

Functional Vulnerability, WASH Barriers and Self-Reported Morbidity among Older Adults in Urban Ghana: A Cross-Sectional Study

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Abstract

Background.

Older adults in low- and middle-income countries face water, sanitation and hygiene (WASH) barriers that are inseparable from their functional capacity, yet WASH research rarely treats functional limitation and hygiene-related morbidity together. This study examined how functional and ageing-related vulnerabilities intersect with WASH barriers and self-reported morbidity among older adults in urban Ghana.

Methods.

Cross-sectional study of 224 adults aged 60 years and above in urban communities of Sunyani Municipality, Bono Region, Ghana (June to July 2025), with structured observation of household sanitation facilities in a nested subset of 177 households. Functional vulnerability was captured through self-reported ageing-related conditions and hygiene-related functional difficulties; WASH barriers were captured by self-report and by direct observation. Outcomes were self-reported hygiene-related symptoms in the preceding six months and healthcare utilisation for such illness. Descriptive statistics with 95% confidence intervals, chi-square tests, and a newly derived observed WASH Barrier Burden score were used. Individual-level survey records were not available for this analysis, so no new multivariable model of morbidity could be fitted; this is reported as an explicit limitation rather than estimated.

Results.

Ageing-related conditions affecting hygiene were common: arthritis 167/224 (75%), low energy 112/224 (50%), visual loss 37/224 (17%), faecal incontinence 27/224 (12%) and urinary incontinence 20/224 (9%). Physical limitation was the leading barrier to intimate-area cleansing (137/224, 61%) and financial constraint the leading overall hygiene barrier (137/224, 61%). Sanitation-related joint pain was the most frequently reported symptom (124/224, 55%), followed by eye infection (64/224, 29%), diarrhoea/stomach upset (50/224, 22%) and skin infection (43/224, 19%); only 29/224 (13%) reported no hygiene-related symptom, and 87/224 (39%) reported healthcare visits more than monthly for such illness. In the observed subset, households carried a median of 5 of 10 concurrent WASH barriers (IQR 3–7), with 138/177 (78%) carrying three or more. Age was associated with sanitation-related joint pain ($p = 0.04$), limited mobility with bathing frequency ($p = 0.01$), and both perceived poor water and poor food hygiene with diarrhoea/stomach upset ($p = 0.01$ each).

Conclusions.

For older adults in this setting, sanitation is not merely a coverage problem. A high burden of functional limitation coincides with dense, concurrent household WASH barriers and with frequently reported hygiene-related symptoms and healthcare use. Findings support disability-inclusive, age-friendly WASH programming, but the cross-sectional design and reliance on self-reported, unverified morbidity preclude causal interpretation.

Introduction

The number of people aged 60 years and above is projected to reach 2.1 billion by 2050, with roughly four-fifths living in low- and middle-income countries (LMICs) [1]. Ghana's older population has grown from about 4.5% of the national total in 1960 to 6.5%, or approximately 1.99 million people, at the 2021 Population and Housing Census [2]. Ageing in this context is not simply a matter of longer life; the World Health Organization frames healthy ageing as the process of developing and maintaining the functional ability that enables wellbeing, and explicitly distinguishes an individual's intrinsic capacity from the environments in which that capacity is exercised [3]. Environments that fail to accommodate declining capacity convert ordinary daily tasks into sources of dependence.

Few domains illustrate this more directly than water, sanitation and hygiene (WASH). Toileting, bathing, perineal cleansing and handwashing all demand balance, lower-limb strength, transfer ability, grip and vision. Environmental gerontology's ecological model holds that behaviour and wellbeing arise from the fit between personal competence and environmental "press"; as competence declines, environmental demands that were previously trivial become disabling [4]. Empirical work in ageing populations supports this: in India and rural China, the physical environment is a demonstrable determinant of toileting and bathing difficulty among older adults, independent of individual health status [5,6], and among older Ghanaians, functional difficulty has been shown to predict toileting problems specifically [7].

Yet WASH monitoring remains largely age-blind. Global indicators record whether a facility exists and whether it is "improved", not whether an older person with arthritic knees, low energy or poor vision can reach, enter, use and clean it unaided [8]. In Ghana, WASH research has concentrated on children, women and general households, and national analyses rarely disaggregate older adults [9,10]; a recent review concluded that evidence on WASH and healthy ageing in Ghana remains scant and called explicitly for empirical work centred on older persons [11]. Where such evidence exists, it points to real health stakes: unimproved water and sanitation are associated with elevated chronic disease risk among older Ghanaians [12], and socio-economic and spatial disparities in older adults' sanitation access have been mapped nationally [13].

What remains largely unexamined is the intersection itself. Functional limitation and WASH inadequacy are typically studied in parallel rather than together, and hygiene-related morbidity among older adults is rarely measured alongside either. A companion analysis of the present study population documented the gap between older adults' reported hygiene practices and the infrastructure observed to support them,

and identified predictors of consistent soap use and of sanitation facility accessibility [14]. The present analysis addresses a distinct question: how functional and ageing-related vulnerabilities intersect with WASH barriers and self-reported morbidity in the same population. Accordingly, this manuscript takes neither soap use nor facility accessibility as an outcome; its outcomes are the hygiene-related symptoms older adults report and the healthcare use those symptoms generate.

The specific objectives were: (1) to characterise functional and ageing-related vulnerabilities affecting hygiene and sanitation practices among older adults in Sunyani Municipality; (2) to determine the prevalence and pattern of self-reported hygiene- and sanitation-related morbidity and associated healthcare utilisation; and (3) to examine associations between functional vulnerability, household WASH conditions and selected self-reported health outcomes, within the limits of the available data.

Materials and Methods

Study design

This was a cross-sectional study with a nested observational component, reported in accordance with the STROBE statement for cross-sectional studies [15]. It is a secondary analysis of data from a single study; the primary analysis of hygiene practices, self-report versus observation, and predictors of soap use and facility accessibility is reported separately [14]. The two manuscripts share only the study population and minimal descriptive characteristics; research question, outcomes, analyses and conclusions differ, and no primary table or model from the companion paper is reproduced here.

Study area

The study was conducted in urban communities of Sunyani Municipality, Bono Region, Ghana. Sunyani Municipal Assembly is one of twelve Metropolitan, Municipal and District Assemblies in the Bono Region and one of the region's most urbanised, with Sunyani as both municipal and regional capital [16]. Fieldwork was conducted in five purposively selected communities (Nkwabeng, Penkwase, Abesim, Sunyani Zongo and New Town) [14].

Study population and sampling

The target population comprised persons aged 60 years and above resident in the selected communities for at least six months, able to give informed consent and to participate in an interview; persons with visible cognitive impairment identified during the consent process were excluded, without a formal cognitive screening instrument [14]. A multi-stage approach was used: five communities were purposively selected on population density and documented presence of older residents; within each, households were visited, eligible older persons listed, and where more than one was eligible a single respondent was selected by balloting [14].

Using Yamane's formula with a 5% margin of error, the required sample size was 383; 224 valid responses were obtained (58.5% of target) [14]. Of these 224 surveyed households, 177 (79%) permitted observational assessment of their sanitation facilities; the observed subset is therefore nested within, and not independent of, the survey sample. The 47 non-observed households declined principally because of privacy concerns or absence of a household head, and observed and non-observed households were reported as similar in respondent age, gender and facility type [14].

Data collection

Data were collected between June and July 2025 using two instruments: a face-to-face structured questionnaire administered to the older person, and an observational checklist completed by trained enumerators at the household sanitation facility [14]. Enumerators were trained on both instruments and the tools were pre-tested outside the study area; completed questionnaires were reviewed daily. Formal inter-rater reliability statistics were not collected for the observational checklist [14].

Measures

Functional-vulnerability variables

Functional vulnerability was operationalised from two question sets in the survey instrument. The first recorded ageing-related conditions reported as influencing hygiene and sanitation practice (arthritis; dementia; dehydration; low energy levels; urinary incontinence; faecal incontinence; skin infection or pressure sore; limited mobility or balance problems; sight loss). The second recorded self-reported challenges to maintaining hygiene (physical disability; limited access to facilities or products; financial constraints; lack of knowledge; other) and, separately, challenges specific to cleansing sensitive (perineal/anogenital) areas (physical limitations; lack of materials; lack of clean water; lack of knowledge; other). Both sets permitted multiple responses. No validated functional-disability scale (for example, Katz ADL, Barthel Index or the Washington Group Short Set) was administered; these are self-reported symptom and difficulty checklists, and are described as such throughout.

WASH variables

Self-reported WASH variables included water source for hygiene, toilet place and technology, cleaning responsibility and maintenance, hygiene-product accessibility, receipt of hygiene assistance, and perceived adequacy, reliability, safety and age-friendliness of facilities. Observed WASH variables (n = 177) covered the presence, type, condition and accessibility of handwashing facilities; toilet age-friendly features, cleanliness, maintenance and hygiene supplies; waste management; water storage and access; and visible environmental hygiene.

Observed WASH Barrier Burden score

To characterise the concurrent, rather than isolated, nature of household WASH inadequacy, a ten-item count of directly observed barriers was derived for the 177 observed households: (1) no designated handwashing place; (2) no soap or detergent at the handwashing station; (3) handwashing facility unclean or non-functional; (4) handwashing facility not fully accessible; (5) no age-friendly toilet features; (6) toilet not regularly cleaned; (7) no soap or disinfectant in the toilet; (8) waste not properly managed; (9) water not easily accessible for personal hygiene; (10) visible signs of poor environmental hygiene. Each item was coded 1 if the barrier was present and 0 otherwise, and summed (range 0–10). Items were selected a priori to span all five observed WASH domains, with consistent directionality; internal consistency was acceptable (KR-20 = 0.72). The score is a descriptive summary of environmental barrier density, not a validated instrument, and is not presented as a measure of individual functional status.

Outcome variables

The health outcomes were self-reported illness experienced in the preceding six months (diarrhoea/stomach upset; skin infection; eye infection; joint pain arising from sanitation-facility use; none; other), recorded as a multiple-response item, and frequency of healthcare visits for hygiene-related illness. All outcomes are respondent-reported symptoms over a six-month recall period. They were not clinically examined, laboratory-confirmed or abstracted from medical records, and are not described as diagnoses anywhere in this manuscript.

A composite "any infectious hygiene-related symptom" variable (diarrhoea, skin infection or eye infection) was considered, as the multiple-response format means these were selectable independently. It was not constructed, because deriving it requires respondent-level records that were not available for this analysis; constructing it from marginal totals alone would require assuming an overlap structure between the three symptoms that the summary tables do not contain. This is reported rather than approximated.

Statistical analysis

Analyses proceeded on two footings, which are distinguished throughout. For the observational component, the raw dataset (177 household records, Survey Solutions export) was available and was analysed directly: frequencies and percentages with Wilson score 95% confidence intervals, median and interquartile range for the barrier score, Mann-Whitney U and Kruskal-Wallis tests for between-group comparison, Spearman correlation for continuous association, and chi-square tests for categorical association. Analyses used Python 3.12 (pandas, pyreadstat, statsmodels, SciPy).

For the survey component (N = 224), individual-level records were not supplied for this analysis; only aggregate tables produced by the original study team were available. Consequently, descriptive frequencies and bivariate test statistics for the survey are reported as transcribed from those tables, with every value cross-checked against the source, and no new statistical test was computed on that

component. In accordance with the analysis plan, no multivariable model of self-reported morbidity was fitted, because fitting one requires respondent-level data. Rather than present estimates that could not be derived from the available material, the absence of an adjusted model is reported as a limitation and specified as the priority next analysis (see Limitations). The survey component's original analyses were conducted in SPSS version 23 (IBM Corp., Armonk, NY) [14]. Statistical significance was set at $p < 0.05$; because a substantial number of bivariate tests were conducted without adjustment for multiple comparisons, p-values near this threshold are treated as hypothesis-generating.

A conceptual framework (Fig. 1) guided variable organisation and interpretation, linking sociodemographic conditions, functional vulnerability, ability to access and use WASH, WASH exposures and barriers, and self-reported morbidity and healthcare utilisation. Given the cross-sectional design, this ordering is conceptual and was not tested as a causal pathway.

Ethical considerations

Ethical clearance (reference CHRE/CA/405/025) was obtained from the institutional research ethics committee of the University of Energy and Natural Resources, Centre for Research in Applied Biology, before commencement. Given literacy realities in the study setting, informed consent was obtained verbally and witnessed by enumerators after participants were informed of the study purpose, the voluntary nature of participation, their right to withdraw, and the intended use of anonymised data in publications; confidentiality was maintained throughout.

Results

Participant characteristics and functional vulnerability

Of the 224 respondents, 149 (67%) were aged 60–75 years and 45 (20%) were aged 81 years or above; 138 (62%) were women. Educational attainment was low: 118 (53%) had no formal education. Most lived in their own house (100, 45%) or a family house (83, 37%) (Table 1).

Ageing-related conditions reported as affecting hygiene and sanitation practice were common and frequently co-occurring. Arthritis was reported by 167 respondents (75%, 95% CI 68–80) and low energy levels by 112 (50%, 95% CI 43–57). Sight loss affected 37 (17%), faecal incontinence 27 (12%), urinary incontinence 20 (9%) and dementia 26 (12%). Limited mobility or balance problems were reported by only 14 respondents (6%). This is markedly lower than the 118 (53%) who reported physical disability as a barrier to maintaining hygiene, suggesting the two items were interpreted differently by respondents. This discrepancy is examined in the Discussion and flagged for coding verification.

Table 1
Sociodemographic and functional characteristics of older adults, Sunyani
Municipality, Ghana, 2025 (N = 224)

Characteristic	n	%	95% CI
Age group			
60–65 years	77	34	28–41
66–70 years	39	17	13–23
71–75 years	33	15	11–20
76–80 years	30	13	10–19
81–85 years	13	6	3–10
86–90 years	21	9	6–14
91 years and above	11	5	3–9
Sex			
Female	138	62	55–68
Male	86	38	32–45
Educational attainment			
No formal education	118	53	46–59
Primary	43	19	15–25
Secondary	48	21	17–27
Tertiary	15	7	4–11
Housing arrangement			
Own house	100	45	38–51
Family house	83	37	31–44
Rented house	38	17	13–23
Ageing-related conditions affecting hygiene practice ☒			
Arthritis	167	75	68–80
Low energy levels	112	50	43–57
Sight loss	37	17	12–22
Faecal incontinence	27	12	8–17
Dementia	26	12	8–17

Characteristic	n	%	95% CI
Skin infection / pressure sore	25	11	8–16
Dehydration	21	9	6–14
Urinary incontinence	20	9	6–13
Limited mobility / balance problems	14	6	4–10

95% CI = Wilson score interval. ☒ Multiple responses permitted; percentages do not sum to 100. Conditions were self-reported without a validated functional-disability instrument.

Functional limitations and WASH-related barriers

Barriers to hygiene were dominated by bodily and economic constraints rather than by knowledge deficits. Financial constraints (137, 61%) and physical disability (118, 53%) were the two most frequently reported challenges to maintaining hygiene overall, with limited access to facilities or products reported by 83 (37%) and lack of knowledge by only 14 (6%). The same pattern held for the more intimate task of cleansing sensitive areas, where physical limitations were reported by 137 (61%), lack of materials by 70 (31%), lack of clean water by 62 (28%) and lack of knowledge by 23 (10%).

Support and adaptation were scarce. Only 26 respondents (12%, 95% CI 8–17) reported access to age-friendly facilities such as handrails or a nearby toilet, and only 48 (21%) reported receiving hygiene assistance when needed. Hygiene products were not easily accessible for 32 (14%) and only moderately accessible for a further 82 (37%). When asked directly whether facilities were adapted to the needs of older persons, 197 (88%) said they were not, and installing age-friendly features was the single most frequently suggested improvement (129, 58%).

Direct observation in the nested subset (n = 177) showed that these barriers rarely occurred singly. Households carried a median of 5 of 10 concurrent observed WASH barriers (IQR 3–7; mean 4.7, SD 2.5; range 0–10); 138 (78%) carried three or more and 94 (53%) carried five or more, while only 4 households (2%) carried none (Table 2, Fig. 2). Barrier burden did not differ significantly by residence type (Kruskal-Wallis $p = 0.23$) and was weakly inversely correlated with household size (Spearman $\rho = -0.15$, $p = 0.044$).

Table 2
Functional limitations and WASH-related barriers among older adults, Sunyani
Municipality, Ghana, 2025

Barrier	n	%	95% CI
Panel A: Self-reported barriers (N = 224) ☒			
Financial constraints	137	61	55–68
Physical disability	118	53	46–59
Limited access to facilities/products	83	37	31–44
Lack of knowledge	14	6	4–10
Panel B: Barriers to cleansing sensitive areas (N = 224) ☒			
Physical limitations	137	61	55–68
Lack of materials (soap/tissue)	70	31	26–38
Lack of clean water	62	28	22–34
Lack of knowledge	23	10	7–15
Panel C: Support and adaptation (N = 224)			
No access to age-friendly facilities	198	88	83–92
Facilities not adapted for older persons' needs	197	88	83–92
Does not receive hygiene assistance when needed	176	79	73–84
Hygiene products not easily accessible	32	14	10–20
Panel D: Observed household WASH barriers (n = 177)			
No age-friendly toilet features	144	81	75–86
No soap/disinfectant in toilet	115	65	58–72
Waste not properly managed	111	63	55–70
Handwashing facility unclean or non-functional	98	55	48–63
Toilet not regularly cleaned	84	48	40–55
No designated handwashing place	67	38	31–45
No soap at handwashing station	65	37	30–44
Handwashing facility not fully accessible	58	33	26–40
Visible signs of poor environmental hygiene	57	32	26–39
Water not easily accessible for hygiene	40	23	17–29

Barrier	n	%	95% CI
Observed WASH Barrier Burden score, median (IQR)	5 (3–7)		
≥3 concurrent barriers	138	78	71–84
≥5 concurrent barriers	94	53	46–60

☒ Multiple responses permitted; percentages do not sum to 100. Panel D derived from direct observation of the nested subset of households (KR-20 = 0.72). 95% CI = Wilson score interval.

Self-reported morbidity and healthcare utilisation

Hygiene- and sanitation-related symptoms were reported by the large majority of respondents; only 29 (13%, 95% CI 9–18) reported none in the preceding six months. Joint pain arising from sanitation-facility use was the most frequently reported symptom, affecting 124 respondents (55%, 95% CI 49–62). This exceeded all three infectious symptom categories. Eye infection was reported by 64 (29%), diarrhoea or stomach upset by 50 (22%) and skin infection by 43 (19%) (Table 3).

Healthcare utilisation was correspondingly high: 87 respondents (39%, 95% CI 33–46) reported visiting a health facility more than once a month for hygiene-related illness, and a further 56 (25%) every two to three months, while 45 (20%) never did. Respondents most often attributed their health problems to poor water (71, 32%), with lack of toilets and overcrowding each cited by 49 (22%); notably, 50 (22%) did not know the cause. Belief in the health value of improved sanitation was near-universal, with 196 (88%) considering that improvement would significantly improve health.

Table 3
Self-reported hygiene- and sanitation-related morbidity and healthcare utilisation (N = 224)

Outcome	n	%	95% CI
Symptoms in preceding six months ☒			
Joint pain from sanitation-facility use	124	55	49–62
Eye infection	64	29	23–35
Diarrhoea / stomach upset	50	22	17–28
Skin infection	43	19	15–25
Other	15	7	4–11
None reported	29	13	9–18
Healthcare visits for hygiene-related illness			
Frequently (more than once monthly)	87	39	33–46
Occasionally (every 2–3 months)	56	25	20–31
Rarely (once or twice yearly)	36	16	12–21
Never	45	20	15–26
Perceived cause of health problems ☒			
Poor water	71	32	26–38
Lack of toilets	49	22	17–28
Overcrowding	49	22	17–28
Flies	21	9	6–14
Unclean surroundings	18	8	5–12
Poor food hygiene	14	6	4–10
Does not know	50	22	17–28
Believes improved sanitation would significantly improve health	196	88	83–91

☒ Multiple responses permitted; percentages do not sum to 100. All outcomes are self-reported over a six-month recall period and were neither clinically examined nor laboratory-confirmed.

Associations between functional vulnerability, WASH conditions and health outcomes

Bivariate associations available from the survey component are summarised in Table 4. Age was associated with sanitation-related joint pain ($\chi^2 = 13$, df = 6, $p = 0.04$; linear-by-linear $p = 0.01$), consistent

with a graded relationship across age groups. Limited mobility was associated with bathing frequency ($\chi^2 = 12$, $df = 1$, $p = 0.01$), indicating that respondents reporting mobility restriction bathed less frequently. Two water- and food-related exposures were associated with diarrhoea or stomach upset: perceived poor water ($\chi^2 = 6$, $df = 1$, $p = 0.01$) and poor food hygiene ($\chi^2 = 7$, $df = 1$, $p = 0.01$). Water source was associated with reporting poor water as a perceived cause ($\chi^2 = 15$, $df = 4$, $p = 0.004$). Frequency of handwashing with soap was not significantly associated with diarrhoea or stomach upset ($\chi^2 = 6$, $df = 3$, $p = 0.12$), although the linear-by-linear component was significant ($p = 0.02$), a pattern consistent with a weak graded association that the omnibus test was underpowered to detect.

In the observed subset, a notable null result emerged. The Observed WASH Barrier Burden score did not differ between households where enumerators judged that the older resident appeared to face difficulty accessing hygiene facilities and those where they did not (median 5 in both groups; Mann-Whitney $U = 3915$, $p = 1.00$). Disaggregation showed why: individual components pointed in different directions and cancelled within the composite. Absence of soap at the handwashing station ($\chi^2 = 17.6$, $p < 0.001$), unmanaged waste ($\chi^2 = 16.2$, $p < 0.001$) and an unclean or non-functional handwashing facility ($\chi^2 = 4.1$, $p = 0.044$) were each associated with observed access difficulty, whereas absence of age-friendly toilet features ($p = 0.10$), inaccessible water ($p = 0.95$) and visible poor environmental hygiene ($p = 0.63$) were not. The composite is therefore useful for describing how densely barriers cluster, but should not be used as an explanatory variable in place of its components.

Table 4

Bivariate associations between functional/WASH factors and selected health and hygiene outcomes

Association	Test	χ^2 (df)	p	Source
Panel A: Survey component (N = 224)				
Age × sanitation-related joint pain	Chi-square	13 (6)	0.04	Survey
Limited mobility × bathing frequency	Chi-square	12 (1)	0.01	Survey
Perceived poor water × diarrhoea/stomach upset	Chi-square	6 (1)	0.01	Survey
Poor food hygiene × diarrhoea/stomach upset	Chi-square	7 (1)	0.01	Survey
Water source × poor water as perceived cause	Chi-square	15 (4)	0.004	Survey
Handwashing frequency × diarrhoea/stomach upset	Chi-square	6 (3)	0.12 $\boxtimes$	Survey
Panel B: Observed component (n = 177)				
No soap at handwashing station × observed access difficulty	Chi-square	17.6 (1)	< 0.001	Observed
Waste not properly managed × observed access difficulty	Chi-square	16.2 (1)	< 0.001	Observed
Handwashing unclean/non-functional × observed access difficulty	Chi-square	4.1 (1)	0.044	Observed
No age-friendly features × observed access difficulty	Chi-square	2.7 (1)	0.099	Observed
Water not accessible × observed access difficulty	Chi-square	0.003 (1)	0.95	Observed
Barrier Burden score × observed access difficulty	Mann-Whitney	U = 3915	1.00	Observed

$\boxtimes$ Omnibus test non-significant; linear-by-linear association $p = 0.02$. Panel A statistics were computed by the original study team on individual-level survey records and are reported as transcribed; Panel B statistics were computed directly from the raw observational dataset for this analysis.

Multivariable analysis

No multivariable model of self-reported morbidity is presented. Individual-level survey records were not available for this analysis, and adjusted odds ratios for the morbidity outcomes cannot be derived from aggregate tables. Fitting such a model, with diarrhoea/stomach upset as the primary outcome and sanitation-related joint pain, skin infection, eye infection and healthcare utilisation as secondary outcomes, adjusted for age, sex, education, functional vulnerability and household WASH conditions, is the single highest-priority next analysis and is specified in the Pre-submission Verification Report

accompanying this manuscript. Presenting estimates that the available material cannot support was judged inappropriate.

Discussion

Principal findings

Three findings define this analysis. First, functional vulnerability in this population is extensive: three-quarters reported arthritis and half reported low energy levels as conditions affecting their hygiene practice, and physical limitation was the leading reported barrier both to hygiene generally and to intimate cleansing specifically. Second, hygiene-related morbidity was widely reported, with only 13% free of any symptom in the preceding six months and 39% attending a health facility more than monthly; the single most common symptom was not infectious but musculoskeletal, namely joint pain arising from using the sanitation facility itself. Third, household WASH barriers were dense rather than isolated, with a median of five concurrent observed barriers per household and 78% of households carrying three or more, against a backdrop in which 88% of respondents said facilities were not adapted to older persons' needs.

Interpretation and plausible mechanisms

Taken together, these findings support an interpretation in which sanitation for older adults is not adequately characterised as a coverage problem. Coverage in this municipality is, on conventional indicators, reasonable: most respondents used a private or shared household latrine and flush or pour-flush technology predominated [14]. What the present analysis adds is that adequate coverage coexists with near-total absence of age-friendly adaptation and with a high burden of the very conditions that make an unadapted facility difficult to use, including arthritis, low energy, impaired vision and incontinence.

The prominence of sanitation-related joint pain is the clearest illustration. A facility that requires squatting, deep knee flexion, or lowering to and rising from an unraised seat without a handrail imposes a mechanical demand that intersects directly with the arthritis reported by three-quarters of this sample. That age was associated with joint pain in a graded fashion is consistent with this reading. It is important to be precise about what this does and does not show: the study demonstrates that both conditions are common and statistically associated, and the literature on environmental determinants of toileting difficulty in ageing populations offers a plausible mechanism [5,6,7], but the cross-sectional design cannot establish that facility design produced the pain, and reverse or reciprocal patterning, in which pain shapes which facilities are used and how they are described, is equally compatible with these data.

A parallel argument applies to the infectious symptoms. Diarrhoea and stomach upset were associated with perceived poor water and poor food hygiene, and observation found soap absent from 65% of toilets and 37% of handwashing stations. The proximal deficits are therefore present, and are

established upstream determinants of diarrhoeal disease. But perceived water quality is itself a self-reported construct measured in the same interview as the outcome, so same-source bias cannot be excluded, and no water quality testing was performed.

The economic dimension deserves emphasis. Financial constraint was the most frequently reported barrier overall (61%), matching physical limitation in prominence. For an older person on a limited or absent income, soap, tissue and disinfectant are recurrent purchases that compete with food and medicines; the observation that soap was absent from most toilets is consistent with a supply that is intermittent rather than simply unavailable. Disability-inclusive WASH programming that installs hardware without addressing consumable affordability is unlikely to change the daily reality documented here.

Finally, the null result for the composite Barrier Burden score is instructive rather than disappointing. Its components behaved heterogeneously, in that soap absence and unmanaged waste were strongly associated with observed access difficulty while age-friendly features and water access were not, and the composite averaged these opposing signals to zero. This is a caution against the increasingly common practice of collapsing WASH indicators into summary indices for use as explanatory variables: density of barriers and the specific nature of barriers are different constructs, and only the latter appears to track observed difficulty here.

Comparison with previous studies

These findings extend rather than contradict existing evidence. Awuviry-Newton and colleagues showed, using SAGE Ghana data, that functional difficulty predicts toileting problems among older Ghanaians [7]; the present analysis approaches the same intersection from the environmental side and adds self-reported morbidity as an outcome, showing that where functional limitation and unadapted facilities coincide, symptoms and healthcare contacts are frequently reported. Gyasi and colleagues linked unimproved water and sanitation to elevated chronic disease risk in older Ghanaians [12]; the barrier profile documented here identifies the granular deficits through which such risk plausibly operates, namely absent soap, unmanaged waste, and the lack of handrails or raised seats. Boateng and colleagues mapped socio-economic and spatial disparities in older adults' sanitation access nationally [13]; this municipal-level analysis suggests that even where access is not the binding constraint, adaptation may be.

Internationally, the finding that the physical environment shapes toileting and bathing difficulty in later life aligns closely with evidence from India and rural China [5,6], and with work linking age-friendly community infrastructure to older adults' health in China [18]. That a similar pattern appears in an urban West African municipality suggests a general LMIC phenomenon rather than a local peculiarity. The near-universal preference for age-friendly features as the top improvement priority (58%) also echoes the WHO Decade of Healthy Ageing's emphasis on environments that sustain function and dignity [19].

Implications for healthy ageing

Framed within the WHO healthy ageing model, these data describe an environment that systematically erodes functional ability among people whose intrinsic capacity is already declining [3]. Hygiene is not a peripheral domain: the ability to use a toilet, wash, and cleanse oneself unaided is foundational to independence and to dignity, and its loss is a common precipitant of dependence on family members. That only 21% of respondents received hygiene assistance when needed, while 79% did not, suggests that the shortfall in environmental support is not being fully offset by informal care. Where the environment cannot be used independently and assistance is unavailable, the likely consequences are reduced frequency of hygiene practice, as the association between limited mobility and lower bathing frequency suggests, with attendant risks to skin integrity, continence management and dignity.

Policy implications for Ghana

Three implications follow for Ghanaian policy and practice. First, age-friendly design standards covering handrails, raised or non-squat seating, non-slip surfaces and adequate lighting should be incorporated into environmental sanitation policy and municipal monitoring frameworks [20], with retrofitting prioritised in shared facilities, which serve a substantial minority of older residents. Second, hygiene-consumable affordability should be treated as a WASH policy object in its own right, given that financial constraint rivalled physical limitation as a reported barrier; targeted subsidy or supply mechanisms for older adults merit evaluation. Third, Ghana's National Ageing Policy and WASH-sector planning should be more explicitly linked, so that age-friendly adaptation is monitored as an indicator rather than assumed to follow from general infrastructure improvement [21]. Specific programme design and costing should be developed with the relevant Ghanaian institutions rather than inferred from these data.

Strengths

This analysis has three principal strengths. It centres older adults, a group largely absent from Ghanaian WASH research. It pairs older persons' own accounts of functional limitation and morbidity with direct household observation of the environments in which they must manage hygiene, rather than relying on either alone. And it treats functional vulnerability, WASH barriers and health outcomes as a single analytic question, which existing Ghanaian evidence has generally addressed in separate literatures.

Limitations

Several limitations materially constrain interpretation. The cross-sectional design precludes any inference about temporality or causality; all associations reported are correlational. Morbidity was self-reported over a six-month recall period and was neither clinically examined nor laboratory-confirmed, so the symptom categories should not be read as diagnoses and are subject to recall bias; social desirability bias may also affect reporting of hygiene practice. Several exposures and outcomes were measured in the same interview, so same-source bias cannot be excluded, particularly for the association between perceived poor water and diarrhoea.

Most consequentially, individual-level survey records were unavailable for this analysis, so no adjusted model of morbidity could be fitted, no composite infectious-symptom outcome could be constructed,

and survey-component statistics could not be independently reproduced. The achieved sample (224 of 383 targeted, 58.5%) reduces precision and raises the possibility of non-response bias, and communities were purposively selected, limiting generalisability beyond urban Sunyani Municipality. Observational data were available for only 177 of 224 households (79%), and although observed and non-observed households were reported as similar on measured characteristics, residual differences cannot be excluded; the observed subset is nested within the survey sample, so the two components are not independent. Formal inter-rater reliability was not assessed for the observational checklist. No validated functional-disability scale was administered, so functional vulnerability rests on self-reported symptom checklists; the discrepancy between self-reported limited mobility (6%) and self-reported physical disability as a hygiene barrier (53%) indicates that these items were not interpreted equivalently and requires coding verification before the functional measures are used in any future model. The original analysts additionally flagged sparse cells, with expected counts below five in 33–57% of cells, in chi-square tests of age, occupation and education against sensitive-area knowledge; those specific tests are not relied upon here. Finally, a large number of bivariate tests were conducted without adjustment for multiple comparisons.

Conclusion

Among older adults in urban Sunyani Municipality, a high burden of ageing-related functional limitation coincides with dense, concurrent household WASH barriers and with frequently reported hygiene-related symptoms and healthcare use. The most commonly reported symptom was joint pain arising from using the sanitation facility itself, and the most commonly requested improvement was the installation of age-friendly features. These findings indicate that for older adults, sanitation adequacy cannot be judged by coverage or facility type alone, and support disability-inclusive, age-friendly WASH programming that addresses both physical adaptation and the affordability of hygiene consumables. Because the design is cross-sectional and morbidity was self-reported, these results identify priorities for investigation and investment rather than established causal relationships; an adjusted analysis using individual-level records is the necessary next step.

Declarations

Author contributions

Ibrahim Shaibu: Conceptualization; Writing, original draft; Writing, review and editing. Ahmed Salim Adam: Formal analysis; Data curation; Visualization; Writing. Andrew Nkansah : Conceptualization, Methodology Review & Editing; Francis Attiogbe : Conceptualization, Methodology, Writing – Review & Editing

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Ethical approval and consent

Ethical clearance (reference CHRE/CA/405/025) was obtained from the institutional research ethics committee of the University of Energy and Natural Resources, Centre for Research in Applied Biology. Verbal informed consent, including consent to publication of anonymised findings, was obtained from all participants.

Competing interests

The authors declare no competing interests.

Data availability

The dataset analysed for this manuscript is available from the corresponding author on reasonable request.

Declaration of generative AI and AI-assisted technologies

During the preparation of this work the authors used an AI-assisted tool to support data analysis, drafting and language editing. The authors reviewed and edited the content and take full responsibility for the content of the publication.

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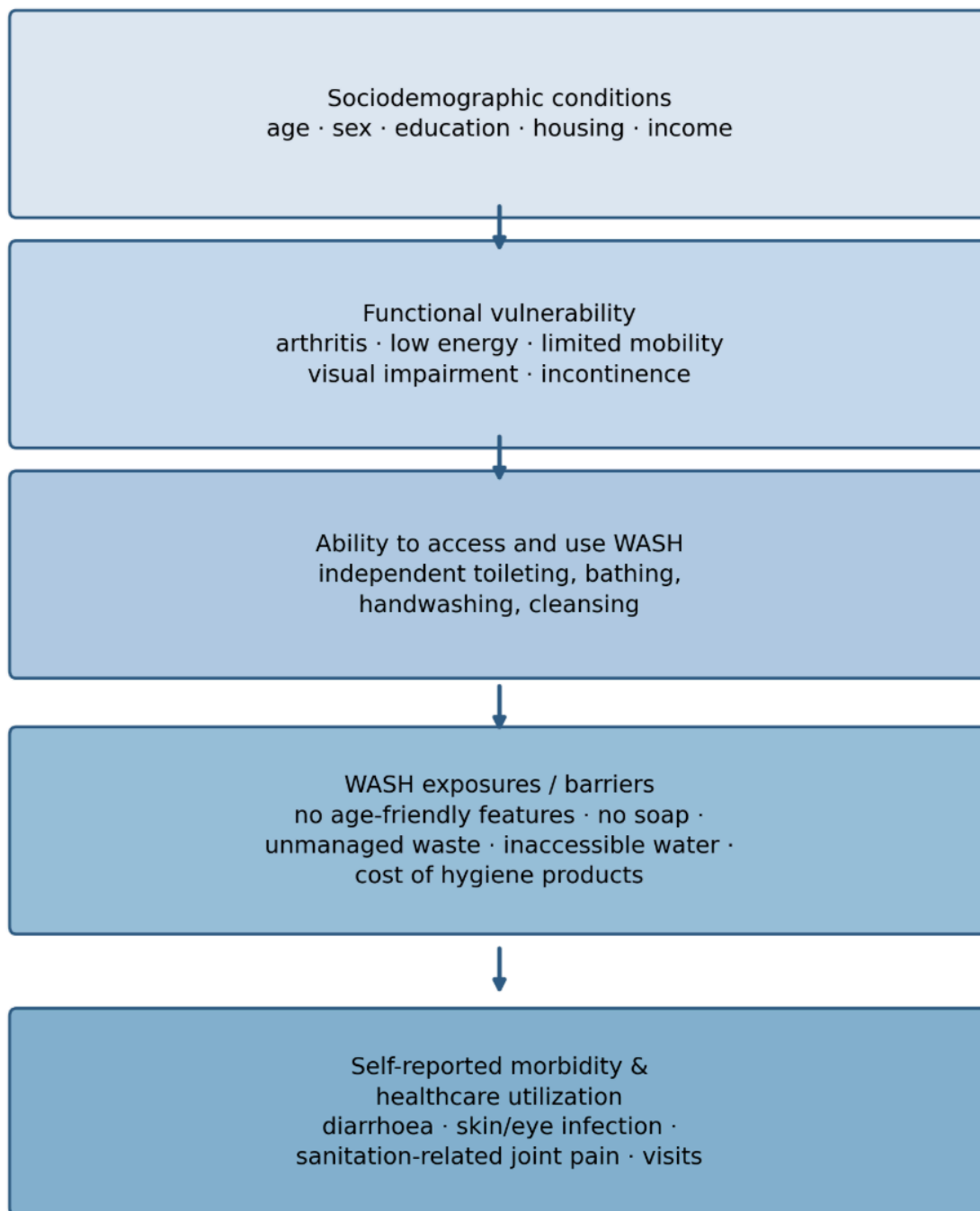
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Figures



Cross-sectional design: pathway is conceptual, not empirically established

Figure 1

Conceptual framework linking sociodemographic conditions, functional vulnerability, WASH access and use, WASH barriers, and self-reported morbidity among older adults.

The ordering shown is conceptual and guided variable organisation and interpretation. Because the study is cross-sectional, the pathway was not tested as a causal model and should not be read as empirically

established.

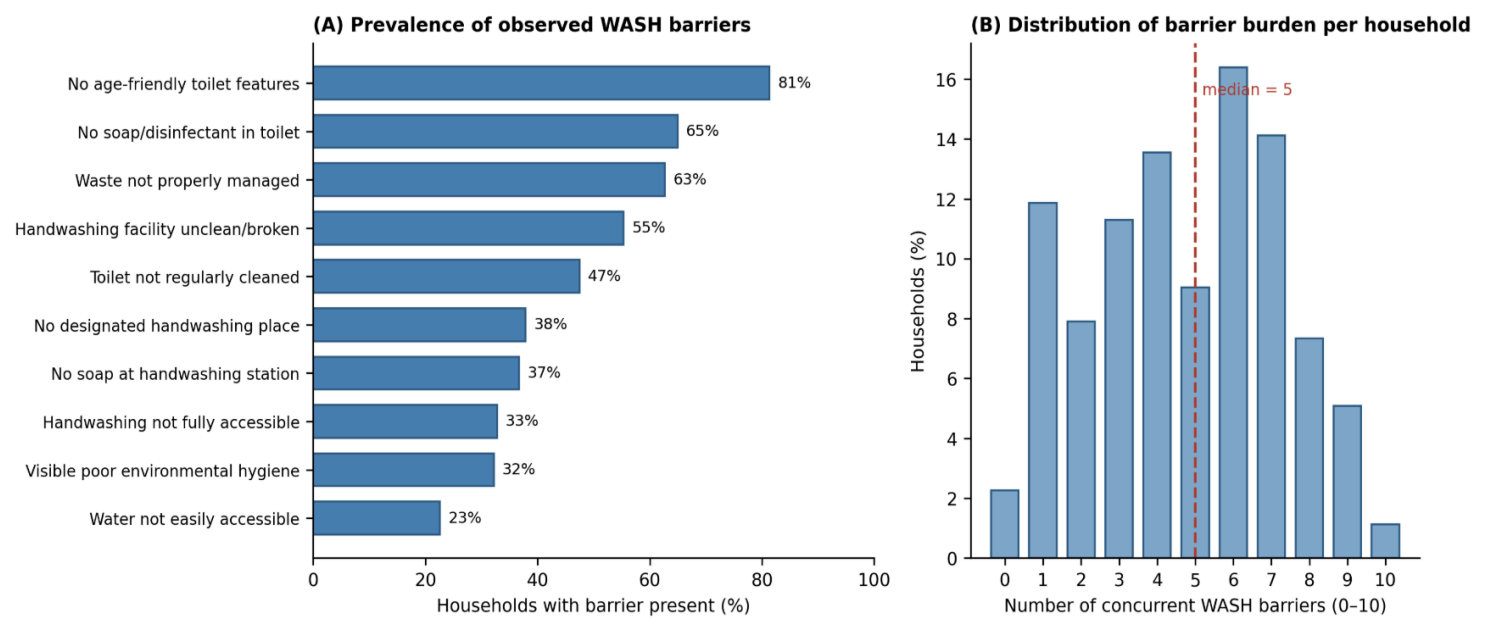


Figure 2

Observed household WASH barriers among older adults' households, Sunyani Municipality, Ghana, 2025 (n = 177). (A) Prevalence of each of ten directly observed barriers. (B) Distribution of the number of concurrent barriers per household.

Barriers derived from the structured observational checklist; internal consistency KR-20 = 0.72. Median barrier count 5 (IQR 3–7).