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THE ADEQUACY OF HOUSEHOLDS SANITATION LEVEL IN THE CITY OF JAKARTA: A MICRODATA ANALYSIS FROM SUSENAS 2017

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ABSTRACT: As a metropolitan city, Jakarta faces the problems of uncontrolled migrant populations and limited housing availability. This results in the uncontrolled growth of organic settlements with a lack of adequate sanitation facilities. Furthermore, open defecation in public spaces is still practiced in some areas. Using the multinomial logistic regression method, this research aims to identify the adequacy of household sanitation in Jakarta, focusing on human waste disposal facilities in households. The dependent variable (adequacy of sanitation facilities) is divided into three categories; adequate private sanitation (used by one household), adequate shared sanitation (used by multiple households), and inadequate sanitation. This research also aims to identify the correlation of household characteristics as predisposition factors towards the trends in the sanitation adequacy. The household characteristics analyzed in this study are income, employment status, level of education, marital status, gender, number of household members, and migrant status. This research uses microdata from the 2017 National Socio-Economic Survey. It was found that 85.64% of the household sanitation sampled in the research is adequate (of which 68.81% are adequate private sanitation and 16.83% adequate shared sanitation), and 14.36% were classified as inadequate. Sanitation adequacy is highly correlated with long term residency, high education, household members ≥4 people, unemployed, married, female-headed household, and high expenditure. The government can utilize those predisposing factors in planning the design policies and interventions on sanitation to lower the percentage of households with inadequate sanitation.

Keywords: Adequacy level, Households, Sanitation, Jakarta

1. INTRODUCTION

Jakarta as a metropolitan city has a massive physical development that is a very strong magnet for migrants seeking a better life in this city. Therefore, Jakarta's population growth is strongly influenced by the influx of migrants. According to the 2019 statistic [1], the average population of Jakarta in the last two years has increased by 247 people every day or equal to 10 people every hour. This data illustrates the exponential population growth of Jakarta, which increases housing needs. As a result of the housing scarcity, some low-income migrant resorts to organic settlements. These organic settlements, with dense and slum characteristics, and also poverty, are often labeled as an urban-diseases.

Most households in Jakarta still use traditional latrines in their sanitation facilities. However, Jakarta's Health Office reported that in January of 2019, there are 115,185 households who are still practicing open defecation [2], or latrines that dump feces directly to the environment.

Lack of sanitation facilities and the practice of open defecation are strongly related to human and environmental health. It can cause water and land pollution, and increase the infection rate of various diseases such as diarrhea. On the other hand, this also results in increased economic burden for cities to address public health problems.

These sanitation issues, have been declared as one of the strategic issues in development in Indonesia [4]. Until now, Indonesia is still struggling to achieve the universal access to sanitation as mandated by the United Nation's 6th Sustainable Development Goals (SDGs). Nevertheless, Jakarta targeted 100% proper and safe sanitation by the year of 2024 [5], even when there are a variety of obstacles to be faced with.

The main objective of this research paper is to map the adequacy of household sanitation in Jakarta, in order to achieve the SDG's target as well as the regional targets. This research also aims to identify the influence of household characteristics on the adequacy of household sanitation. This study focuses on household sanitation facilities for feces disposal in Jakarta, using microdata from the 2017 National Socio-Economic Survey.

2. LITERATUR REVIEW

Human beings can only be healthy in a healthy

environment [6]. Dahlgren and Whitehead argued that environmental health is an important component of public health, where the individual lifestyle to the socio-economic and cultural environment takes part as major determinants [6]. It covers all aspects of human behavior in relation to the living environment, with the aim of improving and maintaining the highest level of human health by modifying social and environmental factors. On the other hand, environmental health is in actuality a byproduct of human activities. Therefore, human activities are keys to the public health.

According to Lawrence Blum, there are four factors that influence public health: 1) environmental factors (physical, biological and socio-cultural), 2) behavioral factors (attitudes and lifestyles), 3) health service factors, and 4) heredity. Green divided the determinants of health behavior into three main factors consisting of predisposing factors, enabling factors, and reinforcing factors [7].

One of physical component that supports the environmental health is the availability of adequate sanitation in households. According to WHO-Unicef Joint Monitoring Program (JMP), the criteria for global measurement of sanitation services known as the sanitation ladders consists of safely managed sanitation, basic sanitation, shared sanitation, unimproved sanitation, and open defecation [3]. The sanitation service refers to the management of excreta from facilities including emptying and transporting process of the excreta from the facilities. This sanitation issues have been declared as The United Nation's 6th Sustainable Development Goal. The goal targets to achieve universal access to basic sanitation services and progressively improving sanitation to safely managed sanitation by the year of 2030. The target can be achieved if all levels of society have healthy sanitation behavior.

According to the theory of Thoughts and Feeling by WHO [8], there are four main factors that shape a person's behavior, one of which is a resource reason which includes facilities, money, time, energy. Resources can have a positive or negative effect on human behavior. On the other hand, the availability of resources is strongly influenced by three reasons: 1) the level of understanding and consideration (the presence of knowledge, beliefs, and attitudes), 2) influence from important people in their lives, and 3) culture. These factors shape the way of life in urban communities.

The Function theory expressed by Katz [8], considers that changes in individual behavior can occur when individuals feel a need. The need revealed the ability of individuals to deal with the surrounding environment. On the other hand, individual behavior also depends on the individual's character, which is shaped in the household.

From the theories explained above, we can further hypothesize that an individual's decision to provide adequate sanitation is influenced by the individual's resources (especially financial), knowledge, and need.

Household income illustrates the economic condition and welfare of the household, the ability to fulfill all basic and non-basic needs, and the ability to maintain their standard of living. Household welfare can be assumed to be in line with the proportion of household expenditure which is spent on non-food needs [9].

Household income is also an important predictor in determining the ability of households to adopt an adequate sanitation facility. There have been numerous research that found a positive correlation between latrine ownership and high socio-economic status [10,11]. Those research found that rich households have a strong will to build their own latrines, even a latent demand for improving sanitation comes from them [12]. In addition, poor households tend to prioritize the fulfillment of basic needs above the procurement of adequate sanitation facilities [13,14]. Poverty has also been proven to reduce the demand for sanitation [15-17], and that individuals with low-income tend to not use latrines [18].

Migration status has a potential correlation in improving household welfare [21] and social status [20]. Most migration is done to increase the current value of the expected lifetime income [22]. Migrants in the new urban environment have better working conditions and quality of life. They are usually women, well educated, older, living in longer migration periods [23], unmarried, and have informal jobs [20].

Education and employment status of a household are reliable indicators for household welfare [19]. Employment provides opportunities to gain income, while education is a way to develop knowledge and get better employment. However, individuals with informal employment status in Jakarta has been found to have higher welfare level due to migration [20].

Education has a significant influence on the use of household latrines [18,16]. Household heads with higher education have more knowledge of healthy living [14]. A better understanding of the health impact of poor sanitation is a driving factor for investment in adequate sanitation, which declines the trend in open defecation [27].

Gender also influences sanitation preferences. Numerous research has shown that females tend to have high preferences for the health and non-health benefits of sanitation such as hygiene and privacy [10,25-27]. Research shows that women have an important role in determining sanitation choices and are able to persuade their partners to invest in

adequate sanitation facilities [25].

Household size also determines the needs for sanitation facilities, especially the size of a septic tank. Commonly, households with four or more household members have a higher chance of having a latrine [28].

Efforts to improve access to sanitation facilities at the household level is expected to reduce the environmental and economic burden of a city. Indirectly, it can improve welfare, helps reduce poverty levels by reducing health costs, productivity gains associate morbidity and mortality, increase gender equality, environmental sustainability, and water resource [12,30]. Ultimately, sanitation adequacy can improve health and save lives.

3. METHODS

This research uses the microdata from the 2017 National Socio-Economic Survey which is conducted by The Indonesia's Central Bureau of Statistics. The survey, also known as *Susenas*, do annual collection of data relating to the socio-economic conditions of the community, including health, education, fertility, family planning, housing and other socio-economic conditions in all provinces in Indonesia. Data and indicators from *Susenas* have been widely used and are seen as important pieces of evidence useful for planning, monitoring, and evaluating government development programs. The 2017 survey sampled 3,483 households spread in six regions in Jakarta.

This research uses a quantitative approach to fulfill the research aims. Descriptive analysis is performed for data analysis using a cross-tabulation method, to map the adequacy of household sanitation in Jakarta. While the inferential analysis is performed using a multinomial logistic regression method, to identify the influence of household characteristics on the adequacy of household sanitation.

The research begins with examining the influence of resources (illustrated by the level of income and employment status of households) on sanitation adequacy. The research then examines the level of understanding (illustrated by the level of education), as well as other variables (marital status, gender, household size and migration status of households) and their correlation to sanitation adequacy.

The dependent variable in this research is the adequacy of household sanitation, adopted from sanitation ladder of The JMP which consists of safely managed sanitation, basic sanitation, shared sanitation, unimproved sanitation, and open defecation [3]. The sanitation ladder was simplified into three categories (Fig.1) as follows: (1) level 0: inadequate sanitation (unimproved sanitation and open defecation), (2) level 1: adequate shared sanitation (shared sanitation), (3) level 2: adequate private sanitation (safely managed sanitation and basic sanitation).

Fig.1 Categories of the simplified sanitation ladder

The independent variables are the predisposing factors that consist of household income (measured by expenditure per-capita (*exp_cap*)), employment status (*workstat*), education (*educ*), marital status (*maritalstat*), gender (*gend*), number of household member (*art*), and migration status (*risenmig* and *lifetimemig*). Pearson correlation method is used to define the correlation between each of independent variables. The result indicates that there is no multicollinearity between independent variables.

3.1 Research Model

The dependent variables are treated in multinomial forms with three categories that do not have a natural sequence. The level labeled 0 (Y=0) set as the reference category that forms the basis of the logit function to compare other categories (Y=1 and Y=2) against Y=0. Modification of the variables results in statistical modeling as follows:

$$\ln\left(\frac{P_{shared}}{P_{inadequate}}\right) = \beta_0 + \beta_1 exp\_cap + \beta_2 workstat + \beta_3 educ + \beta_4 maritalstat + \beta_5 gend + \beta_6 art + \beta_7 risenmig + \beta_8 lifetimemig + \varepsilon$$

$$ln\left(\frac{P_{private}}{P_{inadequate}}\right) = \beta_0 + \beta_1 exp\_cap + \beta_2 workstat + \beta_3 educ + \beta_4 maritalstat + \beta_5 gend + \beta_6 art + \beta_7 risenmig + \beta_8 lifetimemig + \varepsilon$$

with:

$P_{inadequate}$ = opportunity for inadequate sanitation category

P_{shared} = opportunity for adequate shared sanitation category

$P_{private}$ = opportunity for adequate private sanitation category

Iteration log shows how fast the model is converged. The log likelihood value (-2,546.679), Chi-square likelihood ratio of 674.84 with p-value <0.0001, prob>chi2 value <0.05, Pseudo R2 value of 11.7%, and a large sample size shows that the model describes the quality of household sanitation facilities adequately. Partial effect was used in this research, which estimated by the Average Marginal Effect (AME), to obtain additional probabilities in each dependent variable.

4. RESEARCH FINDINGS

The research findings in Table 1 and Figure 2 shows the distribution of household sanitation adequacy in six regions of Jakarta. This research indicates that 85.64% of the sampled households in Jakarta owned adequate sanitation, of which 68.81% are private sanitation and 16.83% are shared sanitation. Meanwhile, the rest of the households (14.36%) owned inadequate sanitation.

Table 1 Distribution of Households Sanitation Adequacy Level in Jakarta

Adequacy Level		Region						Total	
		Thousand Island	South Jakarta	East Jakarta	Central Jakarta	West Jakarta	North Jakarta	%	n
Inadequate		38.03	13.28	10.57	18.31	14.18	19.04	14.36	271,957
Adequate-Shared		2.99	11.86	10.48	34.43	20.9	17.62	16.83	318,821
Adequate-Private		58.98	74.87	78.95	47.27	64.92	63.34	68.81	1,303,538
Total	n	4,917	390,757	523,285	185,535	441,305	348,517	-	1,894,316
	%	100	100	100	100	100	100	100	-

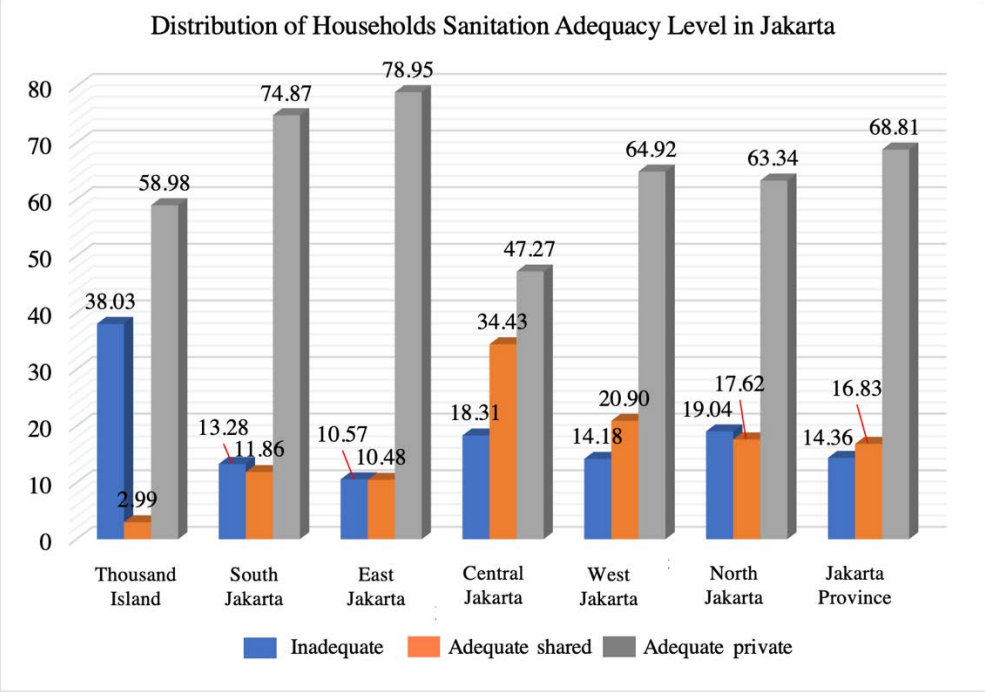

Fig.2 Distribution of Households Sanitation Adequacy Level in Jakarta

East Jakarta has the highest percentage of adequate private sanitation (78.95%), Central Jakarta has the highest percentage of adequate shared sanitation (34.43%), and the Thousand Islands has the highest percentage of inadequate sanitation (38.03%).

This research found that households in East Jakarta tend to have the longest duration of stay, have a private home, with better financial ability. The households in Central Jakarta have a higher percentage of migrant households who live in rental houses. On the other hand, households in Thousand Islands district tend to have a longer duration of stay, have a private home, but have a lower financial ability.

Table 2 Summary of Descriptive Statistic

Dependent Var. / Independent Var.	Adequacy Level of Sanitation Facilities in Households				
	Inadequate	Adequate Shared	Adequate Private	Total	
				%	n
Gender					
Female	11.86	15.72	72.42	100	328,619
Male	14.88	17.06	68.06	100	1,565,697
Number of household member					
< 4 persons	16.00	27.10	56.90	100	865,327
≥ 4 persons	12.97	8.19	78.83	100	1,028,989
Marital status					
Not married	13.44	22.84	63.72	100	506,461
Married	14.69	14.64	70.67	100	1,387,855
Education					
Uneducated	20.36	18.67	60.98	100	148,999
Primary	21.40	19.08	59.52	100	330,771
Middle school	13.89	18.78	67.33	100	1,077,312
University	6.27	7.60	86.13	100	337,234
Employment status					
Unemployed	9.28	8.76	81.96	100	392,172
Informal	15.68	17.32	67.00	100	613,269
Formal	15.68	20.05	64.26	100	888,875
Expenditure per capita (Rp 100.000)	16,232	18,035	24,725	-	-
Recent migrant					
Non-migrant	14.02	15.20	70.78	100	1,811,487
Migrant	21.80	52.45	25.74	100	82,829
Lifetime migrant					
Non-migrant	13.22	11.87	74.91	100	826,159
Migrant	15.24	20.67	64.10	100	1,068,157

Table 2 shows the summary of the descriptive statistics in this research. It provides some initial insight into the household characteristics and its correlation to the quality of sanitation. The descriptive analysis result can be summarized as list below:

1. The independent variables with a strong influence on the private sanitation adequacy are (1) female-headed household (72.42%), (2) household member ≥ 4 people (78.83%), (3) married (70.67%), (4) college education (86.13%), (5) unemployed (81.96%), (6) high expenditure, (7) non-migrant recent (70.78%), and (8) non-migrant lifetime (74.91%).
2. While the inadequate sanitation is strongly related with the independent variables are (1) male-headed household (14.88%), (2) household member <4 people (16%), (3) married (14.69%), (4) low education / primary level (21.4%), (5) informal and formal sector (15.68%), (6) low expenditure, (7) recent migrant status (21.80%), and (8) lifetime migrant status (15.24%).

Table 3 shows the inferential analysis results of the significant relationship between research variables and the comparison within the adequacy of household sanitation. The inferential analysis results are in line with the descriptive results. The comparison result can be summarized in two point:

1. The variables which significantly influence the increase from inadequate to adequate shared sanitation category are household members <4 people (15%), formal employment status (11%), not married (10%), migrant lifetime (4%), and junior/senior high school education (1%). While gender, expenditure, and recent migrant status show no significant effect.
2. The variables which significantly influence the increase from inadequate to adequate private sanitation category are non-migrant recent (26%), higher level of education/university (20%), unemployment (18%), household members ≥4 people (16%), married (11%), female-headed (9%), and high expenditure (1%). The lifetime migrant status shows no significant effect.

Table 3 Summary of Multinomial Logistic Regression Analysis

Independent Variables	Adequate Shared Sanitation			Adequate Private Sanitation		
	Coef.	Std. error	Partial effect	Coef.	Std. error	Partial effect
Gender						
(0 = Female, 1 = Male)	0.17	0.23	0.06	-0.40**	0.21	-0.09
Number of household member						
(0 = <4 persons, 1 = ≥4 persons)	-0.90***	0.14	-0.15	0.48***	0.11	0.16
Marital status						
(0 = not married, 1 = married)	-0.54***	0.20	-0.10	0.37**	0.18	0.11
Education						
Primary (0 = uneducated, 1 = primary)	0.03	0.23	-0.00	0.04	0.18	0.01
Mid.sch (0 = uneducated, 1 = mid.sch)	0.56***	0.22	0.01	0.68***	0.17	0.08
Univ. (0 = uneducated, 1 = univ.)	0.50	0.32	-0.06	1.38***	0.25	0.20
Employment status						
Informal (0 = unemploy, 1= informal)	0.10	0.20	0.07	-0.75***	0.16	-0.13
Formal (0 = unemploy, 1= formal)	0.34*	0.20	0.11	-0.89***	0.16	-0.18
Expenditure per capita						
(Rp.100.000)	-0.01	0.01	-0.00	0.03***	0.00	0.01
Recent migrant						
(0 = non-migrant, 1 = migrant)	0.33	0.27	0.15	-1.30***	0.29	-0.26
Lifetime migrant						
(0 = non-migrant, 1 = migrant)	0.35***	0.13	0.04	-0.04	0.10	-0.04
_cons	0.03	0.27		0.97***	0.21	
Number of obs	3,483					
LR chi2(22)	674.84					
Prob > chi2	0.000					
Pseudo R2	0.117					
Log likelihood	-2,546.6791					

Note: *) significant at 10% ; **) significant at 5% ; ***) significant at 1%

3. DISCUSSION

This research found a statistical correlation between household characteristics with sanitation quality. In this research, longer duration of stay, a higher level of education, and unemployment status have a significant correlation with the high percentage of marginal effect to the adequate private sanitation category. When households have been living longer in Jakarta, it can be assumed that they can adapt to the urban environment and improve their standards of living. On the other hand, education (formal and informal) can catalyze this process of behavior change, especially in increasing the knowledge on the importance of adequate sanitation, as well as improving the chance to have a better job opportunity. On the other hand, the unemployment status does not describe poor financial status. The samples tend to have a good financial ability even though they are unemployed.

From further descriptive investigation, this research found a statistical correlation between some variables, as shown in Table 4 - Table 8. The result can be summarized in two point:

1. female-headed households tend to have a higher correlation to adequate sanitation, with characteristics of not married, unemployed, and live in their own house together with children/ son-in-law/grandchildren.
2. male-headed households tend to have a higher correlation to inadequate sanitation, with characteristics of not married, working in the informal sector, living alone in a rental house with uninhabitable condition.

The operational definition of not married status in this research is divided into three categories: single, widowed by law, and widowed by death. There are two possibilities why females who are not married tend to have adequate sanitation; (1) the female is an elder in her house at the time of the survey, and indirectly appointed as the head of the family, and (2) the females who are widowed have sufficient monthly living expenses or have inheritance so that they are financially capable even though they are unemployed.

On the other hand, the inadequate category indicates a correlation with the status of recent migrants, who live in rental houses, with uninhabitable conditions. Some of the migrants who come to Jakarta may have limited resources or financial ability. They try to survive by settling temporarily in a densely populated area. Many of them are from villages. They may still carry traits and habits that they develop while living in their

previous dwelling. The transition between traditional rural culture to modern urban culture can create problems in their daily life, such as continually practicing open defecation [31]. According to research, these household characteristics found in Central Jakarta area. As for the Thousand Islands, our conjecture is related to low education and low welfare.

The other variables that also have a significant correlation to the adequate private sanitation category are being married, household members of ≥4 people, and female-headed households. Females tend to have a high preference for private defecation facilities in the household due to privacy needs, hygiene, and safety factors. Even, the rate of open defecation is lower in female than in male [21].

Table 4 Distribution of household sanitation adequacy level according to gender and marital status

Adequacy Level	Marital status					
	Female			Male		
	Married (%)	Not Married* (%)	Total (n)	Married (%)	Not Married* (%)	Total (n)
0	13.95	11.74	38,960	14.7	16.17	232,997
1	23.53	15.3	51,667	14.53	34.91	267,154
2	62.51	72.96	237,992	70.77	48.93	1,065,546
Total (n)	311,779	16,840	328,619	1,371,015	194,682	1,565,697

Note: *) marital status of not married consist of not married yet, divorced alive, and divorced by death.

Table 5 Distribution of household sanitation adequacy level according to gender and employment status

Adequacy Level	Employment status*							
	Female				Male			
	A (%)	B (%)	C (%)	Total (n)	A (%)	B (%)	C (%)	Total (n)
0	6.95	12.95	21.65	38,960	11.10	16.08	15.12	232,997
1	10.50	15.98	27.08	51,667	7.40	17.52	19.39	267,154
2	82.55	71.07	51.28	237,992	81.50	66.40	65.50	1,065,546
Total (n)	171,825	79,606	77,188	328,619	220,347	533,663	811,687	1,565,697

Note: *) Employment status: unemployment (A), informal (B), and formal (C).

Table 6 Distribution of households sanitation adequacy level according to gender and physical living space

Adequacy Level	Physical Living Space					
	Female			Male		
	Not Livable (%)	Livable (%)	Total (n)	Not Livable (%)	Livable (%)	Total (n)
0	28.09	7.24	38,960	27.39	7.87	232,997
1	40.6	8.65	51,667	32.92	8.18	267,154
2	31.32	84.11	237,992	39.69	83.95	1,065,546
Total (n)	72,753	255,866	328,619	562,299	1,003,398	1,565,697

Note: The standard of living space for a simple healthy house in Indonesia is 9 m2/person [32].

Table 7 Distribution of households sanitation adequacy level according to gender and home ownership status

Adequacy Level	Home Ownership Status						
	Owned	Rental house	Rental free	Official residence	Others	Total (n)	
0	8.54	22.25	12.23	8.24		38,960	Female
1	5.39	46.6	20.25	4.48		51,667	
2	86.08	31.15	67.52	87.28		237,992	
Total (n)	221,031	71,165	31,472	4,951		328,619	
0	11.2	20.94	17.16	9.06	5.91	232,997	Male
1	3.76	36.56	24.55	30.23	14.3	267,154	
2	85.04	42.5	58.28	60.71	79.79	1,065,546	
Total (n)	827,353	448,428	251,528	30,695	7,693	1,565,697	

Table 8 Distribution of the relationship between second household member and household head (X^*) according to gender and marital status of household head

X^*	Marital status					
	Female			Male		
	Married (%)	Not Married** (%)	Total (n)	Married (%)	Not Married** (%)	Total (n)
X1	22.34	18.83	72,808	46.38	2.02	117,933
X2	0	36.22	6,100	0	96.59	1,324,260
X3	69.69	44.95	224,863	34.97	0.76	78,480
X4	0.64	0	1,994	1.89	0.02	4,005
X5	7.33	0	22,854	16.76	0.61	41,019
Total (n)	311,779	16,840	328,619	194,682	1,371,015	1,565,697

Note: *) X1 = single member; X2 = husband/wife; X3 = son, son-in-law, grandson; X4 = parents/in-laws, X5 = maid/driver, others. **) marital status of not married: not married yet, divorced alive, and divorced by death.

Jakarta is targeted to achieve 100% access to proper and safe sanitation by 2024 [4]. Eradicating 14.36% of the inadequate category is a heavy task. The biggest challenge is presented by the practice of open defecation, inadequate sanitation facility in households, and inadequate clean water and sanitation service coverage. *Susenas* data show that the coverage of clean water services in 2017 is only 60% [5]. It can be ascertained that the remaining 40% still uses ground water sources to fulfill their water needs. Besides that, the coverage of wastewater management services in 2017 is 24.33% [12], and only targeted to be 35% by 2022 [29]. The lack of access to water resources may have influenced the household sanitation adequacy. Heads of households need strong reasons for the importance of adequate sanitation to decide to adopt adequate sanitation.

4. CONCLUSION

Research findings shows that 85.64% of household sanitation facilities in Jakarta have adequate sanitation (68.81% adequate private sanitation and 16.83% adequate shared sanitation), while 14.36% are inadequate. The household characteristics of inadequate sanitations are male-headed household, household members <4 people, married, with low education and income, working in informal sector, migrant (recent migrant and lifetime migrant), and living rented house in low living condition. The household characteristics that significantly influence the change from inadequate to adequate private sanitation are non-migrant recent, university education, household members ≥4 people, unemployed, married, female-headed household, and high expenditure. The problem of low-quality sanitation in households in Jakarta can be overcome by incorporating these correlated household characteristics in the policymaking process, especially to lower the percentage of inadequate sanitation.

5. LIMITATIONS OF THE STUDY

The analysis in this study is dependent on the availability of variables in the *Susenas* data. A comprehensive analysis conducting a household survey specifically to study the feasibility of disposal facilities at the household level in Jakarta is strongly recommended. It will strongly support the analysis results.

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