RESEARCH ARTICLE

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Water, Sanitation and Hygiene (WASH) Conditions and Self-Reported Illness in Rural Afghanistan: A Cross-Sectional Descriptive Study in Achin District, Nangarhar Province

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Abstract

Water, sanitation, and hygiene (WASH) services are still woefully inadequate in many rural and conflict-affected areas of Afghanistan, despite the lack of district-level data. The purpose of this study was to describe the household WASH conditions, self-reported sickness, and drinking water quality in a selection of villages in Nangarhar Province's Achin District. A community-based cross-sectional descriptive study comprising structured questionnaires and in-person field observations involved 200 families. Fourteen drinking water samples were tested for pH, electrical conductivity (EC), total dissolved solids (TDS), salinity, Escherichia coli, and fecal coliforms. In the data analysis, percentages and frequencies were used. The findings showed that the most common home water sources were piped water networks (23.62%), Karez (15.58%), and wells (60.80%). Just 1.70% of houses have filtered drinking water.52.60% of households reported washing their hands with soap, 21.10% reported open defecation, and 78.90% reported having access to latrines. Typhoid-like illness (16.40%), cholera-like illness (20.10%), and diarrhea (28.30%) were the most frequently reported symptoms among the 68.50% of families that reported having at least one disease episode in the three months before. Laboratory investigation revealed that several samples had alkaline pH (>8.5), EC (up to 1,551 µS/cm), and high TDS (up to 1,555 mg/L). Fecal coliform testing was not finished for one site (Pekha School), but four of the thirteen sample locations with complete microbiological data had confirmed contamination (E. coli or fecal coliforms). These findings demonstrate a high frequency of self-reported sickness, verified fecal contamination of sources of drinking water, and significant shortcomings in domestic water treatment, sanitation infrastructure, and hygiene practices. The cross-sectional and descriptive approach prevents it from demonstrating causal relationships. Immediate multi-sectoral interventions are badly needed in this war-affected rural area to improve water quality, end open defecation, and promote hygienic behaviors.

Keywords: Afghanistan; drinking water sources; handwashing; household sanitation; rural health; self-reported illness

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Introduction

Maintaining human health and reducing exposure to enteric pathogens requires good hygiene habits, adequate sanitation [1], and clean drinking water [2]. Inadequate WASH services disproportionately impact rural and resource-constrained areas [3], as households often rely on untreated water sources and lack access to facilities for handwashing and clean sanitation [4, 5]. Even while tainted water and poor sanitation encourage the spread of fecal-oral illnesses [7], handwashing with soap remains one of the most affordable approaches to prevent diarrhea and other infectious disorders [6]. Diarrheal illness continues to have a major impact on children's morbidity and mortality in Afghanistan [8]. The Demographic and Health Survey of Afghanistan (AfDHS) 2015 [10] found that 26.2% of children under five

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had diarrhea in the two weeks before to the survey [9]. Furthermore, the greatest reported rate of diarrhea in the region (29.15%; 95% CI: 28.01–30.31%) is found in South Asian children, including those in Afghanistan [11] [12]. Prolonged violence, economic instability [13], population displacement, climate-induced water stress, and damage to public infrastructure [14] have made it extremely difficult for the country to create and maintain reliable water supply and sanitation systems. Because of this, many rural homes rely on local communal networks [16], springs, canals, wells [15], and Karez (historic subterranean water systems). However, treatment techniques, seasonal conditions, the cleanliness of the surrounding area, and construction quality all have a significant impact on how safe these sources are [17]. Physical, chemical, and microbiological investigations are required to evaluate water safety based just on the type of source [18]. National and provincial studies indicate that access to drinking water, sanitation, and hygiene services remains inconsistent in Afghanistan [19]. Research from Nangarhar Province demonstrates that both institutional and community settings lack proper sanitation facilities, and that rural inhabitants mostly rely on untreated water [20].The majority of existing research, however, focuses on specific institutions, such as schools, is produced at the national or provincial level [21], or examines water and sanitation indicators independently [22]. These assessments provide useful context [23], but they cannot adequately account for the combined effect of many WASH deficiencies at the household level in particular rural locations [24].Due to the semi-arid nature of the area, households in Nangarhar Province's primarily rural Achin District mostly rely on wells, Karez systems, and small communal water networks [25, 26].The district, which borders Pakistan, has been severely impacted by conflict, population displacement, and inadequate infrastructure development [27, 28]. Agriculture and livestock husbandry are major sources of income in the area [29], which increases the risk of animal waste and poor sanitation contaminating water sources [30].There is still a lack of integrated household-level evidence that includes drinking-water sources [32], treatment methods, sanitation access, hygiene practices, laboratory water-quality indicators, and self-reported illness [33–34], despite earlier research in Achin concentrating on climate adaptation and community-based water management [31]. This data gap is critical since physical characteristics like as color, taste, or odor cannot reliably signal microbiological safety [35]. Tests for indicators like E. coli and fecal coliforms are necessary to detect fecal contamination. Furthermore [36], household questionnaire reports of diarrhea, typhoid-like sickness, or cholera-like illness must be interpreted as self-reported outcomes rather than as clinician-verified diagnoses [37–38]. Cross-sectional data can describe the co-occurrence of sickness and WASH limitations, but it cannot establish causation [39–40]. Therefore, this study's goal was to provide a descriptive evaluation of WASH conditions in a few Achin District settlements at the district level [41]. The particular objectives were to: (1) identify the main sources of household drinking water and residential water treatment methods; (2) assess household access to sanitary facilities and reported handwashing habits; and (3) describe the local drinking water sources' physicochemical and microbiological quality; and (4) determine the proportion of families that reported particular illnesses throughout the previous three months. The goal of the study was to generate locally relevant descriptive information for planning and future research [42], rather than to establish causal links [43].

Materials and Methods

Study Area

A few villages in the Achin District of the eastern Afghan province of Nangarhar were employed for the study between February 10, 2025, and April 8, 2025 (late winter to early spring). Achin District's coordinates are 34.0454° N, 70.6692° E.The district's population is estimated by Afghanistan's National Statistics and Information Authority (NSIA) to be 95,468. The district is mostly rural and semi-arid, and its primary sources of revenue are agriculture and animal husbandry. Households primarily obtain their water from wells, small piped-water networks, and Karez (old underground waterways). Adulkhil Ragha Kali, Abdul Khil Salim Ragha Kali, Adul Khil Ashkhil Kali, Abdul Khil Nargosay Kali, Pekhikhwar Dosaraka, Pekhikhwar Qamiza, Pekhikhwar Pakhil, Pekhi Khowar Khoga Khil Kali, Bandar Sperony Kali, Bandar Zari Kali, Bander Lalmy Kali, Desarak Akhondzadgano Kali, Desarak High School, and Pekha School were all covered by the household survey. These places were deliberately picked to represent geographic and socioeconomic diversity.

Study Design

A community-based cross-sectional household survey employed source-water testing, direct household observations, and a standardized questionnaire. The study did not include any qualitative components; neither topic analysis nor semi-structured interviews were conducted.

Table 1: Distribution of surveyed households by village

Sampling characteristic	*Information reported*
Study area	Selected villages of Achin District, Nangarhar Province, Afghanistan
Names of household-survey villages	Adulkhil Ragha Kali, Abdul Khil Salim Ragha Kali, Adul Khil Ashkhil Kali, Abdul Khil Nargosay Kali, Pekhikhwar Dosaraka, Pekhikhwar Qamiza, Pekhikhwar Pakhil, Pekhi Khowar Khoga Khil Kali, Bandar Sperony Kali, Bandar Zari Kali, Bander Lalmy Kali, Desarak Akhondzadgano Kali, Desarak High School, and Pekha School
Total households surveyed	200 households
Total eligible households (sampling frame)	360 households
Households approached (contact attempted)	360 households
Households successfully enrolled (participated)	200 households
Household refusals or non-responses	No outright refusals were documented; however, some selected households were temporarily unavailable (e.g., absent, vacant, or inaccessible) and were replaced per the protocol in §2.4. The remaining 160 households represented the unselected portion of the sampling frame.
Village-selection method	Purposive selection based on geographic location and socioeconomic variation
Household-selection basis	Stratified random sampling across three socioeconomic strata
Representativeness	The sample should not be described as district-representative

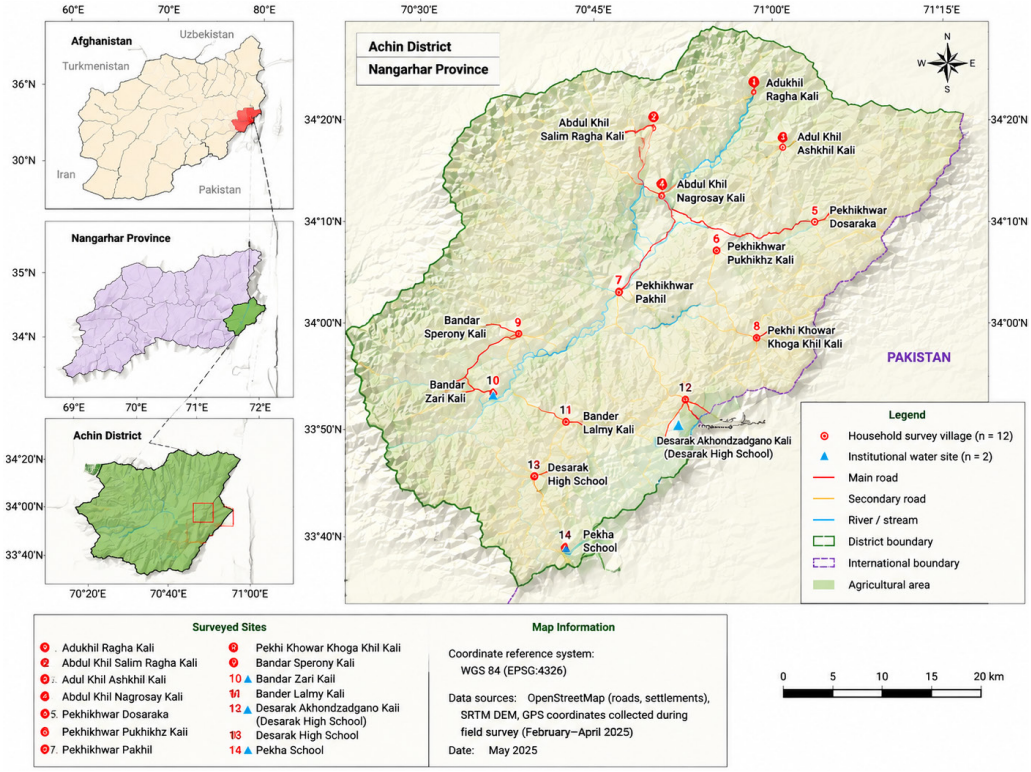


Figure 1: Shows the geographic distribution of the 12 water-sampling locations and surveyed villages in Achin District, Nangarhar Province, Afghanistan (n = 200 households). The district's topography, comprising piped, well, spring, and Karez water sources, is depicted on the map along with the spatial distribution of the sampled villages

Study Population and Eligibility

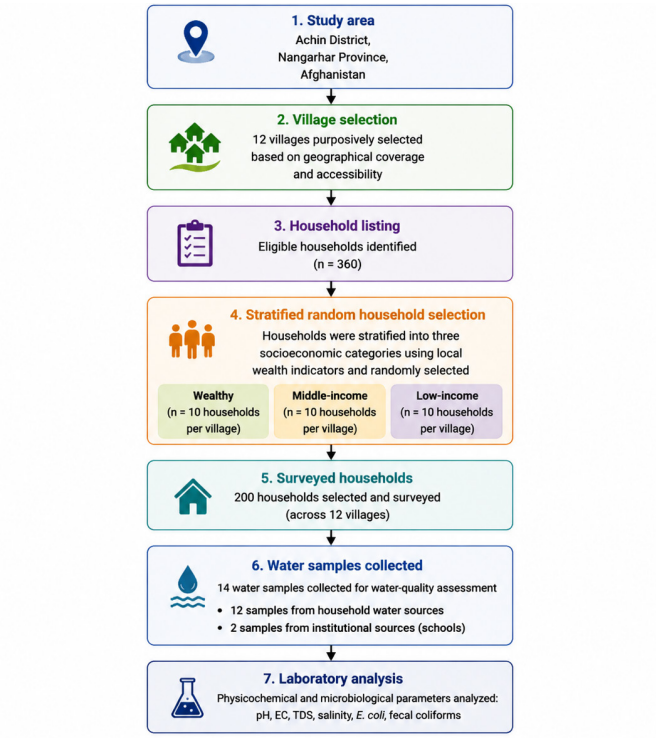
The study population consisted of every permanent resident household in the selected villages. One adult respondent per family, either another adult or the head of the household, who was at least eighteen years old and knowledgeable about recent illnesses and household WASH practices, was interviewed. Visitors and temporary residents were excluded, as were those who did not provide informed permission.

Village and Household Sampling

Twelve residential villages were included in the household survey, while two institutions (Desarak High School and Pekha School) were only included for water quality testing. Villages were specifically selected based on geographic coverage, recognized WASH problems, accessibility, and a range of water supply options. Following consultation with local village leaders, a community-based household directory was established in each hamlet. Households were classified into three socioeconomic groups: wealthy, middle-class, and low-class based on local factors (housing type, land ownership, livestock, and occupation). A total of thirty houses per hamlet were selected proportionately across these strata using a simple random lottery method without replacement. If a selected family was not available after two follow-up visits, a replacement was selected at random from the same stratum. Of the 360 eligible families contacted, 200 participated (55.6% sample rate). Due to field restrictions, such as high terrain, restricted road access, security concerns, and scheduling limits, enrollment ceased at 200 of the 360 targeted houses. The remaining 160 represented the unselected portion of the sample frame rather than documented refusals.

Sample Size and Precision

The goal of 200 families was determined by field limitations and available resources; no systematic a priori sample-size calculation was carried out. For descriptive purposes, a sample size of 200 results in a notional 95% margin of error of around ±6.9 percentage points for a 50% proportion, assuming simple random sampling. Simple random sampling is assumed in this estimation; However, the computation does not take village clustering into account because households were sampled within a purposively chosen collection of villages rather than being drawn separately throughout the district. Clustering usually raises the true margin of error above the simple-random-sampling estimate since outcomes like water source, sanitation access, and reported sickness tend to be associated with in communities. The effective margin of error would increase to approximately ±8.5–9.8 percentage points if a modest design effect of 1.5–2.0 were applied, which is reasonable for village-level clustering of WASH and illness indicators. As a result, the reported ±6.9% should be interpreted as a best-case, probably conservative bound rather than the actual precision of the estimates. It is not appropriate to extend the findings to the entire district. because clustering and non-random village selection are not taken into account. Future analyses should include design-effect-adjusted standard errors because the proportions presented in Results did not include confidence intervals that accounted for the cluster design impact.



Note: Because information on sanitation technology, containment, emptying and final disposal was not collected, facilities were not classified according to WHO/UNICEF Joint Monitoring Programme service levels.

Figure 2. Sampling procedure and study population selection for the household survey and water-quality assessment in Achin District, Afghanistan.

Household Questionnaire

A systematic questionnaire with roughly 45–50 items addressed the following subjects: (i) demographics; (ii) household treatment and drinking water sources; (iii) waste management and toilet access; (iv) soap use and handwashing habits; (v) child health; (vi) self-reported sickness (last three months); (vii) knowledge and instruction; and (viii) observations made by the interviewer. Twelve households from an excluded population took part in a pilot test, experts assessed the instrument's content validity, and it was clarified. Data collectors received three days of training covering study objectives, consent procedures, uniform administration, observation protocols, ethics, and sample methodologies. Field supervisors verified the surveys' consistency and completeness each day.

Structured Observations

During every family visit, a standardized observation checklist was completed to record the presence and condition of latrines (private or shared), waste disposal, the availability of designated handwashing stations with soap and water, and obvious environmental hazards. Independent of the

interviewees, a different, trained observer carried out structured observations.

Drinking-Water Sampling and Laboratory Analysis

Sampling Sites

Fourteen water samples from piped systems, springs, wells, and Karez that supplied the aforementioned schools and towns were gathered. Although springs were sampled as community-level sources for the general water quality evaluation, none of the surveyed households reported using springs as their primary source of drinking water, so they are not included in Table 2 as a household drinking-water source type.

Collection and Transport

Samples were collected from the place of consumption on February 10, 2025. For microbiological study, sterile 250 mL bottles were utilized; for physicochemical analysis, 1 L high-density polyethylene (HDPE) bottles were utilized. The taps were cleaned and water was run for two to three minutes before to collection. After the samples were tagged and transported to the Venco Imtiaz Construction Company Water Lab (VICC Water Lab) in an insulated ice box (2–8 °C), microbiological examination began within six hours.

wPhysicochemical Analysis

pH, EC, TDS, and salinity were measured on-site right away after collection. The pH was measured using a Hanna Instruments HI98127 pH/°C Tester (range -2.0 to 16.0, precision ±0.1 pH). Using standard buffers (4.01, 7.01, and 10.01), it was calibrated daily.EC and TDS were measured using a Hanna Instruments HI98311 DiST® 5 meter (EC range 0–3,999 µS/cm, precision ±2% F.S.; TDS range 0–2,000 mg/L), calibrated daily using a 1413 µS/cm standard.

Microbiological Analysis

E. Coli and fecal coliforms were counted using the membrane filtration (MF) technique in compliance with APHA Method 9222 [44].

A 100 mL sample was filtered through a sterile 0.45 µm membrane. Fecal coliform-containing filters were grown for 24 ± 2 hours at 44.5 ± 0.2°C on m-FC agar with rosolic acid (blue/dark-blue colonies indicate positive). Filters were put on modified m-TEC agar for E. coli, and after being incubated at 35°C for two hours (resuscitation) and then at 44.5°C for 22 ± 2 hours, the colonies were verified by urease test (yellow = E. coli). One CFU per 100 milliliters was the detection limit. The WHO recommendation that no 100 mL sample should include any detectable E. coli (or fecal coliforms) was used to interpret the results [45].

Quality Assurance

Field/laboratory blanks, duplicate samples (RPD ≤5% for physicochemical; ≤10 CFU/100 mL difference for low microbiological counts), positive/negative controls, and instrument calibration were employed. The controls functioned as intended, and every blank was negative.

Study Variables and Operational Definitions

- Drinking-water source: categorized as a piped network, well, watercourse, or Karez. Because there was not enough information on source protection and accessibility, JMP categorization was not used. [46].
- Household water treatment: The definition is self-reported filtering. Boiling, chlorination, and other techniques of treating domestic water were not analyzed in this study; only filtering was evaluated.
- Sanitation: either access to any latrine or open defecation (no latrine). Instead of using household self-report, enumerators used direct observation to evaluate latrine condition (e.g., partially covered, non-standard).
- Hygiene: self-reported soap-based hand washing.
- Self-reported illness: According to the responder, at least one household member had diarrhea, a cholera-like illness, a typhoid-like illness, or another illness within the previous three months. These lacked clinical verification.

Data Management and Statistical Analysis

The data was coded, entered, and verified using IBM SPSS Statistics Version 26 (IBM Corp., Armonk, NY, USA) (100% double-entry). Ranges for water quality and frequencies or percentages for categorical variables were the only descriptive aspects of the analysis. No imputation took place. Regression, hypothesis testing, correlation, and causal inference were not attempted.

Ethical Considerations

The study protocol was approved ethically by the Nangarhar Medical Faculty's Ethical and Research Committee at Nangarhar University (permit no. 012/2023; date: January 15, 2025), and it was conducted in compliance with the Helsinki Declaration. While illiterate participants had their consent read out in front of a witness, literate participants completed their own consent forms. recorded by thumbprint and countersigned; confidentiality was maintained and no personally identifiable information was included in the analytical dataset. Parents or guardians, who gave their consent on behalf of their children and were advised that they might choose not to answer any questions, supplied proxy reports for the collection of child health data.

Results

Household Water Sources and Treatment

Among the 199 houses that reported a primary source of drinking water, wells were the most common (n = 121, 60.80%; one household did not indicate a source), followed by piped water networks (n = 47, 23.62%) and Karez (n = 31, 15.58%).

Table 2: Household drinking-water sources

Water Source Type	*Frequency (n=199)**	*Percentage (%)*
Wells	121	60.80
Piped water network	47	23.62
Karez	31	15.58
Stream/Canal	0	0

*One of the 200 surveyed households did not report a primary drinking-water source and is excluded from this table; percentages are calculated on n=199 valid responses.

No home identified stream water as the primary source. The percentage of respondents who reported filtering their drinking water before drinking it was just 1.70%.

Sanitation Access and Hygiene Practices

While 42 homes (21.10%) did not have a latrine and defecated outside, 158 families (78.90%) reported having access to one. There were no houses using shared latrines. In terms of cleanliness, 105 households (52.60%) said they washed their hands with soap; nevertheless, structured observations showed that authorized handwashing stations sometimes lacked both water and soap at the time of the visit. After using the restroom, 49.9% of participants did not always wash their hands. It should be noted that the 49.9% figure represents respondents who said they did not always wash their hands after using the restroom, whereas the 52.60% figure represents households reporting that soap was available for handwashing; these are distinct indicators measuring access versus consistent practice, not the same underlying measure.

Self-Reported Illness

137 families (68.50%) reported at least one illness episode among household members in the three months before to the survey. Among the 137 reported incidents, diarrhea was the most common illness (n=39, 28.30%), followed by cholera-like sickness (n=28, 20.10%), typhoid-like illness (n=22, 16.40%), and other illnesses (n=48, 35.20%), which included gastrointestinal problems and skin infections.

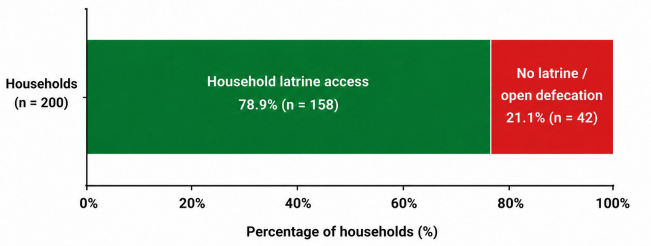
Drinking-Water Quality

Physicochemical Parameters

The physicochemical results for the 14 samples are reported in Table 5. The pH ranged from 6.55 to 9.30, with three samples above the WHO-recommended range of 6.5 to 8.5. TDS ranged from 381 to 1,555 mg/L, with twelve of the fourteen samples above the WHO recommendation of 500 mg/L; EC ranged from 381 to 1,551 µS/cm, with two samples exceeding 1,000 µS/cm. The salinity ranged from 0.1 to 0.7 g/L.

Table 3: Household sanitation facilities

Sanitation type	*Frequency (n=200)*	*Percentage (%)*
Latrine present	158	78.9
No latrine / open defecation	42	21.1



Note: No household reported using a latrine shared with other households or the community (0.0%) and therefore this category is not shown.
Source: Household Survey, Achin District, Nangarhar Province, Afghanistan (February–April 2025).

Figure 3. Household sanitation access among surveyed households in Achin District, Afghanistan (n = 200).

Table 4: Self-reported illness categories

Illness Type	*Frequency (n=137)*	*% of Reported Illnesses*
Diarrhea	39	28.3
Cholera-like illness	28	20.1
Typhoid-like illness	22	16.4
Other illnesses	48	35.2
Total	137	100

Microbiological Parameters

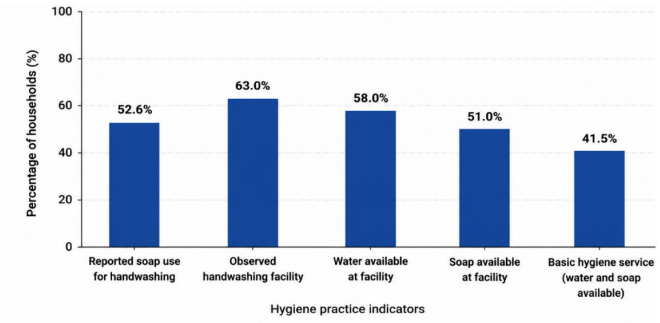
E. coli was found in two samples (5 CFU/100 mL from Abdul Khil Ragha village and 11 CFU/100 mL from Desarak High School). Fecal coliforms were found in two other samples (Abdul Khil Ashkhil village: 7 CFU/100 mL; Pekhikhwar Khogakhil village: 9 CFU/100 mL). Any E. coli or fecal coliform in 100 mL is a sign of fecal contamination and a potential health risk, according to WHO recommendations [33]. Pekha School's fecal coliform test (sample 14; not tested, NT) was not finished. Four of the thirteen sampling sites with complete microbiological data had contamination, and the remaining nine samples had no detectable contamination.

Discussion

A comprehensive descriptive assessment of the WASH conditions in a few Achin District communities is provided by this study. The findings demonstrate a high frequency of self-reported illness, confirmed microbiological contamination of sources of drinking water, and serious deficiencies in household water treatment, sanitation infrastructure, and hygiene practices. These results demonstrate the urgent need for coordinated, multi-sectoral interventions in this conflict-ravaged rural area.

Water Sources and Quality

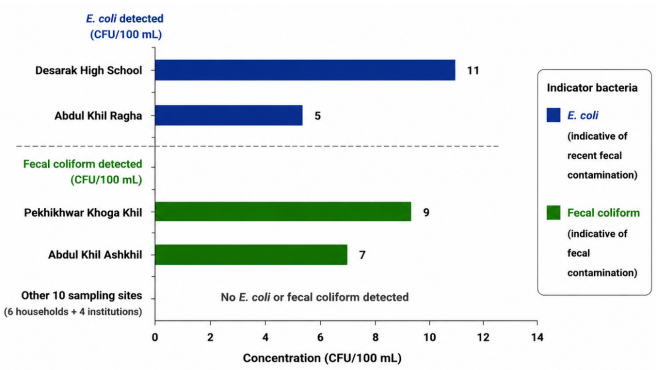
Previous studies from rural Afghanistan are consistent with the significant reliance on wells (60.80%) as the main



Note: Self-reported soap use was not considered equivalent to JMP basic hygiene service unless water and soap were observed at the handwashing facility.

Source: Household Survey, Achin District, Nangarhar Province, Afghanistan (February–April 2025).

Figure 4. Hygiene practice indicators among surveyed households in Achin District, Afghanistan (n = 200).



Note: CFU = Colony Forming Unit. Four of the 14 water samples (28.6%) were contaminated with fecal indicator bacteria (*E. coli* or fecal coliform), indicating the presence of human or animal waste in community water sources.

Source: Household Survey and Water Quality Testing, Achin District, Nangarhar Province, Afghanistan (February–April 2025).

Figure 5. Detection of fecal indicator bacteria in sampled drinking-water sources in Achin District, Afghanistan (n = 14).

source of drinking water. [47] and highlights the limited availability of piped water networks in remote areas. But as evidenced by the microbial contamination found in four places, including a piped supply at Desarak High School [48], improved source types do not guarantee water safety. E. Coli and fecal coliforms are indicators of recent fecal pollution, most often from animal runoff, poorly kept latrines, or open defecation (21.10% of homes). [49]. This outcome is consistent with studies carried out in South Asia, where poor sanitation is still the main cause of contaminated drinking water[50].

Physicochemical features also raised concerns. Elevated TDS (up to 1,555 mg/L) and EC (up to 1,551 µS/cm) at places like Desarak significant School and Pekhikhwar Khoga Khil indicate significant mineralization, which could have an impact on palatability and provide long-term health hazards (such as effects on the heart or kidneys) [51]. Three samples had an alkaline pH (>8.5), with Desarak High School's pH 9.3 above WHO recommendations.[52]. Geogenic mineral leaching or pollution from agricultural pesticides could be the cause. These findings highlight the importance of routine water quality monitoring and point-of-use treatment.

Sanitation and Hygiene Gaps

Despite the fact that 78.9% of households reported having a latrine, this self-reported figure may overstate the degree of safe sanitation because many facilities were classified as "non-standard" or "partially covered." A persistent public health problem, open defecation is practiced by 21.1% of persons,

Table 5: Physicochemical and microbiological results of drinking-water samples (n=14)

No.	*Sampling Site*	*pH*	*Temp (°C)*	*Salinity (g/L)*	*EC (µS/cm)*	*TDS (mg/L)*	*E. coli (CFU/100 mL)*	*Faecal Coliforms (CFU/100 mL)*
1	Abdul Khil Ragha village	8.9	24.5	0.2	525	525	5	0
2	Abdul Khil Salim Ragha	6.55	23.7	0.3	733	733	0	0
3	Abdul Khil Ashkhil village	7.05	24.5	0.2	626	626	0	7
4	Abdul Khil Nargosay	6.95	24.5	0.2	572	572	0	0
5	Pekhikhwar Dosaraka	7.97	24.2	0.2	642	645	0	0
6	Pekhikhwar Qamiza	9.2	25.5	0.2	591	593	0	0
7	Pekhikhwar Pakhil	8.28	25.4	0.3	668	669	0	0
8	Pekhikhwar Khoga Khil	6.67	24.8	0.6	1241	1240	0	9
9	Bandar Sperony village	7.34	24.9	0.4	866	870	0	0
10	Bandar Zari village	6.56	24.1	0.1	381	381	0	0
11	Bandar Lalmy village	6.94	24.9	0.2	560	562	0	0
12	Desarak Akhondzadgano	7.51	24.4	0.2	635	636	0	0
13	Desarak High School	9.3	24.5	0.7	1551	1555	11	0
14	Pekha School	6.9	24.8	0.26	641	417	0	NT

NT = Not Tested. Fecal coliform analysis for sample 14 (Pekha School) was not completed; this result should not be interpreted as an absence of contamination.

which facilitates fecal-oral transmission and environmental contamination [53]. This rate is similar to national statistics for rural Afghanistan and other violent areas.[54]. Although further qualitative research is required, the lack of shared latrines might be a reflection of regional sanitation practices. [55]. Hygiene precautions were shockingly inadequate. Only 52.6% of respondents reported washing their hands with soap, and only 1.7% reported filtering their drinking water. After using the restroom, only 49.9% of respondents reported washing their hands. These figures are concerning because washing your hands with soap is one of the most affordable strategies to avoid diarrheal disease. Lack of community-based hygiene promotion initiatives, low knowledge, and financial limitations (soap affordability) are probably the reasons for the low uptake.[56]. This behavioral gap is critical since hygiene treatments can reduce the prevalence of diarrhea by up to 47% [3].

Disease Burden

Afghanistan's high rates of childhood diarrhea (26.2% in two weeks, AfDHS 2015 [57]) and the highest rate in South Asia (29.15%) are consistent with the high percentage of families reporting illness (68.5% in three months).[58]). In this study, diarrhea, cholera-like disease, and typhoid-like illness collectively account for 64.8% of reported instances of classic WASH-related illnesses. Their co-occurrence indicates regular and continuous exposure to fecal bacteria, It points to structural problems with sanitation and water safety [59]. The "other illnesses" described by 35.2% may include skin infections, lung infections, and digestive problems associated with inadequate cleanliness [60]. Importantly, since these disorders were self-reported without clinical validation, They should be considered perceived morbidity instead of confirmed disease incidence. [61]. Nonetheless, the trend offers strong evidence in favor of the environmental and behavioral risk factors found in this investigation.

Limitations

When interpreting the results, a variety of limitations must be taken into account. First, since of the cross-sectional and descriptive methodology, conclusions about causality cannot be drawn; Correlations found do not demonstrate that WASH inadequacies caused the observed diseases. [62]. Second, recollection bias and misclassification may affect self-reported sickness. [28]. Third, the small sample size and deliberate village selection limit generalizability to the larger Achin District. Fourth, facilities cannot be classified as "improved" or "safely managed" due to incomplete JMP categorization caused by missing data on source construction and excreta management.[64]. Fifth, because the study was restricted to late winter and early spring, There were no seasonal differences in the incidence of diarrhea or water quality. [65]. While the illness recall spanned the previous two months, the water quality assessment was based on a single sample event (February 10, 2025). This single-day test may not represent seasonal change in water quality, especially during rainy seasons when contamination risks increase. Finally, the absence of official ethics committee paperwork and some methodological details in the source data reduces replicability. Despite these limitations, this study provides essential primary data from a conflict-affected, hard-to-reach area where such information is hard to come by.

Implications for Policy, Practice, and Future Research

The reported WASH inadequacies and disease burden have significant implications. Priorities for urgent interventions should be as follows: (1) promoting the adoption of domestic water treatment methods, such as chlorination, filtration) and avoiding well contamination; (2) eliminating open defecation through improved latrines and community-led total sanitation (CLTS); (3) implementing community-based hygiene education that prioritizes washing hands with soap at critical moments; and (4) incorporating WASH elements into school health initiatives [66], especially considering the significant level of pollution at Desarak significant School. A multi-sectoral approach including local communities, NGOs, and the government is crucial to ending the cycle of illness and poverty.[67]. Future research should include district-to-district comparative studies to identify best practices and contextual barriers, clinical verification of self-reported disease, longitudinal research to examine seasonal patterns and randomized controlled trials to evaluate certain WASH solutions.

Conclusion

The study's conclusions show that WASH conditions in Nangarhar Province's Achin District are woefully inadequate. When dangerous water sources coexist with inadequate sanitation and poor hygiene habits, and verified that the high frequency of self-reported diarrhea and other infectious illnesses seen among surveyed households is correlated with fecal contamination of drinking water; however, in line with the cross-sectional design, these correlations do not prove that the reported illnesses were brought on by WASH deficiencies. However, the extent of the deficiencies found—especially the almost complete lack of household water treatment and the continued practice of open defecation—highlights the necessity of immediate, ongoing, and multi-sectoral WASH interventions in this setting devastated by conflict. In order to determine causal pathways and produce the evidence foundation necessary for successful, context-specific policies in rural Afghanistan, future research utilizing clinical verification, randomized controlled trials, and longitudinal designs is required.

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Conflict of Interest

The authors declare that there are no financial or personal conflicts of interest that could have affected the results or interpretations presented in this research.

References

[1] Okesanya OJ, Eshun G, Ukoaka BM, Manirambona E, Olabode ON, Adesola RO, et al. Water, sanitation, and hygiene (WASH) practices in Africa: exploring the effects on public health and sustainable development plans. Tropical Medicine and Health, 2024, 52(1), 68. DOI: 10.1186/s41182-024-00614-3

[2] Chan EYY, Tong KHY, Dubois C, Mc Donnell K, Kim JH, Hung KKC, et al. Narrative review of primary preventive interventions against water-borne diseases: scientific evidence of health-EDRM in contexts with inadequate safe drinking water. International Journal of Environmental Research and Public Health, 2021, 18(23), 12268. DOI: 10.3390/ijerph182312268

[3] John CK, Ajibade FO. Exploring the dynamics of WASH services: challenges, enablers, and strategies for improvement. Discover Civil Engineering, 2024, 1(1), 79. DOI: 10.1007/s44290-024-00085-9

[4] Aydamo AA, Gari SR, Mereta ST. Access to drinking water, sanitation, and hand hygiene facilities in the peri-urban and informal settlements of Hosanna Town, Southern Ethiopia. Environmental Health Insights, 2023, 17, 11786302231193604. DOI: 10.1177/11786302231193604

[5] Bishoge OK. Challenges facing sustainable water supply, sanitation and hygiene achievement in urban areas in sub-Saharan Africa. Local Environment, 2021, 26(7), 893-907. DOI: 10.1080/13549839.2021.1931074

[6] Akinsulie OC, Aliyu VA, Idris I, Ajulo S, Olukogbe O, Ukauwa C, et al. The implications of handwashing and skin hygiene on infectious disease dynamics: the African scenario. Hygiene, 2024, 4(4), 483-499. DOI: 10.3390/hygiene4040036

[7] Masood W, Aquil S, Nadeem A, Mehmood H, Islam Z, Essar MY, et al. Impact of climate change on health in Afghanistan amidst a humanitarian crisis. The Journal of Climate Change and Health, 2022, 6, 100139. DOI: 10.1016/j.joclim.2022.100139

[8] Feleke Y, Legesse A, Abebe M. Prevalence of diarrhea, feeding practice, and associated factors among children under five years in Bereh District, Oromia, Ethiopia. Infectious Diseases in Obstetrics and Gynecology, 2022, 2022(1), 4139648. DOI: 10.1155/2022/4139648

[9] Wasiq AN, Saw YM, Jawid S, Kariya T, Yamamoto E, Hamajima N. Determinants of diarrhea in children under the age of five in Afghanistan: a secondary analysis of the Afghanistan Demographic and Health Survey 2015. Nagoya Journal of Medical Science, 2020, 82(3), 545-556. DOI: 10.18999/nagjms.82.3.545

[10] Sathi NJ, Ahammed B, Alam K, Hashmi R, Lee KY, Keramat SA. Socioeconomic inequalities in low birth weight in South Asia: a comparative analysis using Demographic and Health Surveys. SSM - Population Health, 2022, 20, 101248. DOI: 10.1016/j.ssmph.2022.101248

[11] Sarker AR, Hasan A, Nawar N, Islam R. Childhood diarrhoeal disease in South Asian countries: a population-based analysis. BMJ Public Health, 2025, 3(2). DOI: 10.1136/bmjph-2024-001909

[12] Al-Saidi M, Roach EL, Al-Saeedi BAH. Conflict resilience of water and energy supply infrastructure: insights from Yemen. Water, 2020, 12(11), 3269. DOI: 10.3390/w12113269

[13] Xu L, Famiglietti JS. Global patterns of water-driven human migration. Wiley Interdisciplinary Reviews: Water, 2023, 10(4), e1647. DOI: 10.1002/wat2.1647

[14] Marwaha N, Kourakos G, Levintal E, Dahlke HE. Identifying agricultural managed aquifer recharge locations to benefit drinking water supply in rural communities. Water Resources Research, 2021, 57(3), e2020WR028811. DOI: 10.1029/2020WR028811

[15] Akhtar MM, Mohammad AD, Ehsan M, Akhtar R, ur Rehman J, Manzoor Z. Water resources of Balochistan, Pakistan—a review. Arabian Journal of Geosciences, 2021, 14(4), 289. DOI: 10.1007/s12517-021-06502-y

[16] Gasmi I. Socio-hydrological role of north Africa's traditional water management systems under extreme climatic events. In: Disaster Risk Reduction for Resilience: Disaster Socio-Hydrological Resilience and Sustainability. Cham: Springer International Publishing, 2023, 199-216. DOI: 10.1007/978-3-031-26120-6_10

[17] Ferrer N, Folch A, Masó G, Sanchez S, Sanchez-Vila X. What are the main factors influencing the presence of faecal bacteria pollution in groundwater systems in developing countries? Journal of Contaminant Hydrology, 2020, 228, 103556. DOI: 10.1016/j.jconhyd.2019.103556

[18] Danso G, Otoo M. Readiness of South Asian Countries to Achieve SDG 6 Targets by 2030 in the Sanitation Sector. In: Safe Water and Sanitation for a Healthier World: A Global View of Progress Towards SDG 6. Cham: Springer International Publishing, 2022, 133-148. DOI: 10.1007/978-3-030-94020-1_8

[19] Nahar S, Moran S. Local communities in water and sanitation: practices and challenges. In: Clean Water and Sanitation. Cham: Springer International Publishing, 2022, 390-401. DOI: 10.1007/978-3-319-95846-0_141

[20] Zheng H, Bai Y, Wei W, Meng J, Zhang Z, Song M, et al. Chinese provincial multi-regional input-output database for 2012, 2015, and 2017. Scientific Data, 2021, 8(1), 244. DOI: 10.1038/s41597-021-01023-7

[21] Ahmed J, Wong LP, Chua YP, Hydrie MZI, Channa N. Drinking water, sanitation, and hygiene (WASH) situation in primary schools of Pakistan: the impact of WASH-related interventions and policy on children school performance. Environmental Science and Pollution Research, 2022, 29(1), 1259-1277. DOI: 10.1007/s11356-021-15681-w

[22] Steiss J, Tate T, Graham S, Cruz J, Hebert M, Wang J, et al. Comparing the quality of human and ChatGPT feedback of students' writing. Learning and Instruction, 2024, 91, 101894. DOI: 10.1016/j.learninstruc.2024.101894

[23] Vila-Guilera J, Parikh P, Chaturvedi H, Ciric L, Lakhanpaul M. Towards transformative WASH: an integrated case study exploring environmental, sociocultural, economic and institutional risk factors contributing to infant enteric infections in rural tribal India. BMC Public Health, 2021, 21(1), 1331. DOI: 10.1186/s12889-021-11391-3

[24] Machiwal D, Kar A, Joshi DC, Yadav KK. Land and water resource management in the Thar Desert region. In: Natural Resource Management in the Thar Desert Region of Rajasthan. Cham: Springer International Publishing, 2023, 73-99. DOI: 10.1007/978-3-031-34556-2_4

[25] Yenigun K, Bozkurt A, Isinkaralar O, Isinkaralar K. Ancient karez systems in Şanlıurfa, Türkiye: detection, analysis, and sustainability of historical water supply networks. Spatial Information Research, 2025, 33(3), 22. DOI: 10.1007/s41324-

025-00623-2
[26] Rehman F, Khan A. Environmental impacts of urbanization encroachment in the lowlands of Khyber Pakhtunkhwa, Pakistan. Sustainability, 2022, 14(19), 11959. DOI: 10.3390/su141911959
[27] Das JK, Padhani ZA, Jabeen S, Rizvi A, Ansari U, Fatima M, et al. Impact of conflict on maternal and child health service delivery–how and how not: a country case study of conflict affected areas of Pakistan. Conflict and Health, 2020, 14(1), 32. DOI: 10.1186/s13031-020-00271-3
[28] Ahmad MI, Ma H. Climate change and livelihood vulnerability in mixed crop–livestock areas: the case of province Punjab, Pakistan. Sustainability, 2020, 12(2), 586. DOI: 10.3390/su12020586
[29] Wu X, Nawaz S, Li Y, Zhang H. Environmental health hazards of untreated livestock wastewater: potential risks and future perspectives. Environmental Science and Pollution Research, 2024, 31(17), 24745-24767. DOI: 10.1007/s11356-024-33066-1
[30] Manya T, Manun'Ebo MF, Khang EI, Nkulu-wa-Ngoie C. Assessment of the Quality of Hand-dug Well Water in Lubumbashi, DR Congo: Bacteriological, pH and Temperature Characteristics. British Journal of Healthcare and Medical Research, 2026, 13(02), 114-128.
[31] Greenwood EE, Lauber T, van den Hoogen J, Donmez A, Bain RE, Johnston R, et al. Mapping safe drinking water use in low-and middle-income countries. Science, 2024, 385(6710), 784-790. DOI: 10.1126/science.adh9578
[32] Ahmed J, Wong LP, Chua YP, Channa N, Mahar RB, Yasmin A, et al. Quantitative microbial risk assessment of drinking water quality to predict the risk of waterborne diseases in primary-school children. International Journal of Environmental Research and Public Health, 2020, 17(8), 2774. DOI: 10.3390/ijerph17082774
[33] Abedi-Firoozjah R, Salim SA, Hasanvand S, Assadpour E, Azizi-Lalabadi M, Prieto MA, et al. Application of smart packaging for seafood: a comprehensive review. Comprehensive Reviews in Food Science and Food Safety, 2023, 22(2), 1438-1461. DOI: 10.1111/1541-4337.13117
[34] Holcomb DA, Stewart JR. Microbial indicators of fecal pollution: recent progress and challenges in assessing water quality. Current Environmental Health Reports, 2020, 7(3), 311-324. DOI: 10.1007/s40572-020-00278-1
[35] Li E, Saleem F, Edge TA, Schellhorn HE. Biological indicators for fecal pollution detection and source tracking: a review. Processes, 2021, 9(11), 2058. DOI: 10.3390/pr9112058
[36] Craun GF. The epidemiology of waterborne disease: the importance of drinking water disinfection. In: An Introduction to Environmental Epidemiology. CRC Press, 2024, 123-150.
[37] Rohner F, Rakotovao JM, El-Mallah C, Andrianarison R, Randrenarizo N, Wegmüller R, et al. Burden and co-occurrence of anemia, micronutrient deficiencies, inflammation, and malaria among women, adolescents, and children in Madagascar: a national cross-sectional survey. The Journal of Nutrition, 2026, 101610. DOI: 10.1016/j.tjnut.2026.101610
[38] Jack Jr CR, Andrews JS, Beach TG, Buracchio T, Dunn B, Graf A, et al. Revised criteria for diagnosis and staging of Alzheimer's disease: Alzheimer's Association Workgroup. Alzheimer's & Dementia, 2024, 20(8), 5143-5169. DOI: 10.1002/alz.13859
[39] Szetey K, Moallemi EA, Ashton E, Butcher M, Sprunt B, Bryan BA. Co-creating local socioeconomic pathways for achieving the sustainable development goals. Sustainability Science, 2021, 16(4), 1251-1268. DOI: 10.1007/s11625-021-00921-2
[40] Kaur I, Gulati A, Lamba PS, Jain A, Taneja H, Syal JS. Water quality assessment using machine learning: a focus on coliform prediction in water. Asian Journal of Water, Environment and Pollution, 2024, 21(5), 19-26. DOI: 10.3233/AJW240061
[41] Taiwo AM, Somade OC, Atayese AO, Oyedepo JA, Obuotor TM, Taiwo OT, et al. Groundwater quality and microbial contamination of hand-dug wells near market waste-collection bins in Abeokuta, Nigeria. Discover Environment, 2026, 4(1), 82. DOI: 10.1007/s44274-026-00561-2
[42] Magnan AK, Bell R, Duvat VK, Ford JD, Garschagen M, Haasnoot M, et al. Status of global coastal adaptation. Nature Climate Change, 2023, 13(11), 1213-1221. DOI: 10.1038/s41558-023-01834-x
[43] Justin S, Lihan S, Mik J, Grinang J, Hou KKW, Lazlus L, et al. Land use and seasonal effects on water quality and faecal contamination in Batang Layar river, Sarawak, Malaysia. Discover Applied Sciences, 2025, 8(1), 6. DOI: 10.1007/s42452-025-06489-7
[44] Dhengesu D, Lemma H, Asefa L, Tilahun D. Antimicrobial resistance profile of Enterobacteriaceae and drinking water quality among households in Bule Hora Town, South Ethiopia. Risk Management and Healthcare Policy, 2022, 1569-1580. DOI: 10.2147/RMHP.S373788
[45] Abdulmumin H. Water Availability and Quality Assessment in Health Facilities: A Case Study of Five Primary Health Care Centres in the Federal Capital Territory. UNIABUJA Journal of Engineering and Technology (UJET), 2025, 2(2), 394-412.
[46] Ibrahimi MT, Zaryab A, Ali S, Hasani M. Key Drivers Impacting Water Resources of Afghanistan Under Rapid Climate Change Conditions. Water Conservation Science and Engineering, 2025, 10(2), 80. DOI: 10.1007/s41101-025-00351-8
[47] Deshpande A, Miller-Petrie MK, Lindstedt PA, Baumann MM, Johnson KB, Blacker BF, et al. Mapping geographical inequalities in access to drinking water and sanitation facilities in low-income and middle-income countries, 2000–17. The Lancet Global Health, 2020, 8(9), e1162-e1185. DOI: 10.1016/S2214-109X(20)30278-3
[48] Amadi EC, Ike AC, Eze EA, Imanyikwa IO. Open defecation and water-related parasitic diseases burden: case study in Nigeria—a review. Innovation in Science and Technology, 2024, 3(5), 1-14.
[49] Bazaanah P, Mothapo RA. Sustainability of drinking water and sanitation delivery systems in rural communities of the Lepelle Nkumpi Local Municipality, South Africa. Environment, Development and Sustainability, 2024, 26(6), 14223-14255. DOI: 10.1007/s10668-023-03195-5
[50] Kushwaha R, Vardhan PS, Kushwaha PP. Chronic kidney disease interplay with comorbidities and carbohydrate metabolism: a review. Life, 2023, 14(1), 13. DOI: 10.3390/life14010013
[51] Fetrat S, Islam S. Investigation of the physicochemical parameters of drinking water in Herat province and its comparison with World Health Organization standards. Discover Water, 2024, 4(1), 112. DOI: 10.1007/s43832-024-00169-0
[52] Jesser KJ, Alban V, Lobos AE, Gallard-Góngora J, Trueba G, Lee GO, et al. Microbial source tracking of human and animal fecal contamination in Ecuadorian households. Applied and Environmental Microbiology, 2026, 92(1), e01694-25. DOI: 10.1128/aem.01694-25
[53] Kovess-Masfety V, Keyes K, Karam E, Sabawoon A, Sarwari BA. A national survey on depressive and anxiety disorders in Afghanistan: a highly traumatized population. BMC Psychiatry,

2021, 21(1), 314. DOI: 10.1186/s12888-021-03288-7
[54] Chebet JJ, Kilungo A, Alaofè H, Malebo H, Katani S, Nichter M. Local perceptions, cultural beliefs, practices and changing perspectives of handling infant feces: a case study in a rural Geita District, North-Western Tanzania. International Journal of Environmental Research and Public Health, 2020, 17(9), 3084. DOI: 10.3390/ijerph17093084
[55] Parvez SM, Rahman MJ, Azad R, Rahman M, Unicomb L, Ashraf S, et al. Achieving equitable uptake of handwashing and sanitation by addressing both supply and demand-based constraints: findings from a randomized controlled trial in rural Bangladesh. International Journal for Equity in Health, 2021, 20(1), 16. DOI: 10.1186/s12939-020-01356-6
[56] Fakhri MY. The Causes of Neonatal Mortality in Mazar-i-Sharif, Northern Afghanistan (Doctoral dissertation). Düsseldorf: Heinrich-Heine-Universität, 2025.
[57] Ranasinghe P, Rathnayake N, Wijayawardhana S, Jeyapragasam H, Meegoda VJ, Jayawardena R, et al. Rising trends of diabetes in South Asia: a systematic review and meta-analysis. Diabetes & Metabolic Syndrome: Clinical Research & Reviews, 2024, 18(11-12), 103160. DOI: 10.1016/j.dsx.2024.103160
[58] Meehan K, Jepson W, Harris LM, Wutich A, Beresford M, Fencl A, et al. Exposing the myths of household water insecurity in the global north: a critical review. Wiley Interdisciplinary Reviews: Water, 2020, 7(6), e1486. DOI: 10.1002/wat2.1486
[59] Shrestha A, Six J, Dahal D, Marks S, Meierhofer R. Association of nutrition, water, sanitation and hygiene practices with children's nutritional status, intestinal parasitic infections and diarrhoea in rural Nepal: a cross-sectional study. BMC Public Health, 2020, 20(1), 1241. DOI: 10.1186/s12889-020-09314-1
[60] Freak-Poli R, Ryan J, Neumann JT, Tonkin A, Reid CM, Woods RL, et al. Social isolation, social support and loneliness as predictors of cardiovascular disease incidence and mortality. BMC Geriatrics, 2021, 21(1), 711. DOI: 10.1186/s12877-021-02674-2
[61] Emerson LE, Anantharam P, Yehuala FM, Bilcha KD, Tesfaye AB, Fairley JK. Poor WASH (water, sanitation, and hygiene) conditions are associated with leprosy in North Gondar, Ethiopia. International Journal of Environmental Research and Public Health, 2020, 17(17), 6061. DOI: 10.3390/ijerph17176061
[62] Bong S, Lee K, Dominici F. Differential recall bias in estimating treatment effects in observational studies. Biometrics, 2024, 80(2), ujae058. DOI: 10.1093/biomtc/ujae058
[63] Maxcy-Brown J, Capone D, Elliott MA. Characterizing the nature and extent of access to unsafely managed sanitation in the United States. Nature Water, 2023, 1(11), 915-928. DOI: 10.1038/s44221-023-00139-7
[64] Hubbard S, Wolf J, Oza HH, Arnold BF, Freeman MC, Levy K. Differential effectiveness of water, sanitation, and handwashing interventions to reduce child diarrhea in dry and rainy seasons: a systematic review and meta-analysis of intervention trials. Environmental Health Perspectives, 2025, 133(2), 026001. DOI: 10.1289/EHP14534
[65] Anthonj C, Githinji S, Höser C, Stein A, Blanford J, Grossi V. Kenyan school book knowledge for water, sanitation, hygiene and health education interventions: disconnect, integration or opportunities? International Journal of Hygiene and Environmental Health, 2021, 235, 113756. DOI: 10.1016/j.ijheh.2021.113756
[66] Zhang L, Zhao Y. Breaking the vicious cycle between illness and poverty: empirical actions on land use in an oasis agricultural area. Land, 2021, 10(4), 335. DOI: 10.3390/land10040335
[67] Ante-Testard PA, Rerolle F, Nguyen AT, Ashraf S, Parvez SM, Naser AM, et al. WASH interventions and child diarrhea at the interface of climate and socioeconomic position in Bangladesh. Nature Communications, 2024, 15(1), 1556. DOI: 10.1038/s41467-024-45762-0