

REVIEW

Water, economic systems, and mental health: A review of theorized relationships

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Abstract

Water insecurity—the lack of access to sufficient, safe water to meet all household needs—is an escalating challenge in all world regions. It is also associated with unfavorable mental health outcomes, like anxiety and depression. Often situated in the context of drought or general water scarcity, connections between water and mental health often manifest out of the unique characteristics of water—as an important economic and household resource, and one managed primarily by women. This article identifies recognized and theorized pathways between water insecurity and common mental health conditions, as mediated by broader socioeconomic systems in which households are embedded. To this end, we synthesize and connect different literature sets, including limited economic studies in a resource insecurity framework and a small but authoritative body of ethnographic literature. Our review identifies multiple proximate candidate pathways connecting water insecurity with mental health outcomes including community conflicts and/or perceived injustice around water sharing and upkeep, agricultural decline and unemployment, food insecurity or distress migration, decreased water intake, non-exposure to blue spaces, and stress around water management. The gendered role of water management is an overlapping theme across pathways, exposing women disproportionately to forms of conflict, violence, and injustice associated with the risk of common mental illness. In general, there are varied forms of marginalization that people experience within water-insecure contexts. Greater engagement between economics and other disciplines can lend additional theoretical pathways to empirically test the water and mental health connections, associated with people's water insecurity experiences.

Keywords: water insecurity, mental health, anxiety, depression, emotional stress, women, economics

Introduction

Common mental health conditions like anxiety and depression are a leading cause of disability globally [1] and tend to track generally with wider stresses of the social, cultural, political, environmental, and economic systems in which people are embedded in their daily lives [2]. A range of studies in lower-income countries has identified that water insecurity (inadequate access to sufficient safe water to meet all household needs) associates consistently with heightened expression of common mental illness symptoms [3–13]. Also, water insecurity is a clear marker of material poverty and is consistently linked to other forms of social, political, or economic marginalization, all of which are themselves associated with negative mental health outcomes [14–20]. Yet, global mental health interventions are almost always based on psychiatric or psychological views of mental illness [21] and rarely consider material improvements like water security as relevant interventions in support of mental well-being ([12]; cf. [9, 22]). Part of this could be attributed to both a paucity of relevant empirical evidence to

date and a lack of adequate theory building to provide testable hypotheses.

Over the last decade, a growing set of studies (much of it by social scientists, and most especially by ethnographers) has been theorizing pathways—or more specifically, mechanisms on theorized pathways—that could link poverty and other markers of household economic stress and water insecurity to possible common mental health impacts [4, 11, 14, 16, 23–26]. Specifically, these studies seek to understand why household water insecurity often predicts much worse mental health—most commonly reportedly for women [9, 27–29]. This is emergent literature, and there is still much empirical work to be done. The economics literature especially is yet to make any authoritative contribution in this regard, though it does provide a theoretical as well as an empirical basis to test such a connection.

Economists also have identified key relationships between economic crisis, unemployment (causing resource scarcity/

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uncertainty), and mental ill-health [30–34]. In fact, in the past few decades, mental health more generally has acquired visibility within the health economics literature. This effort produces two lines of evidence that test different types of connections. The predominate theme of inquiry revolves around mental health policy and management, especially the cost (whether monetary, individual, social, or community) associated with mental health delivery [35–42]. As noted by Knapp and Wong [43], the cumulative total of reports on economic evaluation of mental health care and treatment has grown from approximately 100 in 1999 to over 4000 in 2019; this reflects an improvement in the quality of evaluations with better access to data and development of more reliable scales. The other theme is the relationship between resource insecurity due to economic crisis among other factors, and elevated risks of common mental disorders like depression or anxiety [31–34, 44, 45]. The latter theme is arguably most relevant to hypothesizing possible water insecurity and mental health connections.

Based on the review of such indicative evidence from economics and juxtaposing and integrating it with the relevant social science literature, this article reviews contemporary literature and provides a framework for capturing multiple economic as well as non-economic pathways/mechanisms connecting water insecurity and worsening mental health.

Review Methodology

We adopted an integrative and systematic review approach. This included a systematic search from the following databases: Medline, EBSCO Host, and Web of Science. Based on our thematic focus, three sets of coincident keywords were used for the literature search: (1) economics, ecological economics, water economics; (2) water, drought, climate change, reduced rainfall; and (3) mental health, psychological health, depression, anxiety, violence, distress. In addition, we conducted a backward and forward literature search with each identified relevant article. The review was not date-limited and was inclusive of both qualitative and quantitative studies situated in any socioeconomic or geographical context. We then classified the resulting articles by general field of inquiry and co-citation to identify different literature sets linking household insecurity water experiences, economics, and common mental illness or other signals of distress.

Water insecurity, economics, and mental health: theoretical and empirical evidence

Economists have theorized the contribution of inequality and/or uncertainties associated with an economic recession, crisis, or climatic variability toward mental health outcomes [21, 30, 34, 46–54]. These investigations primarily fall in the domain of ecological and environmental economics and, broadly, connect poverty and resource insecurity or scarcity (e.g. in the form of declining income or job loss) to worse mental health outcomes. While household water insecurity itself is not the focus, this provides an evidential basis to conceptualize a relationship between water, as an environmental/economic resource, and mental health.

A few of these studies look at the issue of water and mental health, more directly. For example, Yazd *et al.* [55] in their longitudinal study across 14 waves in the Murray-Darling Basin of Australia, identify that reduced rainfall or drought has a worsening effect on farmers' mental health. Furthermore, farmers who had lower income during drought were much more likely to have worse mental health than in non-drought times. They conclude that unfavorable climatic conditions may pose threat to farmers' mental health. Sekhri and Storeygard [56] in their study in India link dowry deaths and related violence to weather variability and find that dry shocks consistently increase dowry-related harassment of women, which likely has a discouraging effect on women's emotional

health. Interestingly wet shocks were not found to produce such an impact. Chowdhury *et al.* [57] in their study in Bangladesh found that arsenic-contaminated water and longer distance to tube wells for water collection have worsening effects on an individual's mental health. In their systematic review of the circular poverty-mental health- poverty linkages, Ridley *et al.* [58] underscore the role of water scarcity in exacerbating mental illness, which in turn reinforces a poverty trap.

Beyond this, it is difficult to locate discussions around water insecurity in the economics and mental health literature. Also, in most existing cases where an association between water and mental health is theorized, the exact underlying mechanisms remain poorly identified and untested. For example, water is needed for agricultural as well as household products. It can cause reduced income for farmers and food insecurity for the entire community. Lack of water could also be stressful because water is a basic necessity for daily activities. Water scarcity can compromise the quality of living and hence, cause stress and worry. Moreover, water is a key element in multiple domains and can impact mental health uniquely but simultaneously through each of those domains.

In contrast with the economics literature, ethnographic literature, as reviewed previously by Wutich *et al.* [12] and Wutich and Brewis [59], has qualitatively observed a number of possible mechanisms by which water and mental health connect. Their review draws upon ethnographic studies, folklore, and drought research among others, to provide a strong rationale for theorizing water insecurity as a driver of mental health. Over two decades, some novel contributions have established water and mental health connections [3, 7, 9, 13, 14, 20, 23, 60–65].

Situated in varied contexts, these ethnographic contributions explicate multiple pathways, including economic elements, linking water insecurity with emotional distress and mental disorders [5, 6, 10, 11, 13, 27, 66–70]. In the Global South, water insecurity and mental health have been consistently associated [4]; this is supported by in-depth ethnographic and mixed-methods studies in Bangladesh [29, 71], Bolivia [20, 23], Ethiopia [4, 8, 9], Ghana [14, 72], Haiti [5, 6], Kenya [3, 7, 73, 74], Lesotho [13], Mexico [75], Uganda [76, 77], and in the Peruvian Amazon [11]. In the Global North, fewer studies have been conducted but the emerging literature suggests water insecurity is similarly associated with mental health outcomes [78–80]. As elsewhere, within this context, certain vulnerable groups experience particularly escalated vulnerability to water insecurity and mental stress. In a community-led participatory research study in Detroit, USA, Gaber *et al.* [79] developed an ethnographically grounded water security scale and evaluated its relationship with a standardized measure of psychosocial distress. The study found a significant relationship between three different measures of water insecurity and psychological distress, after controlling for various socio-demographic variables. In all contexts, lack of water can itself be a demoralizing effect for many and can affect mental health adversely. Shame and stigma can also be powerful social motivators for pursuing clean water [81]. This implies that failing to acquire clean water, may expose people to social pressure to uphold specific norms—a related stressor for mental health. Clearly, water insecurity can impinge on mental health through multiple pathways.

The following sub-sections systematically capture the multidisciplinary literature organized across key themes within the water and mental health literature. Table 1 also summarizes key evidence connecting water insecurity with worse mental health outcomes, from both economic and non-economic literature.

THE FOOD-WATER NEXUS AND MENTAL HEALTH

Several studies hypothesize water insecurity as a driver of poor mental health outcomes, independently as well as with mediation from/along with household food insecurity through overlapping

Table 1. Summary of key studies proposing connections between household water, economics, and mental health, organized by a general domain of inquiry.

Disciplinary domain	Scholarship	Methods	Findings/conclusions
Economics journals	Yazd et al. [55] [Australia], Sekhri and Storeygard [56] [India]	Quantitative modeling/ national longitudinal survey	Drought, reduced rainfall and less water allocations had significantly worse mental health. For women, they raise exposure to domestic violence and likely emotional health
Anthropology/ Ethnography Health/ interdisciplinary journals/ Anthropology journals	Achore and Bisung [14], Cooper et al. [60] [Ethiopia], Workman and Ureksoy [13], Lesotho et al. (2008) [Bolivia], Ennis-McMillan [18, 82] [Mexico]; Bisung and Elliott [3, 83] (Kenya); Mushavi et al. [76] (Uganda)	Qualitative research/ ethnographic	Water insecurity is systematically associated with emotional distress and low mental well-being
Economic Anthropology/ Ethnography	Wutich et al. [25], Brewis et al. [16], Wutich et al. [63, 64]	Qualitative research/ ethnographic/quantitative	Perceived injustice in the (economic) rules and norms of water distribution is associated with emotional distress and mental ill-health
Health/Geography/ Anthropology/Gender/ Interdisciplinary journals	Sultana [71] [Bangladesh], Stevenson et al. [9] [Ethiopia], Harris et al. [61] [Ghana and South Africa], Brewis et al. [5, 6] [Haiti], Choudhary et al. [12] [Nepal]	Qualitative/Ethnographic/ quantitative	Water insecurity has unique implications for women due to the gendered nature of household water management and surrounding social negotiations
Psychiatry/Medical journals	Luong et al. [84] [Australia]; Austin et al. [85] [Australia], Dean and Stain [86] [Australia] Friel et al. [87], Yap et al. [88]	Quantitative based on longitudinal/panel dataset/qualitative/ ethnography	Drought-driven water scarcity has negative consequences for the mental health of certain population segments
Environment/Ecology/ Psychology journals	Veisi et al. [89] [Iran], Boazar et al. [90] [Iran], Hashi [91] [Somalia], Bijani and Hayati [92] [Iran], Prakash et al. [93] [India]	Mixed method/ quantitative/ethnography	Water insecurity potentially affects mental health by creating social and community conflict around the management and sharing of water as the common good
Nutrition/Psychiatry/ Physiology journals	Luo et al. [94] [Taipei], Haghighatdoost et al. [95] [Iran]; Colleen et al. [96] [Finland], Pross et al. [97] [Helsinki], Edmonds [98] [United Kingdom], Armstrong [99] [USA]	Mostly quantitative and cross-sectional	Positive associations between water consumption /intake and positive mental health outcomes- mood and sometimes also cognitive functioning
Environment, Psychology, and Public Health Journals	Chen and Yuan [100] [China], Vert et al. [101] [Spain], White et al. [102] [multi-country]	Mixed method	Greater and consistent exposure to blue spaces and outdoor water environments is found to result in elevated mood and reduced stress.

pathways (see [7, 73, 74, 103–106]). Brewis and colleagues [5, 6] find associations between water and food insecurity in 27 global sites. In Kenya, Boateng *et al.* [73] report an association between water insecurity, food insecurity, HIV and depression among post-partum women and found that water insecurity predicts food insecurity at later time points. In Lesotho, water insecurity and food insecurity were significantly associated with depression and anxiety scores, though water insecurity was associated with anxiety and depression even when controlling for food insecurity [13]. Collins *et al.* [7] find that women experiencing water insecurity had to modify food-related behaviors, for example changing what was eaten and using money on water that would have otherwise been used to purchase food. Expenditure incurred to procure water was found to be associated with food insecurity and perceived stress in low- and middle-income settings [105]. Unlike most of these studies based in agricultural settings (e.g. [13, 73]), Maxfield [103] found that in urban India, controlling for food insecurity reduced the strength of the association between water insecurity and mental

wellbeing in urban slums. These studies highlight the importance of varied economic contexts in the water-food-mental health nexus.

WATER INSECURITY IN CONTEXT OF DROUGHTS

An important line of evidence within this water and mental health scholarship comes from studies done in the context of drought and climate change [12]. Here, there is some convergence between evidence from very limited economics (e.g. [55]) and relatively broad multidisciplinary literature. These works find drought-driven water scarcity to have negative consequences for the mental health of certain population segments, though outcomes vary to several socio-demographic factors [84–86, 107–109]. The proximate reasons include a range of factors- hunger, migration, disruption in family life, and so on, but the underlying cause is the scarcity of water as an economic and environmental resource and consequent crop failure leading to a decline in income for many. In fact, climate-induced migration is considered as a strategy to

cope with physical and mental health disruptions associated with water insecurity [110].

Vins *et al.* [111] in their comprehensive systematic review of 82 articles connecting drought experiences to mental health, suggest several pathways for drought to adversely affect mental health, particularly among vulnerable populations. In particular, economic effect and mitigation effect pathways were found to be well-supported in the literature. In the study using population-based panel survey data for Australia, Friel *et al.* [87] explain quantitatively how exposure to drought strengthens the association between food insecurity and psychological stress, with a general increase in stress level. Yap *et al.* [88] quantify the relationship between drought and mental health by modeling the impact of average daily rainfall on mental health indicators, again in the context of Australia. Their investigation finds a significant association between the two variables, however, it is found to vary spatially as well as temporally across seasons. In Australia, drought has also been associated with suicidality among farmers [112]. Using data from 1970 to 2007, Hanigan *et al.* [112] find a 15% increase in the relative risk of suicide among rural males aged 30–49 years when the drought index rose to the third quartile. In the context of an intensifying mega-drought in the arid U.S. West, social and material impacts engender negative emotions (including sadness, fear, worry, and anger) for farmers and water stakeholders [113].

CONFLICT/COOPERATION AROUND HOUSEHOLD WATER AND MENTAL HEALTH

Another important and substantial segment of literature potentially connects water with anxiety and stress in the production of social and community conflict, especially in contexts where water is used as a public good or common property [89–92, 114]. Though this literature does not directly look at mental health outcomes associated with conflict, it does suggest potential stressor for mental health outcomes for those involved in/affected by conflict. An analysis of large-scale survey data for countries from sub-Saharan Africa finds that inter-personal conflict both within and outside households was associated with some domains of water insecurity [115]. Specifically, water quality and reliability were significantly related to conflict with neighbors, particularly in the context of seasonal changes in rainfall. Often, with water being common property, a failure to set unambiguous rules for its usage leads to conflict, for example in Somalia, even though a traditional system to manage common pool resources is in place [91]. Elsewhere, people have been found to be inclined to appropriate benefits without meeting their obligations to manage the resource [93, 116–118]. Conflict among farmers regarding water sharing and management in rural areas of Iran, has been studied extensively [89, 90, 92]. In Lesotho, a community water committee collapsed after interpersonal conflict and confusion over the responsibility for decentralized water resources [119]. In contrast, even a modest investment in water infrastructure is found to considerably enhance the community's capabilities to avoid conflicts in the context of rainfall shocks [120]. Taken together, these studies address conflict associated with resource management but also suggest that better management of water as a public good can enhance cooperation and satisfaction, with potentially encouraging implications for their mental health.

WATER SHARING, JUSTICE, AND MENTAL HEALTH

The ethnographic literature in the past decade has pointed to the potential mental health consequences when people perceive injustice in the rules and norms of water distribution and provisioning, especially under conditions of water scarcity and insecurity [12]. For example, Wutich *et al.* [25] describe how the most economically vulnerable households in Bolivian squatter settlements experience shame and humiliation over what they perceive to be unfair rules and procedures for water sales, namely that water vendors can refuse to sell water in the small quantities—the only affordable

option. While this study explicates perceived injustice in rules and norms for market-based water provisioning, many communities around the world rely on *non-market* systems of water sharing to shield themselves from water insecurity [121]. In these cases, water norms for sharing water often stem from deeply held cultural values that obligate the sharing of water with others [122]. But intensifying and chronic conditions of water scarcity and insecurity often limit households' abilities to share water with others and necessitate refusing requests for water [118, 123]. These situations may cause extreme mental and emotional distress for both the person who is forced into a position of refusal, as well as for the person being denied water [63, 64]. While more research is needed to better understand the exact pathways of mental distress under such circumstances, one potential explanation is that distress stems less from the lack of water than from the violation of the culturally expected practices—including culturally-allowable refusals to transfer water—which undermines notions of justice and fairness. Brewis *et al.*'s [16] large study of households in rural Ethiopia, supports this explanation, showing empirically that levels of depression were predicted not only by participation in water sharing systems but especially by perceptions of being unfairly treated compared to other households. In a study of smaller samples but from multiple water-insecure sites, Wutich *et al.* [63, 64] also showed that participation in water-sharing systems was associated with emotional distress.

Importantly, many of these studies indicate that relative—and not solely absolute—inequality is a key driver of health outcomes. Foundational work on water insecurity [18, 20] underscores the importance of relative deprivation and highlight that perceptions of inequity are key predictors, that is, the lived experience and not just external hydro-ecological metrics are valid measures of distress. More recently, in another cross-sectional study of water collectors in Ghana, psycho-emotional distress was lower if people perceived that safe water facilities were equally distributed in the community [14]. Indeed, the exact pathways through which inequalities are localized [4] and embodied [11, 14, 29, 124, 125] have increasingly garnered attention. That is, most social science research situates health within the political economic and political ecologic context and is increasingly exploring how precisely such a context results in ill-health and disease. Syndemic theory, one such framework, iterates the various interfaces between social structure, resource inequities, and individual health [12, 13, 24, 73, 126].

HOUSEHOLD WATER INSECURITY AND GENDERED MENTAL HEALTH CONSEQUENCES

A number of these quantitative and qualitative studies of the stressful dynamics embedded in water poverty, are oriented through a gender studies lens, and highlight why water insecurity is more often associated with the worse mental health of women in particular (e.g., [61, 71, 127, 128]). For example, in rural Bangladesh, Sultana's [71] work captures multiple emotions that women experience during their role as household water managers and associated social negotiations. Sultana adopts a feminist political ecology approach to explicate lived experiences of conflict, fear, and stress while accessing water, especially for women who are primarily responsible for fetching water. Social and gendered relations are reproduced and re/negotiated in the process and emotions play a key role in it. Stevenson *et al.* [9] in their study in Ethiopia use a mixed method approach to demonstrate that women's responsibility to fetch or manage water can expose them to multiple health challenges. This work highlights the cultural embeddedness of water insecurity, that is, the emotional distress, strain, and shame that women may experience while fulfilling their gendered water-related obligations given that women who experienced more water insecurity also reported more symptoms of common mental disorders. Among the Six nations, women experiencing water insecurity and dissatisfaction with currently available water, reported feelings of guilt and shame and this affected their ability to engage in important cultural practices such as the preparation of traditional medicines [78]. In their study based

in Nepal, Tomberge *et al.* [129] explain how the physical burden of carrying water is associated with women's psychosocial health, generally causing emotional distress and reduced functioning in other activities. This relationship, however, was found to be moderated by terrain and women's personal health. In the context of climate change, women's mental health has been found to be particularly affected due to their traditional roles in managing community resources and in negotiating between household needs and resources such as land [130]. In fact, as Ajibade [131] observes, women are found to suffer from anxiety and stress in the context of any disaster (whether water flooding or water scarcity) which makes their caregiving role more challenging. Lack of water as well as coping with water insecurity are both gendered experiences [132].

A few studies have engaged this literature, using surveys and similar data, to test these suggested gendered mechanisms empirically in larger samples. Using data from geographically randomized surveys conducted in three high-poverty communities in Haiti found that inadequate household water insecurity is robustly associated with depression and anxiety among women in both rural and urban areas [5, 6]. As found in the case of a large nationally-representative sample of households in Nepal, limited household water access also translates into women's greater exposure to domestic and intimate partner violence [68], likely leading to a decline in their psychological and emotional health. An economic perspective can explain women's exposure to domestic violence through the intra-household bargaining dynamics over rights resources/property [133]. Through this lens, women's failure to meet their familial obligations (e.g. inability to manage household water as per norm) can weaken their position in the intra-household bargaining process and make them susceptible to domestic violence as well as intimate partner violence both physical and emotional—risk factors for worse mental health) (see e.g.—[68]). Apart from these recognized pathways, gendered mental health consequences of water insecurity can also be theorized through women's unique water needs for menstruation management. There are only a few studies that look at how women's menstrual experiences can implicate their social and psychological well-being [134–139]. Taboos, shame, and embarrassment associated with menstruation provide a key pathway that potentially connects it with women's mental health. For example, the notion of period poverty [134] hints at lack of water as a possible correlate. Here, the lack of water, to the extent it constrains women's abilities for menstruation management in a socially accepted way, can be a probable cause of women's mental ill-health.

PHYSIOLOGICAL IMPORTANCE OF WATER AND MENTAL HEALTH

Yet another line of evidence comes from nutrition and psychological research explicating a physiological mechanism connecting (safe) water consumption and improved mental health. Much of this evidence draws upon middle or high-income country cases. Masento [140] provides a detailed review in this regard. Studies measuring self-reported changes in the mental state have consistently found associations between dehydration or low water intake and mood, though not necessarily but often on cognitive functioning [96–99, 141, 142]. In a cross-sectional study based on a sample of more than 3000 adults in Iran, Haghighatdoost *et al.* [95] found an inverse association between plain water consumption and depression (however, the association was not significant for anxiety). Although the study found a similar association between water drinking and depression risk in men and women, the linkage for anxiety was stronger in men than in women. In an intervention study in Taipei, Luo *et al.* [94, 143] assessed the impact of smart drinking cups on employees' physical and mental health. They found that increased water intake is associated with lower hypertension and higher mental alertness over a period of time. Zhang *et al.* [144] conducted a randomized controlled trial study in China to explore the effects of water restriction and

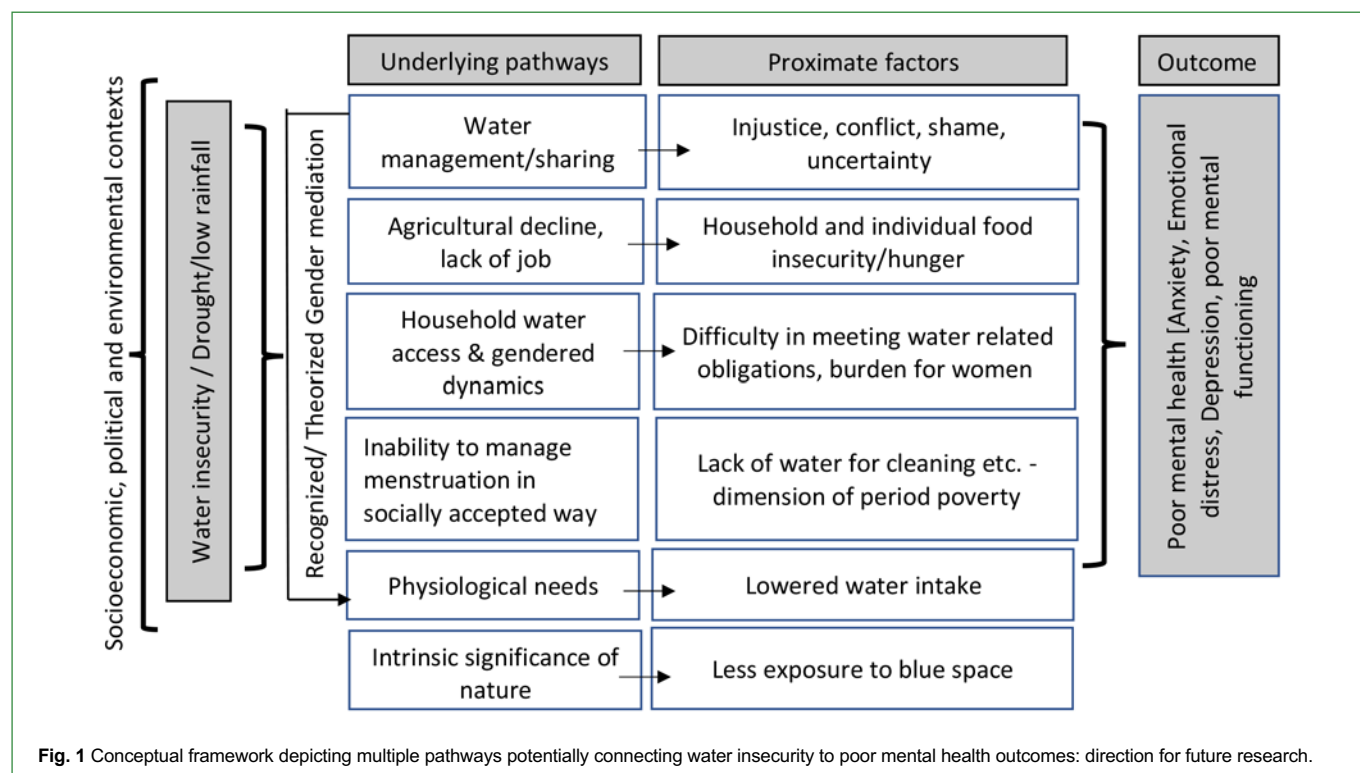
water supplementation on the cognitive performance of young males and females. While water restriction was found to lead to fatigue, water supplementation enhanced mood and raised alertness. While these studies capture the physiological role of water, given these studies are not based in water-scarce contexts, we cannot establish to what extent mental ill-being caused by low water intake is a corollary of poverty or water insecurity. However, these studies represent a possibility that household water insecurity, if translated into low water consumption, can have adverse consequences for an individual's mental health and well-being. Furthermore, if the skewed nature of intra-household bargaining and resource allocation, as explained by the economic approach is extended here, women are likely disadvantaged in the process. Within a water-scarce context, gendered intra-household resource distribution may lead women to receive a lesser share of household drinking water. In such circumstances, the physiological mechanism linking water insecurity to mental health may produce additional mental health implications for household women.

BLUES SPACES AND MENTAL HEALTH

Finally, in recent years, there is increasing empirical investigation by both public health researchers and health economists, into the role of human experiences with nature in promoting human health including mental health [145]. Vujcic *et al.* [146] conducted an intervention study in Serbia, in which randomly selected psychiatric patients were placed in a botanical garden for a certain time period. Greater exposure to nature and horticulture was seen to translate into better mental well-being and reduced stress and anxiety. As a blue space, water can be considered to have a similar effect on the human mind as the green effect has [147–152]. One review indicates that relatively fewer studies are available in this regard, however [153]. What still needs to be researched is the underlying mechanisms that connect the water environment to mental health. A comprehensive study was undertaken by White *et al.* [102] using 18 countries' survey data across four seasonal waves to explore the contribution of green and blue spaces in mitigating multiple mental disorders—mental distress—depression/anxiety medication use. It was found that those who made more frequent visits to both inland- and coastal-blue spaces reported more positive well-being and lower rates of mental distress, even after controlling for the number of green space visits in the past four weeks. Although a cross-country variation was observed in the findings, the study clearly established the positive impact of blue spaces on mental health, in addition to the role of green spaces. A mixed method study conducted by Chen and Yuan [100] on the Chinese elderly in an urban setting, looked at pathways connecting water and mental health and demonstrated a significant association between neighborhood presence of blue space and mental health of the studied sample. This association in turn was mediated by environmental harm reduction and greater social contact. In Spain, Vert *et al.* [101] studied the impact of repeated short walks around blue spaces on the mental well-being of adults compared to non-walkers or those walking in urban spaces and found significant improvement in well-being and mood responses immediately after walking in the blue space compared to other groups.

Water insecurity and mental health: a conceptual framework

Water insecurity is a form and marker of household poverty, but its relationship with mental health is far more complex than simply material deprivation. Based on our review of economics and multidisciplinary literature, multiple and often parallel pathways potentially connecting water insecurity with poor mental health outcomes, can be identified. These pathways may work independently but often overlap in a given context. They are embedded in prevailing socioeconomic, political, and environmental contexts; also likely moderated by household and/or group-specific attributes and are almost universally mediated by gender. These



pathways work at both underlying and proximate levels, directly as well as indirectly. Taking this pathway as an integrated whole, we develop a conceptual framework (Fig. 1) that can provide a basis for organizing future research. The framework is built upon existing works but moves forward to incorporate mechanisms that are yet to be well documented in mainstream literature.

Conclusion

Millions of households globally struggle daily with inadequate access to safe, affordable water, a fundamental material need. Consideration of mental health within the economics literature is growing. However, this literature rarely considers the role for water insecurity as a driver of worse mental health. Our survey found two notable exceptions from the field of Economics, both published in *Ecological Economics* and *Journal of Development Economics* (Table 1). But, broader theoretical rationales grounded in the economics literature suggest potential connections between water and mental health. Most relevant studies linking water insecurity and mental health outcomes are emerging in anthropological, health (including human biology and global public health), nutrition, or transdisciplinary literature, sometimes borrowing on but otherwise fairly disconnected from mainstream economic theory and research. These works provide insight into multiple and often overlapping pathways linking water insecurity to emotional distress and other mental disorder, especially among women. Greater collaboration between economists and other social scientists may yield better theory and tests related to identifying the role of household water insecurity in mental health, and also clarify how poverty, water, and mental health interventions could leverage each other more effectively to improve the well-being of low resource households.

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