






Research Paper

Pattern of child faeces management and disposable diaper usage among under-fives in an Urban Slum of Bandung, Indonesia

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ABSTRACT

Children's faecal waste is a major environmental health issue despite increasing access to sanitation facilities and sanitary products in Indonesia. This cross-sectional study investigated child faecal management practice and disposable diaper usage among under-fives living in an urban slum of Indonesia. Data on household socio-demographics, child characteristics, and child faeces management practices were collected from 184 randomly selected pairs of mothers and children through interviews and observations. Findings revealed children's common defaecation sites as improved toilet, disposable diaper, and reusable diaper at 33.7, 33.2, and 16.3%, respectively. However, hygienic child faeces disposal was at 45%. Multivariate logistic regression indicated that the common use of disposable diapers and bathroom floor as the child's defaecation site increased unhygienic disposal. This prevalence decreased for mothers with higher education and those who had initiated toilet training. Promoting mothers' disposal of child faeces from disposable diapers, preventing child defaecation on the bathroom floor, and initiating toilet training as soon as a child can walk alone are thus potential interventions.

Key words: child faeces, disposable diapers, hygiene, sanitation, toilet training, urban slum

HIGHLIGHTS

- The study explored faecal management trends of under-fives in an urban Indonesian slum.
- Disposable diapers were a shortcut for mothers' unhygienic disposal practices.
- Water bodies and trash bins were the preferred disposal sites for diapers.
- Adult toilets were preferred for the initiation of child toilet training.
- The bathroom floor was a common yet ultimately unhygienic defaecation site; mothers considered it safer.

INTRODUCTION

The United Nations established the provision of safe water and sanitation for promoting global health as one of its Millennium and Sustainable Development Goals (The ASEAN 2017; WHO 2018b). The provision of basic sanitation not only aimed to prevent adult open defaecation but also households' unhygienic child faeces disposal (Odagiri *et al.* 2017). Indonesia achieved 71% of the population having access to a basic toilet in 2015 (The ASEAN 2017); this increased to 80% in 2017 (BKKBN 2017). However, despite the sanitation improvement, only slight changes have occurred in Indonesia's child faeces disposal practice in the past decade (Statistics Indonesia 2003; BKKBN 2017). Currently, only 1.5% of child faeces are disposed through the toilet, while the majority are disposed within disposable diapers in open fields, rivers, and ditches, especially in urban areas (Kurnia 2011).

Unhygienic child faeces disposal practices have been considered as similar to Open Defecation Practices (ODP) among adults (Bain & Luyendijk 2015). In Africa and Asia, unhygienic child faeces disposal is reported as a cause of enteric disease and environmental enteropathy among small children (Aluko *et al.* 2017; Bawankule *et al.* 2017) and diarrhoea (Cronin *et al.*

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2016). Moreover, a multi-country data analysis (Bauza & Guest 2017) revealed that a low coverage of improved child faeces disposal increased the risk of child stunting. Therefore, child faeces management is crucial for alleviating ODP and promoting child health and development.

Urban communities have more access to sanitary products such as potties, potty chairs, reusable and disposable diapers, and sanitation facilities than rural communities (Miller-Petrie *et al.* 2016). However, few households in South Asian studies practised hygienic child faeces disposal even with accessible sanitation infrastructure (Bawankule *et al.* 2017; Islam *et al.* 2018). Others showed how customs of defaecating in nature, socio-economic inequality, the caregivers' awareness and attitudes towards child faeces, and the achievement of child development milestones determined the disposal method (Yeager *et al.* 1999; Aluko *et al.* 2017; Bawankule *et al.* 2017; Ayele *et al.* 2018; Osumanu *et al.* 2019). These factors are modulated by mothers' hygienic behaviour as the main caregiver (Miller-Petrie *et al.* 2016; Aluko *et al.* 2017; Ayele *et al.* 2018). Nevertheless, the specific factors associated with mother's practices of child faeces disposal remain unclear.

Differences in the management of child faeces between urban and rural communities have often been studied (Miller-Petrie *et al.* 2016; Aluko *et al.* 2017). However, there are limited studies revealing urban slum practices. Slums are defined as high-density areas with unhealthy housing and generally low economic status (UN-HABITAT 2016). In urban slums in developing countries, practising good hygiene behaviour is limited by the effect of urbanisation, with its inadequate living space, poverty, and seasonal disasters; low sanitation quality; poor access to clean water; and lack of waste collection facilities (Tariga *et al.* 2016). For example, Tariga *et al.* (2016) shared how solid waste transportation in Bandung City was available for only 61% of the area, and the community would place household waste in plastic, open/closed trash cans and dispose of them in their yards or rivers, or by burning them. Therefore, this study aimed to investigate the pattern of child faeces management practices and under-five disposable diaper usage in an urban slum of Bandung in Indonesia.

METHODS

Study population

From July to August 2018, a cross-sectional, exploratory study was conducted in a densely populated district with several slum settlements in Bandung City, Indonesia. According to Law No.1 of 2011 concerning *Perumahan Kawasan Pemukiman* (Housing and Residential Areas), slum settlements are developments that are unfit for habitation and characterised by building irregularity, high building density, and a quality of buildings, facilities, and infrastructure that do not meet official requirements (Ministry of Law and Human Rights 2011). Our study site had a total population of 132,135 households and struggled with a high prevalence of diarrhoea, child malnutrition, and lack of drainage systems (Otsuka *et al.* 2019). The study was carried out in collaboration with the Integrated Health Service Posts for Mothers and Children Under-five (*Posyandu*), and the sample population comprised all under-five children within their register who frequented the venue for routine check-ups. Participant sampling was conducted by *Posyandu* staff through the selection of random numbers that were associated with each child on the register. From a total population of 634 children, 200 pairs of mothers and under-five children were selected for the study. Mothers who were unable to give consent or refused home visits were excluded, and in households with more than one under-five child, the youngest was recruited. This brought the number of enrolled participants to 184 mother-child pairs. Using a confidence level of 95%, our sample gave a confidence interval of ± 6.09 .

Interview survey and observation

Quantitative and qualitative data were collected through private researcher-participant face-to-face interviews and on-site observations of child disposal sites. Interviews utilised a structured questionnaire (Figure 1) that included items related to socio-demographics (ethnicity, maternal age and education, household income, toilet type, and sanitation), child characteristics (child's gender, age, mobility, and initiation of toilet training), and mother's child faeces management practice (child's common defaecation site, child's faeces transport tools, process of cleaning tools, child anal cleaning material disposal site, and mothers' handwashing with water and soap).

The regional minimum wage (UMR) in Indonesian Rupiah (IDR) would be different for each province and by groups of professions. As of 2017, the lowest minimum wage in West Java ranged between 2,293,275 IDR (157.2 USD) and 3,889,866 IDR (266.7 USD) (Governor of West Java 2017). The criteria also referred to a previous study in Bandung urban slum (Otsuka *et al.* 2019). The house ownership was categorised as 'resident' when the respondent owned the house, as 'family' when the respondent was living in a house owned by their parents or family member, and as 'rental' when the respondent lived independently in rental housing. Criteria for sanitation, and drinking water referred to World Health Organization (WHO) guidelines for



Figure 1 | Interview questions regarding child faeces management, modification from Miller-Petrie *et al.* (2016).

sanitation and health (WHO 2018a), and hygienic disposal were defined as disposing children's faeces into an improved toilet or within a safe sanitation chain that ensured the use of at least safe toilets and safe containment-storage/treatment where sewage did not flow through an open drainage (WHO 2018a) as per previous studies (Bauza & Guest 2017). Children who were found defaecating during the data collection process would be observed. The presence of children's faecal droppings and their location, flies, and food for adults and children, respectively, were recorded.

Ethical considerations

The study protocol and methods were reviewed and approved by the Ethics Review Committee of the Faculty of Health Sciences, Hokkaido University (No. 18-12). All research participants were required to fill out an informed consent form after being briefed on the study.

Statistical analysis

A multivariate logistic regression model was fitted with child faeces disposal as the outcome, and household socio-demographics, child characteristics, and child faeces management practices as the predictors. First, bivariate analysis was performed to obtain crude odds ratios. Second, significant predictors ($p < 0.25$) of unhygienic practice of child faeces disposal were included in a stepwise backward elimination analysis. Third, the multivariate logistic regression model was computed,

adjusting all covariates that were obtained from stepwise backward analysis. The contributing factors with $p < 0.05$ were considered significant, and the results were displayed in terms of adjusted odds ratios (AOR). All statistical analyses used JMP 13.1.0 software.

RESULTS

Participant's characteristics

Half the mothers obtained a secondary school or higher education (54%). In terms of income, 27% earned less than <2,000,000 IDR per month; only 25% generated income of more than 4,000,000 IDR per month. Overall, 82% of the community had a private toilet, and 75% had improved sanitation (Table 1). Under-five children were recruited almost equally

Table 1 | Participant characteristics

| Characteristics | N | Percentage (%) |
|---|-----|----------------|
| Maternal age | | |
| <21 | 9 | 5 |
| 21–39 | 153 | 83 |
| >40 | 22 | 12 |
| Maternal education | | |
| Middle or lower | 85 | 46 |
| Secondary and higher | 99 | 54 |
| Household income* | | |
| <2,000,000 IDR (<137.1 USD) | 50 | 27 |
| 2,000,000–4,000,000 IDR (137.1–274.2 USD) | 89 | 48 |
| >4,000,000 IDR (>274.2 USD) | 45 | 25 |
| House ownership | | |
| Resident | 38 | 21 |
| Family | 86 | 47 |
| Rental | 60 | 33 |
| Toilet type | | |
| Private | 151 | 82 |
| Shared | 33 | 18 |
| Sanitation facility | | |
| Improved | 138 | 75 |
| Unimproved | 46 | 25 |
| Child gender | | |
| Male | 103 | 56 |
| Female | 81 | 44 |
| Age (month) | | |
| 0–23 | 81 | 44 |
| 24–59 | 103 | 56 |
| Child mobility | | |
| Ambulatory | 136 | 74 |
| Pre-ambulatory | 48 | 26 |
| Initiation of toilet training | | |
| Yes | 123 | 67 |
| No | 61 | 33 |

*1 USD: 14,587.90 IDR (August 2017).

according to age and gender, with 26% of them still being pre-ambulatory. Children had toilet training initiation before 12 months (5.9%), 12–24 months (32.6%), and older (28.3%); the rest (33.2%) had not yet received any toilet training.

Child faeces management practices among mothers

As shown in Figure 2, children’s main defaecation sites were an improved (33.7%) and unimproved toilet (12%); about 5% of children used the bathroom floor as their defaecation site. One-third of the children used disposable diapers, while 16.3% used only reusable diapers. During the rainy season, when going to pre-school, visiting family, shopping, and travelling, the use of disposable diapers increased: 20.1% of those children who often defaecated in toilets – either improved or unimproved – used disposable diapers, compared to 16.3% of those children who often defaecated in reusable diapers, and 1.6% of those children who often defaecated on the bathroom floor. The number of disposable diapers used per day ranged from one to eight, but mostly less than four diapers daily. All income levels had some access to disposable diapers; however, middle- (24%) and higher-income households (28.2%) were more likely to use them than lower-income households (19%), showing that income influenced purchasing ability. Almost half the mothers reported spending 2,500–100,000 IDR monthly for disposable diapers. However, the prevalence of use decreased alongside increases in expenditure on disposable diapers. Households with small children less than 24 months allocated more money for the purchase of disposable diapers than those with older children.

Most mothers (75%) used tools to transport their children’s faeces, while 2% used their hands; approximately a quarter of the children always used the toilet, and thus, mothers had no need to transport faeces. Disposable diapers (34.0%), reusable diapers (20.0%), and wet clothes (13.0%) were common transport tools (Figure 2). Furthermore, 0.5% of mothers used a scoop to dispose faeces into an improved toilet, after which it was cleaned with water and soap. Most mothers threw the disposable diapers (30.9%) and wet clothes (13.0%) into the solid waste or open ditch after transportation without prior cleaning. Other transportation tools were tissue paper, which was later disposed into solid waste (2.7%), and water that flowed into the surrounding environment (4.9%).

Almost half the mothers cleaned the child’s anus before disposing of their faeces (49.5%): they used water and soap (58%), water only (26%), wet cotton (5%), and wet tissues (11%). On average, mothers reported disposing of child faeces in about

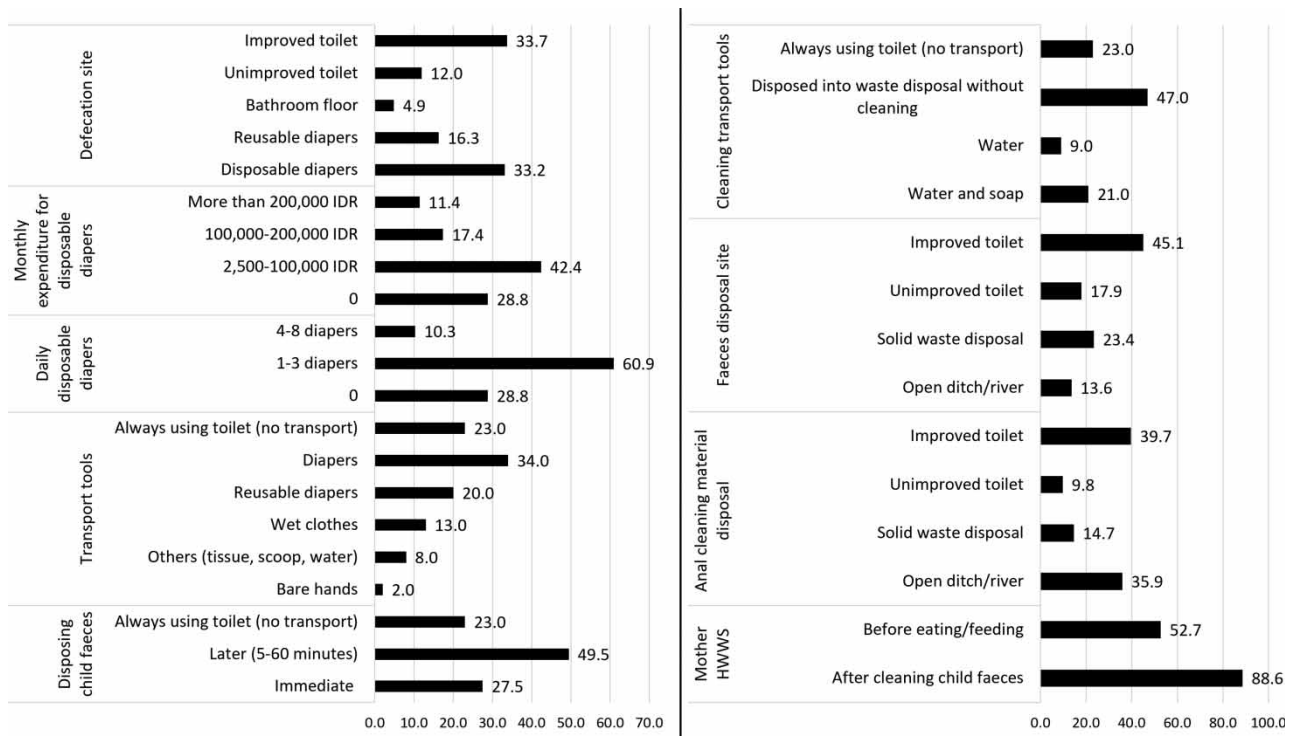


Figure 2 | Child faeces management practices.

5.5 ± 6.0 min (at most 60 min) after cleaning the child. Overall, only 45% of children's faeces were disposed hygienically into an improved toilet (Figure 2). Disposing anal cleansing materials into an open ditch (35.9%) and the solid waste (14.7%) was common, and more than 50% of mothers practised handwashing with soap after cleaning child faeces and before feeding.

Only one child was observed defaecating during the data collection period. However, from 184 households, 26 were found disposing disposable diapers with faeces in the household surrounding. Full disposable diapers were found in solid waste on the kitchen floor (11%) and in open solid waste bins in the kitchen (27%), in the living room (4%), in the bathroom (23%), yard (31%), and in the ditch (4%), respectively; 15 disposal sites had flies hovering and 9 of them had adult and child food nearby.

Associated factors for unhygienic child faeces disposal

The use of reusable and disposable diapers was higher in pre-ambulatory children and decreased in ambulatory children; and the upward trend of toilet use for defaecation among ambulatory children aligned with the number of mothers who disposed of faeces hygienically. Finally, disposing faeces into the open ditch was associated with use of the bathroom floor as a defaecation site.

In multivariate logistic regression, unhygienic child faeces disposal was associated with the use of disposable diapers and bathroom floor as the child's common defaecation site (AOR: 18.69; 95% CI: 5.47–63.95 and AOR: 17.34; 95% CI: 1.84–163.27). Meanwhile, mothers who had attained secondary school or higher education and had initiated toilet training practised unhygienic child faeces disposal less (AOR: 0.22; 95% CI: 0.09–0.47 and AOR: 0.25; 95% CI: 0.08–0.83) (Table 2). It is important to note that from 45.7% of children who defaecated in the toilet, 12.0% still used an unimproved toilet.

DISCUSSION

Participant's characteristics

The socio-demographic characteristics of this urban slum showed a mix between urban and rural characteristics, having comparably lower socio-economic status than urban but higher than rural in accordance with the Indonesian Demographic Health Survey (IDHS) (BKKBN 2017) and consistent with previous studies among slums residents (Nastiti *et al.* 2017; Otsuka *et al.* 2019). Despite numerous upgrading projects to improve the physical living conditions of slums, controlling the rapid migration flow of predominantly unemployed individuals to the city has been difficult. Families try to support migrating relations by way of cheap rentals and/or shared living space, causing household population density increments that are not matched with infrastructural expansions (Tariga *et al.* 2016). This leads to makeshift facilities, imbalanced economic growth, and poverty (UN-HABITAT 2016).

Participants were housewife mothers, most having completed their education up to primary school (46%). To explain this, recent statistics from the IDHS indicated that at the time of the national survey, 2, 7, and 5% of Indonesian women in the age

Table 2 | Associated factors for unhygienic child faeces disposal ($n = 184$)

| Variable | AOR | 95% CI | p-value |
|-------------------------------|-------|-------------|---------|
| Maternal education | | | |
| Middle or lower | 1 | – | – |
| Secondary and higher | 0.22 | 0.09–0.47 | 0.0001 |
| Child defaecation site | | | |
| Disposable diapers | 18.69 | 5.47–63.95 | <0.0001 |
| Washable diapers | 1.71 | 0.53–5.56 | NS |
| Bathroom floor | 17.34 | 1.84–163.27 | 0.0127 |
| Toilet | 1 | – | – |
| Initiation of toilet training | | | |
| Yes | 0.25 | 0.08–0.83 | 0.0229 |
| No | 1 | – | – |

R^2 : 0.36; Akaike information criterion corrected: 175.8; AOR: adjusted odds ratio; CI: confidence interval. Statistically significant difference at the minimum level of $p < 0.05$.

range of 15–19 were either having their first pregnancy, had begun childbearing, or had given birth, respectively; as a result, many young and expecting mothers dropped out of school early (BKKBN 2017). Notably, women's literacy and education are determinants for their childcare hygiene practice (Preeti *et al.* 2016; Ayele *et al.* 2018), and this study emphasises mothers and their role in maintaining child hygiene.

Socio-demographic and unhygienic child faeces disposal practices

The infrastructure in this urban slum, with its access to sanitation facilities, was like that of urban areas; however, child faeces disposal practices were different. When compared to other developing countries, such as Cambodia (Miller-Petrie *et al.* 2016), and rural areas, like those in Ethiopia (Ayele *et al.* 2018), the rate of hygienic child faeces disposal in our study site was low, despite high sanitation coverage (Table 1). This contradicted past studies that stated residing in urban settlements with better socio-economy, improved water, sanitation and hygiene infrastructure, and modern rather than more natural residences had higher hygienic disposal practices than their rural counterparts (Bawankule *et al.* 2017; Ayele *et al.* 2018; Osumanu *et al.* 2019). The rate was higher than that in rural India (23.7%) and the urban slums in Nigeria (19.7%) (Preeti *et al.* 2016; Aluko *et al.* 2017), though it was still far behind the suggested community coverage (>75%) for protection from the effects of unhygienic child faeces disposal (Bauza & Guest 2017); a past Indonesian study and a recent report showed a similar trend indicating a minimal change after infrastructure development (Cronin *et al.* 2016; BKKBN 2017).

Our findings show that maternal literacy and education are determinants of child faecal practices. They confirm the importance of formal educational attainment towards caretaker's hygienic behaviour, as married women who ended at primary-level education tended to have less exposure to the internet, electronic media, and health practitioners where information on hygienic faecal disposal practices could easily be found (Preeti *et al.* 2016; Ayele *et al.* 2018). Previous studies revealed that caretakers had a false perception of child faeces as tiny, odourless, and harmless which determined their improper practices (Yeager *et al.* 1999; Aluko *et al.* 2017). In this study, unhygienic child faeces disposal sites were solid waste (23.4%), unimproved toilet (17.9%), and open ditch (13.6%). Disposable diaper users had the highest proportion of unhygienic child faeces disposal; 20.6% of ambulatory and 56.3% of pre-ambulatory children had faeces disposed unhygienically. This may be because mothers were unaware that disposable diapers required more attention prior to disposal of child faeces; that is, they assumed that any disposal method was acceptable.

Child faeces management and unhygienic child faeces disposal practices

Using a cloth nappy and a child potty as a defaecation site was suggested to encourage caretakers' rinsing child faeces into the toilet (Majorin *et al.* 2014; Miller-Petrie *et al.* 2016; Aluko *et al.* 2017); avoiding child defaecation on the household floor decreased unhygienic disposal (Ayele *et al.* 2018). Similar to our findings, reusable diaper users more likely disposed child faeces into an improved toilet (46.7%) (Figure 2) as mothers naturally paid more attention to rinse faeces in order to simplify the washing process and prevent attracting animals. Further, thorough cleaning of cloth diapers for reuse prevented skin problems (Yeager *et al.* 1999). Unfortunately, cloth diapers were less preferred (Figure 2). Child potty usage was not observed, perhaps due to stigma that potties were only for the elderly or sick.

Child defaecation on the bathroom floor created a greater risk for unhygienic disposal practices (Table 2). According to mothers, it allowed for easy sweeping away of faeces directly to open water and was deemed better than child outdoor defaecation as it avoided shameful feelings; a previous study in Peru mentioned that children's outdoor defaecation near the neighbour's house made neighbours uncomfortable (Yeager *et al.* 1999). Notably, there was a higher proportion of disposable diaper users (33.2%) in this study than the previous ones (Majorin *et al.* 2014; Miller-Petrie *et al.* 2016; Aluko *et al.* 2017). The prevalence was also much higher than that in 2003 (0.3% in urban city) (Statistics Indonesia 2003), indicating a recent cultural shift from traditional use of cloth to disposable diapers.

Globally, disposable diapers were only used by those with better income (Thaman & Eichenfield 2014). This contrasted with our finding that it was more affordable (the cheapest was 2,500 IDR or 0.17\$/diaper) for diverse socio-economic levels. Although those with lower-income spent less than higher-income households, more than 28% of households expended more than 100,000 IDR or 6.85\$ per month on disposable diapers (Figure 2). Mothers may have preferred disposable diapers because they required less frequent changing and a less tiring washing process (Thaman & Eichenfield 2014). In Bandung's urban slum, rather than the access, affordability, and adequate amount of water were major concerns (Otsuka *et al.* 2019), making disposable diapers preferable as they considerably reduced water use. Furthermore, using a disposable diaper helped prevent faecal leaking, promoting a more hygienic environment (Kamat & Malkani 2003).

Unfortunately, our findings revealed that only 10% of mothers rinsed child faeces from disposable diapers to an improved toilet. In contrast, 11 and 70% of them frequently threw a disposable diaper filled with child faeces into open water bodies and household solid waste. Liquid absorbers inside diapers cause them to get stuck and clog drains while spreading faecal matter from their surface, and improper waste management might facilitate further contamination. This finding supported an expert study that cited the result of unavailable safe alternatives for disposable diapers – burying, disposing into household solid waste, or letting child faeces remain in the open – practices akin to open defaecation (Bain & Luyendijk 2015). Thus, although disposable diapers eased tasks for caretakers, hygienic practices were not guaranteed. Good waste management systems and definite guidance to promote proper disposal of child faeces from disposable diapers are essentially important, though not stressed to pre- and post-natal mothers. Safe disposal of child faeces or ensuring children defaecate in the toilet are the most appropriate methods to promote hygienic child faeces disposal.

Initiation of toilet training and unhygienic child faeces disposal practices

Our result showed that the initiation of toilet training reduced improper disposal. Reusable rather than disposable diaper users tended to enhance the initiation process (data not shown); this was similar to findings of a diaper habit report across 11 countries (Thaman & Eichenfield 2014). The initiation of toilet training could be due to mothers' wish to reduce their laundry. When mothers found that disposable diapers were dependable, they were more likely to extend the usage period until their child got older. An introduction to potty training decreased unhygienic child faeces disposal in a South American country, while failure on intensive training was associated with dependence on disposable diapers and household floor as the child defaecation site (Yeager *et al.* 1999). However, since the potty was not used in this study, it is necessary to clarify whether the effect of an introduction to child potty training among urban slum children in Indonesia would potentially reduce unhygienic disposal.

CONCLUSION

High coverage of improved sanitation infrastructure could not guarantee the hygienic disposal of child faeces. However, the initiation of toilet training reduced unhygienic disposal. Without clear guidance and proper knowledge, using disposable diapers surprisingly increased unhygienic practices among urban slum mothers, making reusable cloth diapers a more hygienic option. Therefore, triggering a behavioural change, instead of sole dependence on increasing provision of sanitation infrastructure and accessible sanitary products, is relevant for decreasing unhygienic practices. Additionally, we recommend that child faecal management education be offered through *Posyandu* and women group associations which support mothers to avoid child health risks caused by poor disposal practices.

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DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

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