Jurnal EnviScience Environment Science
Vol. 10 No. 1 Tahun 2026 Page 32-43
Article

Integrating Gender Analysis in Coastal Communities into Environmental Health Risk Assessment: Household Hygiene Behaviour

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Received date: 06 February 2026; Accepted date: 05 April 2026; Published: 29 April 2026

Abstract

Environmental Health Risk Assessment (EHRA) is widely used to evaluate environmental exposure and related health risks, yet most applications assume households as homogeneous units and rarely consider gender-differentiated exposure pathways. In coastal communities characterized by saline intrusion, inadequate sanitation, flooding, and climate-related stressors household hygiene practices are strongly shaped by gendered divisions of labor. This literature review synthesizes recent peer-reviewed studies to examine how gender roles influence exposure patterns within household hygiene practices in coastal settings. A thematic analysis was conducted to identify differential exposure pathways, risk distribution, and structural determinants affecting women and men. The review reveals that women, as primary managers of water, sanitation, and caregiving tasks, face higher frequency and duration of exposure to microbiological and chemical hazards, while men's exposure is more commonly linked to infrastructure-related or occupational activities. Conventional EHRA frameworks rarely disaggregate exposure by gender, potentially underestimating intra-household risk variability. Integrating gender analysis into EHRA improves the accuracy of risk characterization and supports more equitable environmental health interventions in vulnerable coastal communities.

Keywords: Environmental Health Risk Assessment; Gender; Coastal Sanitation; Household Hygiene; Exposure Pathways.

1. Introduction

Environmental Health Risk Assessment (EHRA) is a systematic framework widely used to identify environmental hazards, assess exposure levels, and characterize potential risks to human health. Over the past decades, EHRA has become a critical tool in environmental health policy, particularly in regions facing high ecological vulnerability such as coastal areas. Coastal communities are exposed to complex environmental pressures, including limited access to clean water, inadequate sanitation infrastructure, and poor waste management practices, all of which significantly affect public health outcomes (1). In such contexts,

community behavior plays a central role in determining environmental health conditions, making behavioral factors essential components of risk assessment.

Household hygiene behavior represents a key interface linking environmental exposure to health outcomes. Practices such as water handling, sanitation management, and personal hygiene are shaped not only by environmental conditions but also by socio-cultural and structural factors. (2) demonstrate that sanitation behavior in coastal communities is influenced by multiple determinants, including socio-economic conditions, infrastructure availability, and gender roles within households. Furthermore, empirical evidence indicates that hygiene behavior has a significant association with health outcomes, such as stunting, emphasizing the importance of behavioral factors in environmental health risk pathways (3).

Despite its strengths, conventional EHRA approaches tend to adopt a technocratic perspective and often treat households as homogeneous units of analysis. This assumption overlooks intra-household differences in roles, responsibilities, and exposure patterns, which are frequently structured along gender lines. In many socio-cultural contexts, women are primarily responsible for domestic tasks such as water collection, sanitation maintenance, food preparation, and caregiving, resulting in more frequent and prolonged exposure to environmental contaminants. Gender studies highlight that women often experience greater vulnerability due to unequal access to resources, information, and decision-making power (4).

Moreover, gender dynamics extend beyond the division of domestic labor and reflect broader power structures within society. Gender inequality can limit women's capacity to access adequate sanitation facilities or participate in environmental decision-making processes. Evidence from various socio-cultural contexts shows that women often face structural constraints that affect their physical and mental well-being, particularly in situations of vulnerability and crisis (5). Additionally, women's experiences are shaped by intersectional factors such as socio-economic status, cultural norms, and marginalization, which further compound environmental health risks (6).

However, the integration of gender analysis into EHRA remains limited, particularly in the context of coastal communities. Most existing studies emphasize environmental and technical parameters while neglecting the social dimensions that shape exposure and vulnerability. This gap may lead to incomplete risk estimations and less effective intervention strategies. Therefore, this review article aims to integrate gender analysis into the EHRA framework by focusing on household hygiene behavior in coastal communities. Such an approach is expected to provide a more comprehensive understanding of environmental health

risks and support the development of more equitable, context-sensitive, and evidence-based interventions.

1.2. Literature Gaps: Gender Neutrality and the Limits of Conventional EHRA

Despite growing recognition of social determinants in public health, mainstream EHRA applications remain largely technocratic and implicitly gender-neutral. Exposure assessments typically rely on aggregated household data, standardized contact assumptions, or generalized behavioral parameters, thereby obscuring differentiated exposure pathways within households and reinforcing the assumption that risk is evenly distributed among members. In practice, however, sanitation and hygiene behaviors are shaped by socially constructed roles, particularly gender, which influence the frequency, duration, and intensity of contact with contaminated environmental media. Empirical evidence from coastal sanitation studies highlights that behavioral patterns are strongly associated with socio-cultural structures, including gender roles and access to infrastructure, yet these dimensions are rarely incorporated into conventional EHRA modelling (2). Consequently, existing risk assessments tend to prioritize environmental concentration metrics and toxicological thresholds while neglecting the socially structured interactions that mediate real-world exposure.

Another critical gap lies in the limited application of intersectional analysis within EHRA, particularly in coastal environmental health contexts. Gender intersects with socioeconomic status, age, education, livelihood, and geographic marginality, all of which shape vulnerability and adaptive capacity. In coastal settlements characterized by poverty, informal housing, and climate-related stressors, these overlapping factors may amplify cumulative exposure risks, especially for women who are primarily responsible for domestic hygiene management. Evidence suggests that hygiene behavior significantly influences health outcomes, yet such behavioral determinants are seldom disaggregated by gender or linked to broader structural inequalities (3). The absence of gender-sensitive and intersectional perspectives in EHRA not only limits the accuracy of risk characterization but also weakens the effectiveness of interventions. Therefore, there is a pressing need to reconceptualize EHRA through a gender-analytical lens, particularly in coastal contexts where environmental instability intensifies everyday exposure and reinforces unequal risk distribution.

1.3 Objectives of This Review

This review aims to examine how integrating gender perspectives can strengthen the Environmental Health Risk Assessment (EHRA) framework in the context of household hygiene practices in coastal communities. Specifically, it seeks to:

a. analyze how gendered divisions of labor shape exposure pathways;
b. identify gender-based patterns of risk distribution;
c. evaluate the limitations of gender-neutral EHRA approaches; and
d. propose the integration of gender-responsive indicators into key EHRA stages.

By reframing exposure as socially structured, this review bridges environmental health risk assessment and gender analysis, contributing to more accurate and equitable interventions in climate-vulnerable coastal settings.

2. Conceptual Framework

Environmental Health Risk Assessment (EHRA) provides a structured approach to evaluate the relationship between environmental hazards and human health through four key stages: hazard identification, exposure assessment, dose–response assessment, and risk characterization. However, conventional EHRA applications often treat exposure as environmentally determined while overlooking socially structured interactions with hazards. In coastal settings, risks such as contaminated water, poor sanitation, and tidal flooding are not experienced uniformly, as exposure is shaped by daily practices and roles within households. Evidence shows that hygiene behavior and environmental interaction significantly influence health outcomes, emphasizing the need to incorporate behavioral dimensions into risk assessment ((1); (7)).

A major limitation of EHRA lies in its assumption of household homogeneity, which obscures intra-household variability in exposure. Gendered divisions of labor play a central role in shaping these differences, as women are typically responsible for water management, sanitation, and caregiving tasks, leading to more frequent and prolonged exposure to environmental contaminants. Studies confirm that sanitation behavior in coastal communities is influenced by gender roles, socio-cultural factors, and infrastructure access ((2) ; (8)). Moreover, hygiene practices have been shown to directly affect health risks, yet these behaviours are rarely disaggregated by gender in conventional EHRA models (3); (9).

To address these gaps, integrating gender analysis into EHRA enables a more accurate understanding of exposure pathways and risk distribution. Gender, as a social construct, shapes division of labor, access to resources, decision-making power, and time-use patterns, all of

which influence environmental interactions. In coastal communities, women often experience higher cumulative exposure due to repetitive domestic activities and limited control over sanitation resources. Intersectional factors such as poverty, education, and environmental vulnerability further intensify these risks. Therefore, aligning with the objectives of this review, a gender-responsive EHRA framework is needed to: (a) capture differentiated exposure pathways, (b) identify unequal risk distribution, and (c) improve risk characterization through socially informed indicators. Such integration reframes exposure as both environmental and socially structured, supporting more precise and equitable environmental health interventions in coastal areas.

3. Methodology of Literature Review

This study employed a structured literature review to synthesize research on Environmental Health Risk Assessment (EHRA), gender analysis, household hygiene behavior, and coastal vulnerability. A systematic search was conducted using Scopus, Web of Science, PubMed, and Google Scholar to ensure interdisciplinary coverage across environmental health, gender studies, and sanitation research. Keywords included combinations of *EHRA*, *gender and sanitation*, *household hygiene*, *coastal communities*, and *exposure pathways*. The search primarily focused on studies published within the last 10–15 years, while seminal works were included to support theoretical grounding. Backward citation tracking was also applied to identify additional relevant studies. This approach follows established guidance for systematic and transparent literature reviews ((10); (11)).

Studies were included if they were peer-reviewed, relevant to environmental health risks or hygiene behavior, and addressed gender dimensions explicitly or implicitly, particularly at the household level in vulnerable or coastal settings. Both empirical and conceptual studies were considered to capture diverse perspectives on exposure and risk. Studies focusing solely on clinical outcomes or unrelated occupational risks were excluded. The analysis employed a qualitative thematic synthesis to identify patterns in gendered exposure pathways, sanitation behavior, and risk distribution. Evidence shows that hygiene practices and water–sanitation conditions significantly shape health risks, while gender roles influence exposure frequency and vulnerability ((7); (8)). By integrating thematic coding and gender-based comparison, this review highlights how conventional EHRA models may overlook socially structured exposure differences, supporting the development of a more gender-responsive risk assessment framework.

4. Results and Thematic Discussion

4.1 Gendered Division of Hygiene Labour

The reviewed literature consistently demonstrates that household hygiene practices in coastal communities are strongly shaped by gendered divisions of labour, which in turn influence differentiated exposure pathways. Women are typically responsible for routine domestic activities such as water collection, sanitation management, cleaning, and caregiving, all of which involve frequent contact with potentially contaminated water, waste, and surfaces. In contrast, men are more commonly engaged in infrastructure-related tasks, such as constructing or repairing sanitation systems, resulting in less frequent but occasionally high-intensity exposure. This pattern reflects how socially structured roles determine interaction with environmental hazards rather than exposure being purely environmentally driven (8); (2).

These gendered roles produce unequal exposure dynamics, where women experience more continuous and cumulative contact with environmental risks, particularly in coastal settings characterized by poor sanitation, tidal flooding, and limited access to clean water. Evidence indicates that hygiene behavior and water–sanitation conditions are major determinants of health risks, especially through repeated exposure to microbiological contaminants (7); (9).

From an EHRA perspective, this distinction between chronic, routine exposure (predominantly experienced by women) and episodic exposure (more common among men) is critical but often overlooked. Conventional EHRA models tend to rely on aggregated household assumptions, thereby masking intra-household variability in exposure frequency and duration. As a result, cumulative risks associated with repetitive domestic hygiene practices may be underestimated, particularly among women who bear the primary responsibility for sanitation and caregiving. Integrating gender analysis into EHRA is therefore essential to capture these socially structured exposure differences and improve the accuracy of environmental health risk characterization.

4.2 Differential Exposure, Health Outcomes, and Structural Determinants

The reviewed literature converges on the finding that exposure pathways within households are not uniform but socially structured, particularly by gendered divisions of labour. Studies across WASH and coastal sanitation contexts consistently show that women's routine involvement in water management, sanitation, and caregiving leads to

higher frequency and longer duration of contact with contaminated environmental media, while men's exposure tends to be more episodic and task-specific (8)(2). This synthesis indicates that exposure is not merely determined by environmental concentration but by patterned daily practices, reinforcing the limitation of EHRA models that rely on aggregated household assumptions. Consequently, gendered labour structures systematically shape differentiated exposure pathways that remain underrepresented in conventional risk assessment.

A cross-study comparison further reveals that these differentiated exposure patterns translate into uneven health burdens. Evidence from global WASH assessments and hygiene studies demonstrates that repeated exposure to contaminated water and inadequate sanitation is strongly associated with diarrhoeal diseases, skin disorders, and gastrointestinal infections (7); (9). Importantly, the literature highlights that women's continuous domestic exposure, combined with caregiving responsibilities, creates cumulative risk profiles that are both biological and psychosocial in nature. This suggests that health risks are not only a function of hazard presence but also of exposure intensity over time, which is often underestimated in models using average exposure assumptions.

In addition, the literature consistently emphasizes that gendered exposure is embedded within broader structural determinants. Comparative findings show that poverty, limited access to clean water, low education levels, and patriarchal decision-making systems jointly constrain women's ability to mitigate environmental risks, despite their central role in household hygiene management (8); (7). This synthesis demonstrates that environmental health risks are co-produced by ecological conditions and social inequalities. Therefore, without integrating gender and structural dimensions into EHRA, risk characterization remains incomplete, potentially obscuring cumulative exposure burdens and leading to less effective and inequitable intervention strategies in coastal communities

5. Integrating Gender into the EHRA Framework

The reviewed literature consistently demonstrates that environmental health risks in coastal households are not evenly distributed but are socially structured through gendered roles,

responsibilities, and power relations. Women's dominant involvement in household hygiene activities—such as water collection, sanitation management, and caregiving—results in more frequent and prolonged exposure to environmental hazards compared to men. However, conventional Environmental Health Risk Assessment (EHRA) frameworks largely assume household homogeneity, thereby overlooking intra-household variability in exposure and risk distribution. This limitation has been widely noted in WASH and gender studies, which highlight that environmental risks are mediated by social practices rather than purely environmental factors (8); (7).

A synthesis of the literature suggests that integrating gender into EHRA requires reconceptualizing hazard identification as activity-based rather than purely environmental. Hazards such as contaminated water, sanitation waste, and chemical residues become meaningful risks only when linked to specific daily practices. Since these practices are gendered, exposure is inherently relational and socially mediated. Studies on sanitation behavior in coastal communities confirm that interaction with environmental hazards is strongly shaped by socio-cultural roles, infrastructure access, and behavioral routines (2). This implies that hazard identification must account for who interacts with hazards, how often, and under what conditions.

Exposure assessment represents the stage where gender integration yields the most significant methodological improvement. The literature consistently shows that exposure is a function not only of contaminant concentration but also of activity frequency, duration, and time-use patterns. Women's routine domestic tasks create chronic, low-dose exposure that accumulates over time, while men's exposure is typically episodic and linked to specific infrastructure-related activities. Evidence from hygiene and health studies further supports that repeated exposure to contaminated water and poor sanitation conditions significantly increases health risks (9).

Therefore, role-specific exposure estimation is essential to avoid underestimating cumulative risk burdens within households. The literature also highlights that vulnerability is shaped by both biological and social factors, which are insufficiently addressed in conventional EHRA models. Women often face compounded vulnerability due to reproductive health factors, caregiving burdens, limited access to resources, and restricted decision-making power. These structural inequalities influence both exposure and the ability to respond to environmental risks. Cross-study evidence indicates that gender inequality in water and sanitation systems reduces adaptive capacity and reinforces health disparities, particularly in

climate-vulnerable coastal settings (8). This suggests that risk assessment must incorporate social vulnerability alongside toxicological considerations.

Finally, integrating gender into EHRA significantly improves risk characterization and policy relevance. The literature converges on the need to move beyond aggregated household risk estimates toward gender-disaggregated analysis that captures intra-household risk gradients and cumulative exposure patterns. Such an approach enhances analytical precision while supporting more equitable and targeted interventions. Overall, this synthesis demonstrates that environmental health risks are co-produced by ecological conditions and social structures. Without incorporating gender-responsive indicators, EHRA frameworks risk underestimating chronic exposure, misclassifying vulnerable groups, and limiting the effectiveness of sanitation and health policies in coastal communities.

6. Policy and Research Implications

The literature consistently demonstrates that environmental health risks are socially structured and cannot be adequately addressed through gender-neutral EHRA approaches. Evidence from global WASH research shows that exposure pathways are shaped by behavioral practices and household roles, rather than solely by environmental contamination levels. Studies confirm that household water, sanitation, and hygiene (WASH) practices directly influence exposure to pathogens and health risks, highlighting the importance of incorporating social dimensions into risk assessment models (12); (7)).

From a policy perspective, the literature converges on the need for gender-responsive sanitation planning. Infrastructure effectiveness depends not only on technical design but also on alignment with daily usage patterns, particularly those shaped by women's roles in water management and hygiene. Systematic evidence shows that WASH interventions are more effective when they consider behavioral and social determinants, including gendered responsibilities and access to resources (13); (8).

From a research standpoint, there is strong agreement on the need to refine EHRA methodologies by incorporating behavior-based exposure assessment. Studies indicate that exposure is influenced by how water is collected, stored, and used within households, rather than by water quality alone. This suggests that integrating time-use, activity patterns, and hygiene practices into exposure modelling is essential for improving accuracy and reducing misclassification bias (12).

Furthermore, the literature highlights the importance of integrating quantitative and qualitative approaches to better capture the complexity of environmental exposure. Environmental risks emerge from the interaction between ecological hazards and social systems, including gender norms, labor divisions, and decision-making structures. Without such integration, risk assessments may overlook key mechanisms that shape exposure and vulnerability, particularly in coastal and resource-constrained settings (14), (8).

Finally, longitudinal perspectives are needed to understand cumulative exposure and long-term health impacts. Evidence shows that repeated exposure to contaminated water and inadequate sanitation contributes to persistent health burdens, particularly in vulnerable populations. This reinforces the need for EHRA frameworks that capture temporal dynamics of exposure rather than relying solely on cross-sectional estimates (15); (7). Overall, this synthesis confirms that integrating gender into EHRA is essential for improving both scientific validity and policy relevance. Without incorporating socially structured exposure pathways, risk assessments may underestimate cumulative risks and fail to inform equitable environmental health interventions in coastal communities.

7. Conclusion

This review demonstrates that conventional Environmental Health Risk Assessment (EHRA) frameworks remain limited by assumptions of household homogeneity and gender neutrality, which obscure socially differentiated exposure pathways. In coastal contexts, where environmental stressors such as poor sanitation, flooding, and water contamination are intensified, these limitations become more critical. Household hygiene practices—largely shaped by gendered divisions of labor create unequal exposure patterns, with women experiencing more frequent and cumulative contact with environmental hazards.

Synthesizing the literature, this study highlights that environmental health risks are co-produced by ecological conditions and social structures. Exposure is not solely determined by contaminant levels but also by daily practices, time-use patterns, and access to resources. As a result, aggregated EHRA models may underestimate cumulative risks and misrepresent intra-household vulnerability, particularly in climate-vulnerable coastal communities.

Integrating a gender analysis layer into EHRA—through activity-based hazard identification, role-specific exposure assessment, and differentiated risk characterization significantly improves analytical accuracy and policy relevance. Such an approach enables more precise identification of high-risk groups and supports the development of equitable,

context-sensitive sanitation and environmental health interventions. Ultimately, this review argues that incorporating gender into EHRA is not merely an ethical consideration but a methodological necessity. Without accounting for socially structured exposure, risk assessment frameworks risk perpetuating blind spots in environmental health science and limiting the effectiveness of policy responses in coastal settings.

8. References

1. L. Dupai, W. Widayati, L. Sara, and N. Yuniar, "Study on Community Health Behavior Coastal Society in Kendari City , Province of Southeast Sulawesi , Indonesia," *nternational J. Sci. Basic Appl. Res.*, vol. 36, no. 5, pp. 274–282, 2017, (Online). Available: http://gssrr.org/index.php?journal=JournalOfBasicAndApplied
2. Susilawati, R. H. Harahap, M. B. Mulya, and L. S. Andayani, "Heliyon Behavior model of community-based sanitation management in coastal areas : con fi rmatory factor analysis," *Heliyon*, vol. 8, no. September, p. e11756, 2022, doi: 10.1016/j.heliyon.2022.e11756.
3. Sunawati, Prihayati, and M. Ikhlasiah, "The Relationship of Environmental Sanitation and Hygiene Behavior with Stunting Incidents in Adults in 2024," *Nurs. Heal. Sci. J.*, vol. 4, no. 4, pp. 465–471, 2024, doi: https://doi.org/10.53713/nhsj.v4i4.408.
4. M. Langstieh and S. Sahu, "Patriarchal Constraints in Everyday Lives : Gender Roles , Matrilineality , and the Status of Contemporary Khasi Women," *J. Int. Women ' s Stud.*, vol. 28, no. 1, pp. 1–20, 2026, (Online). Available: https://vc.bridgew.edu/jiws/vol28/iss1/14
5. J. E. Igbe, "Journal of International Women ' s Studies Rural Banditry in North Central Nigeria : The Experience of Women in Affected Communities".
6. M. Naji, A. Mehrabi, E. Aghababaeec, and T. Orchard, "' I Painted It This Way Because I Belong Nowhere ': Using Body Mapping to Explore Gender , Subjectivity , and Resilience among Afghan Immigrant Women in Iran," *J. Int. Women ' s Stud.*, vol. 28, no. 1, pp. 1–25, 2026.
7. W. H. O. (WHO), *Guidelines on sanitation and health*. Switzerland: Licence: CC BY-NC-SA 3.0 IGO., 2018. (Online). Available: http://apps.who.int/iris.%0ASales,
8. B. A. Caruso *et al.*, "Water , sanitation , and women ' s empowerment : A systematic review and qualitative metasynthesis," *PLOS Water*, vol. 1, no. 6 (e0000026), pp. 1–48, 2022, doi: 10.1371/journal.pwat.0000026.

9. M. C. Freeman *et al.*, "PLOS GLOBAL PUBLIC HEALTH The impact of a demand-side sanitation and hygiene promotion intervention on sustained behavior change and health in Amhara , Ethiopia : A cluster-randomized trial," *PLOS Glob Public Heal.*, vol. 2, no. 1, pp. 1–25, 2022, doi: 10.1371/journal.pgph.0000056.
10. H. Snyder, "Literature review as a research methodology : An overview and guidelines," *J. Bus. Res.*, vol. 104, no. July, pp. 333–339, 2019, doi: 10.1016/j.jbusres.2019.07.039.
11. R. B. Petersen, N. Santesso, and G. H. Guyatt, "Systematic reviews of the literature : an introduction to current methods," *Am. Jpurnal Epidemiol.*, vol. 194, pp. 536–542, 2025, doi: https://doi.org/10.1093/aje/kwae232.
12. K. J. Mattos, L. Eichelberger, J. Warren, A. Dotson, M. Hawley, and K. G. Linden, "Household Water, Sanitation, and Hygiene Practices Impact Pathogen Exposure in Remote, Rural, Unpiped Communities," *Environ. Eng. Sci.*, vol. 38, no. 5, pp. 355–367, 2021, doi: 10.1089/ees.2020.0283.
13. A. Mertens *et al.*, "Articles Effects of water , sanitation , and hygiene interventions on detection of enteropathogens and host-specific faecal markers in the environment : a systematic review and individual participant data meta-analysis," *Lancet Planet. Heal.*, vol. 7, no. 3, pp. e197–e208, 2023, doi: 10.1016/S2542-5196(23)00028-1.
14. S. De Wit *et al.*, "Water , sanitation and hygiene (WASH): the evolution of a global health and development sector," *BMJ Glob Heal.*, vol. 9, no. e015367, pp. 1–17, 2024, doi: 10.1136/bmjgh-2024-015367.
15. O. Cumming *et al.*, "The implications of three major new trials for the effect of water , sanitation and hygiene on childhood diarrhea and stunting : a consensus statement," *BMC Med.*, vol. 17, no. 173, pp. 1–9, 2019, doi: https://doi.org/10.1186/s12916-019-1410-x.