SLR will not end in this century but will continue for millennia. The 6th Assessment Report of the IPCC, 2021 (p. 21) has stated that "in the longer term, sea level is committed to rise for centuries to millennia due to continuing deep-ocean warming and ice-sheet melt and will remain elevated for thousands of years". This leads to the second reason that a sustainable urban adaptation to SLR is required (Fu et al., 2017; Hurlimann et al., 2014; Mariano and Marino, 2018). Floating strategies advance aquatic urbanism, an emerging concept to integrating the body of ocean or water as part of the urban development strategy to effectively address SLR and improve the wellbeing of urban community at the same time. Floating complements other tactics (e.g. fortify, accommodate, and release) to enhance future urban resilience and promote sustainable adaptation.

However, whether living on top of water would be socially inclusive remains questionable. Some studies suggest that coastal populations who are vulnerable to SLR are reluctant to consider relocation and would rather stay and cope with the SLR, because of their strong sense of place and economic constraints. (Crichton et al., 2020; Jameroa et al., 2016; Simms, 2017; Solecki and Friedman, 2021; Song and Peng, 2017). There are also studies exploring the technological feasibility of living on the top of water is progressing (Abid et al., 2019; Baumeister et al., 2021; Liu et al., 2020; Radulovich et al., 2017; Wang et al., 2019; Wang et al., 2021). We acknowledge that the floating strategy has economic and technical issues to overcome, i.e. affordability and technological feasibility. Nonetheless, our study focuses on attitudinal dimensions, which have not been previously explored, i.e., the degree of people's acceptance to the idea of living on top of water via non-conventional, high-tech floating houses.

Currently, the floating strategy is mainly advocated by some scientists and industries. There is a lack of socio-economic research into people's response to this potentially transformative solution, especially in the Global South. We address this knowledge gap by exploring public acceptance of a floating strategy in North Jakarta. Our research aims to investigate the attitude of North Jakarta's residents toward floating houses. This analysis assesses the level of public willingness to accept this strategy as a long-term solution to SLR impacts, and identifies key factors that explain individual's support.

This study is important to inform decision makers to enrich policy options in dealing with SLR and the sinking of Jakarta. In general, it can inform and broaden the way policymakers in proposing development policy pathways particularly in dealing with future coastal urban development.

2. Literature review

Our main arguments are rooted in a migration theory in the field of population geography (Barcus and Halfacree, 2018). The movement of people from land-based to water-based settlements can be seen as a form of migration, which is a part of nature, society, individual and life course expressions. It adds to the legacy of classic "push" and "pull" factors at the origin and destination respectively. Tidal flooding, SLR, and the slow on-set risks they present in a particular location are push factors that may create pressures on inhabitants to move from the existing location, particularly when the risk is no longer tolerable. The potential benefits offered by living on top of water are pull factors for adopting this strategy.

People's migration decision is influenced by cognitive mechanisms that are related to (i) place utility, (ii) satisficer, (iii) people-place attachment, and (iv) stress (Barcus and Halfacree, 2018). The first concept highlights that individuals choose to live in places that give them higher overall utility. However, the meaning of utility is highly subjective based on individual perception. This leads to the second mechanism, which emphasizes the potential irrationality of migration because people may decide to migrate for satisfaction rather than optimality. The notion of people-place attachment focuses on the locational ties, which are shaped by sustained experience in a particular location and social relationships. The mechanism of stress suggests that the individual has a certain level of threshold to tolerate discomfort at their current location. Environmental change in people's neighborhoods is one source of stress that either leads to an increase in the threshold level – psychologically adapting to the changed environment - or migrating.

Living on top of water can be seen as a form of transformative adaptation, which is believed to be a radical option for addressing the impacts of climate change. Transformative adaptation involves multiple aspects and is oriented towards fundamental systemic change in the long term. Transformative adaptation brings about changes in habits and behaviour, ensuring ecosystem integrity, envisioning new communities, institutions and economies based on people-centric planning and at the same time being able to address the issue of inequality (Chu et al., 2019). Therefore, it is not about maintaining business as usual.

However, transformative adaptation is challenging when political and economic costs are prohibitive (Gibbs, 2016; Lo et al., 2020, 2024) and people's places and place attachment are compromised (Solecki and Friedman, 2021). Floating strategies are challenging if they present a transformative change. Solecki and Friedman (2021) argue that the transformation is likely to be resisted by individuals if it is too disruptive. The idea of living on top of water can potentially come into conflict with people's sense of place and therefore can be highly disruptive.

Place attachment can pose a barrier to transformational change. Studies of communities' preferences in coastal Lousiana (Simms, 2017), Samoa Island (Crichton et al., 2020), and Australia's peanut industry (Marshall et al., 2012) have shown that most communities

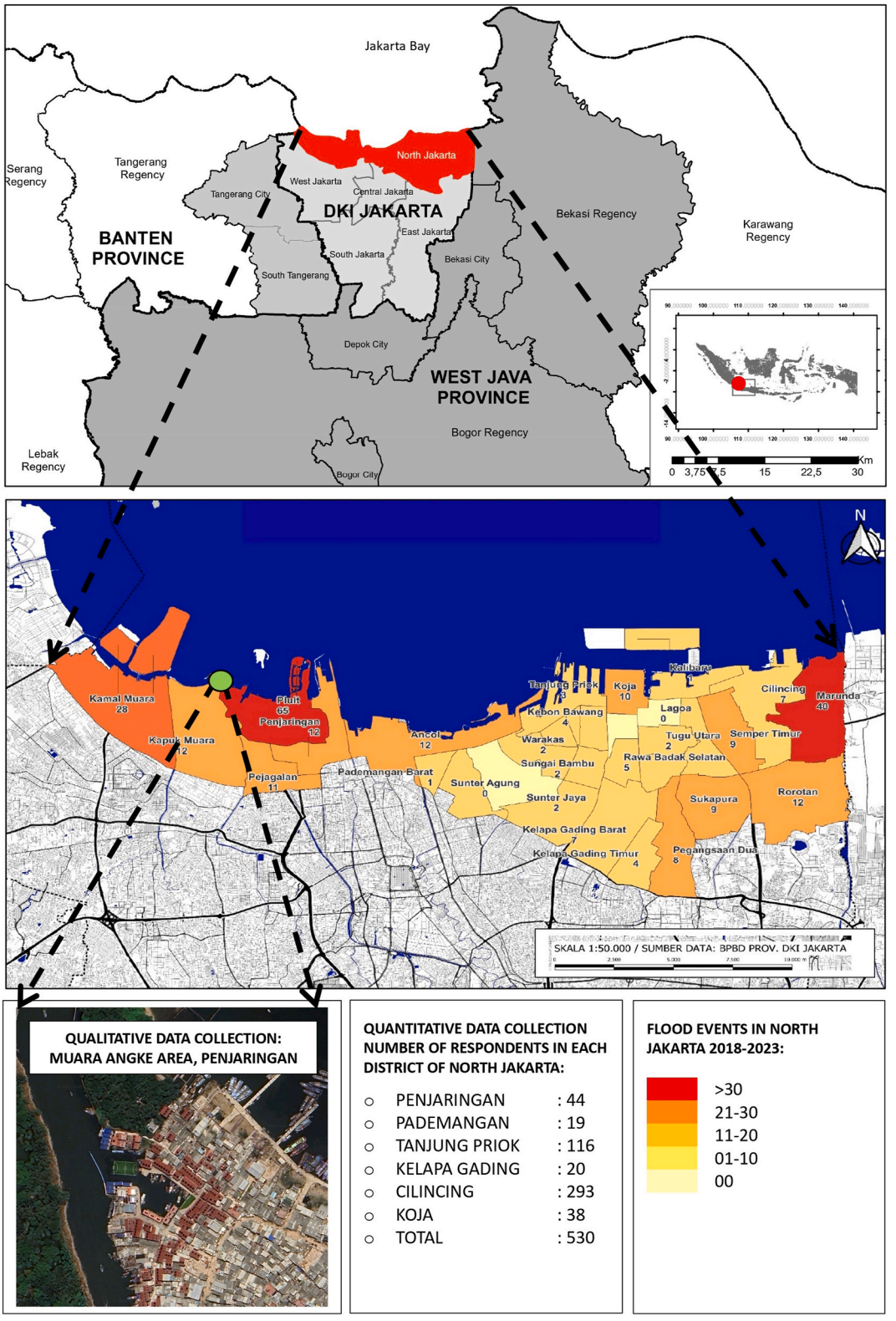

Fig. 1. Map of study area.

prefer adaptation to relocation of their settlements. Relocation is regarded as the least desirable option by some island and coastal communities that have a strong desire to stay in order to preserve their lifestyles, traditions, and livelihoods. Similarly, communities in Indonesia at risks of flooding are also reluctant to relocate and, instead, prefer renovations and incremental solutions (Some et al., 2009; Santosa and Therik, 2016; Sutiari et al., 2017). In addition, the local people have invested a lot of resources in improving assets and the environment. They have also built strong social ties among community members because of a common destiny and fate. All of these strengthen the individual's attachment to the place, which becomes a barrier to accepting transformative changes. Place attachment is likely be higher when they perceive governance to be less fair with uncertain outcomes. Solecki and Friedman (2021), for instance, find that the strength of place attachment is inversely correlated with perceptions of fair governance. In the face of governance failures and uncertainties, people tend to stay attached to their existing place to maintain a sense of stability.

In the wake of a post-disaster event, displaced people prefer relocation sites that are culturally and geographically close to their original neighbourhoods (Barcus and Halfacree, 2018; Jameroa et al., 2016; Lo and Cheung, 2016; Wang and Lo, 2022). If an unavoidable and devastating tidal flooding disaster occurs and people's location is often inundated by frequently recurring flooding, floating strategies may create a 'new location' for them, which would not be far from their existing place of living. In comparison to degraded neighbourhoods due to inundation, living on the top of water or floating at least could potentially deliver higher place utility, offer a way for coping with stress, and increase life satisfaction. Living on top of water has a potential to address the idea of livability and sustainability.

However, living on top of water presents two socio-economic risks (Setiadi et al., 2020, 2023). First, it may lead to gentrification in the coastal area. Floating houses may eventually become luxurious real estate project for the wealthier segments of community. There will then be an affordability issue for the low-income groups. Second, inhabitants of floating houses may find themselves constrained by the surrounding physical and environmental conditions – more than living on the land. There would be various constraints on people's access to infrastructure, resources and other places. For example, not everyone can swim, and living on water may be challenging and risky for elderly people and those facing mobility constraints. Floating houses in some locations would be directly exposed to storms and evacuation may be more difficult.

Socio and demographic attributes are another set of internal factors determining people's decision to live on top of water. However, not many studies have presented empirical evidence. Song and Peng (2017) examines the attitudes towards relocation in response to SLR in Panama Beach, USA. They show that adults aged between 18 and 45 are more likely to stay in the face of SLR, because people at this age range have stable income sources and good social networks to cope with risks. People with college degrees or lower qualifications are reluctant to move, and instead prefer individual-level adaptation strategies.

Kourtit et al. (2020) analyze the "body and soul" of cities that influence city attractiveness to their citizens. Both, the "body" and the "soul" are important. Living on top of water is a creative idea. Planners, architects, engineers, and scientists could design a modernized residential building or complex perfectly from the beginning as an individual or compound settlement, which is environmentally friendly, safe, adaptive and resilient from the harsh oceanic environment. The ideal design of a new floating settlement will likely solve some of the environmental problems by using renewable resources (e.g. solar energy). Nonetheless, this is not yet a mainstream urban development strategy. Living on top of water may only provide a better 'body' part of a city, but not the 'soul'.

3. Methods

We combined quantitative and qualitative methods in this study. Questionnaire data from the North Jakarta population was enriched with interviews with residents of the Muara Angke neighborhood in Penjaringan District. This working-class community is home to the first planned floating neighborhood, which has been operating for a year and a half.

3.1. Study area

This study was conducted in Jakarta, one of the 285 large cities and metropolitans in the world (Barragán and Andrés, 2015). Jakarta was the second fastest sinking city after Tokyo, with mean cumulative subsidence about 2 m from 1900 to 2013 (Deltares, 2015). Unlike Tokyo, the problem of sinking is deteriorating in Jakarta. Recent studies on the modelling of coastal flood in Jakarta demonstrate that in any scenario, sea level rise in combination with land subsidence will inundate North Jakarta up to 3 m by 2040 and the ocean penetrates the coastal area up to 10 km in land by 2050 (Latief et al., 2018; Takagi et al., 2016a). The combination of SLR and land subsidence is bringing a high risk of coastal inundation to 1.6 million people living in North Jakarta. Our study involves 29 sub-districts in North Jakarta. These sub-districts are located in six flood-prone Districts of North Jakarta (i.e. Penjaringan, Pademangan, Tanjung Priok, Koja, Cilincing, and Kelapa Gading) that are predicted to be inundated by 2050. Fig. 1 shows a map of the study area.

These Districts already fall below sea level. Three types of infrastructure, namely, dykes, polders, and pumps, have been constructed to help them adapt to SLR. Many coastal residents in Jakarta remain confident in the capacity of dykes and sea walls (Esteban et al., 2017). However, dykes and sea walls have not removed the threat of SLR. Setiadi et al. (2023) have detailed how SLR has impacted individuals in the coastal area of Jakarta in a variety of ways, with tidal floods being the most common phenomena, followed by a loss in land area and destroyed infrastructure. Even on a typical day, certain drainage networks in North Jakarta's urban kampong experience blockages. Tidal flooding disrupts people's daily activities, diminishes their living comfort, lowers the value of their property, and has psychological impacts on them.

The majority of residents had already taken precautions to safeguard their homes from moisture by making repairs. At the neighborhood level, residents worked with the local authorities to enhance walkways and roads. Some landowners have chosen to

relocate due to rising water levels. Certain waterlogged areas have been abandoned or repurposed for other uses, such as small-scale fish farming. Wealthier and higher-income groups experience less severe impacts from SLR. They are able to maintain their standard of living, and there is no significant observed degradation of the physical environment in their settlements. In locations like Mutiara Marina in Pademangan District or Pantai Indah Kapuk in Penjaringan District, there is no indication of declining property values. To the contrary, the influx of businesses is driving up house prices, making land values in these areas among the highest in the country. However, a specific area of Penjaringan District, known as Muara Angke, is adapting through developing stilt houses and floating houses.

3.2. Questionnaire survey

We conducted a questionnaire survey in these 29 sub-districts in North Jakarta. We developed a website dedicated to this survey and created an online questionnaire and shared the questionnaire link to all official sub-district leaders in the targeted study areas. These leaders were then requested to share the online questionnaire with members of their community via their internal communication channels. We also used paid services of social media (e.g. Facebook and Instagram) for promoting the survey to local community groups. Finally, we used informal networks (e.g. friends, professional contacts) which have access to community members of the study areas. We received 540 completed online questionnaires from residents in North Jakarta.

3.2.1. The structure of questionnaire

The questionnaire was built on an individual decision making framework that is influenced by both internal and external factors (e.g. socio-economic, culture, perception to risks, etc.). The survey questions did not require the respondent to have prior knowledge about floating houses. Pictures were presented to help the respondent envisage how these houses look like.

Apart from the demographic and socio-economic attributes of the respondents, we suggest that cultural resistance and public distrust could potentially influence people's attitudes toward this issue. Consequently, the questionnaire also sought information about existing behavioral responses to SLR, preferences for current strategies (such as adaptation or elevated house design), ongoing strategies, and the novel floating strategy as a solution to combat SLR and land subsidence.

In addition, risk perception may have an effect on people's attitude. We used a flood map released by Indonesian National Board for Disaster Management (BNPB) as a reference which indicates flooding risks for all parts of the study area. The category of risks is the function of hazard, vulnerability, and capacity indexes, which is available in InaRISK platform managed by BNPB.[1] Three sub-districts (e.g. Rorotan, Sunter Jaya and Marunda) are categorized as high risk, while seven sub-districts (e.g. Kapuk Muara, Sunter Agung, Tanjung Priok, Ancol, Kalibaru, Kelapa Gading Timur and Koja) are categorized as low risk. The remaining 19 sub-districts are categorized as medium risk category. Table 1 summarizes the structure of the questionnaire.

3.2.2. Data analysis

We identify factors that explain individual response to the floating strategy. A probit model was estimated, with people's stated willingness to try living in a floating house as dependent variable, which is a discrete and binary value. The model is specified as:

$$p(y_i) = \alpha_1 + \beta_j x_{j_i} + \beta_k x_{ki} \ldots + \beta_w x_{wi} + \varepsilon_{i1}$$

where $p(y_i)$ represents the probability of the respondent indicating interest in the idea. α is the intercept. β is a vector of regression coefficients. $x_{ji \ldots} x_{wi}$ denotes explanatory variables, which include those related to risk perception and risk awareness, actual flood risk, attitude toward the floating strategy, and the respondent's socio-economic characteristics $j \ldots w$, as listed in Table 3 below. ε_i is the error term. Because there are more male respondents than females in our sample (explained below), we conducted an additional analysis for the two groups separately. We performed this analysis using STATA/IC.

3.3. Qualitative data collection

To supplement our questionnaire data, we conducted open-ended interviews with residents of the Muara Angke neighborhood in Penjaringan District. This is the site of the nation's first planned floating community, which came into operation in 2024. The community consists of 16 floating houses, nearly 200 stilt houses, and a number of landed houses. Research participants were identified through a transect walk that began at the core of the floating neighborhood and moved outward (Fig. 2). This methodology allowed us to gather a range of perspectives from residents living in various housing types—floating, stilt, and landed. Our interviews included ten households in total: three from floating houses and seven from either stilt or landed houses.

We developed specific interview questions for each resident group. Interviews with residents of floating houses explored three main themes: their feelings and experiences, the perceived advantages and disadvantages of their homes, and their motivations for choosing to live in a floating home. For residents in stilt and landed houses, the interviews were structured around their perception of the floating houses in the neighborhood, their willingness to move into one, and the factors influencing their decision to either transition to a floating house or remain in their current home. The research was completed in June 2025.

[1] Please refer to the Inarisk website for details: https://inarisk.bnpb.go.id/metodologi.

Table 1
Structure of the questionnaire.

Theme	Key information collected
Socio-Economic characteristics	Age, Gender, Education, Average income, House ownership, Role in the household
Culture	Livelihoods, Expectation on quality of life, Length of stay, Flood coping strategy
Political	Trust to government, Response to government project, Sense security with the project
Perception to flood risk[a]	Flood experience, Risk awareness, Flood risk perception, Actual flood risk
Perception to living on top of water	Optimism about the idea, Effect to job security, Effect to quality of life
Willingness to live on top of water	Select preferred photo

[a] Confirmed/verified by actual flood risk map.

Table 2
Demographic profile of the sample.

Age	Percentage (%)	Sex	Percentage (%)
15–24	16.1	Male	62.0
25–34	32.1	Female	38.0
35–39	14.2	Total	100.0
40–44	11.9		
45–54	17.7	**Average monthly income**	
55–64	6.3	No Income	10.9
65 or older	1.7	0–209 USD	24
Total	100.0	210–350 USD	46.9
		351–488 USD	7.3
Highest qualification		489–697 USD	4.6
No qualification	4.0	>698 USD	6.3
High school	74.7	Total	100.0
Undergraduate	18.4		
Postgraduate	2.9	**Home ownership**	
Total	100.0	Private owner	58.7
		Renting	27.0
Household head		Parents' property	12.0
Yes	62.9	Others	2.3
No	37.1	Total	100.0
Total	100.0		

Table 3
Descriptive statistics for sense of security and floating risk perception.

	Mean	Standard Deviation
Sense of security		
A1. The giant city walls built on the coasts for preventing big waves and the sea level rise are secure	3.47	1.08
A2. This strategy is effective for the long term	3.31	1.14
Cronbach's alpha (A1-A2)	0.86	
Floating risk perception		
B1. Living on the top of water will place yourself into risk of sinking	3.60	1.24
B2. Living on the top of water will place yourself into risk of wave and seasick	3.79	1.28
B3. Living on the top of water will place yourself into risk of storm	3.84	1.20
B4. Living on the top of water will place yourself into risk of flooding	3.29	1.39
Cronbach's alpha (B1-B4)	0.85	

All items were measured on a five-point scale (1–5). Higher values denote higher sense of security (A1 - A2), and greater concern about the floating strategy (B1 – B4).

4. Result and discussion

4.1. Characteristics of survey respondents

Ten questionnaires were incomplete, reducing the sample size to 530. Sixty-two per cent of our respondents are below 40 years old, comparing to the 40.8 % among North Jakarta residents. Twenty-one per cent of our respondents completed undergraduate or postgraduate education, comparing to the 9.03 % among North Jakarta residents. The differences reflect a limit of our sample strategy, i.e., younger and educated individuals are often over-represented in online surveys. In Indonesia, males feel more comfortable in expressing opinion about public affairs and there are cultural norms against females doing the same (Williams, 1990). This explains the gender imbalance in our sample, which has 62 % males and 38 % females (Table 2). Consistent with the gender distribution, 62.9 % of respondents are head of the household (in Indonesia, male adults are usually the decision-makers in the family). This is reflected in our

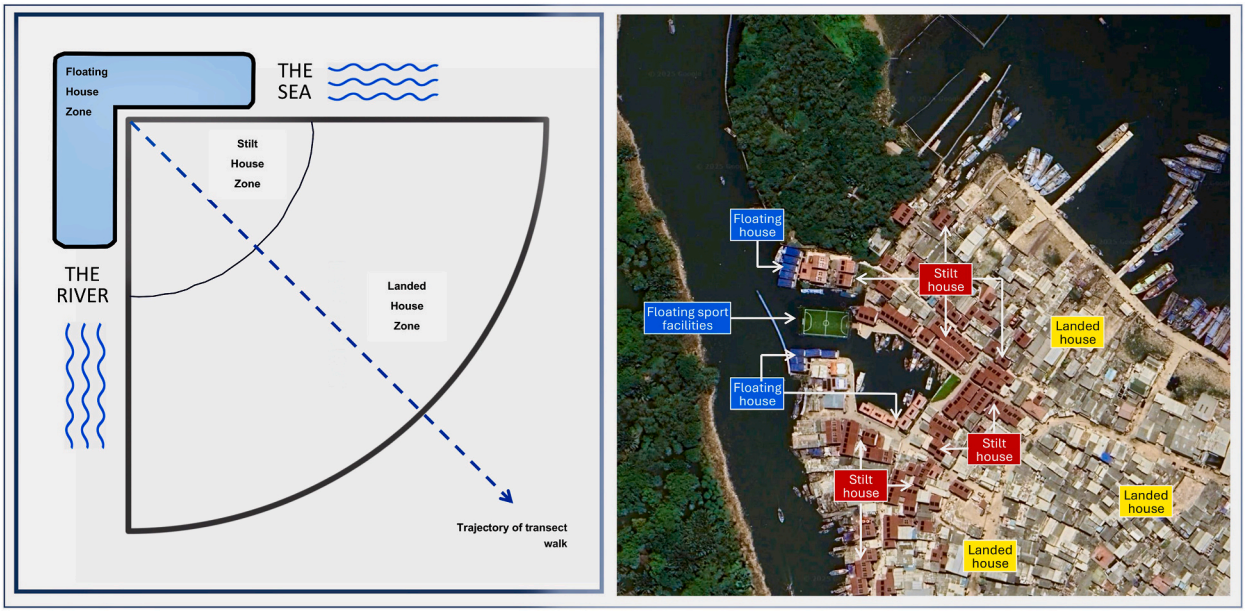

Fig. 2. (a) conceptual map of transect walk, (b) map of the surveyed area in Muara Angke.

sample - 22.4 % of the household heads are females but 77.6 % are males. Over half (58.7 %) own the house they currently live in. Close to half of sample (46.9 %) have an average monthly household income of IDR 3,000,000–5,000,000, which is equivalent to 210–350 USD. We are unable to find any comparable and recent estimate for North Jakarta. As a reference, the median household income for Indonesia in 2018 was IDR 2,485,750 which is equivalent to 173 USD (Bureau Central of Statistic of the Republic of Indonesia, 2021).

4.2. *Public response to sea level rise and the idea of floating house*

Our survey shows that a sizeable number of respondents agree with various proposed strategies dedicated to address tidal flood and threat from SLR. Respondents agree and do not oppose the development of giant sea wall (a fortify strategy) (80.9 %), moving to other higher land (a release strategy) (79.4 %), modification on their houses (an accommodating strategy) (76 %), and living on the top of water (a floating strategy) (48.8 %). It indicates that in general, while people in the study area have a preference for conventional adaptation strategies, some of them are interested in innovative and transformational ones, such as floating houses.

The questionnaire included two questions about the giant city walls built on the coasts of Jakarta for preventing big waves and the sea level rise. Results indicate that 15.4 % of respondents do not believe that this measure is safe, whereas 44.9 % are confident. Also, 21.6 % do not believe that this measure is effective, whereas 41.0 % hold the opposite view. These two questions yield an average 3.47 and 3.31 on a five-point scale, respectively, suggesting a moderately higher level of confidence (Table 3). A composite variable is

Table 4
Descriptive statistics of model variables.

Variable	Description	Range	Mean	S.D.
Independent variable				
Risk awareness	Aware of the sea level rise and land subsidence issues in Jakarta. Yes (1), No (0)	0–1	0.82	0.39
Flood risk perception	The respondent's home is safe from flood in the next 30 years. No (1), Otherwise (0)	0–1	0.49	0.50
Actual flood risk	Flooding risk of the district where the respondent lived based on flood maps. High (1), Low or medium (0)	0–1	0.21	0.41
Sense of security	Sum of two items (A1-A2). Higher values denote higher sense of security	2–10	6.78	2.08
Floating risk perception	Sum of four items (B1-B4). Higher values denote greater concern about floating	4–20	14.53	4.19
Optimism	Feeling optimistic about the idea of living on top of water. Yes (1), No (0)	0–1	0.20	0.40
Expected job security	Able to keep the job if living on top of water. Yes (1), No (0)	0–1	0.61	0.49
Expected quality of life	Able to maintain quality of life if living on top of water. Yes (1), No (0)	0–1	0.44	0.50
Age	Below 40 (1), Otherwise (0)	0–1	0.62	0.49
Sex	Male (1), Female (0)	0–1	0.62	0.49
Income	Average monthly income. Lower (< Rp 5,000,000) (1), Higher (> Rp 5,000,000) (0)	0–1	0.82	0.38
Education	Bachelor's degree or higher (1), Otherwise (0)	0–1	1.21	0.41
Household head	Yes (1), No (0)	0–1	0.63	0.48
Home ownership	Owner. Yes (1), No (0)	0–1	0.58	0.49
Dependent variable				
Willingness	Stated willingness to try living on top of water. Yes (1), No (0)	0–1	0.44	0.50

created by adding up these two items (A1 and A2). The Cronbach's alpha value exceeds the usual benchmark of 0.70, indicating a satisfactory level of reliability.

Four questions asked respondents if living on top of water will place them in the risk of sink, wave and seasick, storm, and flooding, respectively. At least 45 % of respondents indicated agreement in any of these statement (B1 – B4). The average scores range from 3.29 to 3.84, suggesting a public concern about the idea of living on water as an adaptive strategy, especially the first three items (Table 3). A composite variable is created by adding up these four items, which as a Cronbach's alpha value of 0.85.

Two additional binary questions captured respondents' risk perception. As many as 82 % of respondents are aware of the sea level rise and land subsidence issues in Jakarta (Table 4). Nearly half (49 %) of all respondents consider their home to be not safe from flooding in the next 30 years. Based on local flood maps, we identify 21 % of our respondents as living on an area of high flood risk. While living on top of water is potentially an effective adaption strategy, North Jakarta residents have mixed feelings about the idea. Only 20 % are generally optimistic, but most of them (61 %) believe that their current job would not be affected, and 44 % would be able to maintain the quality of life as living on the land.

4.3. Individual willingness to live in a floating house

This section aims to identify the factors that explain people's support to the idea of living in a floating house. Forty-four per cent of North Jakarta residents indicated interest in this idea. Table 5 displays the results of the probit analysis, including marginal effects. Marginal effects are interpreted in terms of a percentage change in the likelihood of reporting the dependent variable outcome for a one-unit or discrete change in the independent variable.

Younger respondents are more receptive to the idea of living in a floating house. Those aged 40 or below are 12.4 % more likely to indicate a positive response to the creative housing idea. The opposite is true for household heads, who are 16.8 % less likely to indicate a positive response. No other socio-economic variables produce statistically significant results. Higher interest is also found among people who feel optimistic about the idea and believe that they can maintain the quality of life as living on the land. These people are 23.2 % and 21.8 % more likely to indicate a positive response, respectively. None of the risk-related variables, including flood risk perceptions, awareness of sea level rise issues, and actual flood risk, had a statistically significant impact.

Because females are under-represented in our sample, we performed an additional analysis for each gender group to mitigate this sampling bias. As shown in Table 6, the results for the female group are slightly different. The variables representing household headship and optimism have lost their significant impact. Nonetheless, female respondents who have a higher income and are located at an area of low or medium flood risk are more willing to try living in a floating house. They are 21.8 % and 24.3 % more likely to indicate a positive response, respectively.

On the other hand, results for the male group presented in Table 7 are generally consistent with those for the full sample. However, male respondents' willingness is also associated with the belief that they can keep their current job running if moving to a floating house. Household heads are more interested, but this effect is significant in the male group only. This probably reflects their more pragmatic considerations about the ability to raise the family if they take the risk of adopting such a creative housing mode. Unlike the female group, actual flood risk did not predict willingness to live in a floating house.

Table 5
Probit Regression Analysis (full sample).

Variable	Coefficient	S.E.	Marginal effects			
			dy/dx	S.E.	95 % C.I.	
					Lower	Upper
Age	0.386***	0.132	0.124	0.041	0.043	0.205
Sex	0.212	0.138	0.068	0.044	−0.019	0.155
Income	−0.249	0.190	−0.080	0.061	−0.199	0.039
Education	−0.117	0.176	−0.038	0.057	−0.149	0.073
Household head	−0.523***	0.145	−0.168	0.045	−0.257	−0.080
Home ownership	0.163	0.128	0.053	0.041	−0.027	0.133
Actual flood risk	−0.261	0.159	−0.084	0.051	−0.183	0.016
Risk awareness	−0.130	0.162	−0.042	0.052	−0.144	0.060
Flood risk perception	−0.132	0.125	−0.042	0.040	−0.121	0.036
Sense of security	−0.018	0.031	−0.006	0.010	−0.025	0.013
Floating risk perception	−0.023	0.015	−0.007	0.005	−0.017	0.002
Optimism	0.723***	0.164	0.232	0.050	0.134	0.331
Expected job security	0.216	0.133	0.069	0.043	−0.014	0.153
Expected quality of life	0.677***	0.130	0.218	0.039	0.142	0.293
Constant	0.218	0.528				
p-value	0.000					
Pseudo R^2	0.176					
Log likelihood	−292.4					
Number of obs	518					

Dependent variable: Willingness.
*** significance at 0.01 level, ** significance at 0.05 level.

Table 6
Probit Regression Analysis (female sub-sample).

Variable	Coefficient	S.E.	Marginal effects			
			dy/dx	S.E.	95 % C.I.	
					Lower	Upper
Age	0.619***	0.225	0.193	0.066	0.063	0.323
Income	−0.698**	0.347	−0.218	0.105	−0.424	−0.012
Education	−0.277	0.299	−0.086	0.093	−0.268	0.095
Household head	−0.344	0.222	−0.107	0.068	−0.241	0.026
Home ownership	0.163	0.213	0.051	0.066	−0.079	0.180
Actual flood risk	−0.777***	0.277	−0.243	0.081	−0.402	−0.083
Risk awareness	0.307	0.262	0.096	0.081	−0.063	0.255
Flood risk perception	−0.192	0.206	−0.060	0.064	−0.185	0.065
Sense of security	−0.098	0.054	−0.030	0.017	−0.063	0.002
Floating risk perception	−0.015	0.026	−0.005	0.008	−0.020	0.011
Optimism	0.559	0.309	0.174	0.094	−0.010	0.359
Expected job security	−0.016	0.224	−0.005	0.070	−0.142	0.132
Expected quality of life	0.725***	0.220	0.226	0.063	0.103	0.350
Constant	0.709	0.868				
p-value	0.000					
Pseudo R^2	0.182					
Log likelihood	−108.1					
Number of obs	196					

Dependent variable: Willingness.
*** significance at 0.01 level, ** significance at 0.05 level.

Table 7
Probit Regression Analysis (male sub-sample).

Variable	Coefficient	S.E.	Marginal effects			
			dy/dx	S.E.	95 % C.I.	
					Lower	Upper
Age	0.234	0.179	0.071	0.054	−0.034	0.176
Income	−0.055	0.235	−0.017	0.071	−0.156	0.123
Education	−0.149	0.227	−0.045	0.069	−0.180	0.089
Household head	−0.876***	0.215	−0.265	0.061	−0.384	−0.146
Home ownership	0.153	0.168	0.046	0.051	−0.053	0.145
Actual flood risk	0.152	0.214	0.046	0.065	−0.081	0.173
Risk awareness	−0.239	0.222	−0.072	0.067	−0.203	0.059
Flood risk perception	−0.077	0.165	−0.023	0.050	−0.121	0.074
Sense of security	0.015	0.039	0.004	0.012	−0.019	0.028
Floating risk perception	−0.019	0.019	−0.006	0.006	−0.017	0.005
Optimism	0.759***	0.200	0.230	0.057	0.118	0.341
Expected job security	0.379**	0.179	0.115	0.053	0.011	0.219
Expected quality of life	0.752***	0.171	0.228	0.047	0.135	0.320
Constant	0.284	0.707				
p-value	0.000					
Pseudo R^2	0.230					
Log likelihood	−171.5					
Number of obs	322					

Dependent variable: Willingness.
*** significance at 0.01 level, ** significance at 0.05 level.

4.4. Qualitative analysis

In Muara Angke, the floating house neighborhood is a national government initiative led by the Ministry of Defense with support from a local university. This project was developed to tackle persistent local issues, including slum conditions, poverty, and environmental degradation, all of which are exacerbated by tidal flooding and SLR. The floating houses served as a transitional housing solution during the neighborhood's redevelopment. Families whose stilt homes were undergoing reconstruction were temporarily moved into the 16 floating units. Once their homes were rebuilt, the families returned, and the floating houses were occupied by the next group in a rotation that continued until the entire reconstruction project was finished.

Upon completion of the redevelopment, the government transferred ownership of the floating houses to vulnerable local residents, specifically impoverished, elderly families without land tenure. Our interviews with all floating house occupants revealed a high

degree of satisfaction. They view the floating houses as a form of full government subsidy, which provides them with permanent housing and reduces their living expenses. These residents live rent-free, and their utility costs are lowered by solar panels and a centralized, desalinated water system. Pictures of floating and stilt houses in Muara Angke are shown in Fig. 3.

Residents living in the floating houses described a mix of pros and cons. A significant advantage is that they can sleep more soundly, knowing their homes will simply rise with the water level, protecting them from high tides and flooding. On the other hand, the houses can be uncomfortably hot during the day because they are not equipped with air conditioning. Occupants also voiced concerns about strong waves and winds. Even with these challenges, the benefits of the location outweigh the negatives. Because the floating houses are attached to the existing neighborhood, residents can easily access casual jobs, which is a major benefit. This allows them to overcome the disadvantages, and as a result, they are satisfied with their living situation and have no intention of moving elsewhere. Our findings are summarized in Table 8.

Residents of stilt and landed homes hold a range of views on the floating houses. Those with a positive outlook are grateful for the project's ability to provide resilient and adequate shelter for the poor. They also view floating houses as a viable solution for individuals who need to live near the coast for their livelihoods but cannot afford land-based housing. One interviewee suggested that this development could also alleviate the neighborhood's high population density.

Fig. 3. Floating and stilt houses in Muara Angke.

Table 8
Perception of floating house residents in Muara Angke, North Jakarta.

Floating House Resident	Perceived advantages	Perceived disadvantages	Key motivation to live in floating house
#1 Female, Shellfish Peeler	Feel relived, sleep better, no longer worrying about floods	Affected by waves during ship passing and during extreme weather High indoor temperatures during the day (as the floating house unit is not equipped with air conditioning)	Received assistance/subsidy from a government program, reducing the costs of living.
#2 Male, Kite Seller	Not discussed	Facing risks of waves and strong winds during extreme weather as the location in outer part of the coast	
#3 Husband and Wife, Fish market workers	Living in an area that is economically strategic (easy to get casual jobs)	The house and road can rise up following the water level. Dizzy in the first couple of weeks and then can adapt to the condition.	

Attitudes toward floating houses are also influenced by employment, homeownership, and satisfaction with their current living situation. For instance, interviewees who rent their homes, are dissatisfied with rental costs, and expect lower living expenses from a floating house are more willing to move. In contrast, those whose livelihoods would be negatively affected by the move—such as pedicab drivers and food sellers—tend to prefer their land-based homes. The existing floating house design, they note, does not provide adequate space for activities like food preparation or the safe storage of a pedicab. Table 9 summarizes residents' attitudes toward floating houses, including hypothetical scenarios and their connection to livelihoods.

4.5. Discussion

Our survey shows that overall young people are more receptive to the idea of living above water. A possible explanation is that younger people have a stronger sense of adventure and face fewer physical barriers (Blanchflower, 2021). It may also be closely connected to their optimism towards the floating strategy and their capability to maintain their jobs while living on top of water. Young people in Indonesia, particularly the millennials, have become less interested to work in primary sectors than in tertiary sectors or creative industries (Bureau Central of Statistic of the Republic of Indonesia, 2018). They are understood as more creative, connected and confident than their predecessors. This shift in norms and culture may explain the potential of living on water for younger group in the near future. Our open-ended interviews also show that job types other than traditional marine and fisheries sectors have limited influences on people's willingness to live in a floating house.

The preference of our female respondents for living on top of water is associated with age, income, and expectation on better quality of life, although they are living on the low to medium flood risks area. It can be understood that young females with higher incomes have fewer constraints to move, and their desires to experience a better quality of life might contribute to their higher acceptance of the idea of living on top of water.

In contrast, household heads are less likely to see this idea as acceptable. There are two reasons. First, our survey shows that most of them are men and do not earn high incomes. It is possible that their preference reflects their concern about cost and affordability (development structure on water is estimated to cost about 500–700 USD per square meter). Second, a household head's decision is not only for themselves, but taking into account the needs of their family members, such as child, wife, and parents. It is possible that respondents assume that it would be very difficult to meet the different needs of everyone in the household, such as access to essential land-based facilities and services (e.g, schools, playgrounds, health centres).

Living on the top of water may become acceptable, but only in the medium-term future, because the age structure in Indonesia will remain young until 2045. Complicating this demographic trend is the shift in marriage age (older) and people's attitude toward family formation (e.g. child-free household). An important point to consider is that the decision to live in a floating house is not primarily based on a sense of security or risk. For example, despite Muara Angke being categorized as a medium-risk area, almost all interviewees were willing to live in a floating house. Our interview results suggest that people are more motivated by opportunities, such as government aid and subsidies than by security concerns. In Muara Angke, for instance, floating houses were provided to poor and vulnerable groups as a legacy of a neighborhood redevelopment project, initially serving as temporary shelters. While these arrangements are good for introducing the public to the idea of floating homes (Setiadi and Rachmawati, 2025), their long-term viability in Muara Angke is uncertain, as the community's poorest residents will likely be unable to afford maintenance.

In general, people in Jakarta do not oppose any strategies in dealing with SLR, particularly to building giant sea walls. However, the risk perception of some community members is not consistent with the actual risk they face. Based on a study of North Jakarta, Esteban et al. (2017:78) conclude that "residents have a high level of awareness about coastal hazards in general, given their frequent exposure to flooding events in the last few years, though they appear to think that the dykes protecting them are far stronger than what they actually are". Furthermore, Esteban et al. (2017:78) emphasize that "due to the rapid subsidence, it is likely that with every passing year their vulnerability is rapidly increasing, yet they might still think that they can manage to survive in the same way as they did during past events." In other words, people in the study area normalize and underestimate the risks of flooding and SLR.

The public have a preference for short term strategies (e.g. sea wall protection) for two reasons. First, these strategies do not cause substantial disruption to the place and the sense of place. They are unwilling to move and support protective adaptation strategies.

Table 9
Perception of stilt and landed house residents in Muara Angke, North Jakarta.

Stilt House Resident	Attitude to the floating house	Hypothetical Questions on Floating House		
		Willingness to live in	Reasons	Affecting jobs?
#4 Male, fish vendor	Positive. Develop floating house in this neighborhood is the right decision. No other option for them (inhabitants of the floating house) to afford landed house.	High	Working in fishery sectors needs to locate either on or near to the coast.	No -working in fisheries sector and require proximity to the coast
#5 Female, food seller	Positive. Feel grateful for the program (coastal urban regeneration though floating and stilt houses) helps the poor.	High	Willing to live on floating house if there is no land for settlement This area is easy for living or making money with informal jobs in the neighborhood.	Yes - need a larger place for preparing food and my food stall
#6 Male, Contract worker	Positive. Feel grateful for those inhabitants who are living in the floating house as they can have a better life, free from flood.	High	Willing to live on floating house if there is no land for settlement	No -job location is away from Muara Angke.
Landed House Residents				
#7 Male, Grocery storekeeper	Neutral. Aware of the floating houses in this area but never been that area	High	Currently renting but want to have their own house	No - can work anywhere
#8 Male, Garbage collector	Positive. Floating homes can solve density problem in the area.	High	Currently renting but want to have their own house	No
#9 Male, pedicab driver	Neutral. No specific view as they are pedicab *(becak)* driver, not fisherman.	Low	Although the floating house is flood free, the roads are often inundated.	Yes, It is not safe for pedicabs *(becak)*.
#10 Male, pedicab driver	Neutral. No experience living there.	High	Current house is sometime inundated by floods	Not sure

Solecki and Friedman (2021) state that flood risk or experience does not affect the strength of place attachment or support for adaptation. A study in Jakarta Bay (Bott et al., 2021) suggests that citizens of coastal zones are reluctant to relocate and, instead, tend to accommodate higher floods - one of the consequences of SLR and land subsidence. Local communities in Jakarta Bay tend to stay in their current settlement by adapting to SLR and supporting risk mitigation plans. This explains why elevating the house floor is commonly adopted by many coastal communities in North Jakarta. A similar case is also evident from a study on the decision of Lousiana coastal residents living in a vulnerable area (Simms, 2017). Despite the threat of cyclone, they repeatedly express a strong commitment to remain in place. A narrative of sense of place and community resilience are mixed together in this context and influence people's decision to live on top of water.

5. Conclusion

Indonesia's climate resilience development policy 2020–2045 (Bappenas, 2021) has identified North Jakarta as one of the priority locations in coastal sector adaptation. Coastal adaptation efforts focus on: (i) structural and vegetation-based protection, (ii) flood management control, and (iii) coastal settlement upgrading and relocation. As a form of transformational adaptation, floating houses represent another option for coastal settlement upgrading. However, costs and affordability issues must be addressed in order make this option viable for Indonesia as well as other coastal communities in the Global South.

Although floating strategies have received less community support than conventional hard-protective infrastructure, some community members hold a positive view, notably the younger ones. Based on this, policy makers need to reconsider the range of policy options in dealing with unavoidable SLR, particularly in climate-vulnerable coastal areas where business-as-usual strategies may eventually fail. As this strategy will require significant financial and fiscal investments, the prices of floating houses are likely to be high, in the absence of generous government subsidies or international funding. The risk of gentrification along the coasts also warrants further investigation.

CRediT authorship contribution statement

Rukuh Setiadi: Writing – original draft, Supervision, Resources, Project administration, Methodology, Funding acquisition, Data curation, Conceptualization. **Joerg Baumeister:** Funding acquisition, Conceptualization. **Alex Y. Lo:** Writing – review & editing, Methodology, Formal analysis. **Luna Perita:** Project administration, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data availability

Data will be made available on request.

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