

ORIGINAL ARTICLE

Pregnancy Complications Associated with Household Wastewater Management

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ABSTRACT

Introduction: Household wastewater management significantly impacts the health of pregnant women. The improper disposal of unprocessed waste pollutes the environment and can lead to various diseases. Pregnant women are increasingly vulnerable to complications such as miscarriage, preterm birth, and low birth weight. This study aims to evaluate the effect of household liquid waste management on the prevalence of pregnancy complications.

Methods: An observational analytic methodology was employed, specifically a cross-sectional approach. The study employed a cross-sectional design with a total sampling method, involving 30 pregnant women who met the inclusion criteria and accessed maternal health services in Kalirejo Village between January and August 2024. Chi-square analysis investigated the association between household liquid waste management and pregnancy complications.

Results: The results revealed no statistically significant association (P -value = 0.269). The most common pregnancy complications reported were vaginosis (40%), followed by bleeding (13.3%), spontaneous abortion, and septicemia (10%). Additionally, the study found that proximity to healthcare facilities and environmental health measures did not significantly affect pregnancy complications. **Conclusion:** The research site demonstrated adequate liquid waste and hygiene management. However, illness was more prevalent among residents living near rivers. Consequently, professionals and environmental advocates should implement regular educational programs to mitigate river pollution by addressing the actions of river polluters. Enhanced collaboration between government and community is crucial to reducing pollution and restoring effective preventive measures.

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INTRODUCTION

The environment plays a crucial role in shaping public health outcomes (1,2), serving as the foundation for healthy living conditions (3). Among the key environmental determinants are access to clean water, proper sanitation, and safe waste disposal, all of which are essential for preventing disease and promoting well-being (4,5). However, in many low and middle income communities, inadequate household liquid waste management remains a persistent issue (6). Untreated greywater from kitchens, bathrooms, and laundry is often discharged directly into the surrounding environment without proper processing (7). This practice not only contributes to environmental degradation but also heightens the risk of waterborne and hygiene-

related illnesses (8). Global attention to this issue has increased in recent years (9). Recognizing the vital link between environmental conditions and health (10), the Sustainable Development Goals (SDGs) highlight the need for improved water quality, sanitation, and waste management (11). Given this context, inadequate household wastewater management poses risks not only to environmental sustainability but also to human health (12). The discharge of untreated greywater containing pathogens, chemicals, and organic matter into the environment can degrade ecosystems (13) and reduce access to clean water (14), both of which are vital for safeguarding vulnerable populations (15). For pregnant women, such environmental conditions increase the likelihood of exposure to harmful contaminants, thereby heightening the risk of adverse maternal health outcomes (16,17). Hence, examining how domestic liquid waste practices influence maternal health is essential to inform targeted, context-specific, and sustainable public health strategies.

Prioritising the welfare of mothers is essential for the holistic welfare of society. The well-being of pregnant women not only impacts their own health but also has consequences for the health of the developing baby and future generations (18). Despite growing environmental concerns, appropriate household wastewater treatment remains crucial for safeguarding maternal and fetal health (17). Kalirejo Village, in Pesawaran Regency, Lampung Province, Indonesia, faces environmental challenges similar to those in other rural communities, particularly in managing domestic wastewater (19). Poor household wastewater management practices (20) such as the direct disposal of greywater and sewage into the environment (21) can expose pregnant women to harmful substances, including pathogens, heavy metals, and endocrine-disrupting chemicals (22). Exposure to such contaminants during pregnancy has been linked to complications such as preterm birth, low birth weight, still birth, spontaneous abortion, neonatal death and impaired fetal development (23). A comprehensive study of waste management's impact on maternal health (24) would improve community understanding of health issues and lay the groundwork for effective treatments (25). This study investigates how household wastewater treatment affects pregnant women. Gaining an understanding of factors that affect pregnant women and unborn babies helps improve public health and create a healthier, more sustainable environment.

MATERIALS AND METHODS

Research Design

This observational analytical study employs a cross-sectional methodology and a total sampling strategy. The research was conducted at the Kalirejo Village Public Health Center (Puskesmas Desa Kalirejo), Pesawaran Regency, Lampung Province, Indonesia, between January and August 2024. The sample comprised all pregnant women who were at least 20 weeks pregnant during the study period and met the inclusion criteria. A total of 30 participants were included in the final analysis. The inclusion criteria were: pregnant women who resided in Kalirejo Village, had a history of using maternal health services in the area, and provided informed consent to participate in the study.

Research Instrument

The study utilised questionnaires, direct interviews, observations, and medical record data obtained from the Kalirejo Village Public Health Center (Puskesmas Kalirejo), which served as the primary health facility for all respondents. All pregnant women involved in the study routinely accessed antenatal care, childbirth services, and other maternal health services at this health center. Accordingly, medical record data were retrieved from this same facility to ensure data consistency and accuracy. The questionnaire assessed household waste management, pregnancy-related variables, and pregnancy complications. The development of

the questionnaire was based on the Regulation of the Minister of Health of the Republic of Indonesia Number 3 of 2014 concerning Community-Based Total Sanitation, which outlines indicators related to community and household sanitation behavior.

The data collection instrument in this study was a structured questionnaire consisting of three sections. The first section evaluated household liquid waste management practices and consisted of 30 dichotomous (Yes/No) items. The indicators were derived from the Ministry of Health Regulation No. 3 of 2014 concerning Community-Based Total Sanitation. This section assessed drainage systems for waste from clothes washing, dishwashing, food preparation, bathing, toileting, floor mopping, and vehicle cleaning. It also addressed the disposal methods used, the condition of bathroom puddles, and the type and state of toilets. No validity or reliability testing was conducted for this section, as it consisted of factual, observable conditions rather than perceptual constructs.

The second section addressed environmental and behavioral factors that may contribute to pregnancy complications. It included six items with 5-point Likert-scale responses (1 to 5), covering the following areas: availability of clean water; hand-washing behavior; household waste management; defecation behavior/toilet use; drinking water and food management; frequency of visits to ANC/integrated health post (posyandu)/pregnancy classes. This section underwent statistical testing for validity and reliability. Pearson’s product-moment correlation showed that five of the six items were significantly correlated with the total score ($r = 0.486\text{--}0.761$, $p < 0.01$), indicating acceptable item validity. One item (clean water availability) had a weak and non-significant correlation ($r = 0.138$, $p = 0.466$), but was retained due to its contextual and analytical importance. Reliability testing using Cronbach’s Alpha yielded a coefficient of 0.380, indicating low internal consistency. Nonetheless, the instrument was considered acceptable for use in exploratory research.

The third section documented whether participants had experienced any of ten types of pregnancy complications, including bleeding, urinary tract infections (UTIs), premature rupture of membranes (PROM), septicaemia, miscarriage, vaginosis, low birth weight (LBW), preterm birth, stillbirth, and hypertension (26–32). Responses were coded dichotomously (Yes/No). No validity or reliability testing was performed for this section, as it relied on clinical events confirmed through medical history or self-report.

All statistical instrument tests were conducted using responses from the main study participants. No separate pilot test location was used for any part of the questionnaire, due to the specificity and limited size of the study population.

Data Analysis

We employed statistical software to analyse the data. This study used univariate and bivariate statistical analyses. The frequency distribution of household liquid waste and complications was determined using univariate analysis. A p-value greater than 0.05 indicates no statistically significant link between research variables. Our alternative test was the Mann-Whitney test.

Ethical Clearance

This study was approved by the Research Ethics Committee, Faculty of Medicine Universitas Lampung, No. 3451/UN26.18/PP.05.02.00/2024.

RESULTS

Most survey respondents (83%) were pregnant women of reproductive age. The study included women aged 22 to 47, with an average of two pregnancies. The most common educational attainment was high school or vocational high school, with 47% of respondents. Junior high, diploma (D3), and primary school were the next most frequent levels of schooling. Housewives comprised 83% of the sample, followed by midwives at 17% (Table I).

Univariate analysis was conducted to determine the frequency distribution of each variable, as presented in Table II.

According to Table II, 56.7% of households in Kalirejo Village have inadequate liquid waste management, while 43.3% manage their household wastewater adequately. This indicates that more than half of the households still require improvement in their wastewater management practices. Overall, the condition of household liquid waste management in the village remains a concern.

Figure 1 illustrates the specific distribution of pregnancy

Table I. Characteristics of research respondents

Respondents Characteristics	Percentage (%)
Age	
≤35 years	83
>35 years	17
Education Level	
Primary School	7
Junior High School	27
Senior High School	47
Diploma 3	20
Occupation	
Midwife	17
Housewife	83
Average Number of Pregnancies	2

Table II. Distribution of Research Samples on Independent/Free and Dependent/Bound Variables

Variables	Total	
	Frequency (n)	Percentage
Household waste-water manage-ment	≤ 25 (Inadequate)	17
	>25 (Adequate)	13
Other factors influencing pre-gnancy complica-tions*	≤ 25 (Inadequate)	13
	>25 (Adequate)	17
Pregnancy com-plications**	Yes	15
	No	15

*The household wastewater management and pregnancy issues survey has a maximum score of 30. Scores under 25 are ‘inadequate’, while scores over 25 are classified as ‘sufficient’.
**The questionnaire includes 10 categories of pregnancy issues. Respondents who have experienced any pregnancy issues are marked as “yes/ever,” while those who have never encountered such issues are marked as “never/no.”



Figure 1: Distribution of pregnancy complications among respondents (n=30)

complications among the respondents. Vaginitis emerged as the most prevalent condition, affecting 40% of the participants. None of the respondents reported experiencing hypertension, resulting in a 0% incidence rate. As defined by the research questionnaire, vaginitis includes symptoms such as vaginal discomfort and the presence of a fishy-smelling white or grey discharge.

A bivariate analysis was conducted to assess the correlation between household wastewater management and pregnancy complications, as well as the influence of additional factors on pregnancy difficulties. The results of this analysis are shown in Table III.

Table III. Results of chi-square analysis on each research variable

Variables	Pregnancy Complications			
	Pearson chi-square	df	P-value*	Phi
Household waste-water management	1.222	1	0.269	0.202
Other factors influencing pregnancy complications	3.394	1	0.065	0.336

*significance value $\alpha < 0.05$

The chi-square analysis in this study is deemed valid as no expected count values were found to be less than 5. The results (Table III) reveal that there is no statistically significant correlation between household wastewater management and pregnancy complications. Similarly, no significant association was identified between other factors influencing pregnancy and the occurrence of complications. The respective P-values are 0.269 and 0.065. The influence of the independent variable on the dependent variable, represented by the effect size, is shown in the phi column. Household wastewater management accounts for 20.2% of pregnancy complications, while other factors contribute to 33.6%. These other factors exert a stronger influence than household wastewater management.

DISCUSSION

Among the participants in this study, 83% were within the productive age range (≤ 35 years). The optimal age range for women to conceive is between 20 and 35 years (33). Alternative sources indicate that the optimal age range for pregnancy is between 25 and 35 years. The mother's age influences foetal and infant development. Early pregnancy carries an elevated risk of complications, including anaemia, preterm birth, low birth weight, and stillbirth. Conversely, mothers who conceive at an advanced age, specifically over 35 years, face an increased likelihood of encountering medical and obstetric issues. However, they may be psychologically better prepared for the responsibilities of raising and nurturing a child. Additionally, women of advanced maternal age experience a higher rate of maternal death. Effective prenatal care can mitigate age-related pregnancy problems (34). The World Health Organisation (WHO) advises pregnant women to undergo focused antenatal care (FAC) at least four times during pregnancy. According to Regulation of the Minister of Health Number 52 of 2017, focused antenatal care is effective in preventing the transmission of syphilis, HIV, and hepatitis B from mother to child (35).

The group was led by mothers who had completed high school or vocational high school, representing 47% of the study's respondents. According to Mufida's (2020) study, high school-educated mothers seek prenatal care at healthcare institutions, which helps manage and resolve major pregnancy complications. There is a significant correlation between a mother's level of education and her commitment to undergoing prenatal care screenings in the final trimester of pregnancy (36). Among the participants, 83% are stay-at-home mothers. Previous research has linked the mother's occupation to higher-risk pregnancies. We advise pregnant women to maintain a healthy lifestyle and attend antenatal care to detect high-risk pregnancies (37).

Table II displays the allocation of study samples based on

independent and dependent variables. The independent variables encompass wastewater management and other elements influencing pregnancy, whereas the dependent variable is pregnancy complications. Figure 1 elucidates the various pregnancy issues encountered by the participants. Respondents frequently identified vaginosis as the most common pregnancy problem. Bacterial vaginosis (BV) is prevalent among primigravidae, particularly in younger individuals. Vaginosis was diagnosed in 17.9% of the 52 pregnant women in the study, with 50% of those developing the condition during the second trimester. There is a correlation between personal hygiene practices and vaginosis. Thus, pregnant women require targeted health education to prevent BV (38). Bacterial vaginosis (BV) occurs due to an imbalance in the natural vaginal flora, leading to changes in bacterial composition and abundance. BV increases susceptibility to additional sexually transmitted infections (STIs), as it facilitates the entry of other vaginal infections into the upper genital tract. This condition results in enzymes that weaken the body's white blood cells' ability to fight infection and leads to an increased release of endotoxins, which stimulate the production of cytokines and prostaglandins in the vagina (39–41).

Pregnancy-related bleeding was cited by 13.3% of respondents as the second most common issue. French et al. (1999) found that early prenatal screening detected infections in up to 60% of women experiencing first-trimester bleeding. Haemorrhaging during the initial trimester was correlated with the incidence of bacterial vaginosis. Preterm birth was associated with an increased risk among mothers with bacterial vaginosis who had experienced bleeding during the first trimester of their pregnancy. Systemic antibiotic therapy has effectively reduced the occurrence of preterm delivery in mothers with bacterial vaginosis who did not suffer from bleeding in the first trimester. However, similar therapy showed no significant impact on mothers who experienced both bacterial vaginosis and bleeding during the first trimester. In this study, preterm birth was classified as a distinct group of prenatal complications. The presence of bleeding and bacterial vaginosis in mothers may affect preterm deliveries. Consequently, it is essential to conduct regular antenatal care workshops to guide sanitation and cleanliness to expectant mothers. Vaginosis is the most frequently cited pregnancy complication by respondents. Bacterial vaginosis (BV) is prevalent among young pregnant women, particularly during their initial pregnancy. Vaginosis was diagnosed in 17.9% of the 52 pregnant women surveyed. Approximately 50% of pregnant women with bacterial vaginosis experienced the condition during the second trimester. Personal hygiene practices have been associated with vaginosis. Therefore, it is imperative to implement targeted health education programmes for pregnant women to reduce the incidence of BV (38). Bacterial vaginosis (BV) results from an imbalance in

the indigenous vaginal flora. Indicators of bacterial vaginosis include alterations in the general composition and prevalence of bacteria. BV increases susceptibility to other sexually transmitted infections (STIs) by facilitating the entry of additional vaginal infections into the upper genital tract. BV also leads to the secretion of enzymes that diminish the effectiveness of host leukocytes in combating infection, alongside an increased release of endotoxins that stimulate the production of cytokines and prostaglandins in the vagina (39–41).

Liquid waste management does not affect maternal pregnancy difficulties in Kalirejo Village (P-value = 0.269), according to bivariate analysis (Table 3). These findings support Sari et al. (2024), who found no effect of waste management on maternal mortality. In Kalirejo Village, 13 of 30 households have well-functioning liquid waste disposal systems, while the remaining 17 homes achieve adequate waste management. Most women reported having a waste disposal tank or public gutter in their homes. According to Widhi et al. (2021), the majority of residences (63.1%) had waste disposal systems and wastewater facilities installed; nevertheless, the quality of these facilities was poor. In line with this study, several respondents mentioned that liquid waste and debris were often dumped into rivers. The main reason for discarding rubbish in rivers is the improper placement of waste channels. As a result, individuals use the river as a convenient and economical alternative for waste disposal. This behaviour occurs because the public is unaware of the long-term effects of river pollution. The garbage in the river generates an unpleasant odour, pollutes the air, alters the area's appearance, and promotes the proliferation of disease-carrying organisms. The government must implement aggressive, environmentally friendly waste management strategies. As waste disposal education, knowledge, and community behaviour are interconnected, regular counselling and mentoring sessions to enhance community competency in this area are essential (45). Table III indicates the effect size as 20.2%. This implies that inadequate liquid waste management accounts for 20.2% of pregnancy issues. However, this negative impact can be mitigated by improving the knowledge and education of the local population. This improvement will benefit the community by enhancing behavioural patterns related to liquid waste management (45).

Family hygiene habits such as hand washing and toilet use greatly influence community waste disposal patterns (44). Therefore, this study included supplementary variables affecting maternal health. These variables encompass environmental health aspects such as clean water availability, food handling, and solid waste management, as well as hand hygiene and defecation/toilet habits. The research instrument was a Likert-scale questionnaire assessing behavioral and environmental factors related to pregnancy complications. Validity testing using Pearson's correlation showed that five

of six items had significant correlations with the total score ($r = 0.486$ – 0.761 ; $p < 0.01$), indicating acceptable construct validity. One item (clean water availability) had a low and non-significant correlation ($r = 0.138$; $p = 0.466$), but was retained due to its contextual relevance in the rural study setting. Reliability testing yielded a Cronbach's alpha of 0.380, indicating limited internal consistency. However, this was considered acceptable for exploratory analysis in community-based field research.

Bivariate analysis using chi-square tests revealed no statistically significant association between household wastewater management and pregnancy complications ($p = 0.269$; $\phi = 0.202$), nor between composite environmental-behavioral factors and complications ($p = 0.065$; $\phi = 0.336$). Although the latter approached statistical significance and showed a moderate effect size, over half of the respondents (56.7%) were categorized as having inadequate hygiene, waste management, and health service use, suggesting that these practices alone may not account for the high incidence of pregnancy complications (50%).

Field observations support this interpretation. Despite self-reported adequate individual hygiene behaviors, many respondents resided near a river into which household waste was routinely discharged. Open drains and unmanaged greywater around dwellings likely increased environmental exposure to pathogens, diminishing the protective effect of personal practices. These structural conditions may help explain the lack of significant statistical associations.

Additionally, potential response bias such as social desirability may have influenced questionnaire responses, particularly regarding health behavior. The relatively small sample size ($n = 30$) may also have limited the power to detect statistical significance. The high rate of complications may instead be linked to unmeasured risk factors, including maternal anemia, poor nutritional status, high parity or short interpregnancy intervals, psychosocial stress, limited access to emergency obstetric care, and exposure to endemic infections. These findings suggest the need for integrated maternal health interventions that address not only behavior change but also environmental sanitation, infrastructure, and health system access.

The personal hygiene of pregnant women and the environmental cleanliness in Kalirejo Village are commendable. However, improvements are needed in achieving trash-free living conditions and in preventing bacterial vaginosis (BV). Pregnancy is often associated with an increased susceptibility to infection. Personal hygiene is essential for food safety and for preventing disorders related to microorganisms. This primarily includes handwashing before handling food. Proper hand hygiene involves washing with soap and water for

20 seconds (46). Personal hygiene promotes food safety and overall health. Illnesses related to environmental cleanliness can be reduced through proper hygiene measures, including handwashing and effective waste disposal. Rah et al. (2015) found that improving sanitation and hygiene reduces stunting in Indian villages. Anaemia, infectious illnesses, and malnutrition during pregnancy heighten the risk of low birth weight (LBW) and stunted growth in offspring. This study indicates that the incidence of low birth weight (LBW) is 6.7%. Medhin et al. (2010) found that maternal health during pregnancy strongly impacts birth and newborn outcomes. Postnatal growth is primarily influenced by environmental factors (44).

The findings of this study underscore the need for integrated maternal health strategies that go beyond individual behavior change and address structural determinants such as environmental sanitation, waste infrastructure, and access to comprehensive antenatal care. Public health programs should incorporate targeted health education for pregnant women on hygiene and sanitation, particularly in rural areas with inadequate waste management. Moreover, local governments must prioritize the development and maintenance of environmentally sound wastewater disposal systems to reduce community-level exposure to pathogens. These efforts can complement maternal health interventions and potentially reduce pregnancy complications associated with poor environmental conditions.

This study has several limitations. First, the internal consistency of the second section of the questionnaire, which assessed environmental and behavioral risk factors, was low (Cronbach’s Alpha = 0.380). Although one item (clean water availability) showed weak validity, it was retained due to its contextual relevance and its statistical association in the bivariate analysis. Further refinement and validation of this section are recommended for future research. Second, only Section 2 underwent validity and reliability testing, as it measured perceptions and behaviors using Likert-scale items. Sections 1 and 3 consisted of factual, observable variables and clinical outcomes, and were therefore not subjected to psychometric evaluation. Third, no pilot testing was conducted in a separate test location for any part of the questionnaire. All validity and reliability assessments were carried out using responses from the main study participants in Kalirejo Village. While this approach was necessary due to the limited sample size and context-specific nature of the study population, it may limit the generalizability of the findings.

In addition, environmental exposure variables such as proximity to open wastewater or rivers, and community-level waste disposal behavior, were not quantitatively measured, although field observations suggested these factors may influence maternal health outcomes. Future research should incorporate these structural and

environmental dimensions more systematically. Finally, the cross-sectional design of this study limits the ability to draw causal inferences. Longitudinal or mixed-method studies are recommended to explore causal pathways between environmental conditions and maternal health outcomes over time.

CONCLUSION

This study found that while household waste management in Kalirejo Village is generally functional, gaps in sanitation quality and personal hygiene practices remain. Notably, 43.3% of pregnant women demonstrated limited understanding of personal hygiene, with bacterial vaginosis (40%) and early pregnancy bleeding (13.3%) emerging as the most common complications. Although household liquid waste management was not statistically associated with pregnancy complications, a moderate effect size suggests potential indirect impacts. Therefore, integrated community interventions focusing on hygiene education and improved environmental sanitation are recommended to support maternal health outcomes.

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