


## Research Paper

**Beyond a facility: A cross-sectional survey on WASH service levels and informal social accountability in childcare centres in Nairobi's informal settlements**Ivy Chumo <sup>a,\*</sup>, Caroline Kabaria<sup>a</sup>, Penelope A. Phillips-Howard<sup>b</sup>, Hellen Gitau<sup>a</sup>, Helen Elsey<sup>c</sup> and Blessing Mberu<sup>a,d</sup><sup>a</sup> African Population and Health Research Centre (APHRC), Nairobi, Kenya<sup>b</sup> Department of Clinical Sciences, Liverpool School of Tropical Medicine, Liverpool, UK<sup>c</sup> University of York, and Hull York Medical School, York, UK<sup>d</sup> Demography and Population Studies, University of Witwatersrand, Johannesburg, South Africa

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 IC, 0000-0003-1235-719X**ABSTRACT**

Access to clean water, sanitation, and hygiene (WASH) services is crucial for a healthy start in life. Social accountability has a potential for enhancing WASH services in childcare centres. However, there are inadequate studies to understand how informal social accountability mechanisms contribute to WASH service provision. To address this gap, we conducted a cross-sectional survey in Korogocho and Viwandani informal settlements in Nairobi, Kenya, to explore the relationship between different levels of WASH services (ranging from basic to limited or nonexistent) and indicators of informal social accountability, including rewards, sanctions, voice, and responsiveness. We employed multinomial regression analysis, utilizing a robust error variance estimator to account for potential biases. Our findings revealed disparities in WASH service provision between the two studied areas, with childcare centres in Korogocho exhibiting higher access to basic WASH services compared to those in Viwandani. Our analysis also highlighted a significant association between informal social accountability mechanisms and the provision of WASH services. Notably, the sanction mechanism exhibited a correlation with all WASH services, suggesting its pivotal role in shaping service delivery outcomes. In light of these findings, it is imperative to prioritize efforts aimed at reinforcing social accountability mechanisms in WASH service delivery frameworks.

**Key words:** informal settlements, Kenya, social accountability, water, sanitation and hygiene**HIGHLIGHTS**

- Safe environment with access to water, sanitation and hygiene (WASH) is every child's right.
- Informal social accountability mechanism (ISAM) is key in strengthening WASH service delivery in the context of a weak formal service delivery structure.
- Improved access to WASH services can be attributed to WASH interventions that emerged during the Covid-19 outbreak.
- It is important to continue rebuilding and strengthening social accountability in WASH service delivery to complement weak formal service delivery systems in childcare centres.

**1. INTRODUCTION**

There is a rapid pace of urbanization in low- and middle-income countries (UNICEF 2018). Africa's urbanization is identified as the most rapid, resulting in the expansion of informal settlements and increasing urbanization of poverty (Fox 2012; Mberu *et al.* 2016) and unmet needs among marginalized and vulnerable groups: children, older persons and persons with disability (Chumo *et al.* 2023b). The major challenge facing marginalized and vulnerable groups in informal settlements are linked to access to service deficit in vital sectors of water, sanitation and hygiene (WASH), education, solid waste management housing and health services, which are exacerbated by the near absence of the public sector (Soura *et al.* 2015; Chumo *et al.* 2023a). Among children under five years in childcare centres, who were identified among the most marginalized and vulnerable, the need for WASH services presents a specific profound challenge, particularly as children spend a significant portion of their

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day in childcare centres, while their parents search for employment and livelihood opportunities, often leaving home very early in the morning and returning very late in the evening (Chumo *et al.* 2022c).

WASH service delivery beyond the household, and particularly in the childcare setting, is crucial to child health, child development, education and overall child wellbeing (WHO/UNICEF Joint Monitoring Programme for Water Supply & Sanitation (JMP) 2018). This importance is captured in the nurturing care framework, which describes the need to support children from risks related to unsafe environments by creating safe communities (World Health Organization (WHO) 2018). Additionally, the importance of WASH service provision in a childcare setting is implicitly captured in the Sustainable Development Goals (SDGs) relating to universal high-quality education in safe, effective and inclusive environments (SDG 4) and universal access to clean water and sanitation (SDG 6) (Mishra & Huber 2019). Consequently, achieving the nurturing care framework on safety and attaining the SDGs 4 and 6 will enable young children to establish positive WASH-related attitudes, skills, behaviours and habits at an early age that can benefit children throughout their lives and within their families, and be important in WASH service delivery (Wagner & Pramling Samuelsson 2019).

In Nairobi's informal settlements, available evidence has pointed to a strong belief by parents that enrolling children in a childcare centre is beneficial for their holistic development and future success (Clark *et al.* 2021). However, access to WASH services is a challenge in childcare centres, more so in informal settlements (Piper *et al.* 2017; Wagner & Pramling Samuelsson 2019; Clark *et al.* 2021). It is with this understanding that questions relating to social accountability become relevant, as it is identified as a positive force in WASH service delivery in childcare centres (Chumo *et al.* 2022b), following the lack or near absence of services from the formal sectors in informal settlements (Soura *et al.* 2015; Hollander *et al.* 2020; Chumo *et al.* 2022a, 2022b, 2022c). Social accountability is a process in which individuals (childcare providers) are obliged to explain their actions to other individuals (children, childcare providers, parents or local authorities), who have the right to judge them and administer positive or negative consequences in response to the actions taken (Lodenstein *et al.* 2018). Informal social accountability mechanisms (iSAMS) are an alternative to formal social accountability, and include informal sanctions, rewards, responsiveness and reports from any actor involved in service delivery or use (Chumo *et al.* 2022b). Despite how iSAMS help to counter challenges in access to WASH services in informal settlements (Chumo *et al.* 2023c), grey literature and practitioners mainly focus on formal social accountability mechanisms (Lodenstein *et al.* 2018; Melariri *et al.* 2019). Consequently, this paper explores and uncovers the iSAMS that are common in informal settlements and their association with WASH service delivery in the context of childcare centres. This becomes critical in the context of poor service delivery and weak or near absence of formal accountability systems in informal settlements.

The World Health Organization (WHO) and the Joint Monitoring Programme (JMP) produce internationally comparable estimates of progress on WASH service levels. The 2021 data showed WASH levels for primary and secondary schools (i.e. 67% of primary schools and 76% of secondary schools had a basic drinking water service; 68% of primary schools and 75% of secondary schools had basic sanitation; 58% of primary schools and 60% of secondary schools had a basic hygiene service) (WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) 2018). Data were insufficient to generate global estimates for childcare centres. However, there are reports of low access to WASH services, and inadequate data on WASH service levels (WHO/UNICEF Joint Monitoring Programme for Water Supply & Sanitation (JMP) 2018; Wagner & Pramling Samuelsson 2019). The status of iSAMS and their roles in childcare centres in Nairobi's informal settlements is also unknown (Chumo *et al.* 2022c). This study builds on the importance of WASH services for under five years children and the WASH service deficits in childcare centres, inadequate data on WASH levels in childcare centres in informal settlements, together with the need for evidence on iSAMS and their roles in WASH service delivery in childcare centres in two deprived informal settlements in Nairobi, Kenya.

## 2. METHODOLOGY

### 2.1. Aim/objectives

Our study explores the associations between iSAMS and levels of WASH service delivery in childcare centres in Nairobi slum settlements.

### 2.2. Study setting

The study is nested within a multidisciplinary, multi-country and multi-year study: Accountability and Responsiveness in Informal Settlements for Equity (ARISE Hub) (Tolhurst *et al.* 2024). The study was conducted in Korogocho and Viwandani informal settlements in Nairobi. Korogocho has a stable and settled population and residents have lived in the area for many

years (Emina *et al.* 2011), while Viwandani is located next to an industrial area with many highly mobile residents who work or seek jobs in the industrial area (Emina *et al.* 2011). Each of the informal settlements has eight subdivisions/units/villages. There are approximately 50 and 60 childcare centres in Korogocho and Viwandani, respectively (Chumo *et al.* 2022b). Close to 70% of childcare centres have between 10 and 25 children enrolled. Many centres are owned by individuals (home-based care), few are owned by faith-based organizations and very few are centre-based (attached to primary schools), all of which were operating mostly during the day (between 6 am and 5 pm) (Wagner & Pramling Samuelsson 2019).

### 2.3. Study design, population and sampling

This was a cross-sectional survey study with 40 and 37 childcare service providers in 40 and 37 childcare centres in Korogocho and Viwandani, respectively. We drew our sample from a sampling frame of childcare centres mapped during community profiling in the study sites. Community profiling involves locating notable features such as WASH services in a study area (Martín & Meza 2010; Dannaway *et al.* 2014). It is an iterative process, with some information collected early in a project phase, while others may not be uncovered until later in project development or production (Martín & Meza 2010). In the ARISE project (Tolhurst *et al.* 2024), where this study was nested, 55 and 62 childcare centres were profiled in Korogocho and Viwandani informal settlements, respectively, in May–June 2020. Consequently, we collected data from only functional/operational centres in the sampling frame. Due to logistical challenges, the need for accurate data on WASH services and social accountability, and the dynamics of childcare centres, our decision on the sample size was pragmatic.

### 2.4. Data collection

Consultative and advisory meetings were held between researchers and community advisory committees in the two study sites. The committees offered advice among many other roles of education and awareness creation, protecting community interests and acting as gatekeepers, for effective data collection processes (Chumo *et al.* 2022a), including the best time to collect the data, and support for locating the childcare centres during data collection. Data were collected from centre providers between January and March 2022, anytime between 9 am and noon, during which time children were actively involved. The data were collected electronically on a tablet using a structured questionnaire that was informed by a literature review, such as on WASH service level monitoring using JMP variables of basic, limited and no service (WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) 2018), and from the exploratory qualitative study phase on social accountability variables: rewards, sanctions, responsiveness and voice variables) (Chumo *et al.* 2022b). The study tool had items on WASH, social accountability and socio-demographic variables including sex, educational status, certification status and type of childcare centre. The study tool had a section for research assistants to observe WASH facilities. Research assistants received training for 6 days on the aims of the study, data collection tools, electronic data collection process and research ethics. We piloted the study tools with one centre provider in each of the study sites, followed by a debriefing session. The pilot exercise enabled us to adjust the translated tools to the language understood by the study participants and to estimate the time an interview would take. We excluded the two centre providers from the two pilot childcare centres from the main study. Researchers accompanied research assistants to assess data quality through spot-checks. Debriefing and reflection sessions among the research assistants and between them and the researchers were held at the end of each working day to assess progress and ensure quality data collection. The interviews lasted between 30 and 45 min.

### 2.5. Measurements

We describe outcome and predictor variables of the study.

### 2.6. Outcome variables

Outcome variables comprised components of WASH measured by the level of access and use of WASH at the time of study. This culminated in documenting the level of availability as a service ladder (WHO/UNICEF Joint Monitoring Programme for Water Supply & Sanitation (JMP). 2018). Building on the WASH service classification in schools (WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) 2018), the options were grouped into three categories basic, limited and no access levels for WASH (see Table 1).

**Table 1** | Outcome variables

Service ladder	Definition	Measurement
Basic water service	Water from an improved source provided collection time is less than 30 min for a roundtrip, including queuing <sup>a</sup>	<ul style="list-style-type: none"> <li>• Direct questions were asked</li> <li>• Observation and time measurement: the data collectors measured the collection time through a demonstration walk starting from the water source. Then the time was approximately recorded for centre. These methods were used to distinguish between basic vs. limited service.</li> </ul>
Limited water service	Drinking water from an improved source where collection time exceeds 30 min for a roundtrip, including queuing	
No water service	Absence of drinking water, water from unimproved source or surface water <sup>b</sup>	Limited drinking water from an improved source where collection time exceeds 30 min for a roundtrip, including queuing
Basic sanitation	Improved sanitation facilities at the childcare centres that are usable (accessible, functional, safe, child appropriate) and well disposed at the time of the survey	
Limited sanitation	Improved sanitation facilities at the school that are not usable (not accessible, not functional, unsafe, not child appropriate) and not well disposed at the time of the survey	
No sanitation	No facility or disposing faecal waste in open spaces or use of pit latrines without a slab or platform, hanging latrines and bucket latrines	
Basic hygiene	Handwashing facility with soap and water	
Limited hygiene	Handwashing facility without soap or water	
No hygiene	No handwashing facility	

<sup>a</sup>Improved source: water sources that are protected from outside contamination and from faecal matter improved water sources include piped water inside childcare structure, public standpipes, boreholes, protected dug wells and protected rainwater collection.

<sup>b</sup>Unimproved – drinking water from an unprotected dug well. Surface water – drinking water directly collected from a river.

## 2.7. Predictor variables

Predictor factors included social accountability mechanisms that were identified in an exploratory study using governance diaries and multimethod qualitative longitudinal data collection (Chumo *et al.* 2022b). Accountability measures used included rewards, sanctions, voice/complaints and responsiveness by childcare managers (Table 2).

## 2.8. Data analysis

Descriptive statistics were used to describe the number and proportion of socio-demographic, outcome and predictor variables. Percentages and frequencies were computed to present WASH service ladder levels and their relationship to social accountability indicators. Chi-square test was conducted to compare bivariate differences in proportions between predictor and outcome variables and to identify informal social accountability variables independently associated with WASH. Multinomial logistic regression was used to examine the strength of associations between the social accountability predictor factors and WASH service levels (limited or no service) using basic service as the reference category. This included stepwise elimination of the least significant variables (i.e. those with the highest *p* values) at every step until a parsimonious model was

**Table 2** | Predictor variables

Social accountability	Definition	Measurement
Rewards	Prizes in the form of money or actual provision of WASH services based on the extent to which someone complies with WASH needs of children (Odondi 2014)	<ul style="list-style-type: none"> <li>• Direct questions were asked</li> </ul>
Sanctions	Punitive measures in the form of declining to admit a child based on the extent to which there is failure to comply with WASH needs of children by the parent or childcare manager (Odondi 2014)	
Voice	Complains or reports on status of WASH service provision (Schaaf <i>et al.</i> 2017)	
Responsiveness	Taking charge of WASH needs of the child (Deffains 2013)	

achieved. This is achieved when most variables had a  $p$ -value  $< 0.05$  (Chowdhury & Turin 2020). The likelihood-ratio test was used to assess the goodness-of-fit of the adjusted final reduced model against the initial full model containing all explanatory variables. The multinomial logistic regression model was adjusted for the study site and ownership type of childcare centre, e.g. individually owned, faith based and centre based. Adjusted relative risk ratios (aRRRs) and 95% confidence interval (CI) were reported for the predictors.

## 2.9. Research ethics

We sought ethical clearance from the AMREF Ethics and Scientific Review Committee (ESRC) and a research permit from the National Commission for Science, Technology and Innovation (NACOSTI). The committees reviewed the protocol to ensure sufficient safeguarding and protection of participants, namely their rights to autonomy, confidentiality, voluntary participation in the research and scientific soundness of the study.

Verbal consent to participate in the study was initially sought when we explained the nature of the study and asked individuals (parents and childcare providers who were selected to participate in the study) if they would like to participate. After receiving their verbal consent, we went through the informed consent process before data collection began. Each participant who accepted to participate was then asked to sign the consent form if convinced. All participants were informed of their right to withdraw from the study at any time, with no risk of any associated implications for their ongoing role. Throughout the research process, anonymity and confidentiality were critical priorities. During the reporting of findings, we ensured that no personal identifiers were revealed.

## 3. RESULTS

### 3.1. Demographic information

In the two study sites, the majority of childcare providers were female, and had certification in childcare. Many centres were owned by individual entrepreneurs, home based and notably, with higher percentages in Korogocho than in the Viwandani study site (see Table 3).

### 3.2. Access to WASH services (outcome variable)

#### 3.2.1. WASH facilities in childcare centres

All childcare centres had access to WASH in the two study sites (Table 4). Particularly, centres in Korogocho had access to water only from improved sources (i.e. tap in the compound – 88% and public taps – 14%). In Viwandani, in addition to the

**Table 3** | Demographic characteristics

Study site	Korogocho	Viwandani
<b>Characteristics</b>	<b>Percent (number) <math>n = 40</math></b>	<b>Percent (number) <math>n = 37</math></b>
<b>Respondents sex</b>		
Male	17.5 (7)	2.7 (1)
Female	82.5 (33)	97.3 (36)
<b>Highest level of school you attained/completed</b>		
Primary school (Grades 1–8)	5 (2)	2.7 (1)
Secondary education (Grades 1–6)	20 (8)	13.5 (5)
Vocational education (education not linked to early childhood or childcare)	5 (2)	13.5 (5)
Tertiary education/short courses on early childhood or childcare)	70 (28)	70.3 (26)
<b>Certification or capacity building to work with children</b>		
Yes	80 (32)	89.2 (33)
No	20 (8)	10.8 (4)
<b>Type of centre</b>		
Individually owned (home-based centres)	67.5 (27)	78.38 (29)
Faith-based owned	27.5 (11)	16.22 (6)
Centre attached to public schools	5 (2)	5.41 (2)

**Table 4** | WASH facilities in childcare centres

Study site	Korogocho	Viwandani
Access to WASH	Percent (number) $n = 40$	Percent (number) $n = 37$
<b>a) Where does the school normally collect water to drink?</b>		
Tap on the compound	87.5 (35)	37.9 (14)
Public tap or fountain	13.5 (5)	40.5 (15)
Borehole	0 (0)	2.7 (1)
Bottled or packaged water	0 (0)	18.9 (7)
<b>b) <sup>a</sup>What types of sanitation facilities do children use?</b>		
Potty/container-based sanitation	82.5 (33)	86.5 (32)
Pour flush toilet connected to onsite open pit	2.5 (1)	2.7 (1)
Pit latrine with slab	22.5 (9)	13.5 (5)
Pit latrine without a slab	2.5 (1)	10.8 (4)
<b>c) <sup>a</sup>Where are hand washing stations located</b>		
Near the toilets/latrine/container-based sanitation	97.5 (39)	89.2 (33)
In the classroom	87.5	86.5
Near the school gate	35	32.4

<sup>a</sup>Multiple response.

improved water sources (i.e. tap water in the compound – 38%, public tap – 41% and bottled water – 19%), a small percentage (2.7%) of childcare centres depended on an unimproved water source, namely a borehole. Many sanitation (toilet facilities) in childcare centres in both study sites were improved. Remarkably, centres in Viwandani had more unimproved toilet facilities without slab (11%) compared to centres in Korogocho (3%). For handwashing stations, more than three-quarters of the handwashing facilities were located near the sanitation facilities and in the classrooms in childcare centres in both study sites, with slightly higher rates in Korogocho than Viwandani (see Table 4).

**Figure 1** | Study sites.

### 3.2.2. WASH ladder in childcare centres

Using the JMP stacked ladders, 78% of centres had access to basic hygiene, 68% had access to basic water and 40% had access to basic sanitation in the Korogocho study site (Figure 1). In Viwandani lower access was documented with 65% access to basic hygiene, 59% access to basic water and 27% access to basic sanitation. A higher proportion (>50%) of centres had access to basic water and hygiene compared to limited and no service in both study sites, while a higher proportion (>50%) of centres had access to limited sanitation compared to basic and no service (see Figure 2).

### 3.3. Social accountability and WASH service levels

#### 3.3.1. Two-way frequencies-iSAM (predictor variable) by WASH levels (outcome variables)

A composite variable of informal social accountability across the sanitation service ladder showed that centres with basic sanitation had a higher level of accountability compared to those with limited or no services. This was similar across the

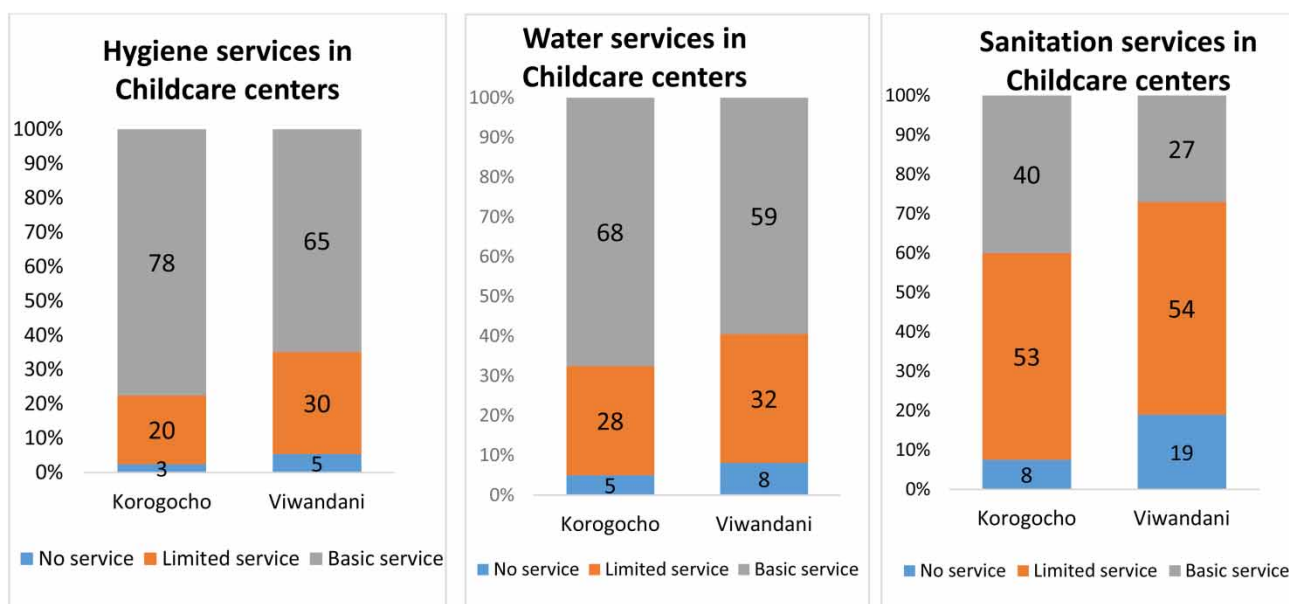


Figure 2 | WASH service delivery in childcare centres.

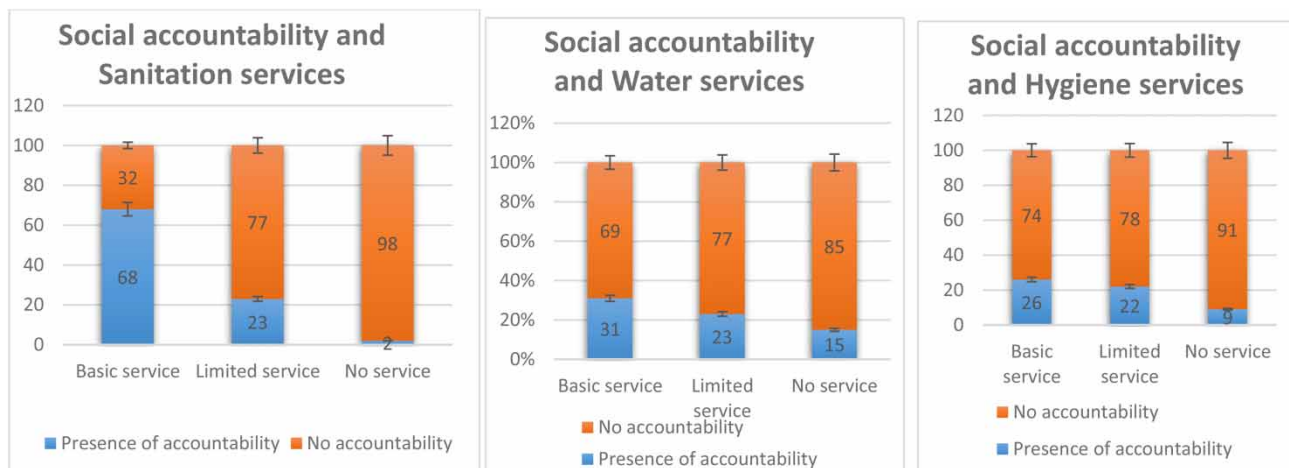


Figure 3 | Social accountability by WASH service delivery.

water and hygiene ladder, with 68% of social accountability associated with basic sanitation, 31% with basic water and 26% with basic hygiene services. Consistently across all services, social accountability measures were relatively low in all centres with limited services and lower in centres with no services (Figure 3).

### 3.3.2. Chi-square tests-iSAMs (predictor variables) by WASH (outcome variables)

From Pearson chi-square tests, rewards and sanctions were significantly associated with access to sanitation in the Viwandani study site, while only responsiveness was significantly associated with access in the Korogocho site. Voice/complaints were, however, not significantly associated with sanitation in both study sites. Sanctions were significant, while voice and responsiveness were not significantly associated with access to water in both study sites. Rewards, on the other hand, were only significantly associated with access to water in the Viwandani study site. The three iSAMs were associated with hygiene in both study sites, i.e. sanctions, voice/complaints and responsiveness by childcare managers.

### 3.3.3. Multi-variate regression result-iSAMs (predictor variable) by WASH (outcome variable)

Rewards, sanctions and responsiveness that were associated with sanitation service provision in bivariate analysis were subjected to multinomial analysis, and all three co-variables had a strong association with WASH service outcomes. In the model comparing basic service vs no facility/services, participants who used rewards, sanctions and responsiveness (versus not used) in sanitation services were more likely to have basic services, with relative risk ratios (RRRs) for rewards (aRRR 5.14; 95% CI 3.71, 9.1); sanctions (aRRR 1.8; 95% CI 1.39, 9.36) and responsiveness (aRRR 1.6; 95% CI 1.4, 16.57). On water services, participants who used sanctions (versus not), were more likely to have basic services (aRRR 6.7; 95% CI 2.97, 9.5). On hygiene services, participants who used responsiveness (versus not) were more likely to have basic services, with RRRs (aRRR 3; 95% CI 2.27, 8.46). The sequel for other mechanisms are sanctions (aRRR 2; 95% CI 1.16, 4.12) and feedback reports (aRRR 2; 95% CI 1.29, 3.27). Notably, in Model 2; aRRR on the association of iSAMs and access to basic water and hygiene services were higher in no service compared to limited services and were less likely associated with basic sanitation vs limited sanitation service delivery (Table 5).

**Table 5** | Multi-variate-iSAMs by WASH (multinomial aRRR)

Accountability/WASH	Model 1		Model 2	
	No service vs basic service aRRR (CI = 95%)	p-Value	Limited service vs basic service aRRR (CI = 95%)	p-value
<b>Sanitation</b>				
Rewards	No (ref)			
	Yes	5.14 (3.71, 9.1)	0.01	0.5 (0.15, 0.69)
Sanctions	No			
	Yes	1.8 (1.39, 9.36)	0.04	0.7 (0.13, 0.85)
Responsiveness	No			
	Yes	1.6 (1.4, 16.57)	0.03	0.3 (0.14, 0.61)
<b>Water</b>				
<b>No</b>				
Sanctions	No			
	Yes	6.7 (2.97, 9.5)	0.04	1.4 (1.36, 4.2)
<b>Hygiene</b>				
<b>No</b>				
Sanctions	No			
	Yes	2 (1.16, 4.12)	0.05	1.1 (1.0, 1.82)
Responsiveness	No			
	Yes	3 (2.27, 8.46)	0.04	1.2 (1.1, 3.85)
Voice/ complains	No			
	Yes	2 (1.29, 3.27)	0.05	1.8 (1.28, 1.68)

Variables included are those in the final model after backward elimination. p-Value <0.05; aRRR: adjusted relative risk ratio; CI 95%: confidence interval.



## 4. DISCUSSION

Our results showed that access to WASH was higher in Korogocho than in Viwandani study sites. This was different from the norm, where access to basic services such as health care, education and WASH services were usually higher in Viwandani than in Korogocho due to structural differences between the study sites (Emina *et al.* 2011; Beguy *et al.* 2015). Structural differences in our current results were depicted by higher education levels of childcare providers, with those attaining beyond the secondary level of education at 75% in Korogocho and 84% in Viwandani, whereas capacity building on childcare-related skills was 80 and 89% in Korogocho and Viwandani, respectively. This was also illustrated by other studies done in the two study sites, describing how the Viwandani study site is bordered by an industrial area, and attracts migrants with relatively higher education levels, while residents in Korogocho are more stable and have a higher proportion of co-resident couples and multi-generational households (Beguy *et al.* 2015).

Our data collection was implemented during the peak period of the Covid-19 outbreak, and the overall improved access to WASH is attributed to several WASH interventions that emerged in the community during the Covid-19 outbreak. In principle, Covid-19 interventions could be the motive for better access to water and hygiene and lower access to sanitation. Water and hygiene service provision was prioritized in informal settlements during the peak seasons of the Covid-19 outbreak control measures (Parikh *et al.* 2020; Kim & Laituri 2022). This was portrayed by actors, including the governments, distributing clean water and establishing handwashing stations in the community and in childcare centres (Chumo *et al.* 2022c; Kim & Laituri 2022). Local, national and internationally recognized intervention strategies for Covid-19 containment included water and hygiene measures (Belle *et al.* 2020; French *et al.* 2020), hence the high levels of water and hygiene service delivery in childcare centres at the time of this study.

Notably, iSAMS co-variables of rewards, sanctions, voice and responsiveness differed in their association with WASH service provision levels. Particularly, sanctions were significantly associated with all the levels of the WASH service ladders, in relation to having basic vs no services. This was also illustrated in other studies conducted in urban areas describing how sanctions are significantly associated with the provision of basic water services, and that sanctions are effective when used without compromise (Lodenstein *et al.* 2018). Those who receive sanctions change their behaviour or increase their contributions (Kamei *et al.* 2015). A previous study in the same setting described how sanctions were associated with access to WASH service delivery, because, when a centre performs below expectations, parents/guardians use their discretion to punish or send reputational signals that may have adverse implications for a childcare centre (Chumo *et al.* 2022b). This study extends the previous study by offering quantitative measurements of iSAMS including sanctions (Chumo *et al.* 2022b; Chumo *et al.* 2023c). The outcome could be attributed to the fact that residents in informal settlements have many unmet needs and may be willing but cannot afford to reward childcare centre providers (Chen *et al.* 2018; Baek *et al.* 2020; Chumo *et al.* 2023b).

There were three iSAMS associated with sanitation compared to one mechanism associated with water, yet access to basic water was higher than basic sanitation in both study sites. This depicts how quality and not the number of accountability mechanisms is key to achieving WASH service delivery in informal settlements (Friis-hansen *et al.* 2013). Equally, iSAMS are essential in the WASH sector for several reasons. Firstly, it is a human rights principle and is needed for the realization of the human right to WASH. Secondly, it is a key mechanism to strengthen WASH systems, though it is given scant or no mention in WASH systems strengthening literature to date (Hollander *et al.* 2020). Remarkably, childcare providers and parents who are key actors (Chumo *et al.* 2022c) are likely overwhelmed contributing to poor WASH service delivery in low-income settlements in Africa (Deffains 2013; Melariri *et al.* 2019), and hence the need for exploration of iSAMS and how it can amplify WASH service delivery.

### 4.1. Strengths and limitations

The strengths of the study included strong networks in the study sites, and well-trained and skilled data collectors recruited from the community. This heightened the validity of the study results. Our study is not without limitations. The study was conducted in only two informal settlements in Nairobi; Korogocho informal settlements have a more steady population and multi-generational inhabitants have resided in the region for several years (Emina *et al.* 2011). Viwandani is situated near an industrial zone with more educated occupants who work or travel for jobs in the nearby industries outside the informal settlements (Emina *et al.* 2011; Chumo *et al.* 2022c). At the outset of the study, we aimed to do a comparison of results between the two study sites, with 77 childcare centre owners from the two informal settlements. The findings were necessary for painting a picture of the levels of WASH service provision and social accountability beyond household levels to include

childcare settings in informal settlements. iSAMs that were identified during the exploratory phase during governance diaries data collection that included rewards, sanctions, voice and responsiveness (Chumo *et al.* 2022b) were included in the study. There could be other iSAMs that were missed. Notwithstanding, the four mechanisms provided a reference point and basis for other iSAMs.

## 5. CONCLUSION

This paper argues for and develops in detail the idea that informal social accountability is key for strengthening WASH service delivery in the context of weak formal service delivery structures. Childcare providers in Nairobi's informal settlements have operational iSAMs that have been a critical support for the provision and access to WASH services in their childcare centres. The iSAMs heightened during the Covid-19 pandemic and hence improved access to WASH services was recorded over the period. Although cross-cutting measures and interventions can have an impact on WASH service delivery, the roots of opportunities or challenges to WASH service delivery may lie not only in the infrastructures and access to interventions, but beyond the facilities to include important dimensions of the social structure such as iSAMs. Given the reported progress in WASH service delivery linked to informal social accountability, it is necessary to continue building, rebuilding and strengthening iSAMs in WASH service delivery. It is useful to view our results from a perspective that sees iSAMs not simply as an alternative but also as a complement to formal social accountability mechanisms in informal settlements. As such, relevant Ministries in Kenya may need to continually support all childcare centres in their efforts to ensure adequate and appropriate WASH service delivery to the most vulnerable sub populations.

To the best of our knowledge, this is the first study in childcare centres in informal settlements using the JMP ladder to establish the status of WASH, as such, it is important to have another future study to compare and validate these findings, more so after the peak period of the Covid-19 outbreak. Furthermore, in addition to one-time assessment, efforts may need to be made by governments and other actors to establish continuous monitoring systems to regularly track the needs and improvements needed as related to WASH service delivery in childcare centres.

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## AUTHOR CONTRIBUTIONS

Ivy Chumo contributed to conceptualization, data curation, formal analysis, visualization, methodology and writing the original draft. Blessing Mberu, Helen Elsey, Penelope A. Phillips-Howard and Caroline Kabaria contributed to supervision and validation of this research. Hellen Gitau contributed to validation of this research.

## DATA AVAILABILITY STATEMENT

Data cannot be made publicly available; readers should contact the corresponding author for details.

## CONFLICT OF INTEREST

The authors declare there is no conflict.

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