Open defecation: risk factors for adverse outcomes in Indonesia

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Research Article

Keywords: latrine, human excrement, fecal contamination, sanitation

Posted Date: January 13th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-839497/v1>

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Abstract

The increasing number of Indonesian population has caused serious issue of open defecation. Indonesia ranks the second large of open defecation prevalence in the world, after India. Human's excrement was disposed in trench, drain, terrace, grassland, backwoods, forest, river, lake or other open spaces, thus, contaminates the water system. Open defecation can lead to the increasing risk of transmission of water-boorne diseases of child morbidity in Indonesia. This study aimed at exploring different socio-economic and demographic factors of Indonesians who practice open defecation. Data were obtained from 49,627 female respondents of the 2017 Indonesia Demographic and Health Survey. The data were examined utilizing descriptive and logistic regression. The results reveal that the practice of open defecation is significantly influenced by place of residence, household's wealth quintile, and household's water supply. The findings suggest the needs for toilet construction and water supply sustainability in public area as well as in poor neighbourhood to eliminate open defecation in the country.

Introduction

The significance of eliminate open defecation to safeguard human health is indisputable and has critical public health concerns. Access to sanitation has been essential for the environment, human health, dignity and welfare. Open defecation is unsafely managed human excreta or fecal contamination in the environment (i.e. fields, forests, bushes, trench, drain, terrace, grassland, backwoods or other space for human disposal) rather than into a toilet, which leads to potential for exposure to enteric pathogens (Bhatt et al., 2019; Abebe and Tucho, 2020; Rakotomanana et al., 2020).

Open defecation has led to numerous parasite vectors (Pray et al., 2019). In each gram of fresh human feces contain 101 helminth eggs, 106 bacteria, 106 viruses, and 104 protozoan cysts (Hajj-Mohamad et al., 2019). Human's fecal released in the open-surface environment can contaminate open trenches (Jaitawat et al., 2004), beach (Park et al., 2018), water supply (Schriewer et al., 2015), and open-air (Casanovas-Massana and Blanch, 2013). Open defecation has been acknowledged as carrier of disease of hepatitis (Junaid, Agina and Abubakar, 2014), diarrhea (Njuguna, 2016), intestinal worm infections (Molla and Mamo, 2018), cholera (Goswami et al., 2019), typhoid (Mbae et al., 2020), polio (Martinez-Bakker, King and Rohani, 2015), trachoma (Macleod et al., 2019), schistosomiasis (Cha et al., 2019), and others. Diarrhoea has been known as the leading cause of mortality among Indonesian children (Hakim et al., 2018). Bhatt et al. (2019) and Fewtrell et al. (2005) found that the diarrheal illness eradicates over e.6 million children annually due to poor sanitation (Fewtrell et al., 2005; Bhatt et al., 2019).

Open defecation could cause a trachoma, an acute visual disorder, which spread over flies that breed on unprotected human feces (Macleod et al., 2019). Moreover, open defecation can cause snail fever, known as schistosomiasis, an enduring parasitical illness spread through skin contact with an infection freshwater snail or drinking of excreta contaminated water (Colley et al., 2014; Osakunor, Woolhouse and Mutapi, 2018). Cholera is also linked to consuming contaminated water due to human excreta (Diaconu et al., 2018; Goswami et al., 2019). Open human excreta contain ovas of herminths that live in land until

the next two years and can caused infectious such as ascariasis, trichuriasis, and hookworm (Bethony et al., 2006; McKay, Shute and Lopes, 2017). Hepatitis illness also occur within feces-contaminated drinking water supply (Junaid, Agina and Abubakar, 2014; Himmelsbach, Bender and Hildt, 2018).

The Sustainable Development Goals (SDGs) 6.2 has targeted open defecation to be eliminated by 2030 (Mara and Evans, 2017; Odagiri et al., 2017). However, open human excrement disposal is still major challenge for Indonesia since Indonesia has been identified as the second largest number of open defecation in the world, after India (Cameron, Olivia and Shah, 2019; Cameron et al., 2021). A study of drinking water in Yogyakarta in 2017 has revealed that 67 per cent of household drinking water and 89 per cent of water supplies were infected by part of human excreta (Aidan A Cronin et al., 2017).

Many studies have studied various factors associated open defecation in Nepal (Budhathoki et al., 2017), Kenya (Njuguna and Muruka, 2017), and Ethiopia (Tessema, 2017). Most of open human excrement disposal practices occur in rural areas (Sara and Graham, 2014; Vyas et al., 2019) and in low-income families (Njuguna, 2019; Chakrabarti, Singh and Bruckner, 2020). Place of residence (Vyas and Spears, 2018), region of residence (Aidan A Cronin et al., 2017); head of household (Odagiri et al., 2017), head of household's age (Njuguna and Muruka, 2017), head of household's educational level (Sinharoy et al., 2019), household's water supply (Vyas et al., 2019; Deshpande et al., 2020) and household's wealth quintile (Biran et al., 2011) were also highly associated with open defecation. Understanding the associated factors for open human excrement disposal could accompaniment the continuing struggle to eliminate open defecation in Indonesia. The aim of this research is to identify risk factors of open human excrement disposal in Indonesia. The objective of this study is to explore different aspects of people who practice open defecation in Indonesia.

Methods

Study population

The latest national representative survey, 2017 Indonesia Demographic and Health Survey (IDHS), has been utilized in this study (National Population and Family Planning Board (BKKBN), Statistics Indonesia (BPS), Ministry of Health (Kemenkes), 2018). The open-accessed data were attained from the DHS MEASURE Program's website that contain information on an extensive variety of demographic, health and environment indicators such as household ownership, sanitation, water-supply, maternal and child health variables (USAID, 2020). This study employed weighted-household-dataset of the 2017 IDHS because sanitary decisions (particularly constructing a toilet) is generated mostly at household level (Rutstein and Rojas, 2006; Croft et al., 2018). A two-stage sample study-design has been conducted to screen respondents of the study. Data on 49,627 respondents were generated from the interviewed women of reproductive age (15–49 years) in the primary questionnaire. Entire information on household ownership were collected including sanitary history. These sanitary data were used to identify the open defecation practice in a household.

The Study Variables

The dependent variable of this study is open defecation in which a household undertake open human excrement disposal or not (binary), defined as respondents reporting not having any form of septic tank – sanitary facility or disposing of human feces in open land, river, stream, creek, pit, yard, forest, backwoods, farmland for open defecation. The variable was measured utilizing the IDHS questionnaire on: “what kind of toilet facility do members of your household usually use?” (toilet with septic tank, toilet with no septic tank, shared/public toilet, river/stream/creek, pit or yard/bush/forest). The open defecation status categorised as 0 = septic tank-closed toilet for a house that that utilize all other types of septic tank-closed system toilet facilities and 1 = open defecation for a house without septic tank toilet facility or use open land/river/ stream/creek/ pit/bush/forest/ field for disposing human excreta. The independent variables considered in this study include place of residence, region of residence, head of household, head of household’s age, head of household’s educational level, household’s wealth quintile and household’s water supply. Consideration of these variables were traced by the previous studies on open human excrement disposal in developing countries.

Statistical analysis

This study conducted descriptive statistics to reveal the percentage distribution of selected background characteristics of open defecation in Indonesia. Further logistic regression analyses were conducted to measure household and head of household’s characteristics that might be correlated with open defecation. Predictive models for open defecation were also developed.

Results

Out of the 49,627 female respondents retrieved from the data set, 35,490 (71.5%) of them were reported utilizing septic tank-closed system toilet, and 14,138 (28.5%) were classified as open defecation. Most of the households were headed by males. However, the association between head of household and open defecation revealed insignificant association. Nearly 64 percent of respondents who practice open defecation lived in rural areas. About 52.4 percent of the respondents practicing open defecation lived in Java-Bali islands.

Table 1
The association between open defecation and social-demographic status

Socio-demographic factors	Open defecation		
	Septic tank-closed toilet	Open defecation	p-value
Place of residence			
Rural	14,962 (42.2%)	9,123 (64.5%)	0.000
Urban (r)	20,528 (57.8%)	5,015 (35.5%)	
Region of residence			
Java Bali	22,280 (62.8%)	7,409 (52.4%)	0.000
Outer Java Bali (r)	13,210 (37.2%)	6,729 (47.6%)	
Head of household			
Female headed	496 (1.4%)	685 (4.9%)	0.106
Male headed (r)	34,994 (98.6%)	13,453 (95.15%)	
Head of household's age			
15–35 years	14,524 (40.92%)	8,432 (59.64%)	0.273
36–54 years (r)	20,966 (44.82%)	5,706 (40.36%)	
Head of household's educational level			
No schooling or primary	7,230 (20.4%)	5,267 (37.3%)	0.301
Secondary or higher (r)	28,260 (79.6%)	8,871 (62.8%)	
Household's wealth quintile			
Poor-poorest	7,807 (22.0%)	10,165 (71.9%)	0.000
Upper-middle (r)	27,683 (78.0%)	3,973 (28.1%)	
Household's water supply			
Unprotected water supply	21,601 (60.9%)	9,426 (66.7%)	0.000
Protected water supply (r)	13,889 (39.1%)	4,712 (33.3%)	

Nearly half of the respondents who practice open defecation were declared that their head of household's aged – 35 years old, yet insignificant association. Nearly 9,426 (66.7%) of households who practice open defecation had unprotected water supply. The bivariate analysis, as shown in Table 1, reveals that the primary modifiable risk factors significantly associated with open defecation were place of residence, region of residence, head of household education level, wealth status and source of drinking water.

However, though head of household education level was significant in the bivariate analysis model (Table 1), its significance disappeared after adjusting for all factors (i.e. place of residence, region of residence, wealth status and source of drinking water) (Table 2).

Rural household has increased odds of open defecation compared to their counterparts from urban households (aOR = 2.041 [95% CI: 0.801, 0.884]). Contrary to expectation, increase in number of open defecation is associated with Java-Bali households rather than outer Java Bali households (aOR = 1.106 [95% CI: 0.816, 0.898]). Head of household education level (aOR = 0.778 [95% CI: 1.740, 0.818]) were not associated with decreased odds of open defecation. Poor-poorest households have increased odds of open defecation compared to upper-middle households (aOR = 2.116 95% CI: 1.111, 0.122]) (Table 2). Unprotected source of drinking water increased the odds of open defecation compared to having protected source of drinking water (aOR = 1.043 [95% CI: 0.614–0.675]).

Table 2
Logistic regression of open defecation with socio-demographic status

	<i>aOR</i>	P value	95% CI
Place of Residence			
Rural	2.041	0.000	0.801–0.884
Urban (r)	1.000		
Region of Residence			
Java-Bali	1.106	0.000	0.816–0.898
Outer Java-Bali (r)	1.000		
Educational level of head of household			
No schooling or primary	0.778	0.731	1.740–0.818
Secondary or higher (r)	1.000		
Household wealth status			
Poor-poorest	2.116	0.000	0.111–0.122
Upper-middle (r)	1.000		
Source of water supply			
Unprotected water supply	1.043	0.000	0.614–0.675
Protected water supply (r)	1.000		
FP: family planning. Data presented as Odd Ratio (95% CI). Statistically significant at p < 0.05.			

Discussion

The study sets out to develop predictive model and to investigate modifiable risk factors for open defecation across households in Indonesia. The study observed that out of the 49,627 female respondents in the data, 14,138 (28.5%) were reported practicing open defecation. Modifiable risk factors associated with open human excrement disposal were place of residence, region of residence, household wealth quintile, and household's water supply. Of particular interest in this study is the unobserved household level variations in open defecation outcome. It is no doubt that the health and general wellbeing of household members depend heavily on the sanitary system in which they reside.

The present study supports previous studies that investigated open defecation in developing countries, especially in Africa (Njuguna, 2016; Osumanu, Kosoe and Ategeeng, 2019) and Asia (Spears, Ghosh and Cumming, 2013; McMichael, 2018) countries. The result of this study reveals that those household in rural areas, Java Bali, poor-poorest and utilizing unprotected water supply are linked with increased probabilities of open human excrement disposal. This study reveals evidence that open defecation is relatively common in the rural area (Bhatt et al., 2019), despite SDG's target that suggest universal access to sanitation. A study conducted by Jain et al. (2020) reaffirmed that 69% of households in rural Bihar, India did not own a latrine in 2011 (Jain et al., 2020). Majority of poor households cannot build a septic tank toilet and without financial and technical support (Abebe and Tucho, 2020). Open defecation practice contributes to and increased jeopardy of infected, gastrointestinal, respiratory, neurocognitive, and psychological diseases (Macleod et al., 2019).

All these variables are related to poverty and limited access of health. The practice of open defecation may result in morbidity and mortality as well. Also, increase in open defecation could result in lack of productivity of household members as morbidity level within household increased (Thakur et al., 2018). Open defecation has caused Kenya loses \$88 million per year for health care, medicines, and treatment of their population (Abebe and Tucho, 2020). Furthermore, open defecation has caused in the loss of several productive working days (Njuguna, 2016). Open human excrement disposal also increases school absence, which lead to low academic achievement, failure to pass classes, increase drop-out rates, and delays in social improvement (Muluneh, Hailu and Alemu, 2020). The abstinence of toilet causes many women to walk long distances from their home to find isolated-unexposed places to dispose, cope their menstrual issues which causes them exposed to encounter verbal, physical and sexual violence (Saleem, Burdett and Heaslip, 2019). The discriminating anxiety, embarrassment and weakness are prevalent in the girls and women of countries where open defecation still occurred (Saleem, Burdett and Heaslip, 2019).

A reduction in the likelihood of open defecation among wealthier families suggests that improving economic condition of households through community empowerment will improve the likelihood of household's healthy life issues, which is related to earlier studies (Cassivi et al., 2020). This is predicted since advancements in economic level of household will lead to better sanitary system and healthier life of the parents, their children and the community (A A Cronin et al., 2017). For instance, upper-middle households have higher privileges to evolve better sanitation and water supply facilities for their households' members needs, particularly employment of protected water supply practices which in turn

will result in better health outcomes for both parents and their children (Aluko et al., 2018). Thus, the wealth condition of households could modify the utilization of curative health services (McCullough and Jonathon P Leider, 2017). The expected finding that the risk of open defecation decreased with increase in the wealth quintile in household, which is consistent with previous studies (Smith et al., 2015). Java-Bali's residences have increased risk of open defecation compared to outer Java-Bali residences.

This study is consistent with previous findings that high density of Java-Bali islands is correlate with increasing numbers of home-less families and influences their health outcomes particularly in open defecation issues (Cameron, Olivia and Shah, 2019). In fact, high-economic gap in Java-Bali areas largely influence the socio-economic resources and health conditions of populations at the local, regional and national levels (Suparmi *et al.*, 2018).

This study is persistent with earlier findings that high density of Java-Bali islands is correlate with increasing numbers of home-less families and influences their health outcomes particularly in open human excrement disposal issues (Odagiri et al., 2017; Cameron, Olivia and Shah, 2019). In fact, high-economic gap in Java Bali areas largely influence the socio-economic resources and living conditions of populations (Suparmi *et al.*, 2018) In country, there is a continual regional gaps in the distribution of socio-economic resources, particularly health care delivery, health services and wealth among the vulnerable and the poor households with inadequate health services and poor living conditions of households (Hosseinpoor et al., 2018). The likelihood of open human excrement disposal decreased among urban households compared to their rural counterparts (Boisson et al., 2014). A plausible explanation could be that urban households are more likely to earn more economic resources, that is very crucial to develop healthy sanitation unlike their rural counterparts (Boisson et al., 2014; Sara and Graham, 2014; Bhatt et al., 2019).

This study used the 2017 IDHS that is a nationally representative population-based study on household which contain an immense sample size in 34 provinces of Indonesia, which had been selected randomly. Hence, the findings of this study can be generalise to the Indonesian households and to other similar populations. The study's limitation is its potentially recall bias and social desirability to declare the actual practice of open defecation due to self-reporting measurement. Nevertheless, due to the cross-sectional nature of the study, this finding is incapability to measure fundamental consequences of open defecation. Other socio-cultural nor economic habituate of households, such as cultural beliefs, could be associated with open defecation. Furthermore, there are deficient data on some crucial variables such as working status, hence, were not included in the analysis.

Conclusion

The unseen of open defecation has been acknowledged as a decisive public health issue in Indonesia. This study has emphasised crucial strategies for eliminating open defecation in the country through providing healthy sanitary system and increasing access to clean water supply. Eliminating open defecation has been an urge to decrease the spread of intestinal parasites and enteric pathogens to

combat the child morbidity and mortality. Government and community should focus on increasing the economic level of household to increase the health status of household members as well as to improve the prevailing standard of living among Indonesians households.

Declarations

Author contribution. DKI contributed to the initial idea, conception, analysis, writing and approved the final version of the manuscript and agreed to be responsible for the quality and accuracy of all parts of the work. WU contributed to the cleaning data, statistical analysis, interpretation of data result and agreed to be responsible for the quality and accuracy of all parts of the work.

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Funding. This research was funded by Badan Kependudukan dan Keluarga Berencana Nasional (BKKBN).

Ethics approval and consent to participate. Not applicable

Consent for publication. Not applicable

Availability of supporting data. Data are available on measure DHS website.

Conflict of interest. The authors declare no competing interests.

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