

Relationship of the Significance of Freshwater Use to Health Protocols During the Covid-19 Pandemic in Bantul Village, Yogyakarta

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Abstract. The Covid-19 pandemic has an impact on the use of freshwater. Freshwater has an essential role in preventing the spread of Covid-19 related to the implementation of health protocols also Clean and Healthy Living Behavior. The important factors that influence water use are socio-economic conditions, including income level, type of work, and education level. The spread of Covid-19 significantly occurs in urban areas. Bantul village is the center of government, economy and one of the planned areas of urban settlements in Bantul Regency. Bantul village is also a hinterland of the Yogyakarta agglomeration area. This study was conducted to determine the influence of socio-economic conditions on the significance of changes in water use during the Covid-19 pandemic to implement health protocols in Bantul village. The data was obtained through interviews with 99 respondents based on random sampling techniques. This research was conducted with quantitative methods and descriptive analysis techniques. The result shows an increase in freshwater use during the pandemic, particularly washing hands and taking a shower. The highest increase in freshwater use is in Kurahan Hamlet. While in Grujugan Hamlet, there has been no increase. The increase in freshwater use indicates the suitable implementation of health protocols.

1 Introduction

The Covid-19 pandemic has caused profound impacts on human life and the environment, including freshwater use globally [1]. The primary benefit of freshwater for residents is the need for domestic water used daily, such as drinking, cooking, bathing, washing, and cleaning equipment. The use of freshwater for daily activities helps people avoid various diseases. Freshwater supports the sustainability of all lives, especially during the Covid-19 pandemic. During the Covid-19 pandemic, frequent handwashing with soap and water is recommended as one of the most effective measures to reduce the spread of infection. Regular handwashing with soap and running water is a preventive measure of Covid-19 transmission recommended by WHO and the Ministry of Health [2]. The current Covid-19 pandemic has caused the use of freshwater to increase, especially in central areas of activity and high population density.

The amount of domestic water use in each region is different. The amount of water use is influenced by population and type of activity [3]. The high population and activity lead to higher water use. According to the research by [4], domestic water use is influenced by income levels and technology. The urban center of China has more per capita domestic water use than its suburbs, while American urban centers have lower per capita water use than their suburbs. Residents of American urban centers have high incomes and water-saving technology so that the water use per capita of the population is less.

Bantul sub-district is the capital of Bantul Regency. Bantul sub-district consists of 5 villages, namely Palbapang, Ringinharjo, Bantul, Trirenggo, and Sabdodadi. Among the five villages, Bantul Village has the highest population density. Bantul Village is in the center of the Bantul Sub-district and becomes the center of activity in the Bantul Regency. Population density is not the leading cause and has no significant effect on the spread of Covid-19 [5]. However, high population

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density can lead to faster disease transmission with a more compact and complex spread chain. Bantul Village as a center of activity is also an additional trigger in the spread of Covid-19. Thus, preventing the spread of the Covid-19 virus by carrying out health protocols, especially the use of clean water, is very important. Bantul Village residents have socio-economic characteristics, water needs, and diverse freshwater usage patterns. Based on this description, this study aims to (1) identify the socio-economic characteristics of the population and its effect on the level of water needs; (2) identify the socio-economic characteristics of the population towards the application of health protocols; and (3) analyze the significance of the increased water needs during the pandemic to the application of health protocols.

Research for correlations of the community's socio-economic conditions on the significance of changes in water use during the Covid-19 pandemic to implement health protocols has never been carried out by other researchers. Previous research was limited to observing the socio-economic influence of the community on water use patterns. The existence of this research can deepen understanding related to water use patterns in the community so that it is known the factors that influence and the extent to which people use it for implementing health protocols.

2 Methods

This research is included in the descriptive quantitative type to look for correlations of the community's socio-economic conditions on the significance of changes in water use during the Covid-19 pandemic to implement health protocols in Bantul Villages. In this case, water use is defined as the daily water requirement in the household for daily activities such as bathing, washing, and watering. Water use is based on the average daily clean water use and the number of family members or by using the following formula [6]:

$$\text{Domestic water needs: } \frac{[\text{Water Needs}/\text{Families}/\text{Days}]}{[\text{Number of people per Family (person)}]} \quad (1)$$

The population used in this study was the Head of Family in Bantul Villages which has 16,535 families [7]. In this case, the number of samples is determined using the Slovin formula This formula allows a researcher to sample the population with a certain level of accuracy [8].

$$n = \frac{N}{N(d)^2 + 1} \quad (2)$$

N = Population size
 n = Size of sample required
 d = Default error used (0,1)

The formula is known as the number of 99 respondents with the level of error used by 10%. This is because the population is known to be quite large. There

are limitations in terms of the source of funds, time, and energy available. Then by using the proportional random sampling technique, the distribution of sample proportions in 12 hamlets in Bantul Villages (figure 1).

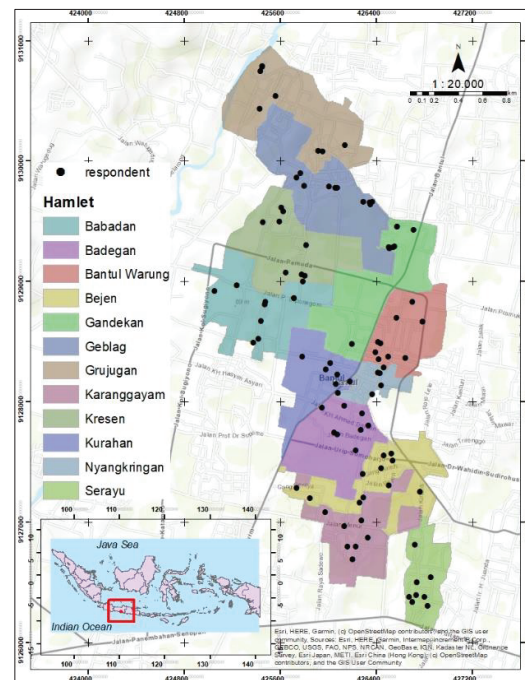


Fig. 1. Distribution of research respondents in Bantul Village

Sampling data is done by sharing questionnaires by creating a list of questions related to the focus of the research. Population water usage data is processed using SPSS (Statistical Package for Social Sciences) application. Analysis of water usage data before and during the Covid-19 Pandemic was conducted with significance tests using the Wilcoxon test. This test is used for normal non-redistributed data characters. Statistical test results are analyzed using descriptive analysis. This is the easiest to interpret and perfectly suited for collating and summarizing quantitative data [9]. However, the analysis was carried out without intending to make conclusions that apply to the public or generalization [10].

3 Results and Discussions

3.1 The Amount of Domestic Water Use

The average amount of domestic water use per capita in urban areas is 171 liters/day/capita and that in rural area is 114 liters/day/capita [11]. Based on the survey, the amount of domestic water use per capita of Bantul Villages varies greatly, ranging from 54 liters/day to 1044 liters/day. The amount of water use per capita is classified into three classes: low (66-325.5 liters/day/capita), medium (325.6-651 liters/day/capita), and high (651.1-1,042.5 liters/day/capita). Based on 99 respondents as representatives of the population in Kalurahan Bantul, 91 respondents with moderate per

capita water use (91.9%), one respondent with low per capita water use (1%), and seven respondents with high per capita water use (7.1%). This proves that it is infrequent for the population to have too little or too much water uses than the National Standard that has been set. Based on the analysis results, variations in domestic water use are not influenced by socio-economic conditions. This is evidenced by the absence of a pattern formed when domestic water use data is crosstab with income levels, types of jobs, and education levels (table 1).

Table 1. Crosstab results (a) the level of education and water use. (b) the type of work and water use. (c) the income level and water use.

Education	Classification of normal water use			
	High	Medium	Low	Total
No education	1	0	5	6
Primary School	1	0	10	11
Junior High School	2	0	7	9
High School	2	1	47	50
Bachelor	0	0	1	1
Master	7	1	91	99
Total	1	0	5	6

(a)

Profession	Classification of normal water use			
	High	Medium	Low	Total
Unemployment	0	0	2	2
Breeder	0	0	1	1
College student	0	0	3	3
Entrepreneur	0	0	3	3
Farmer	1	0	10	11
Government employees	0	0	5	5
Housewife	1	1	27	29
Laborer	1	0	3	4
Private	2	0	17	19
Retired	2	0	9	11
Teacher	0	0	3	3
Trader	0	0	8	8
Total	7	1	91	99

(b)

Income Classification	Classification of normal water use			
	High	Medium	Low	Total
Low (<1500000)	3	0	25	28
Medium (1500000-2500000)	2	0	19	21
High (2500000-3500000)	2	1	10	13
Very high (>3500000)	0	0	37	37
Total	7	1	91	99

(c)

Source: Data processing, 2021

3.2 Pandemic and Significance of Water Use

Pandemics have a substantial impact on water use in areas with larger populations. Overall, the effect is in the form of increased domestic water use in urban areas. The results follow the study by [12], which stated an increase in water use in the settlement category. The increase in the use of clean water in Bantul Village for bathing needs occurred by 4.6%, while the increase in the use of clean water for hand washing purposes occurred very significantly by 101.4%. This figure increased dramatically compared to the pre-pandemic situation of Covid-19. Table 2 describes in more detail the increasing use of clean water for various domestic needs from pre-pandemic conditions and during pandemics.

Considering the variation of average water consumption before and during the pandemic, there was an increase in water use of 13.5 liters/day/capita. Figure 2 shows a map showing the distribution of the significance of total water consumption, both for bathing and handwashing in each Hamlets. The consumption of clean water began to increase even before the quarantine period began. Nevertheless, all categories appear to be affected by measures to limit the spread of pandemics, especially the implementation of health protocols and clean and healthy living behaviors.

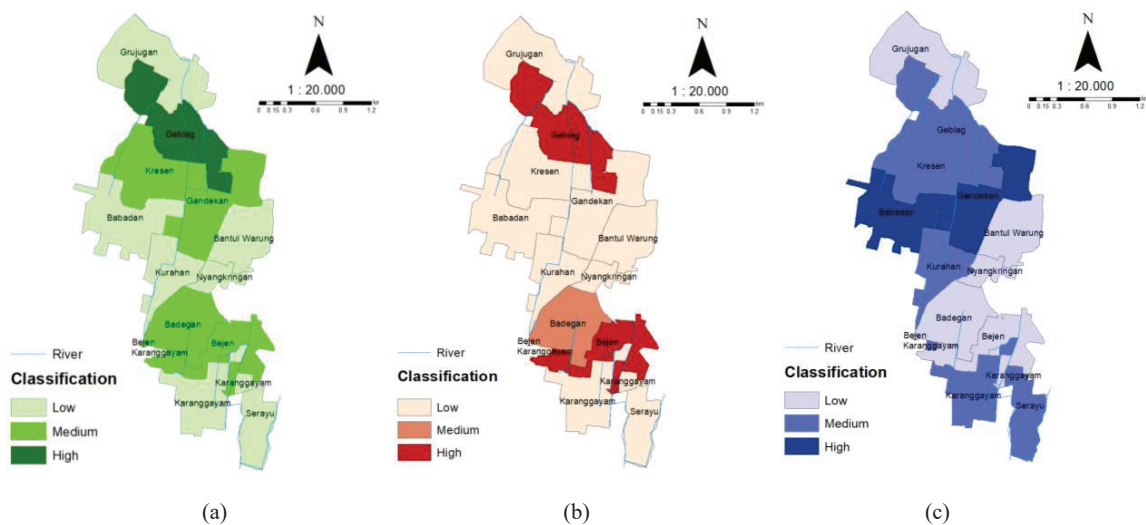


Fig. 2. Distribution of significance of clean water use during the Covid-19 pandemic. (a) The total significance of water use. (b) Significance of water used for bathing purposes. (c) The significance of the use of water for handwashing.

Source: Data processing, 2021

Table 2. Significance of Clean Water Use During the Covid-19 Pandemic

Freshwater Uses	Before the Covid-19 pandemic (liter/day/capita)	During the Covid-19 pandemic (liter/day/capita)	Increase in freshwater use during the pandemic (liter/capita/day)	The signification of freshwater use during the pandemic (%)
Take a shower	178.48	186.71	8.22	4.60
Wash clothes	31.52	31.61	0.09	0.70
Drinking water	1.86	1.86	0.00	0.00
Watering plants	7.08	7.08	0.00	0.00
Cook	5.24	5.34	0.10	0.75
Wudu'	10.70	10.79	0.09	0.65
Washing vehicles	0.89	0.89	0.00	0.00
Hand washing	4.89	9.85	4.96	101.4
Other	0.42	0.45	0.03	0.22

Source: Data processing, 2021

Figure 2a shows the total significance of high-category clean water use occurring in Geblag Hamlet, while in the category of significance is occurring in Kresen, Gandekan, Badegan, and Bejen Hamlets. The remaining seven hamlets have a low significance category for water use during the Covid-19 pandemic. The significance of the use of clean water is inseparable from the application of health protocols by the people of Bantul Village, one of which is hand washing. During the Covid-19 pandemic, frequent handwashing with soap and water is recommended as one of the most effective measures to reduce the spread of infection. Figure 2c shows almost all communities in each of the Hamlets in Bantul Village experiencing the significance of using water for handwashing.

3.3 Implementation of Health Protocols

The increase in clean water using during the pandemic is caused by several factors, including the use of water for bathing and hand washing which is included in the application of health protocols. The amount of water reportedly used for handwashing that has allowed reduction of fecal contamination ranges from 0.5-2 liters per person. In addition, WHO and UNICEF also recommend washing hands in running water with soap and rubbing for at least 20 seconds [2]. Water use is significant for handwashing per capita during the Covid-19 and pre-Covid-19 pandemics of 4.9 liters and 9.9 liters (figure 3), respectively.

The study found that, based on 99 respondents, there are 98.9% had implemented health protocols, while 1.1% did not implement health protocols during the Covid-19 pandemic (figure 4). This indicates that people in some districts in Bantul Village have implemented suitable health protocols following the government's recommendations. The increase in the use of water for handwashing during Covid-19 is also coherent with other studies.

According to research by [13], people begin to wash their hands during activities outside routinely and after returning from outside during the pandemic situation.

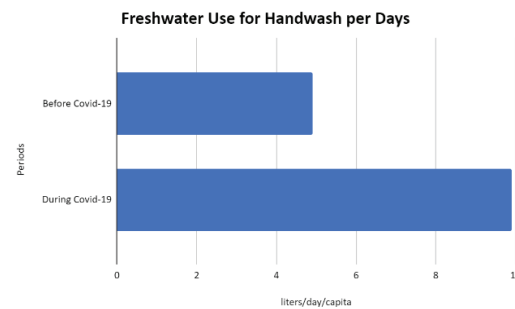


Fig. 3. Use of clean water for hand washing purposes per day during the Covid-19 and pre-Covid-19 pandemics.

Source: Data processing, 2021

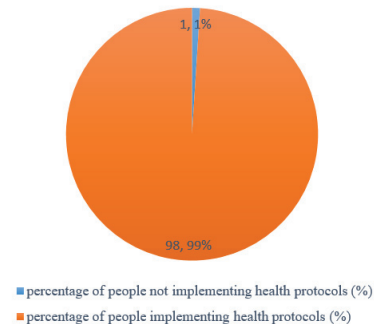


Fig. 4. Percentage of health protocol and implementation in Bantul Village.

Source: Data processing, 2021

3.4 Socio-economic and Significance of Water Use

The significance of Bantul Villages domestic water use is mostly at low levels. The survey results showed that out of a total of 99 respondents, 96 respondents had the significance of domestic water use at a low level (0-77.2 liters/day/capita), while two respondents at the moderate level (77.3-154.4 liters/day/capita) and one respondent at the high level (154.5-231.7 liters/day/capita).

Table 3. shows crosstab results between education level, income level, and type of work with the significance of water use. Crosstab results showed no pattern between socio-economic characteristics and the significance of household water use. Low or high levels of education, employment, and incomes have low domestic water use significance. This indicates that socio-economic characteristics do not affect the significance of water use.

Table 3. Crosstab results (a) the level of education and significance of water use. (b) the income level and significance of water use. (c) the type of work and significance of water use.

Education	Classification of water use significance	Classification of water use significance			Total
		High	Medium	Low	
No education		0	0	6	6
Primary School		0	0	11	11
Junior High School		0	0	9	9
High School		1	0	49	50
Bachelor		0	2	20	22
Master		0	0	1	1
Total		1	2	96	99

(a)

Profession	Classification of water use significance	Classification of water use significance			Total
		High	Medium	Low	
Unemployment		0	0	2	2
Breeder		0	0	1	1
College student		0	0	3	3
Entrepreneur		0	0	3	3
Farmer		0	0	11	11
Government employees		0	0	5	5
Housewife		0	0	29	29
Laborer		0	0	4	4
Private		0	0	19	19
Retired		0	1	10	11
Teacher		1	1	1	3
Trader		0	0	8	8
Total		1	96	2	99

(b)

Income Classification	Classification of water use significance	Classification of water use significance			Total
		High	Medium	Low	
Low (<1500000)		0	0	28	28
Medium (1500000-2500000)		0	0	21	21
High (2500000-3500000)		0	0	13	13
Very high (>3500000)		1	2	34	37
Total		1	2	96	99

(c)

Source: Data processing, 2021

3.5 Socio-economic and Health Protocols

The socio-economic characteristics of Bantul villagers are classified based on the level of education, the level of income, and the type of work. Tables 4, 5, and 6 show crosstab results between education level, income level, and job type with the type of implementation of health protocol. Although, in general, all respondents apply hand washing or handwashing and bathing as a health protocol that is often applied. It can be seen the type of health protocol based on the most dominant respondents.

Table 4. Crosstab results between the income level and the implementation of health protocols.

Implementation of health protocols	Income Classification	Income Classification				Total
		I1	I2	I3	I4	
Hand washing		12	3	1	12	28
Hand washing, hand sanitizer		0	0	0	2	2
Hand washing, mask		1	1	2	1	5
Hand washing, mask, hand sanitizer		0	0	0	1	1
Hand washing, mask, physical distancing		0	1	1	1	3
Hand washing, physical distancing		1	0	0	0	1
Hand washing, take a shower		10	12	8	6	36
Hand washing, take a shower, disinfectant		0	0	0	1	1
Hand washing, take a shower, mask		2	3	1	10	16
Hand washing, take a shower, mask, hand sanitizer		0	0	0	2	2
Hand washing, take a shower, mask, physical distancing		1	1	0	0	2
Hand sanitizer		0	0	0	1	1
Not implement		1	0	0	0	1
Total		28	21	13	37	99

I1. Low (<Rp 1.500.000); I2. Medium (Rp 1.500.000-Rp 2.500.000); I3. High (Rp 2.500.000- Rp 3.500.000); I4. Very High (>Rp 3.500.000)

Source: Data processing, 2021

Table 4 shows the crosstab results between income levels and the implementation of health protocols. Most of the respondents have a high-income level (>Rp 3,500,000). However, most respondents applied slightly more handwashing than other health protocols. In addition to hand washing and bathing, respondents have been able to apply health protocols in the form of the use of masks. It is seen in every crosstab result that the application of health protocols in the form of hand washing, bathing, and wearing masks has often been applied by respondents in all socio-economic characteristics.

Table 5. Crosstab results between the type of work and the implementation of health protocols.

Implementation of health protocols \ Profession	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	Total
Hand washing	2	1	1	1	3	1	7	1	4	2	1	4	28
Hand washing, hand sanitizer	0	0	0	0	0	0	0	0	0	2	0	0	2
Hand washing, mask	0	0	0	0	0	0	3	1	0	1	0	0	5
Hand washing, mask, hand sanitizer	0	0	0	0	0	0	0	0	0	1	0	0	1
Hand washing, mask, physical distancing	0	0	0	1	0	0	1	0	0	1	0	0	3
Hand washing, physical distancing	0	0	0	0	1	0	0	0	0	0	0	0	1
Hand washing, take a shower	0	0	2	1	5	2	12	2	7	3	0	2	36
Hand washing, take a shower, disinfectant	0	0	0	0	0	1	0	0	0	0	0	0	1
Hand washing, take a shower, mask	0	0	0	0	2	1	4	0	6	0	2	1	16
Hand washing, take a shower, mask, hand sanitizer	0	0	0	0	0	1	0	0	0	1	0	0	2
Hand washing, take a shower, mask, physical distancing	0	0	0	0	0	0	1	0	0	0	0	1	2
Hand sanitizer	0	0	0	0	0	1	0	0	0	0	0	0	1
Not implement	0	0	0	0	0	0	1	0	0	0	0	0	1
Total	2	1	3	3	11	7	29	4	17	11	3	8	99

P1. Unemployment; P2. Breeder; P3. College Student; P4. Entrepreneur; P5. Farmer; P6. Government employee; P7. A housewife; P8. Laborer; P9. Private; P10. Retired; P11. Teacher; P12. Trader.

Source: Data processing, 2021

Table 6. Crosstab results between the level of education and the implementation of health protocols.

Implementation of health protocols \ Education	E1	E2	E3	E4	E5	E6	Total
Hand washing	0	2	2	18	6	0	28
Hand washing, hand sanitizer	0	0	0	1	1	0	2
Hand washing, mask	0	1	0	3	1	0	5
Hand washing, mask, hand sanitizer	0	0	0	0	1	0	1
Hand washing, mask, physical distancing	0	0	0	1	2	0	3
Hand washing, physical distancing	0	0	0	1	0	0	1
Hand washing, take a shower	4	6	4	18	4	0	36
Hand washing, take a shower, disinfectant	0	0	0	0	0	1	1
Hand washing, take a shower, mask	1	1	3	6	5	0	16
Hand washing, take a shower, mask, hand sanitizer	0	0	0	1	1	0	2
Hand washing, take a shower, mask, physical distancing	1	0	0	1	0	0	2
Hand sanitizer	0	0	0	0	1	0	1
Not implement	0	1	0	0	0	0	1
Total	6	11	9	50	22	1	99

E1. No education; E2. Primary School; E3. Junior High School; E4. High School; E5. Bachelor E6. Master

Source: Data processing, 2021

Table 5 shows the crosstab results between job types and the implementation of health protocols. Of the 99 participants, 29 were housewives. Most housewives apply more hand washing and bathing. Table 6 shows the crosstab results between education levels and health protocols. Of the 99 participants, 50 respondents have the last level of high school education. Most respondents applied hand washing and hand washing and bathing with the same proportion.

The crosstab results do not show any pattern between socio-economic characteristics and health protocols applied by the residents of Bantul Village. This indicates that socio-economic characteristics do not affect the type of health protocols applied by Bantul Village residents. Finally, the type of health protocol carried out by the residents of Bantul Village generally is not influenced by socio-economic characteristics. All respondents with different socio-economic characteristics (education level, income level, and type of occupation) applied handwashing or handwashing and bathing as a form of frequently applied health protocol measures.

4 Conclusion

The Covid-19 pandemic had an impact on freshwater use in larger areas. Overall, the real impact is the increasing use of freshwater in the domestic sector by residents in urban areas. Bantul Village residents have socio-economic characteristics, water needs, and diverse clean water usage patterns. Low and high levels of education, employment, and income have low household water use significance. This indicates that socio-economic characteristics do not affect the significance of water use. The amount of household freshwater use per

capita of Bantul Village is very high, ranging from 54 liters/day to 1,044 liters/day. In addition, socio-economic characteristics do not affect the type of health protocols applied by Bantul Village residents. However, the variations of the average water consumption before and during the pandemic occurred, there was a water usage significance of 13.5 liters/day/capita.

The significance of the use of freshwater during the pandemic is most for bathing and washing hands. The increase of freshwater use is very high in Kurahan Hamlet, while in Grjugan Hamlet, there is no increase. The increase in freshwater use indicates the suitable implementation of health protocols. Based on 99 respondents, there are 98.9% had implemented health protocols, while 1.1% did not implement health protocols during the Covid-19 pandemic. So further studies are required not only in Bantul Village but also worldwide. New findings of this study will benefit future research to comprehensively assess the socio-economic impact associated with the significance of freshwater use in developed and developing countries due to new health protocols also clean and healthy living behavior during the Covid-19 outbreak.

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