

Measuring Access to Sanitation and Sanitation-related Quality of Life among Refugees in Gambella, Ethiopia

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Abstract

Background

In refugee settings, safe and private access to sanitation is often constrained by overcrowding and limited infrastructure. While coverage indicators such as toilet availability are often used to monitor progress, they do not capture users lived experiences. The Sanitation-related Quality of Life (SanQoL-5) index measures individual sanitation experiences across five dimensions: privacy, safety, disgust, shame, and disease risk. This study assessed sanitation access and SanQoL-5 among refugee populations in Gambella, Ethiopia, and identify factors associated with variation in SanQoL-5.

Methods

We conducted a cross-sectional, representative survey across two refugee settlements in Gambella, Ethiopia, a region hosting approximately 42% of the country's total refugee population. Data were collected on sanitation access, facility type, location and characteristics, alongside experiential outcomes using SanQoL-5 (scored 0–1; higher scores indicate better quality of life). Generalised linear regression models were used to explore associations between SanQoL-5 scores, and hypothesised factors, including gender, facility type and location, construction quality, and cleaning arrangements. Analyses were stratified by toilet location (on- or off-compound) following evidence of effect modification.

Results

764 respondents participated, of whom 307 (40%) reported access to a sanitation facility. Among toilet users, 36% ($n = 110$) used pit latrines and 64% ($n = 197$) urine-diverting dry toilets (UDDTs). The remaining 457 (60%) respondents reported practising open defecation (OD). Mean SanQoL-5 scores were higher among toilet users (SanQoL-5 0.60, 95% CI: 0.58–0.62) than those practising OD (SanQoL-5: 0.25, 95% CI: 0.23–0.28). Toilet location emerged as a determinant of SanQoL-5, with higher scores observed for toilets located outside household compounds. Among toilets located within compounds, users of pit latrines reported slightly higher SanQoL-5 scores than users of UDDTs ($\beta = 0.04$, $p = 0.057$), while no such differences were observed for toilets located outside compounds. Female respondents consistently reported lower SanQoL-5 scores than males regardless of toilet access, type, or location.

Conclusions

Sanitation coverage was low, with 60% of respondents reporting no access to a sanitation facility. SanQoL-5 varied widely by toilet access, toilet location, and gender, while sanitation facility type played a more limited role, illustrating the value of measuring experiences as well as infrastructure. This study represents the first application of SanQoL-5 in a humanitarian setting, demonstrating its feasibility and utility in refugee populations. From an operational perspective, improving access to sanitation and optimising toilet location may yield greater gains in user experience than facility type alone in refugee settings.

Introduction

Sanitation is fundamental to human health, dignity, and well-being. However, despite global progress in expanding access, over 4.2 billion people worldwide still rely on sanitation services that leave human waste untreated, posing serious risks to public health and the environment (1, 2). Approximately 673 million continue to practice open defecation. This gap in sanitation coverage directly undermines efforts to achieve Sustainable Development Goal (SDG) 6, which calls for universal and equitable access to water, sanitation, and hygiene (WASH) by 2030.

Global monitoring is limited by the underlying surveys, which can exclude refugees and internally displaced persons (IDPs). For example, many IDP and refugee settlements were excluded from the 2011 Ethiopia's Demographic and Health Survey due to security concerns (3). However, limited data suggest sanitation facility coverage is low, with a 2022 review of 21 refugee settlements across Bangladesh, Kenya, South Sudan, Uganda, and Zimbabwe estimating that only 30% of refugee households have access to basic sanitation (4). As of 2023, over 117 million people were estimated to be forcibly displaced (5), many of whom live in settlements that are labelled 'temporary' despite often persisting for decades. Classification as temporary contributes to underinvestment in sanitation infrastructure and long-term service provision (6).

While much of the existing research on sanitation has focused on health outcomes, there is increasing recognition of the broader experiential dimensions of sanitation, such as privacy, safety, and dignity, and their impact on psychosocial well-being (7–16). Capturing these experiences is essential for understanding how sanitation services affect people's daily lives. Experiential data from forcibly displaced populations are scarce, but existing research highlights significant challenges. In Uganda, 40% of women and girls in a refugee settlement reported avoiding communal latrines due to privacy and safety concerns (17). Another study in Uganda, also reported that the location, build quality (doors, walls, locks etc.) and condition of sanitation facilities had a significant impact on usage rates (18). Adverse environmental conditions and political instability further exacerbate the risks associated with inadequate sanitation in these contexts (6, 19, 20).

The Sanitation-related Quality of Life (SanQoL-5) index is an approach used to measure experiential dimensions of sanitation (21–25). Developed using methods from health economics and Sen’s capability approach, SanQoL-5 assesses the perceived sanitation-related quality of life across five empirically defined domains: privacy, safety, disease risk, shame, and disgust (14, 26). While validated and used in six countries, the tool has yet to be applied in displacement settings, where it could provide crucial insights, and inform the implementation of more inclusive and effective sanitation interventions.

In this study, we aimed to measure the access to sanitation and experience of sanitation measured by SanQoL-5 and factors associated with changes in SanQoL-5 among the Gambella refugee population in Ethiopia.

Methods

Study design

We conducted a cross-sectional survey among a representative sample of individuals residing in two refugee settlements housing approximately 170,000 people.

Study setting

The Gambella region hosts the largest refugee population in Ethiopia, approximately 42% of the total number of refugees in the country, currently living across seven settlements. The region has 383,795 South Sudanese refugees (74,390 households). Two settlements were selected as study sites: Tierkidi (69,503 refugees) and Nguenyiel (101,938 refugees) (27). The selection of settlements was decided based on feasibility in this high to medium-risk environment, logistics of working in an active humanitarian response and consultation with Oxfam Ethiopia, United Nations High Commissioner for Refugees (UNHCR) and in close coordination with the government of Ethiopia’s Refugees and Returnees Service (RRS).

Study outcomes

The outcomes of interest include access to sanitation facilities and participants' SanQoL-5 index. Access to sanitation was measured through surveys and direct observations of the sanitation facilities. If respondents confirmed a latrine was used, visual inspection of the facility was used to classify the latrine as a urine-diverting dry toilet (UDDTs) or a pit latrine. Characteristics of the sanitation facility were recorded through direct observation, including: if the facility was shared; if the facility was located within the compound; had solid walls; had a hard material roof; had a door; had an inside lock; had a ventilation pipe; had accessibility features (such as ramps, handles, handrails etc.); had cleansing materials on site; had a cleaning rota; and if there was visible faeces or dirt on the toilet.

Respondents then administered the SanQoL-5 index questions, which consists of five individual items related to frequency of experiential aspects of sanitation, specifically disgust, disease risk, privacy, shame, and safety, in the past 4 weeks (Example: *Can you use the toilet without feeling disgusted?*). Response options were on a three-level frequency scale of “always” “sometimes” or “never”. There are 243 ($= 3^5$) possible combinations of SanQoL-5 attribute levels. Responses are combined as an index by weighting attributes according to their relative importance to the population. The ensuing weights, which sum to 1, are used to calculate SanQoL-5 index values from 0 (worst) to 1 (best).

Study participants and sample size

Based on data provided by UNHCR, the settlements comprised 129 community blocks in Ngueniyel and 49 in Tierkidi, with each settlement divided into four zones. Community blocks, which represent the lowest organizational level in the settlements, were chosen as the primary sampling unit. These blocks were randomly selected using a random number generator, with the study team visiting one block per day.

Within each selected community block, households were enrolled using systematic random sampling: every third household was approached. In each selected household, all adults (aged 18 and older) capable of providing consent were identified, and one individual was randomly chosen to participate. If a selected household was unavailable or declined participation, the study team moved on to the next household. Note that due to security challenges, data collection in some community blocks was completed earlier than anticipated.

To assess factors influencing the SanQoL-5 index, the sample size estimation was based on parameters from previous applications, where the intracluster correlation coefficient (ICC) typically ranged 0.03–0.08, mean SanQoL-5 ranged 0.5–0.7 with standard deviation (SD) 0.20–0.30. For this setting we anticipated enrolling 30 participants per community block, a mean SanQoL of 0.5 (SD 0.25) and conservative ICC of 0.07, with 80% power at 0.05 significance. With these parameters, a sample size of 600 across 20 clusters would be necessary to observe a minimal detectable difference in SanQoL-5 of 0.10 between sanitation user groups (defined as those practising open defecation, using pit latrines, or using UDDTs). Due to population movements and uncertainty about the relative size of user groups, we oversampled to 700, aiming for approximately 350 from each settlement.

Data collection

A standardised questionnaire was administered to enrolled individuals and included questions on their household demographics including time spent living in the settlements, sanitation type and characteristics, and experience with sanitation facilities measured as

SanQoL-5 attributes. Enumerators carried out observations of sanitation facilities during the survey.

To assess the relative importance of each SanQoL-5 attribute (safety, disease risk, privacy, shame, disgust), a structured attribute ranking exercise was conducted with all participants. The activity used laminated felt boards and movable labelled cards to facilitate participant engagement and accommodate varying levels of literacy. Participants were asked to physically rank the five attributes from most important (1st) to least important (5th) in the context of their own sanitation experiences. Trained enumerators guided the process to ensure clarity and consistency. Each ranking was recorded manually by enumerators and subsequently entered into the survey tool. Rankings were treated as ordinal data and analysed to determine the median rank and modal position for each attribute across the sample. This method was adapted from participatory ranking techniques previously used in WASH-related studies in low-resource settings, and allowed for culturally grounded, respondent-led prioritization of sanitation-related quality-of-life domains (28). Question phrasing is outlined in Supplementary Materials.

All data was collected in March-April 2024. Data collection was carried out by 16 Nuer-speaking enumerators and a project supervisor who all work for or study at Gambella University. The training was carried out over one week in March 2024, and questionnaires were refined with translation and verbal back translations carried out from English to Nuer among enumerators to check questions. One day of piloting with the entire study team was carried out, and during data collection, we monitored data collection and conducted quality checks. Data was collected on password-protected mobile phones, using encrypted surveys written in English on SurveyCTO (Dobility Inc, Washington DC, USA). Datasets were stored on secure servers at Oxfam and subsequently downloaded to LSHTM servers, and only accessible to the research study team.

Statistical analysis

Quantitative data was downloaded into MS Excel and to Stata 18 (StataCorp, College Station, TX, USA) to form a single dataset for analysis. Data were cleaned and analysed in Stata 18.

Each domain of SanQoL-5 was assessed using a single item and rescaled to range from 0 to 1, with higher values indicating better sanitation-related quality of life. Following the SanQoL-5 framework, domain scores were combined using preference-based weights derived from the attribute ranking exercise conducted with participants, as described above. Rankings of the five domains were used to generate population-specific weights, which were normalised to sum to one, following the method published by Ross et al{Ross,

2022 #3760}. The overall SanQoL-5 score was calculated as the weighted sum of the five domain scores, resulting in a continuous index ranging from 0 to 1.

Descriptive statistics were generated on households and their sanitation facilities. SanQoL-5 was analysed as a continuous outcome. Generalised linear models (GLM), with Gaussian distribution and identity link, were used to test hypothesised associations of factors that may affect SanQoL-5, including gender (binary), age (categorical), education (binary), years living in the settlement (continuous), access to water (categorical), type of sanitation facility (binary), and sanitation facility characteristics including sharing (binary), location (binary), solid walls (binary), roof (binary), door (binary), inside lock (binary), ventilation pipe or window (binary), accessibility features (binary), access to a handwashing facility with soap (binary), presence of cleaning materials (binary), arrangements between households for cleaning (binary), and if there was visible faeces on the slab (binary). All analyses were adjusted for clustering by community block within each settlement.

Univariate analyses were first conducted to explore associations between each explanatory variable and SanQoL-5. Variables were carried forward into the multivariate model with $p < 0.05$ as the cut-off from the regression analysis, alongside gender which was retained *a priori*. Model fit was assessed with the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), with lower values indicating improved model fit.

Based on conceptual hypotheses and evidence of effect modification, interactions between sanitation facility type and toilet location were explored in multivariable models. Where interaction terms indicated that associations varied by toilet location, stratified multivariable analyses were conducted for toilets located within and outside the compound to facilitate interpretation. Variables that did not demonstrate meaningful associations or contribute to model stability were removed during model refinement.

Heteroscedasticity was assessed by plotting residuals against fitted values from the GLM analysis to visually inspect for unequal variance and by conducting the Breusch-Pagan test to formally detect non-constant variance. Analyses were not pre-specified. Results are reported according to the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) Supplementary Materials.

Results

Participant characteristics

A total of 764 respondents were enrolled into the study (Ngueniyel $n = 388$; Tierkidi, $n = 376$) across 23 randomly selected community blocks (Table 1). Most respondents were

female (n = 531, 70%), had lived in the settlements for more than five years and the average household size was seven people (range 1–10).

Table 1
Characteristics of study participants

Number of households (N)	n	% or range
	764	
Nguenyyiel settlement	388	51
Tierkidi settlement	376	49
Respondent is female	531	70
Respondent age groups		
Aged 18–29	273	36
Aged 30–44	332	43
Aged 45–59	111	15
Aged 60+	48	6
Length of time living in a settlement (years)	7	1–10 years
Completed at least primary education	377	49
Average household size (range)	7	1–10 people
Household has ≥ 1 child under five	700	92
Household has ≥ 1 older adult (> 65 years)	551	72
Household has ≥ 1 person with a disability	259	34
Access to at least basic drinking water source (an improved source, provided collection time is not more than 30 minutes for a roundtrip including queuing)	549	72

SanQoL-5 Valuation of Attributes

The SanQoL-5 index represents a given population's relative valuation of the attributes, so weights can be different in different countries. In our setting, safety was the top ranked attribute, followed by disease risk, and privacy. Shame and disgust were ranked lower in the final SanQoL-5 Index. (Table 2).

Table 2
Sanitation-related Quality of Life (SanQoL-5) attributes and weights

SanQoL-5 Attribute	Weight
Safety	0.29
Disease Risk	0.25
Privacy	0.22
Shame	0.13
Disgust	0.10

SanQoL-5 and factors associated with changes in SanQoL-5

Among the 764 respondents, 307 reported use of a sanitation facility (40%) and the remaining 457 respondents practiced open defecation (60%). Among the 307 users of sanitation facilities, 64% used UDDTs (n = 197) and 36% used pit latrines (n = 110). Mean SanQoL-5 for respondents who reported using a sanitation facility was 0.60 (95% CI: 0.58–0.62), with higher SanQoL-5 among pit latrine users than UDDT users (0.63 vs 0.58 SanQoL-5). Mean SanQoL-5 for households practising open defecation was 0.25 (95% CI: 0.23–0.28) (Table 3 and Fig. 1). Female respondents had lower SanQoL-5 scores in both OD and toilet user groups, except for among pit latrine users. Differences between the characteristics of male and female respondents are presented in Supplementary Materials. Open defecation was associated with a 0.34-unit decrease in SanQoL-5 (-0.38- -0.31 95%CI, $p = < 0.001$) (Table 4).

Table 3
Sanitation-related Quality of Life (SanQoL-5) by toilet access, type, and gender

	SanQoL-5 (0–1 scale)				
	n	Mean	Standard Deviation	95% Confidence Interval	
Open defecation	457	0.25	0.24	0.23	0.28
Female	316	0.25	0.24	0.22	0.27
Male	141	0.27	0.26	0.23	0.32
Toilet users	307	0.60	0.16	0.58	0.62
Female	215	0.59	0.16	0.57	0.61
Male	92	0.62	0.15	0.59	0.65
By UDDT users	197	0.58	0.16	0.56	0.60
Female	145	0.57	0.17	0.54	0.60
Male	52	0.61	0.15	0.57	0.66
By pit latrine users	110	0.63	0.14	0.60	0.65
Female	70	0.63	0.13	0.60	0.66
Male	40	0.63	0.15	0.58	0.68

Table 4
Association of access to sanitation with Sanitation-related Quality of Life (SanQoL-5)

Any toilet	N	n	ß coefficient	95% CI		p
			Ref.			
Open defecation	764	457	-0.34	-0.38	-0.31	< 0.001
Gender (female)	764	316	-0.03	-0.06	0.00	0.086

Sanitation type and characteristics

Amongst toilet users, 43% shared with other households (n = 133), and 18% (n = 56) of facilities were located outside of the compound (Table 5). Over half (52%, n = 160) of toilets had solid walls (e.g. burnt brick, iron sheets) compared to other materials (plastic sheeting, cloth, grass). Most had hard material roofs (n = 254, 83%). Nearly three-quarters (n = 220, 72%) had doors, however, only 13% (n = 102) had locks inside. There was a pipe for ventilation in 76% (n = 232) of facilities. Over half (n = 183, 60%) of facilities had an accessibility feature including ramps, handles, handrails, commodes, or room enough for a wheelchair. There were visible faeces on the slab in 41% of facilities (n = 125),

Handwashing facilities (defined as a bucket with a tap) with water and soap were available at 18% (n = 56) of sanitation facilities. There were anal cleansing materials available in 57% of facilities (n = 174), and 45% (n = 137) of facilities had a cleaning rota.

Table 5
Sanitation facilities, characteristics, and univariate analysis of factors associated with changes in SanQoL-5

Toilet Type	n	%	β coefficient	95% CI		p
Urine Diversion Dry Toilet (UDDT)	197	26	ref.			
Pit latrine with slab	110	14	0.05	0.01	0.08	0.012
Toilet location						
Outside compound	56	18	0.09	0.04	0.13	< 0.001
Sharing status						
Toilet shared with other households	133	43	-0.02	0.04	0.13	0.198
Toilet characteristics						
Toilet has solid walls	160	52	0.00	-0.03	0.04	0.947
Toilet has a roof	254	83	0.02	-0.03	0.06	0.438
Toilet has a door	220	72	0.01	-0.03	0.05	0.741
Toilet had an inside lock	102	13	0.00	-0.04	0.04	0.920
Toilet has a ventilation pipe or window	232	76	0.05	0.00	0.09	0.028
Sanitation facility has accessibility features (e.g., ramps, handles, hand railing, commodes, toilet large enough for a wheelchair)	183	60	0.01	-0.03	0.04	0.755
Handwashing facility with soap and water available at the sanitation facility	56	18	-0.02	-0.07	0.03	0.506
Anal cleansing materials available at the facility	174	57	-0.01	-0.05	0.03	0.701
Sanitation facility has a cleaning rota	137	45	0.01	-0.02	0.05	0.488
Toilet has visible faeces on slab	125	41	-0.02	-0.06	0.01	0.238

Evidence of effect modification by toilet location was observed in multivariable models; therefore, all subsequent analyses were stratified by whether toilets were located within or outside the household compound. Table 6 presents stratified multivariable associations between sanitation facility characteristics and SanQoL-5

Among toilets located within the compound (Table 6, Panel A), sanitation facility type was modestly associated with SanQoL-5. Users of pit latrines reported slightly higher SanQoL-5 scores compared with users of UDDTs ($\beta = 0.04$), although this association was borderline statistically significant. Gender differences were evident in this group, with women reporting significantly lower SanQoL-5 scores than men. Reduced smell showed a positive, though non-significant, association with SanQoL-5.

In contrast, among toilets located outside the compound (Table 6, Panel B), sanitation facility type was not associated with SanQoL-5. SanQoL-5 scores were higher overall in this group, and no meaningful differences were observed by sanitation facility type, smell reduction, or gender; however, estimates were imprecise due to the smaller sample size. Taken together, these findings indicate that while pit latrines may be modestly preferred within compound settings, toilet location is a stronger determinant of SanQoL-5 than facility type alone.

Table 6
Association of sanitation type and sanitation characteristics with Sanitation-related Quality of Life (SanQoL-5)

	Panel A: inside compound				Panel B: outside compound			
	β coefficient	95% CI		p	β coefficient	95% CI		p
Toilet Type								
UDDT	Ref.							
Pit latrine with slab	0.04	0.00	0.07	0.057	-0.03	-0.08	0.02	0.231
Toilet has a ventilation pipe or window	0.03	-0.01	0.08	0.124	0.01	-0.03	0.05	0.627
Gender (female)	0.04	0.00	0.07	0.057	-0.03	-0.08	0.02	0.231

Discussion

This study examined sanitation access and user experience in two refugee settlements in Gambella, Ethiopia. Most respondents practised open defecation and only 40% had access

to basic sanitation, a figure consistent with other refugee settlements but lower than recent regional or national estimates (2, 4). Using the SanQoL-5 index, we found that access to toilets was associated with higher sanitation-related quality of life compared with open defecation. Facility location emerged as a key determinant of user experience, and sanitation technology played a more modest, context-dependent role.

Open defecation was widely practised by over half of the respondents. Decisions to practice open defecation are influenced by technological, behavioural, and social factors (12, 29, 30), including availability, maintenance, and cultural norms. In our study, however, the distinction between using any facility and practising open defecation represented the most substantial experiential difference. Toilet user was consistently associated with higher SanQoL-5 scores, reinforcing evidence of the negative health, safety, and dignity impacts of open defecation (21). These risks are amplified in humanitarian contexts where inadequate sanitation increases exposure to environmental contamination and heightens vulnerabilities to assault or harassment (31). Our findings therefore reaffirm that expanding access to functional sanitation remains foundational for improving well-being in displacement contexts. While technology type and design features matter, the most pronounced improvement in sanitation-related quality of life occurred at the point of gaining access to a facility.

Beyond access itself, toilet location emerged as a central determinant of SanQoL-5. We observed effect modification by location, indicating that associations between sanitation characteristics and SanQoL-5 differed depending on whether facilities were located within or outside the compound. This suggests that sanitation experience is shaped not only by infrastructure type, but by spatial configuration and daily accessibility. Contrary to much of the literature, which generally reports higher acceptability for toilets located closer to the household (32–34), we observed higher SanQoL-5 scores for toilets outside compounds. This divergence likely reflects context-specific characteristics of the refugee settlements, including differences in ventilation, separation from living spaces, or maintenance arrangements. Such findings highlight that the relationship between proximity and user experience are not uniform and may depend on settlement design and management systems (26, 35).

Sanitation technology played a more modest role. Within compounds, pit latrines were associated with slightly higher SanQoL-5 scores compared with UDDTs, suggesting a context-specific preference. However, this difference diminished for facilities located outside the compound (Table 6), indicating that placement may be more influential than technology alone. Familiarity may also shape preferences. Given that pit latrines are common in South Sudan, UDDTs may represent a less familiar technology for this population. Previous research has shown that sanitation experiences are mediated by previous exposure and duration of time living in the refugee camps (36), and that

maintenance practices strongly influence sanitation acceptability (37–40, 41.) We did not find a statistically significant association between sharing status and SanQoL-5 scores, despite evidence that shared sanitation can affect user experience (38, 39, 42, 43).

Gender was a consistent determinant of sanitation-related quality of life. Female respondents reported lower SanQoL-5 scores across sanitation types and locations, with the largest difference among those practising open defecation. This aligns with evidence that women and girls face heightened risks when accessing sanitation humanitarian settings (44, 45)(46).

Although infrastructure features such as doors and locks are promoted to enhance privacy and safety (13, 47), we did not find these features to be associated with SanQoL-5. Nor were cleanliness, roofs, walls or accessibility features associated with SanQoL-5, despite evidence from other contexts that these characteristics matter (12, 14–16, 21, 26, 36, 37, 48–51). This may reflect constrained maintenance resources or differing expectations in protracted displacement settings. Importantly, the presence of infrastructure alone may not translate into a perceived sense of safety or dignity if facilities remain distant or socially insecure (4).

Safety was the highest-ranked SanQoL-5 attribute in this population, followed by disease risk, privacy, shame and then disgust. This contrasts with other SanQoL-5 studies in which disease risk has been the most highly weighted attribute (26). The prominence of safety likely reflects the specific vulnerabilities of displacement, where refugees navigate unfamiliar environments and social networks (52). Qualitative evidence from displacement settings consistently documents risks of harassment and sexual violence (53), particularly with poor sanitation access or distant or poorly lit facilities (31, 46). Our findings reinforce that safety should be a central consideration in sanitation facility design alongside health and privacy (14).

Limitations

This study interviewed one adult per household and did not explicitly capture the sanitation experiences of children, people with disabilities or older adults. Female respondents were overrepresented, likely reflecting availability during the survey hours. Social desirability bias may have influenced responses, particularly given the presence of multiple NGOs operating in the settlements. Strengths of our study include the use of a validated measure to assess sanitation-related experience. Whilst some of our results differ from the other SanQoL-5 studies, this underlies the fact that sanitation experiences can be highly context-specific. SanQoL-5 could, in future studies, be used to measure or monitor changes in sanitation-related experiences from interventions provided for or among refugee populations.

Conclusions

Access to sanitation was strongly associated with improved sanitation-related quality of life among refugees in Gambella. Beyond access, toilet location emerged as a central determinant of user experience, with effects that were context-specific and sometimes more influential than sanitation technology. Women consistently reported lower sanitation-related quality of life, underscoring the need for gender-responsive sanitation design in humanitarian settings. Integrating user-centred measures such as SanQoL-5 into monitoring frameworks may help ensure that sanitation interventions respond not only to technical standards, but also to safety, dignity and lived experience.

Declarations

Ethical approval

The study received written approval from the Regional Health Bureau of Gambella and the Research Ethics Committee of the London School of Hygiene and Tropical Medicine (LSHTM) (#28154). Informed, written consent was obtained from all study participants. Data have been published following consent.

Consent for publication

All participants and study authors have consented to publish the study.

Availability of data and materials

Data and code can be found on LSHTM Data Compass: DOI to be confirmed.

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Conflict of interest

There are no conflicts of interest among the study authors.

Author contributions

LDG, JL, MF and AB conceived and designed the study. LDG, MF and AB supported funding acquisition. LDG, JL, RD and IR developed the study protocol and data collection processes. LDG, JL and BCN developed data collection tools and oversaw technical implementation. LDG, JL and BCN coordinated and participated in data collection. LDG, RD and IR contributed to data analysis and interpretation of results. LDG wrote the first draft of the manuscript. All authors participated in the critical revision of the manuscript and had final responsibility for the decision to submit it for publication.

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Figures

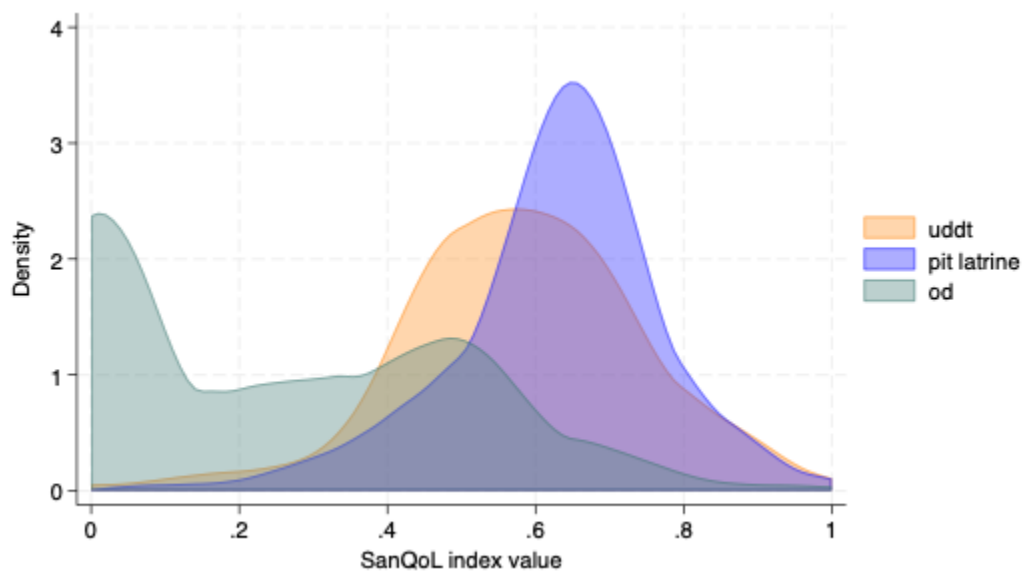


Figure 1

Sanitation-related Quality of Life (SanQoL-5) by toilet type