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Preference-Based Assessments

Valuing an Index of Sanitation-Related Quality of Life in Urban Mozambique: A Discrete Choice Experiment

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ABSTRACT

Objectives: A total of 1.5 billion people live without basic sanitation. A 5-attribute index of sanitation-related quality of life (SanQoL-5) has been applied in 9 countries. SanQoL-5 attributes and their levels require weighting (valuation), with the resulting index ranging from 0 to 1. To date, SanQoL-5 valuation applied simple methods such as rank sum, not robust methods such as discrete choice experiment (DCE). We aimed to value SanQoL-5 using a DCE in urban Mozambique.

Methods: We enrolled 601 adults in the cities of Maputo and Dondo, sampling women and men equally. The DCE task was a choice of which was "better" among 2 combinations of SanQoL-5 attribute levels (always, sometimes, never). Each respondent completed 10 tasks and a dominance test. After fitting a mixed logit model, we rescaled coefficients to derive the index.

Results: The highest-valued attribute was disgust ("never feel disgusted while using the toilet") at 0.25. The other attributes had similar values (ranging 0.18-0.19). People valued "sometimes" levels at approximately 60% of "never" levels. Therefore, moving from the middle level to the worst involves a larger decrement than moving from the best to the middle. Mean SanQoL-5 by toilet type followed a gradient with Sustainable Development Goal 6 categories: "open defecation" 0.30, "unimproved" 0.45, "limited" 0.60, and "at least basic" 0.70.

Conclusions: To our knowledge, this is the first DCE-based valuation of any index of sanitation-related quality of life, enabling SanQoL-5 to be used in economic evaluation. Identifying sanitation service transitions associated with the greatest quality of life gains could inform more efficient resource allocation.

Keywords: discrete choice experiment, quality of life, resource allocation, sanitation.

VALUE HEALTH REG ISSUES. 2025; 47:101087

Introduction

A total of 1.5 billion people live without basic sanitation,[1] with billions of dollars spent every year to address this situation.[2] However, economic evaluations typically measure and value infectious disease alone,[3] when toilet users often value other benefits such as improvements in privacy, safety, and dignity.[4-6] Under the capability approach to welfare economics, these outcomes represent what people have "reason to value" about sanitation.[7] Therefore, these are attributes of good quality of life (QoL) and contribute to health in its broadest sense including mental and social well-being, "not just the absence of disease."[8]

It is often argued in sanitation economic evaluation studies that QoL improvements arising from sanitation improvements comprise an economic benefit, but that methods for measuring and valuing QoL benefits are lacking.[9-11] QoL improvements are an economic benefit because they are often cited as motivations underpinning willingness to pay for toilets[5,12] (themselves an asset not an economic benefit per se). Excluding QoL benefits may result in inefficient resource allocation. A recent study developed a 5-attribute index of sanitation-related quality of life (SanQoL-5) in Mozambique,[13] which has now been validated in 6 countries (Ethiopia, India, Kenya, Malawi, Mozambique, and Zambia).[14] SanQoL-5 has 5 attributes (disgust, disease, privacy, shame, and safety), each measured by a question with a 3-level response scale (always, sometimes, never). Therefore, SanQoL-5 describes 243 (= 3^5) sanitation states or possible combinations of attribute levels. The maximum score (1.0) represents "full sanitation capability," building on the "ICECAP" measures' framing of anchor points.[15] The assumption in such framings is that a person's QoL cannot increase further once they indicate no deprivation for any attribute in the index.

In health economics, "valuing" an index is the process of deriving a weight for each attribute level that reflects a population's preferences when trading attribute levels off against each other. The valuation process allows the conversion of unweighted

attribute scores to a weighted index. Limitation of applications of SanQoL-5 thus far is the use of the rank sum method or attribute scoring to derive the index.[16] These methods do not fully reflect what people value because they involve weighting attributes per se rather than trading off different *levels* of attributes.[17] Application of discrete choice methods, as used in the valuation of the EQ-5D and other influential health-related QoL indices, would be best practice.[18,19] For those new to these concepts, it can be helpful to think of attribute levels as having unweighted scores before valuation (eg, "always" = 0, "sometimes" = 1, "never" = 2), with an unweighted score achieved by summing and dividing through by 10 (= 2 × 5). However, after valuation, the "sometimes" level of one attribute has a different value to the "sometimes" level of another.

In this study, we aimed to estimate a SanQoL-5 index using a discrete choice experiment (DCE) in 2 different urban settings in Mozambique. We derived a SanQoL-5 index value ranging from 0 to 1 and compared valuations by gender. We hypothesized that not all attributes would be valued equally and that, for all attributes, the "middle" levels would be seen as worth more than half the value of the "high" levels. The decision makers who would use our results are the Mozambican Ministry of Health and Ministry of Public Works, but we anticipate wider relevance in other countries where decisions about investments in basic sanitation are made. SanQoL-5 has been used in 15 studies across 9 countries, mostly for impact evaluation and program monitoring, but only once in economic evaluation (using the rank sum method).[20] Rigorous valuation using DCE would facilitate further use in economic evaluation.

Methods

We followed the Bridges et al's[21] checklist for conjoint analysis in health[21] and reported against it in Appendix A in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087. Data and replication code are available at https://osf.io/38vsh/

Study Population and Sampling

The study took place in 2 cities in Mozambique: Maputo (population 1.1 million) and Dondo (population 100 000). Given that this is the first time DCE-based valuation has been used for any index of sanitation-related QoL, our sampling priority was not to achieve representativeness of the cities' population. Rather, we aimed to achieve diversity in the type of toilet used (see Appendix B in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087). The study population was adults aged 18+ living in 2 neighborhoods/*bairros* in Maputo (Polana Caniço A and Polana Caniço B) and 2 in Dondo (Macharote and Nhamainga). These areas were selected because they are mixed in terms of housing quality and, in particular, have a diversity of toilet types used.

We aimed to recruit 600 respondents to meet other study objectives and to allow for dropping some of the sample on data quality grounds.[22] We aimed to interview 300 women and 300 men per site, to allow exploration of whether valuation varies by gender. For toilet type, we aimed to sample 200 people using flush toilets, 340 people using pit latrines, and 60 people practicing open defecation (OD) (no toilet), aiming to approximately achieve the mix of these service types in urban Mozambique nationally.[23] We achieved this by sampling based on data from existing health surveillance surveys (see Appendix B in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087).[24] The *bairros* in Dondo were selected on the basis of surveillance data indicating that the prevalence of OD was >10%, given that OD was uncommon in the Maputo site (see Appendix B in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087).

SanQoL-5 Index

The SanQoL-5 is a multiattribute measure of sanitation-related QoL, developed from primary qualitative research and supported by the literature on what people value about sanitation.[13,25] Its descriptive system (Table 1) has 5 questions, each measuring a capability-based attribute: disgust, disease, privacy, shame, and safety. Each is measured on a 3-level frequency scale (always, sometimes, never), with questions framed such that "never" is the best outcome. Therefore, there are 15 attribute levels to be valued in 243 (= 3-5) possible combinations. Following norms in health-related QoL (HRQoL), each combination is termed a "sanitation state." Adopting HRQoL notation, the best state is denoted 11111 ("never" for all levels) and the worst 33333, with intermediary states such as 23132, 11213, etc.

Data Collection

Our study was a face-to-face survey using the Open Data Kit Collect software (Get ODK Inc, San Diego, CA) on tablet computers. Although the survey was administered in Portuguese in the vast majority of cases, some participants preferred to speak in the predominant local language (Changana in Maputo, Sena in Dondo). Therefore, 2 teams (one per site) were recruited and underwent 5-day programs of training and piloting. Data collection was undertaken during May to July 2023. The questionnaire was translated into Portuguese and the translations were discussed at length with the field team. No incentives for participation were provided.

Discrete Choice Study Design

After questions about socioeconomic status and sanitation, the DCE section started with a series of warm-up tasks, to ensure participants fully understood the choices they were being asked to make. First, participants answered the SanQoL-5 questions (Table 1) and completed the sanitation visual analog scale (VAS)—a 0 to 100 scale on which people rate how they feel about their level of sanitation today (see Appendix B in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087).

Table 1. SanQoL-5 descriptive system.

Attribute	Question*	Responses
Disgust	How often do you feel disgusted when using the toilet?	Always Sometimes Never
Disease	How often do you worry that the toilet spreads diseases?	
Privacy	How often do you worry about being seen while using the toilet?	
Shame	How often do you feel ashamed about using the toilet?	
Safety	How often do you feel unsafe while using the toilet?	

SanQoL-5 indicates 5-attribute index of sanitation-related quality of life.
*A preamble is as follows: "The following questions are about your sanitation experiences in the past 30 days, meaning defecation, urination, and anything else you do in a toilet. Please respond with always, sometimes or never." If less literate respondents struggle with a question, it can be reformulated as "Do you feel disgusted while using the toilet? How often?" Before the SanQoL-5 questions, the respondent is asked about the last place they defecated. If the respondent practiced open defecation (OD), eg, in fields or wasteland, they are directed to OD-specific questions, eg, "How often do you worry about being seen while practising open defecation?"

Second, participants watched 3 video vignettes on the tablet, to provide more meaning to hypothetical states and introduce the images used to frame attributes (see Appendix B in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087). In each video, a hypothetical person describes the toilet they use and how it makes them feel about each of the SanQoL-5 attributes, ie, describes their sanitation state. After each video, the participant was asked to score that person's level of sanitation on the VAS, to get them used to the idea of comparing states. The videos deliberately include multiple interpretations of attributes, eg, safety in terms of latrine collapse and in terms of assault risk. Third, participants were asked to complete a food-based menu choice card (see Appendix B in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087), to emphasize that the 2 columns as a whole are being compared and trading items between columns was not possible. The last warm-up task involved being shown 3 sanitation states and asked to choose which was worst and which was best, as well as their reasoning, to assess whether they understood the task (see Appendix B in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087).

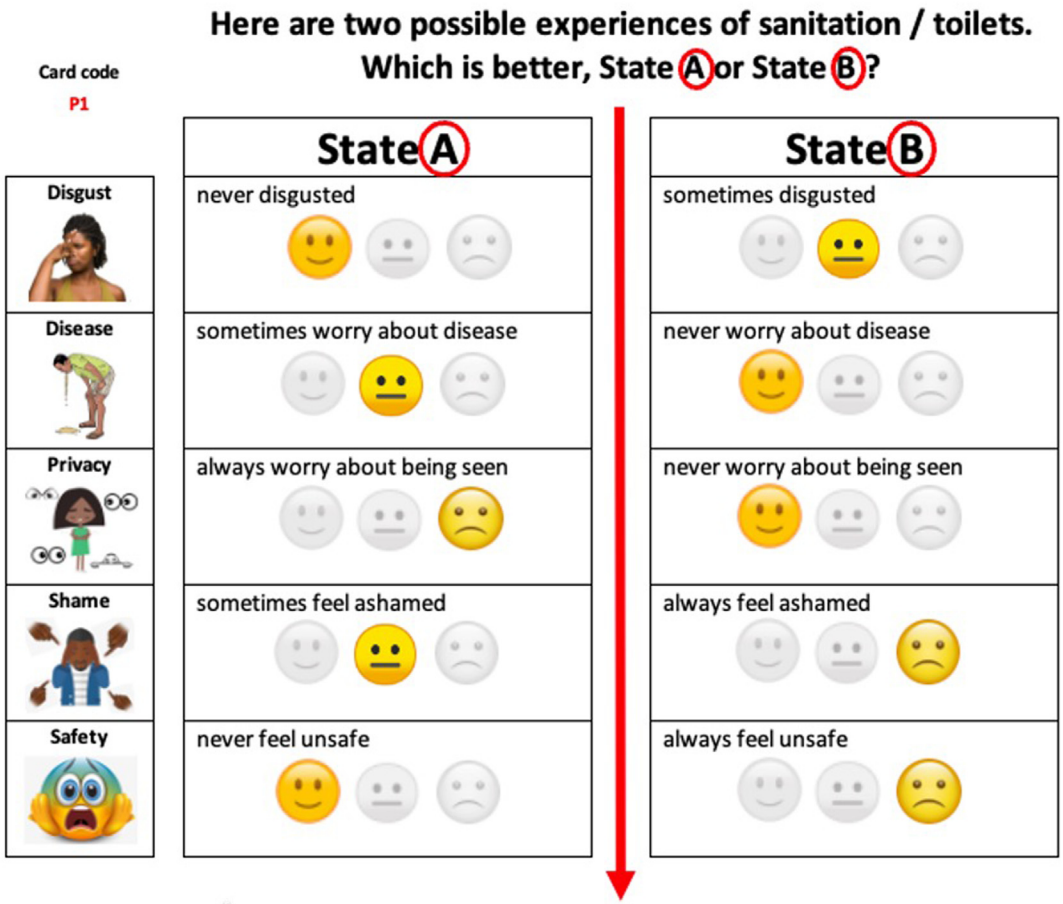
For the actual DCE choice tasks, participants were shown a card with 2 sanitation states as profiles of SanQoL-5 attribute levels (Fig. 1) with the same emoji visualization as the warm-up tasks. Participants were asked to select which state was "better," with no opt-out. This follows best practices from valuation protocols for the EuroQoL 5-dimension (EQ-5D) measure of HRQoL.[19,26] Participants were told to not consider their present toilet or level of sanitation, but instead to imagine being in the states in the scenario.

Each participant undertook 10 choice tasks. We identified a 6-block efficient design using the *dcreate* program in Stata 18 (StataCorp LLC, College Station, TX) with a modified Fedorov algorithm (d-efficiency 10.4).[27] With 60 choice tasks (6×10), there were 120 sanitation states compared in all. Each block included states across the range of severity. To avoid bias from the ordering of the tasks (eg, less care taken over later tasks), we randomized participants into 12 groups, with half of the groups doing tasks in reverse.[28]

Quality Control

Each interviewer undertook 8 pilot interviews (80 DCE tasks per interviewer in total), in areas outside the study sample—the data were not included in the analysis. The pilot identified issues with the time taken to complete the survey, which resulted in removing some sociodemographic questions and randomizing some non-DCE questionnaire modules to subsamples. Preliminary analysis of the pilot data indicated that choice data were consistent with expectations according to level sum scores (LSSs). Other aspects of quality control included timestamps throughout the survey, to allow flagging when a participant completed a section extremely rapidly relative to most others. We also included a

Figure 1. Example choice task.



dominance test halfway through the DCE, in which one state (12121) was objectively better than the other (23232) on all 5 attributes, so there is a "correct" answer. Dominance test choices were not included in the analysis.

For the primary analysis, we excluded data from participants who met one or more of these conditions: (1) failed the dominance test, (2) completed the first 5 tasks in less than 10 seconds per task, and (3) completed the second 5 tasks and dominance task in less than 5 seconds per task. In a sensitivity analysis, we included all 601 participants' data. We also examined the choices in respect of LSS, which is the sum of attribute levels in state notation (eg, the LSS of 11113 is 7). We calculated the difference in LSS between the 2 options a respondent was shown and observed the distribution of responses. Hypothetically, a larger LSS difference should increase the likelihood that a respondent chooses the option with the lower LSS. The LSS of the best state (11111) is 5 and the worst state is 15. We reconfirmed fieldworkers' classifications of toilet types by verifying photos they took of toilets' interiors against entered data on toilet characteristics.

Data Analysis

We analyzed choices in Stata 18 first using a conditional logit model, which assumes that preferences are not correlated across individuals. We then used a mixed logit model with correlated parameters, which aims to account for (1) preference heterogeneity (when differences among individuals' preferences cannot be explained by observable characteristics) and (2) scale heterogeneity (when unmeasured factors affect individuals' responses to different extents).[29] We based model selection on whether there was evidence of heterogeneity, as well as the Akaike (AIC) and Bayesian information criteria (BIC).

Our analytical approach was based on the EQ-5D valuation protocol.[19,26] The model assumes that, in making their choice, people are comparing the QoL they would have in 2 sanitation states [Eq. (1)], namely V_{ijl} (left-hand option l for individual i within DCE pair j) and V_{ijr} (right-hand option r). Equation 1 represents the choice as an inequality, with the sign ($<$ or $>$) decided by the participant's response. Because there is no opt-out, the respondent cannot give them equal value.

$$V_{ijl} = \alpha - \sum_{k=1}^{10} \beta_k x_k^{ijl} + e_i^{lj} > \ ? < V_{ijr} = \alpha - \sum_{k=1}^{10} \beta_k x_k^{ijr} + e_i^{rj} \quad (1)$$

The variable x represents a sanitation state using 10 dummy (binary) variables. The first 2 dummies refer to "sometimes" and "always" levels of the disgust dimension. If the state involves being "sometimes" disgusted (Table 1), the "sometimes" dummy takes the value 1. For the "always" level, its respective dummy takes the value 1. If both dummies are 0, then the state includes "never" being disgusted. The other 8 dummies are the equivalents for the remaining attributes.

If all 10 dummies are zero, then the state is 11111 (full sanitation capability), its value denoted by α, which cancels out once the participant makes their choice. The parameter β is a 10×1 vector aligning to the dummies. Its first 2 elements reflect decrements of "sometimes" or "always" being disgusted against the value of "never" being disgusted. Because estimated coefficients are decrements, they are expected to be negative. The overall decrement of moving from "never" to "always" is the sum of the coefficients for "sometimes" and "always." Error terms are assumed to follow an extreme value distribution. We rescaled estimated coefficients to a 0 to 1 index, whereby 0 is the value of the worst state and 1 the value of the best. This is achieved by dividing through by the sum of the coefficients of the worst levels (ie, always)—the process is explained in Appendix C in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087.

We included a subgroup analysis by gender. First, we explored whether differences in preferences between women and men were explained solely by differences in the randomness of choices by subgroups, ie, scale heterogeneity.[30] We assessed this using the Swait-Louviere test,[31] effectively a likelihood ratio test comparing the log-likelihood statistics of the pooled model with subgroup models. Following Mott et al,[29] our main subgroup analysis was to compare relative attribute importance (RAI) in the 2 subgroup regressions. To estimate RAI scores, we calculated ratios of each attribute's "always" coefficient to that of the lowest-valued attribute. Therefore, attributes with higher RAI have a higher value. We estimated RAI difference by subtracting RAI scores in the men's sample from those in the women's sample and estimated confidence intervals using *nlcom* in Stata 18.

Finally, we included a latent class analysis using *lclogit2* in Stata.[32] We tested models including 2, 3, 4, and 5 classes, selecting the model with the lowest BIC. We then estimated posterior probabilities of being in each class and reported coefficients for each class separately.[33] We also estimated the mean probability of being in each class for women/men and for Sustainable Development Goal (SDG) level of service categories.

Ethics

The study received previous approval from the *Comité Institucional de Ética* at the *Instituto Nacional de Saúde* in Mozambique (ref: 028/CIE-INS/2023) and the Research Ethics Committee at the London School of Hygiene and Tropical Medicine (ref: 28190). Informed written consent was obtained from all participants.

Results

We enrolled 601 participants between May and July 2023, after approaching 605 individuals (response rate 99%). We included 541 participants in the final analysis, dropping data for 41 (7%) who failed the dominance test and 19 (3%) who completed tasks faster than the minima set out above. Of the respondents included in the analysis, 54% were women, and 63% had access to on-plot piped water (Table 2). We compare certain sample characteristics with those from the Demographic and Health Survey 2022-2023, where possible, in Appendix D in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087.

The most common sanitation type (61%) was an off-set pit latrine with a pour flush but no water seal. In this design, the pit is not directly visible to the user but there is no water seal (u-bend) in the connecting pipe to stop the passage of smells or flies. Therefore, it is a step down in toilet quality from a pour-flush toilet with a water seal, which was the second most common toilet type used (19%). Photos of common toilet types are in Appendix E in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087. Among participants using toilets, 29% shared the toilet with 1 or more other households. Background characteristics of participants in the 2 cities are presented in Table 2 (and by gender in Appendix F in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087). Considering participants' levels of SanQoL-5, the attribute for which people had the worst outcomes was perception of disease risk, with 41% selecting "always" (see Appendix F in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087). Maximum SanQoL-5 was reported by 5% of participants and minimum by 3%.

In both regression models (Table 3), coefficients for every attribute level were negative and significant at the 1% level. In the

Table 2. Sample characteristics.

Characteristic	Maputo (n = 292)	Dondo (n = 249)	Total (n = 541)
Respondent demographic characteristics			
Respondent is a woman	149 (51%)	143 (57%)	292 (54%)
Age category			
18-29	103 (35%)	85 (34%)	188 (35%)
30-44	91 (31%)	72 (29%)	163 (30%)
45-59	56 (19%)	44 (18%)	100 (18%)
60+	42 (14%)	48 (19%)	90 (17%)
Household size	5.2 (2.5)	5.2 (2.4)	5.2 (2.4)
Completed primary school or above	208 (71%)	158 (63%)	366 (68%)
Moderate problems walking about (or worse)*	10 (7%)	16 (13%)	26 (10%)
Moderate pain (or worse)*	17 (12%)	28 (22%)	45 (17%)
Dwelling characteristics			
Sealed floor	278 (95%)	164 (66%)	442 (82%)
Solid exterior wall	285 (98%)	135 (54%)	420 (78%)
Households with fridge	167 (57%)	47 (19%)	214 (40%)
Households with television	247 (85%)	126 (51%)	373 (69%)
Access to electricity connection	271 (93%)	184 (74%)	455 (84%)
Access to on-plot piped water	254 (87%)	86 (35%)	340 (63%)
Respondent rents dwelling	39 (13%)	7 (3%)	46 (9%)
Toilet type used			
Cistern-flush toilet with water seal	67 (23%)	17 (7%)	84 (16%)
Pour-flush toilet with water seal	77 (26%)	25 (10%)	102 (19%)
Off-set pit latrine with pour flush but no water seal	80 (27%)	139 (56%)	219 (40%)
Pit latrine with concrete slab	45 (15%)	9 (4%)	54 (10%)
Pit latrine with non-concrete slab (soil, tires, wood)	23 (8%)	17 (7%)	40 (7%)
Open defecation	0 (0%)	42 (17%)	42 (8%)
Sanitation service characteristics			
Uses on-plot toilet	291 (>99%)	190 (76%)	481 (89%)
Shares toilet with other households	90 (31%)	53 (26%)	143 (29%)
Number of households sharing toilet (among sharers)	3.0 (1.4)	3.6 (2.1)	3.2 (1.7)
Number of people sharing toilet (among sharers)	9.2 (4.5)	12.4 (6.9)	10.4 (5.7)

Note. Data are n (%) for categorical variables and mean (SD) for numerical variables.
*Questions asked of a random half of the sample.

mixed logit model, every SD was significant at the 1% level, which is evidence of preference heterogeneity and suggests that the mixed logit is more appropriate than the conditional logit. Selection of the mixed logit is supported by the higher log-likelihood and lower AIC, with the higher BIC contradicting this slightly. However, BIC has a larger penalty than AIC for the number of model parameters, and 55 are added when allowing for correlated parameters (as is advisable, to account for heterogeneity).

After rescaling to a 0 to 1 index (Fig. 2), disgust was the highest-valued attribute, with its "never" level valued at 0.25 after rescaling. Safety was valued the lowest (0.18 for its "never" level). The "sometimes" levels were valued at 53% to 62% of the "never" levels of each attribute (Fig. 2), indicating that respondents perceived moving from the middle level to the worst as a larger decrement than moving from the best level to the middle. The value set is provided with standard errors in Appendix F in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087. SanQoL-5 by toilet type followed a gradient with objective toilet quality according to categories used in SDG 6. In particular, people practicing OD had the lowest mean SanQoL-5 (0.30) and people with "at least basic" sanitation had the highest (0.70), with "unimproved" and "limited" sanitation in between (0.45 and 0.60, respectively).

When comparing responses based on LSS differences, the pattern is as expected (Fig. 3), which brings confidence in data quality. When there was a LSS difference of ±3 or greater, 91% to 97% of choices were for the expected option. There was also an approximately equal split in choosing A versus B when the LSS difference was 0 (Fig. 3).

The Swait-Louviere test did not reject the null hypothesis of equal preference structure in the 2 subgroups ($P = .24$), allowing us to proceed with RAI comparison. There was no significant gender difference in the valuation of attributes (see Appendix F in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2

Table 3. Regression output.

Attribute levels	Conditional logit		Mixed logit	
	Coeff.	SE	Coeff.	SE
Disgust (sometimes)	−1.26*	0.06	−2.22*	0.20
Disgust (always)	−2.17*	0.10	−4.18*	0.37
Health (sometimes)	−0.93*	0.07	−2.01*	0.24
Health (always)	−1.60*	0.09	−3.24*	0.36
Privacy (sometimes)	−1.60*	0.07	−1.99*	0.21
Privacy (always)	−0.96*	0.08	−3.25*	0.37
Shame (sometimes)	−1.60*	0.06	−1.79*	0.23
Shame (always)	−0.96*	0.08	−3.14*	0.32
Safety (sometimes)	−1.61*	0.06	−1.67*	0.23
Safety (always)	−0.80*	0.08	−2.98*	0.32
SD (disgust, sometimes)	NA	NA	1.18*	0.17
SD (disgust, always)	NA	NA	2.03*	0.27
SD (health, sometimes)	NA	NA	1.50*	0.31
SD (health, always)	NA	NA	1.90*	0.26
SD (privacy, sometimes)	NA	NA	1.52*	0.21
SD (privacy, always)	NA	NA	1.75*	0.26
SD (shame, sometimes)	NA	NA	1.21*	0.25
SD (shame, always)	NA	NA	1.58*	0.28
SD (safety, sometimes)	NA	NA	1.14*	0.27
SD (safety, always)	NA	NA	1.51*	0.22
Number of choices	10 820		10 820	
Number of participants	541		541	
Log likelihood	−2231		−2072	
AIC	4482		4274	
BIC	4555		4748	

Note. Mixed logit models were estimated using the Broyden-Fletcher-Goldfarb-Shanno (BFGS) algorithm with 500 Halton draws and uncorrelated parameters used as starting values.
AIC indicates Akaike information criterion; BIC, Bayesian information criterion; Coeff., coefficient; NA, not applicable; SE, standard error.
*Significance at the 1% level.

025.101087), with no statistically significant differences in RAI score. However, there was suggestive evidence (P = .08) for men valuing disgust more highly than women, with women considering disgust to be 1.29 times as important as safety (the attribute lowest valued by both genders) compared with 1.43 times for men.

The best-fitting latent class model had 3 classes, which we characterize as (1) indifferent, with low coefficients for all attributes (35% class share); (2) higher value for privacy and disease (22%), although confidence intervals overlap; and (3) higher value for disgust (42%), although confidence intervals overlap. Analysis by gender and SDG level of service did not invite strong conclusions given that subgroups had approximately equal mean probability of belonging in each class. Latent class results are presented and discussed in Appendix G in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087.

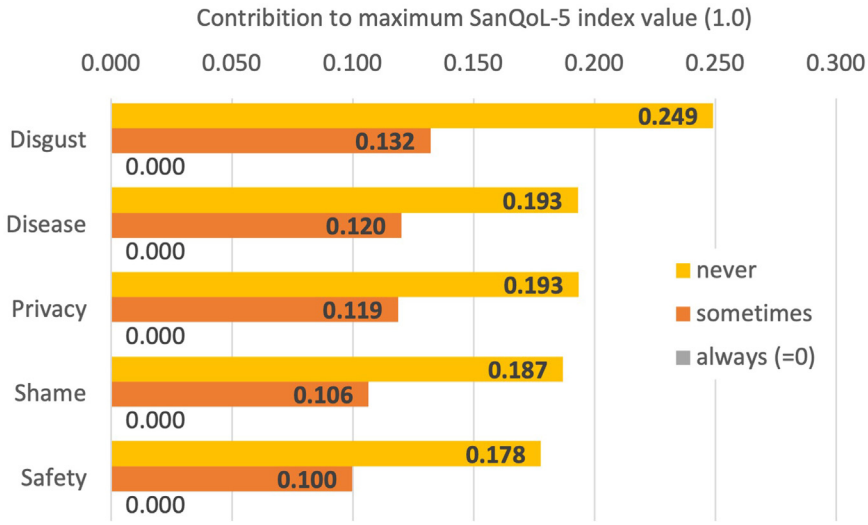
Sensitivity analysis including all participants (n = 601) is presented in Appendix H in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087. All coefficients and SDs in the mixed logit are again significant at the 1% level. The preference order from the mixed logit is the same as the main results (disgust highest, safety lowest) with a slightly higher overall weight for disgust than the other attributes.

Discussion

In this study, an index of sanitation-related QoL was valued (weighted) using the SanQoL-5 descriptive system for sanitation states. Index values for 243 sanitation states were derived from the stated preferences of 541 adults in urban Mozambique, after excluding data for 60 participants on quality grounds. The highest-valued attribute was disgust ("never feeling disgusted while using the toilet"), with a SanQoL-5 index value of 0.25. The other attributes were valued similarly to one another (ranging 0.18-0.19). To our knowledge, our study is the first assessment of the relative value of SanQoL-5 attributes for individuals using robust preference elicitation methods.

There are 2 broad points to take away from our results. First, we have shown that people place different values on different aspects of sanitation-related QoL. This underlines the importance of accounting for weighting when attributing monetary value to changes in such outcomes. For example, the intended use of SanQoL-5 is in providing weights for the sanitation-adjusted person-year, a measure analogous to the quality-adjusted life-year.[20] Sanitation-adjusted person-years are intended primarily for use in benefit-cost analysis after monetary valuation by

Figure 2. Final SanQoL-5 value set.

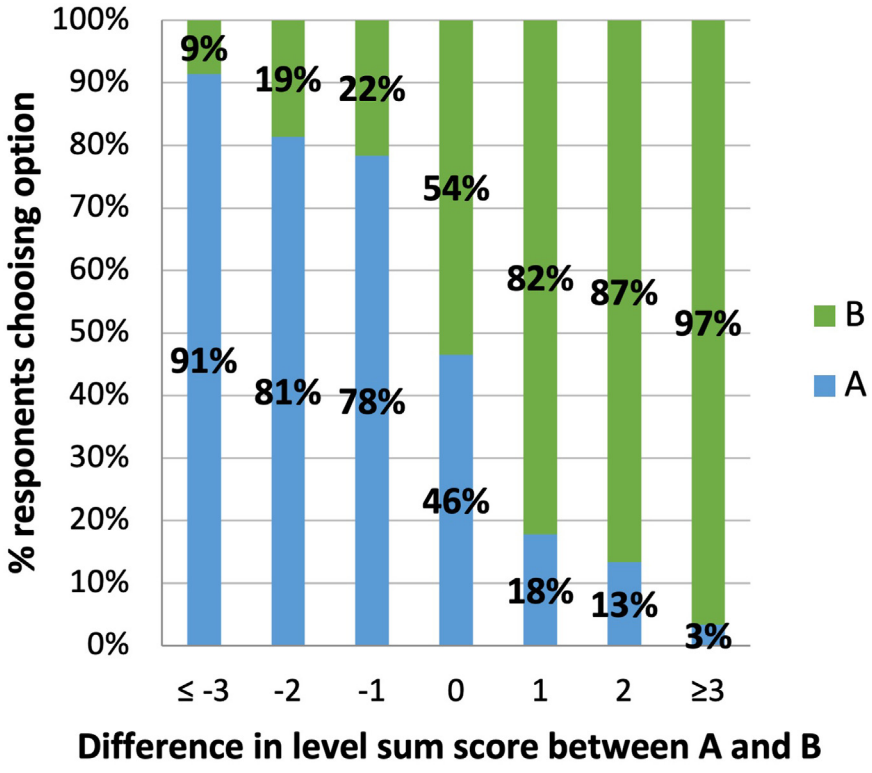


SanQoL-5 indicates 5-attribute index of sanitation-related quality of life.

willingness to pay.[34] Sanitation economic evaluations have previously described QoL benefits as intangible.[9-11] SanQoL-5 makes them tangible, with DCE valuation in this study an important step toward monetary valuation.

Second, not only are the attributes per se valued differently, but different degrees of their achievement (ie, levels) are valued differently. For example, people valued the "sometimes" levels of attributes at approximately 60% of the "never" levels. Therefore, moving from the middle level to the worst level was a larger decrement in QoL than moving from the best level to the middle. This further emphasizes the importance of, wherever possible, using SanQoL-5 value sets based on robust preference elicitation rather than simpler methods (eg, rank sum), which account for only attribute weights but not level weights. The patterns in level

Figure 3. Choice (A or B) by difference in level sum score (A minus B).



weights we observed are commonly observed in value sets for EQ-5D and other HRQoL indices, including in African countries.[35,36] Given that, to our knowledge, this is the first DCE of SanQoL-5, it is not possible to compare the relative value of attributes or levels with those of other studies.

The implications of these 2 points for researchers and implementers are that, when QoL gains are to be measured in studies or monitoring, the measure (eg, SanQoL-5 or otherwise) should be carefully selected according to the intended use of the findings. Other considerations are also important (eg, questionnaire space, evidence of validity, appropriateness for the population). Future research should include the valuation of SanQoL-5 in other countries and settings, with a view to understanding whether similar patterns of relative importance of attributes are seen or not. Implications for policy makers are that, as attention paid to QoL outcomes in the sanitation field increases, care should be taken in interrogating what is actually being measured and how. For example, the concept of "privacy" can be understood and measured in many different ways, which are not necessarily comparable.

SanQoL-5 can be used to monitor and evaluate sanitation programs, eg, to measure differences over time or between groups, as well as for capturing QoL benefits in benefit-cost analysis. These use cases of SanQoL-5 are similar to those of HRQoL indices such as the EQ-5D that, since its inception in 1987, had been used in more than 17 000 studies by 2015 to inform efficient allocation of resources for health.[37] SanQoL-5 has now been validated in 6 countries,[14] with that study concluding that SanQoL-5 can be widely applied in adult populations in both rural and urban areas. The SanQoL-5 value set we report here (Fig. 2) can be used to evaluate sanitation investments in Mozambique, as well as in other countries when a local value set is not available. With the SDG target for sanitation off-track,[1] sanitation investment will need to be evaluated for many years to come. SanQoL-5 has already been included as an outcome in 5 studies evaluating the impact of an intervention. It can be used in "gender-sensitive" analyses (according to the World Health Organization gender-responsiveness assessment scale).[38] This is because, with questions applicable to any gender based on priorities identified by both women and men,[25] it can be used to identify gender inequalities and facilitate their being addressed.

SanQoL-5 attributes differ from HRQoL attributes in various respects. First, people are likely to experience HRQoL attributes for a larger proportion of every day than SanQoL-5 attributes. This is because SanQoL-5 attributes are likely to be mostly experienced during the use of the toilet rather than much of the time, although they could be a source of anticipatory or subsequent stress.[39] Second, most people are likely to have experienced something close to "full health" (HRQoL = 1.0) for some part of their life, but this is less likely to be the case for SanQoL-5 for people with lower levels of sanitation service. Nonetheless, in the most recent SanQoL-5 validation study, the modal value was 1.0 in most of the 6 data sets, with distributions similarly shaped to EQ-5D, including the 2 data sets that were nationally representative (Kenya) and state representative (India).[14] Third, HRQoL has a natural anchor at death (zero) and health states worse than death (HRQoL < 0) are possible, but the same is not true of sanitation which has no natural zero. In SanQoL-5 the values of 0 and 1 are analogous to the "EQ-VAS" (best/worst imaginable health)[40] and the "ICECAP" family of capability measures (full/no capability).[41]

We are confident in the quality of the data, for several reasons. First, we dropped 10% of the original sample on the grounds of failing the dominance test or completing tasks excessively quickly. A relatively low proportion (7%) failed the dominance test, indicating that the tasks were understandable.[22] Second, the pattern of choices in relation to LSS (Fig. 3) aligns with theory and shows similar patterns to those found in EQ-5D DCEs.[42,43] Third, we carefully monitored the interviewer's performance. After the first 15 interviews, we noted that one interviewer in Maputo had consistently very low durations for the DCE section compared with other interviewers, as well as some geolocations well outside the study area. They agreed to leave the study team and their 15 observations were dropped, with 15 additional Maputo households sampled to replace them. Fourth, half of the participants were randomized into answering their block of choice tasks in reverse.

It is of potential concern that the highest-weighted attribute (Fig. 2) was also the first listed in the choice tasks (Fig. 1). It is possible that this is down to chance, but it is also possible that participants paid more attention to the attributes higher up the choice card. However, we see 2 reasons not to be too concerned. First, several methodological studies exploring attribute ordering in DCEs found no evidence that order influences results.[44-46] Second, in our gender subgroup analysis, women valued privacy slightly higher than disease (which was higher up in the card) although the difference was not statistically significant (see Appendix D in Supplemental Materials found at https://doi.org/10.1016/j.vhri.2025.101087). Nonetheless, in future SanQoL-5 DCEs, we recommend randomizing participants into blocks with different attribute orderings, to avert the risk of bias.

Our study has a number of limitations. First, as set out earlier, choice cards presented attributes in a consistent order to all participants, so we are unable to account for the risk of attribute order bias in our results. Second, attributes may be interpreted differently by different people. Through the use of video vignettes, we aimed to illustrate the multiple meanings of attributes (eg, one video discussed safety in terms of pit collapse, and another video in terms of assault risk), but there was only time for 3 vignettes. Third, the exclusion of an opt-out in the DCE forces the participant to choose one option even if they consider both to be of equal value. However, this follows norms in health state valuation (eg, EQ-5D),[19] and the risk of bias is minimal. Fourth, the sample was designed to demonstrate proof of concept among users of diverse types of sanitation, rather than to be representative of a given population. In the future, nationally representative samples would ideally be used, so that societal preferences are reflected where resource allocation is to be informed.

Conclusions

To our knowledge, our study presents the first discrete choice valuation of the SanQoL-5 index or indeed any measure of sanitation-related QoL. Our results suggest that discrete choice valuation is feasible and acceptable in resource-constrained settings, and only 7% of participants failed the dominance test. We expect that the availability of this value set will facilitate the economic evaluation of sanitation programs in Mozambique and beyond. We also hope it will support broader research into sanitation-related QoL.

Author Disclosures

Author disclosure forms can be accessed below in the Supplemental Material section.

Supplemental Material

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.vhri.2025.101087.

Article and Author Information

Accepted for Publication: December 29, 2024

Published Online: February 12, 2025

doi: https://doi.org/10.1016/j.vhri.2025.101087

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Obtaining funding: Cumming, Viegas, Ross
Administrative, technical, or logistic support: Katana, Banze, Manhiça, Cubai, Viera, Fulai, Cumming, Viegas, Capitine
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Funding/Support: This work was funded by the Bill & Melinda Gates Foundation (OPP1137224). Ian Ross acknowledges the support of a postdoctoral fellowship from the Reckitt Global Hygiene Institute in the period when the paper was drafted.

Role of the Funder/Sponsor: The funder had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Acknowledgment: We greatly appreciated the cooperation of survey participants in providing their time, as well as the efforts of the fieldworkers in Dondo and Maputo. We also acknowledge the feedback of participants at the WASH Economics Conference 2024 in Marseille, France, particularly the discussant Joe Cook.

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