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Use of Water and Hygiene Products: A COVID-19 Investigation in Indonesia

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Abstract: This study examines the impact of the COVID-19 pandemic on hygiene practices and water consumption in Indonesia. Data were collected through an online survey, supplemented by the official national socio-economic survey. The findings indicate an increase in hygiene practices, particularly handwashing, aligned with health protocols. This behavior led to higher water and hygiene product usage, unaffected by socio-economic factors. Respondents' perception of COVID-19 and compliance with health protocols drove the increase, with older individuals preferring handwashing with water and younger individuals favoring hand sanitizer. Access to improved drinking water remained stagnant, while bottled water consumption rose. This highlights challenges in achieving the SDG 6 targets for safe drinking water. This study stresses the need to address COVID-19 perception to promote better hygiene practices and raises concerns about increased water usage, domestic pollution, and wastewater management during and after the pandemic. These insights could inform policymakers, researchers, and practitioners working in public health and water management to achieve SDG 6 goals amidst the pandemic and beyond.

Keywords: COVID-19 pandemic; water consumption; hygiene product usage; health protocol compliance; Indonesia

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1. Introduction

The coronavirus disease (COVID-19) was declared a global pandemic in early 2020, affecting numerous countries worldwide, and even in early 2022, many countries continued to struggle with its spread. Measures like physical distancing, mask-wearing, and hand hygiene, which are crucial in preventing virus spread, have inadvertently posed environmental challenges, particularly in domestic water pollution. These challenges underscore the pandemic's intersection with broader sustainability issues. The Sustainable Development Goals (SDGs) offer a comprehensive framework for addressing global concerns and enhancing human welfare and environmental health [1]. Notably, SDG 6, which emphasizes access to clean water and sanitation, plays a pivotal role in safeguarding public health and other areas [2]. Understanding the pandemic's impact on personal hygiene, water consumption, and water quality is imperative for advancing SDG 6. By examining how the pandemic has influenced these aspects, we can identify strategies and solutions to maintain progress toward the goal of universal access to clean water and sanitation, even in the face of global health crises.

Several studies conducted in various countries, including India, Italy, Morocco, and Indonesia, during the early stages of the pandemic have reported changes in water pollution levels due to reductions in certain activities, i.e., industrial and tourism-related activities [3–9]. Conversely, the closing of workplaces and schools has resulted in increased

domestic water usage [10–12] and changes in hourly water usage patterns [11,13]. Personal hygiene measures, including handwashing and the use of disinfectants, have also influenced water consumption [14] and the usage of cleaning products [15,16]. The active agents in these products may persist in domestic wastewater and, without adequate treatment, can enter the aquatic environment, thereby affecting water quality and posing environmental challenges [17].

While several studies have investigated changes in hand hygiene behavior during the COVID-19 pandemic [18–20], there remains a notable research gap concerning the broader implications of the pandemic on personal hygiene, water consumption, and water quality. This gap is particularly evident in low-income countries with constrained access to water, sanitation, and hygiene (WASH) services. This study aims to address this gap by examining shifts in personal hygiene practices, water utilization patterns, and the use of sanitation products in Indonesia during the COVID-19 pandemic in 2021.

Although the most immediate changes were observed within the initial three years of the pandemic, the repercussions on WASH services may persist for an extended duration [21,22]. Furthermore, the pandemic's influence on hygiene behaviors, adherence to health protocols, and the heightened utilization of water and hygiene products has emerged as a significant determinant of both water demand and quality [22]. By delving into the psychosocial and pandemic-related contexts, the present study seeks to offer valuable insights into the interplay between the pandemic, individual hygiene practices, and the utilization of water and sanitation products.

To address our research objectives, we employed an online questionnaire as the primary data collection method to investigate shifts in personal hygiene practices, alterations in water consumption patterns, and variations in the utilization of sanitation products. The questionnaire was diligently administered to a diverse sample of respondents across Indonesia. Subsequently, the outcomes derived from this survey were meticulously compared with data obtained from the Indonesian National Socio-Economic Survey (SUSENAS). This comprehensive dataset formed the foundation for our rigorous statistical analysis and subsequent data interpretation.

Our study makes a significant contribution to the existing body of knowledge by offering a thorough and insightful examination of the multifaceted impacts of the COVID-19 pandemic on personal hygiene behaviors, water utilization trends, and water quality within the context of Indonesia. The results we have garnered hold intrinsic value for a broad spectrum of stakeholders, ranging from policymakers and water resource managers to public health authorities. These findings offer a profound understanding of the far-reaching consequences of COVID-19 preventive measures on water resources, thereby facilitating the formulation of targeted educational initiatives and hygiene campaigns.

Furthermore, our research underscores the critical importance of prioritizing the sustainability of water and sanitation infrastructure, particularly in low-income nations. This emphasis on long-term infrastructure sustainability is indispensable for ensuring equitable access to clean water and fostering the adoption of safe hygiene practices, especially in the face of widespread health crises like the one posed by the COVID-19 pandemic.

2. Materials and Methods

2.1. COVID-19 and WASH in Indonesia

The first COVID-19 case in Indonesia was reported on 2 March 2020. In order to limit the spread of COVID-19, the first regional movement restriction measure was implemented in April 2020, with different starting points in various regions based on perceived risk. Since then, multiple levels of movement and activity restrictions have been implemented in response to the evolving COVID-19 situation [23].

Until October 2021, Indonesia had experienced two waves of the pandemic [24]. The first wave occurred in January–February 2021, reaching its peak with 14,518 new cases (on 30 January 2021) and 476 deaths (on 28 January 2021) per day. The second wave

occurred in June–August 2021, reaching its peak with 56,757 new cases (on 15 July 2021) and 2069 deaths (on 27 July 2021) per day.

In 2019, prior to the COVID-19 pandemic, merely 83% of the Indonesian population had access to basic sanitation services [25]. Subsequently, a study conducted in Indonesia from May to June 2020, utilizing online surveys, revealed an overarching surge in hand hygiene practices among respondents, alongside a pronounced determination to sustain these improved practices even in a post-pandemic landscape [19]. In light of the new wave of COVID-19 in 2021, the current study aimed to investigate changes in personal hygiene, water usage, and sanitation product usage in 2021.

2.2. Primary Data Collection

A web-based questionnaire was developed to capture changes in water and hygiene product usage patterns before and during the COVID-19 pandemic in Indonesia. Given the mobility restrictions and physical distancing measures in place, an online survey was chosen as the preferred method for data collection. Ethical clearance was obtained from the Committee of Research Clearance Ethics, Indonesian Institute of Sciences (LIPI).

The questionnaire was administered between 22 February 2021 and 24 March 2021 using the KoBotoolbox platform. Due to the limitations of online surveys, convenience sampling was conducted instead of random sampling. The survey link was distributed through various channels such as email, WhatsApp groups, personal contacts of researchers, Twitter, Facebook, and Instagram. Respondents were also encouraged to share the survey link with others through their contact lists and social media. A total of 1093 responses were received through the online survey. After screening for age (18 years old or older), eliminating double responses, and removing extreme outliers, 889 responses were considered for further analysis.

The questionnaire began with a brief description of the study, its purpose, the expected survey duration, and the assurance of anonymity and confidentiality. Participants were required to provide their consent before proceeding with the survey. The estimated time to complete the questionnaire was 10 to 15 min. It consisted of multiple-choice and open-ended questions divided into ten sections, covering topics such as changes in hygiene behavior, water and hygiene product usage patterns, COVID-19-related information, and demographic details. The reliability of the questionnaire was tested through two rounds of piloting before its administration.

The first section of the questionnaire examined changes in the frequency of hygiene activities, including handwashing, showering, and hair washing. The section on changes in water and hygiene product patterns inquired about adjustments in usage frequency and quantity for clean water, hand soap, body (shower) soap, and shampoo. Changes in hygiene activities were assessed using a set of questions employing both qualitative (5-scale answers ranging from greatly decrease to greatly increase) and quantitative approaches. Conversely, changes in water and hygiene product usage were assessed qualitatively, as the quantitative approach might have posed difficulties for respondents to recall precise usage numbers, especially from before the pandemic.

Furthermore, background information was collected to support the analysis, including COVID-19-related information, such as respondents' beliefs and perceptions about COVID-19, compliance with health protocols, and changes in work and income patterns during the pandemic. The questionnaire also included demographic information such as sex, age, education level, and location (provinces). Detailed information on the dataset, outcomes, and questionnaire structure from this web-based survey is accessible in the Supplementary Materials (refer to Tables S1, S2 and S4).

2.3. Indonesian National Socio-Economic Survey

This study utilized the annual Indonesia National Socio-Economic Survey (SUSENAS) cross-sectional data set, which represents the socio-economic characteristics of a large number of households in Indonesia. The survey is conducted every March and September,

with the March survey covering 0.7–1.1 million households and the September survey covering 200,000–286,000 households.

The March SUSENAS consists of two questionnaires: the core questionnaire and the module questionnaire. The core questionnaire collects information on population demographics, education, health, employment, and housing characteristics. The module questionnaire focuses on households' consumption, expenditure, and income. The September SUSENAS includes module questionnaires and special questionnaires, covering areas such as socio-cultural and education, housing and health, and social resilience.

Table 1 provides an overview of the SUSENAS data, including the number of respondents, which represents the total number of households and the population in Indonesia for each year. For this study, a household-level dataset was derived from the SUSENAS surveys conducted between March 2019 and March 2021, representing the period both preceding and during the COVID-19 pandemic. Notably, the first COVID-19 case in Indonesia emerged in March 2020. Consequently, it is important to acknowledge that the 2020 SUSENAS data might not entirely capture alterations in personal hygiene and water consumption behavior specifically associated with COVID-19.

Table 1. Representation of the population and households from the number of respondents in SUSENAS data.

Year	Household Respondent	Representative Households	Representative Population
2019	315,672	71,438,289	267,306,564
2020	334,229	72,792,286	270,315,430
2021	340,032	75,615,091	271,584,775

Source: SUSENAS 2019–2021, authors' calculations.

It is worth emphasizing that our web-based questionnaire and the SUSENAS dataset are distinct entities, each serving complementary roles in our research. Together, they provide unique insights into our study's objectives.

2.4. Statistical Analysis

The collected responses from the questionnaire were analyzed qualitatively and presented as percentages (%). Additionally, a multivariate logistic analysis was conducted to identify factors associated with the increased consumption of water and four hygiene products (hand soap, hand sanitizer, body soap, and shampoo) during the pandemic compared with before. The dependent variable in the analysis was a dummy variable indicating whether the consumption increased (1) or not (0). To accommodate this, we reclassified consumption change from five into two categories—"greatly decrease", "decrease", and "constant" become "not increasing" (coded as 0), while "increase" and "greatly increase" become "increasing" (coded as 1). The analysis considered socio-demographic variables such as sex, age, education, occupation, working pattern during the pandemic, income, and household size. Two indexes, the perception of COVID-19 index and compliance with the health protocol index, were also included in the analysis. The logistic regression results were presented as odds ratios (OR).

In the case of the SUSENAS data, we employed graphical methods to examine changes in personal hygiene and water consumption behavior both prior to and during the COVID-19 pandemic in Indonesia. The expenditure data were adjusted to account for changes in prices (inflation), using constant prices from 2018. This adjustment was made using consumer price index (CPI) data obtained from the Central Bureau of Statistics [26,27]. Additionally, we have provided descriptive statistics, along with results from Mann–Whitney tests, in the Supplementary Materials (Table S3) for reference.

3. Results and Discussion

3.1. Respondents' Characteristics

3.1.1. Demographic

This study included respondents from 31 out of 34 provinces in Indonesia (Figure 1), with a majority of them (82%) coming from six provinces on Java Island, particularly West Java (53%). As Java Island was the main epicenter of COVID-19 spread in Indonesia [28], this allowed us to capture respondents who were likely affected by the pandemic and examine changes in their personal hygiene behaviors. Table 2 presents the demographic characteristics of the respondents. The majority were female (54.9%) with an average age of 39 years and at least a bachelor's degree. The respondents represented a diverse range of occupations, with civil servants, teachers, and employees of state-owned and private companies being the dominant group (58.6%). Most of the respondents belonged to the middle- and upper-income classes (Figure 2a), and over 90% had a high educational level (diploma, bachelor, master, or doctorate). These characteristics align with previous studies in Indonesia [19] and the general pattern of online surveys, where higher education levels [29] and stable employment are commonly observed [30].

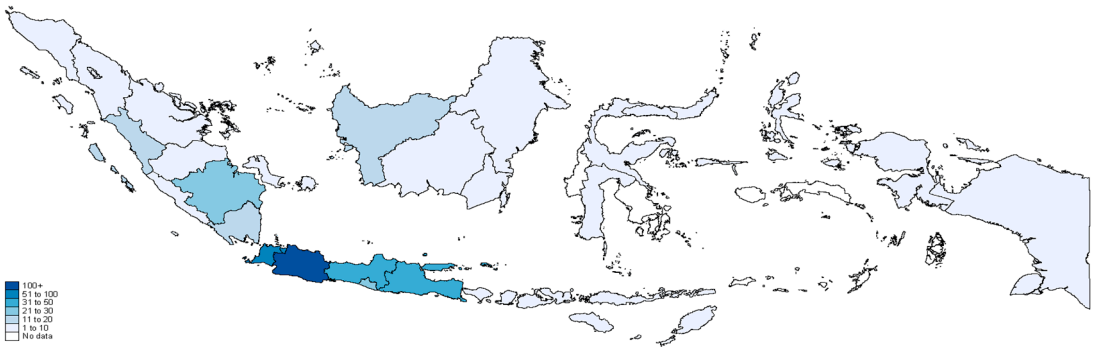

Figure 1. Distribution of respondents by province. Source: Online survey result.

Table 2. Demographic characteristics of the respondents (n = 889).

Variables	*n*	%/(Mean)
Gender		
Male	401	45.1
Female	488	54.9
Age	889	(39.2)
Educational level		
Not completed primary school	0	0.0
Primary school	1	0.1
Junior high school	2	0.2
Senior high school	75	8.4
Diploma I/II/III	40	4.5
Diploma IV/ Bachelor	395	44.4
Master/ Doctor	376	42.3
Job type		
Unemployed	19	2.1
Student	72	8.1
Housewife	59	6.6
Health worker	13	1.5
Army/ police	0	0.0
Factory worker	14	1.6
Entrepreneur/merchant/service worker	95	10.7
Civil servant/teacher/state-owned & private employees	521	58.6
Farmer/farm labor/construction labor/transportation labor	2	0.2
Other	94	10.6

Source: Online survey result.

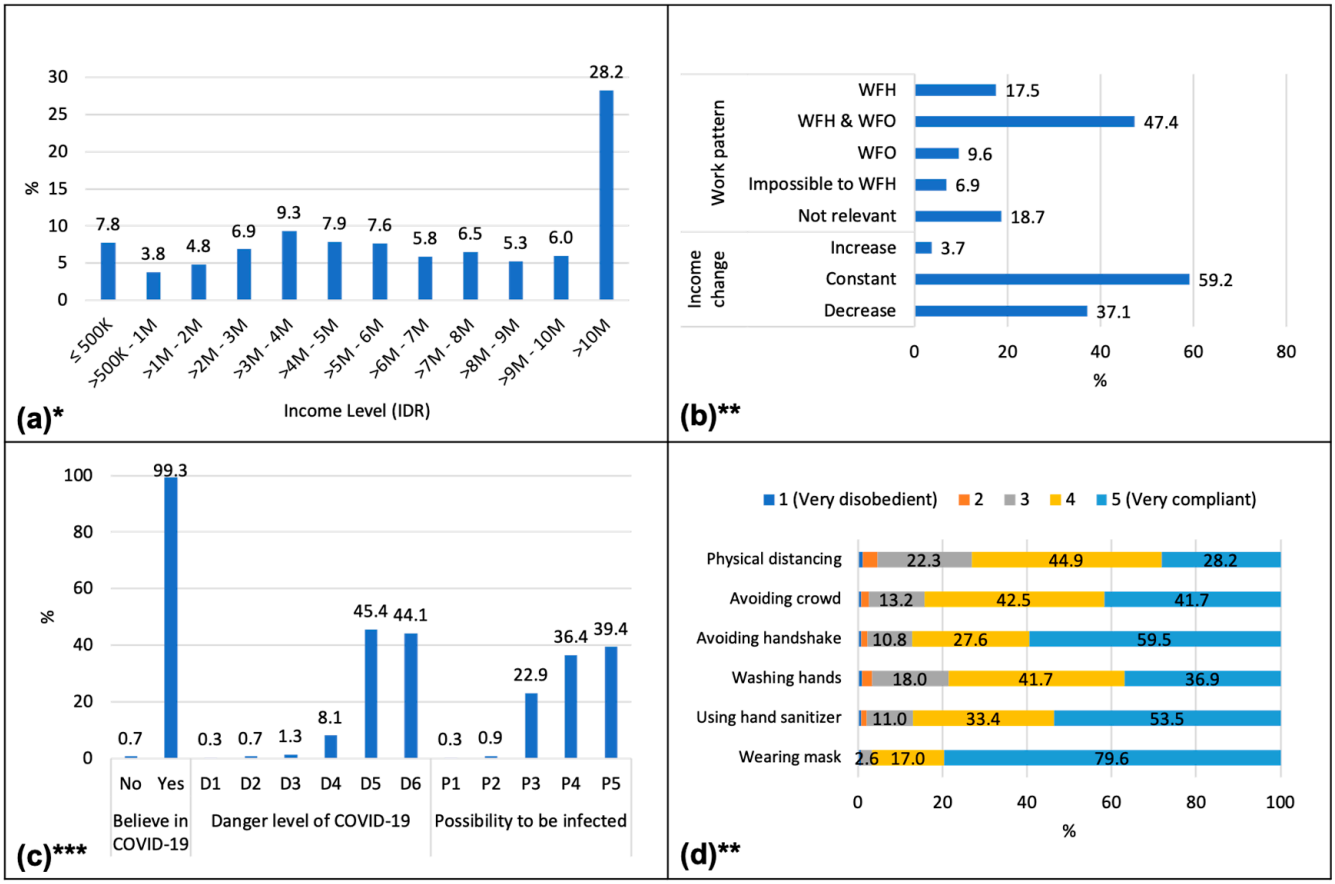

Figure 2. Distribution characteristics of respondents by (**a**) income group; (**b**) changes in work and income patterns due to the pandemic; (**c**) perception of COVID-19; (**d**) compliance with health protocol-related activities during the pandemic. All figures are expressed in percentage of respondents with a total of 100% (n = 889). Notes: * IDR = Indonesian Rupiah ** WFH = working from home, WFO = working from office *** D1 = Not dangerous at all, D6 = Very dangerous. P1 = Very impossible, P5 = Very possible. Due to space constraints, only notable proportions are displayed; for complete details, please refer to the Supplementary Materials (Table S2). Source: Online survey result.

3.1.2. Working during the Pandemic

Additional information was collected regarding the respondents' working patterns, perception of COVID-19, and adherence to health protocols during the pandemic. Although Indonesia did not implement a national lockdown, regional movement and activity restrictions were imposed based on the COVID-19 situation. The first large-scale social restriction (*pembatasan sosial berskala besar*–PSBB) was implemented in West Java, the province in which this study has the highest number of respondents, from 6 May to 25 June 2020. This involved the closure of schools, places of worship, non-essential workplaces, and public facilities. After the PSBB, some relaxations were introduced, such as allowing office buildings to operate at 50% capacity. However, strict compliance with the PSBB guidelines was challenging for some businesses [31], and considerable mobility was still observed during weekends and public holidays [32].

Figure 2b illustrates that 47% of the respondents had a combination of working from home (WFH) and working from the office (WFO). Only 17.5% could exclusively work from home, while another 17.5% were unable to work from home at all. The remaining 18.7% included unemployed individuals, students, and housewives for whom the WFH and WFO options were not applicable.

In terms of income, nearly 60% of the respondents experienced no changes (Figure 2b), which is consistent with the fact that many had stable jobs as civil servants or teachers, or

were employees of state-owned and private companies. However, 37% reported a decrease in their income, particularly entrepreneurs, merchants, service workers, farmers, farm laborers, construction laborers, and transportation laborers. This decrease can be attributed to the vulnerability of private sector companies and small businesses to the economic fluctuations caused by the pandemic [33].

3.1.3. Perception on COVID-19

Figure 2c presents the respondents' perception of COVID-19 and its implications. Almost all respondents believed in the existence of the COVID-19 pandemic. The majority perceived COVID-19 as a dangerous disease and acknowledged the possibility of getting infected. However, a small percentage (0.7%) did not believe in COVID-19, 0.3% did not consider it dangerous, and 0.3% believed it was impossible to be infected. These percentages are higher compared with a similar study conducted in Indonesia in 2020, where only 66.9% of respondents perceived a medium to low risk of infection [19]. The differences in perception can be attributed to the fluctuation in the pandemic situation in Indonesia [19]. Overall, these perceptions of COVID-19 danger and risk influenced the adoption of prevention measures and compliance with health protocols.

3.1.4. Compliance with the Health Protocol

The respondents' compliance with health protocols during the pandemic (Figure 2d) aligns with their perceptions (Figure 2c), particularly regarding wearing masks and avoiding handshakes. Similar to a study conducted in the United States, respondents who perceived a higher risk of infection were more likely to adhere to health protocols, as they recognized the broader impact of the pandemic, including economic consequences [34]. However, some respondents found it challenging to avoid crowds and maintain physical distancing. Interestingly, complying with handwashing recommendations was more difficult compared with using hand sanitizers. This behavior can be attributed to the convenience of hand sanitizers, which are readily available, do not require water, and are less time-consuming [35].

3.2. Access to Sanitation and Drinking Water

The water supply in Indonesia encompasses various sources, including branded bottled water, refillable bottled water, piped water (metered and retailed), protected and unprotected wells, protected and unprotected springs, rainwater, surface water, and others. Among these sources, paid and free water sources exist [36].

To gain insights into sanitation-water sources in Indonesia, this study classified water sources into three categories based on UNICEF and WHO classifications: improved, unimproved, and surface water. Improved water sources include bottled water (branded and refillable), piped water (metered and retailed), protected wells, protected springs, and rainwater. Unimproved water refers to sources such as unprotected wells and springs, while surface water remains categorized as "surface water".

Figure 3a shows that in 2019, 87% of households had access to improved sanitation-water sources, which increased to 88% in 2021. Over the study period, the proportion of households using unimproved and surface water sources decreased. A similar trend was observed in rural areas, except in 2021, where the proportion of households with access to improved sanitation-water sources decreased.

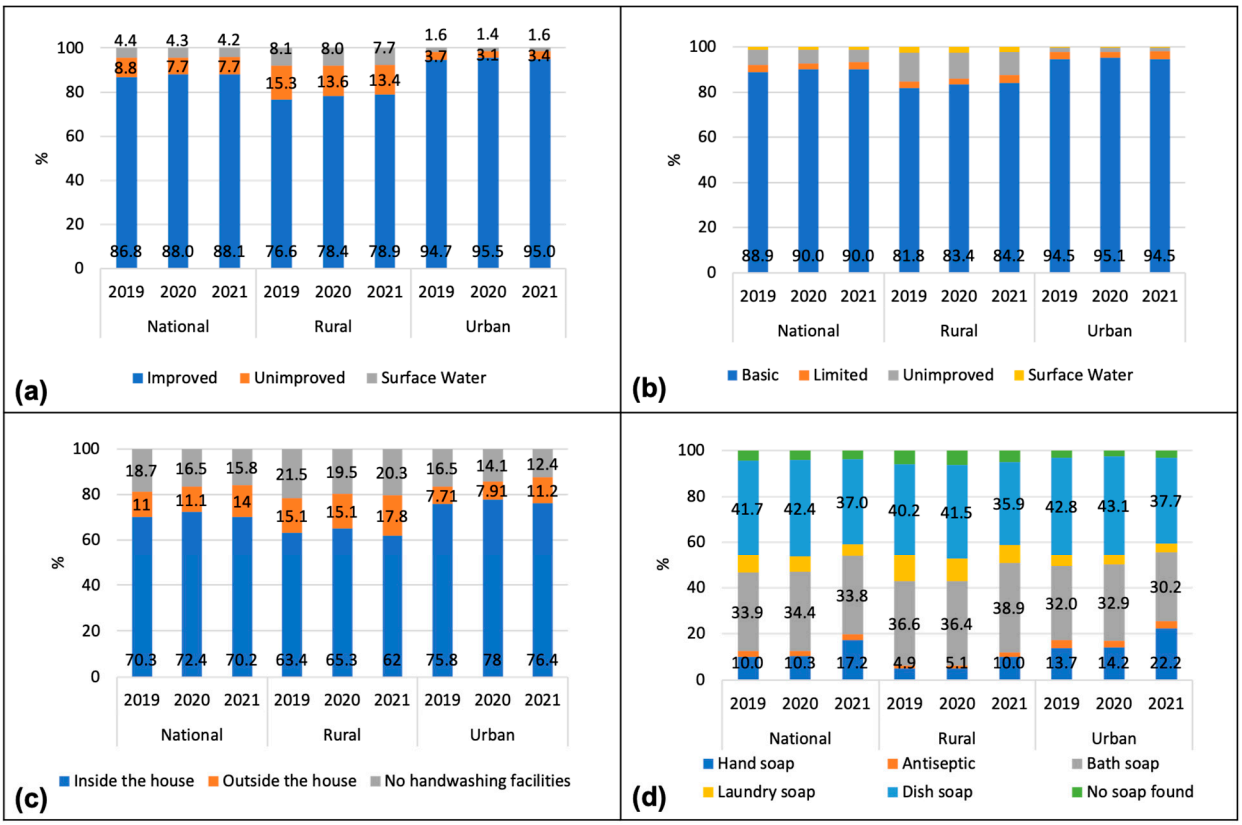

Figure 3. Percentage of households by (**a**) the accessibility of main sanitation-water sources; (**b**) the accessibility of main drinking-water sources; (**c**) the availability of hand washing facilities; (**d**) the availability of soap in hand washing facilities, in Indonesia 2019–2021 (refer to Table 1 for the description of the *n* values). Notes: All figures show a total of 100%, but due to space constraints, only notable proportions are displayed; for complete details, please refer to the Supplementary Materials (Table S3). Source: SUSENAS 2019–2021, authors' calculations.

Regarding drinking-water sources, this study classified them into four categories: improved, limited, unimproved, and surface water, following UNICEF and WHO classifications. Improved water sources, including branded bottled water, refilled water, piped water (metered and retailed), protected springs, protected wells, and rainwater accessible within 30 min, were the most commonly used by households in Indonesia. The percentage of households using improved drinking water sources increased from 89% at the beginning of the study period to 90% by the end of the study period (Figure 3b). In contrast, in urban areas, the usage of improved drinking-water sources decreased in 2021 due to increased prices, leading households to opt for limited water sources.

The availability of handwashing facilities showed an increasing trend from 2019 to 2021 (Figure 3c). In 2019, the majority of households in Indonesia had handwashing facilities, with 70% located inside the house and 11% located outside. In 2020, approximately 72% of households had handwashing facilities inside and 11% outside. In 2021, the availability of handwashing facilities outside the house increased to 14%, while the percentage of facilities inside decreased to 70%.

Similar patterns were observed in rural and urban areas. In 2020, there was an increase in the percentage of households with handwashing facilities inside and outside the house. However, in 2021, the percentage of households with facilities inside decreased, while those with facilities outside increased, possibly due to the recommendation of washing hands before entering the house after traveling [37].

The availability of water and soap in handwashing facilities also increased during the pandemic. In 2021, 98% of households had water available in their handwashing facilities, and the percentage of soap availability consistently increased over the study period.

Figure 3d shows that dish soap, bath soap, and hand soap were the most common types of soap found in household handwashing facilities. Dish soap availability reached 42% in 2019, bath soap availability reached 34%, and hand soap availability reached 10%. These figures consistently increased during the study period.

3.3. Water and Hygiene Products Use Pattern

This section highlights the main findings of the study regarding changes in water and hygiene product usage patterns during the pandemic compared with before. The analysis also incorporates socio-economic data obtained from SUSENAS to provide a comprehensive understanding of the observed changes.

3.3.1. Changes in Hygiene Activities Behavior

The respondents reported a substantial increase in hygiene activities during the pandemic compared with before, with a particular focus on handwashing (Figure 4a). Prior to the pandemic, respondents washed their hands an average of 6.6 times per day, which then doubled to 13.6 times per day during the pandemic (Figure 5). Similar findings were reported in another study, where handwashing frequency of less than 4 and 4–8 times per day increased to 8–12 times per day during the pandemic [19].

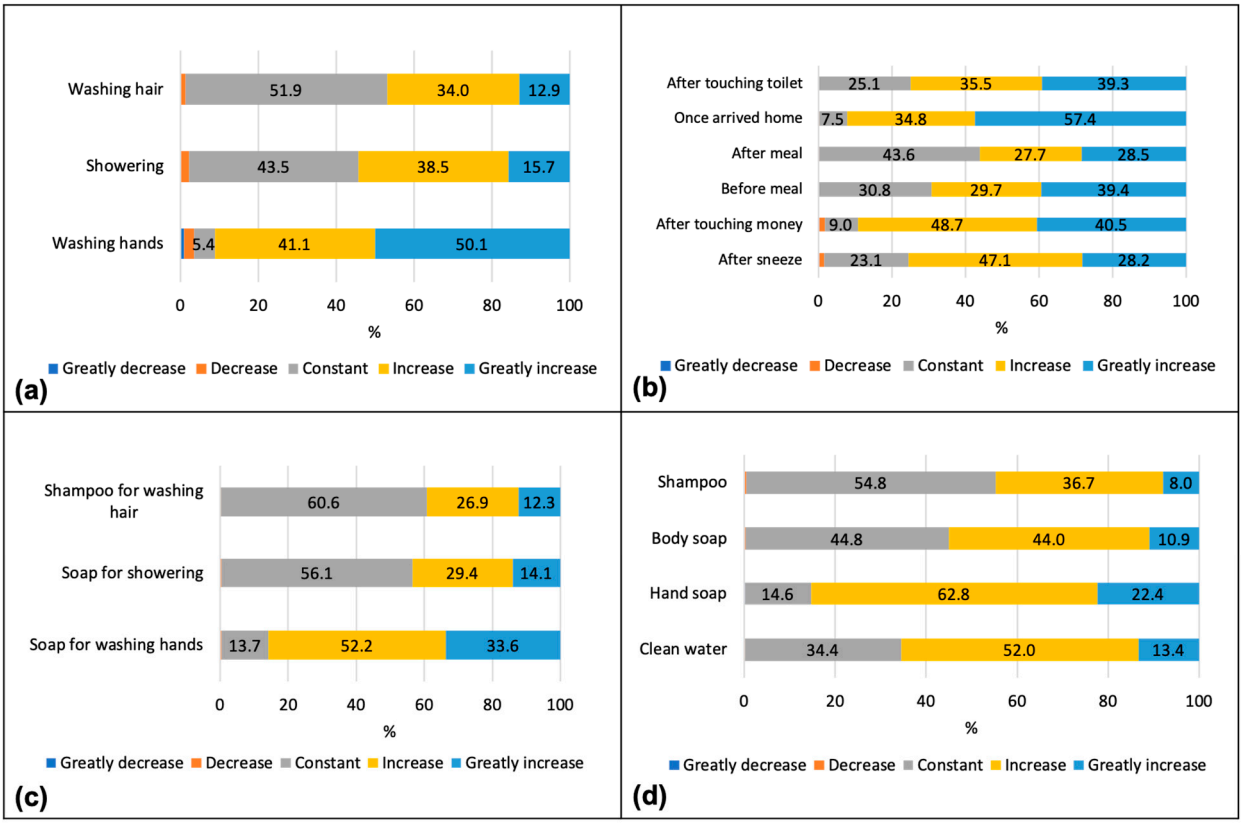

Figure 4. Changes in (**a**) frequencies of hygiene activities; (**b**) handwashing frequency; (**c**) hygiene products use frequency; (**d**) consumption/purchase quantity of water and hygiene product use, during the pandemic in comparison to before the pandemic. All figures are expressed in percentage of respondents with a total of 100% (n = 889). Due to space constraints, only notable proportions are displayed; for complete details, please refer to the Supplementary Materials (Table S2). Source: Online survey result.

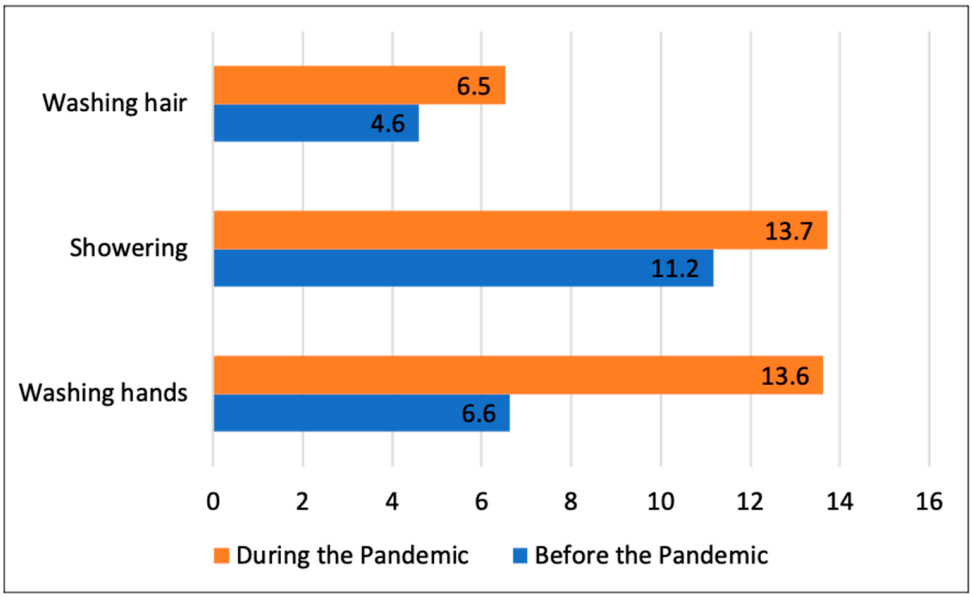

Figure 5. Average frequency of hygiene activities during and before the pandemic (n = 889). Source: Online survey result.

The increase in handwashing frequency was particularly noticeable upon arriving at home and after handling money (Figure 4b). There were also smaller increases observed for handwashing after touching the toilet, before meals, after sneezing, and after meals. This increase in handwashing frequency aligns with the rise in households with handwashing facilities during the pandemic (Figure 3c). Similar patterns were observed in studies conducted in Brazil and Saudi Arabia [38,39]. The heightened focus on hygiene activities during the COVID-19 pandemic can be attributed to the preventive measures aimed at maintaining hand cleanliness [39].

While some respondents reported an increased frequency of showering and hair washing, a notable portion (43.5%) reported no change in showering frequency, and (52%) reported no change in hair washing frequency (Figure 4a). On average, the frequency of showering slightly increased from 11.2 times per week before the pandemic to 13.7 times per week (twice a day) during the pandemic (Figure 5). Similarly, the average frequency of hair washing increased from 4.6 times per week before the pandemic to 6.5 times per week (once a day) during the pandemic. These findings are consistent with a study conducted in Saudi Arabia, where there was an increase in showering and hair washing frequency during the COVID-19 pandemic, likely due to preventive measures [39]. This increase in hygiene activities during the pandemic might result in increased water and hygiene product consumption.

3.3.2. Changes in Water and Hygiene Products Use

To assess the changes in water and hygiene product usage, respondents were asked about the frequency of using hygiene products and the quantity of water and hygiene products consumed or purchased. Figure 4c shows that there was a substantial increase in the use of hand soap, with 85.6% of respondents reporting an increase (52.2%) or a great increase (33.6%). The use of body soap (for showering) also slightly increased, reported by 43.4% of respondents. The use of shampoo showed an increase and great increase among 26.9% and 12.3% of respondents, respectively.

Regarding the quantity of water and hygiene product consumption/purchase, Figure 4d indicates a substantial increase in the consumption of hand soap, with 62.8% reporting an increase and 22.4% reporting a great increase. Consumption quantities of body soap and shampoo also increased, although to a lesser extent. The consumption of clean water was reported to increase by over half of the respondents and greatly increase by 13.4%

of the respondents. Similar trends were observed in studies conducted in Saudi Arabia and England, where water consumption increased during the lockdown period due to increased hygiene practices and remote work [10,40].

In terms of household behavior, SUSENAS data show that the availability of hand soap at handwashing facilities substantially increased from 10% in early 2020 to 17% in 2021 (Figure 3d). This shift indicates a preference for hand soap and antiseptic over dish soap and bath soap. The proportion of households with bath soap and dish soap decreased in 2021 compared with 2019. These findings align with the results of the online survey (Figure 4c) that showed a substantial increase in the use of hand soap.

Figure 6a presents the average household expenditure on bath soap, toothpaste, toothbrush, and shampoo. Notably, there was a slight increase in expenditure (0.18%) between 2019 and 2020, and this trend continued with a more pronounced rise of 5.9% between 2020 and 2021. Similar trends were observed in both urban and rural areas. It is worth noting that this surge in expenditure between 2020 and 2021 aligns seamlessly with the findings from the online survey (depicted in Figure 4d), which indicated an increased consumption of body soap and shampoo during this pandemic period.

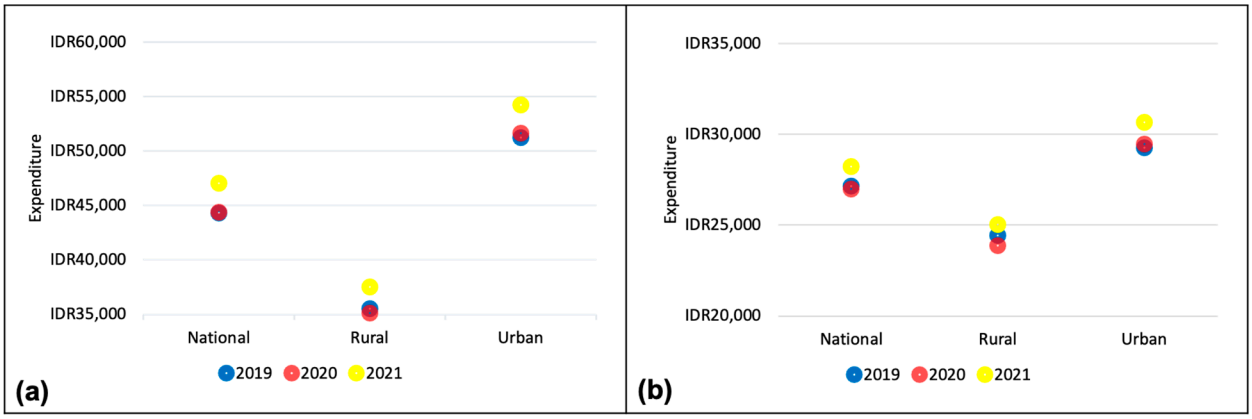

Figure 6. Average monthly expenditure on (**a**) bath soap/toothbrush/toothpaste/shampoo; (**b**) laundry soap, in Indonesia 2019–2021 (please refer to Table 1 for the description of the *n* values). Notes: IDR = Indonesian Rupiah. Source: SUSENAS 2019–2021, authors' calculations.

Figure 6b shows the household average monthly expenditure on laundry soap, which increased during the study period, primarily in urban areas. This increase could be attributed to the rise in showering frequency during the pandemic caused by the rapid increase in COVID-19 cases in the urban area (Figure 5). However, it is important to note that SUSENAS only provides expenditure information and not consumption quantities for these hygiene products.

Regarding piped water consumption, Figure 7a illustrates that at the national and urban levels, the average monthly quantity and expenditure increased in 2020, while a different trend occurred in rural areas, where both decreased over the study period. In 2021, the average monthly quantity of piped water consumption decreased at the national, urban, and rural levels. However, the expenditure on piped water still increased at the national and urban levels due to higher consumption and expenditure in the higher expenditure (decil) category. These findings align with previous studies indicating that piped water is more accessible to middle and upper-class households, while poorer households rely on free water sources [36].

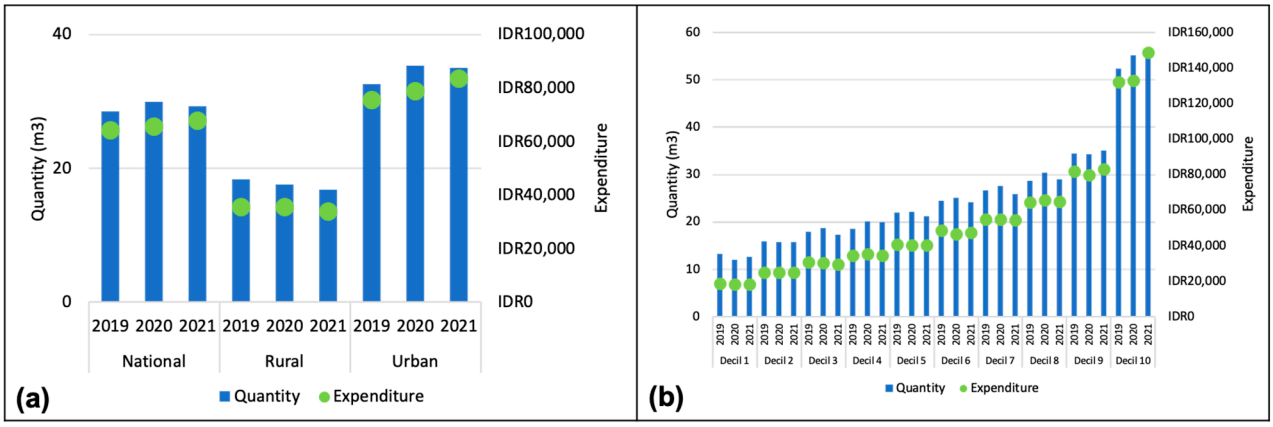

Figure 7. Average monthly quantity and expenditure on (**a**) piped water; (**b**) piped water based on household expenditure category, in Indonesia 2019–2021 (please refer to Table 1 for the description of the *n* values). Notes: IDR = Indonesian Rupiah. Source: SUSENAS 2019–2021, authors' calculations.

This study also examined the quantity and expenditure of bottled water consumption. At the national, urban, and rural levels, the average quantity of 19 L-bottled water increased in 2021, accompanied by a slight increase in expenditure (Figure 8a). This trend was likely driven by the growing demand for clean and more convenient sources of drinking water during the COVID-19 pandemic [41,42]. The greater increase in quantity compared with the rise in expenditure suggests that the household may have transitioned from branded (more expensive) bottled water to refillable (cheaper) bottled water in order to meet their drinking water needs while managing reduced income during the pandemic.

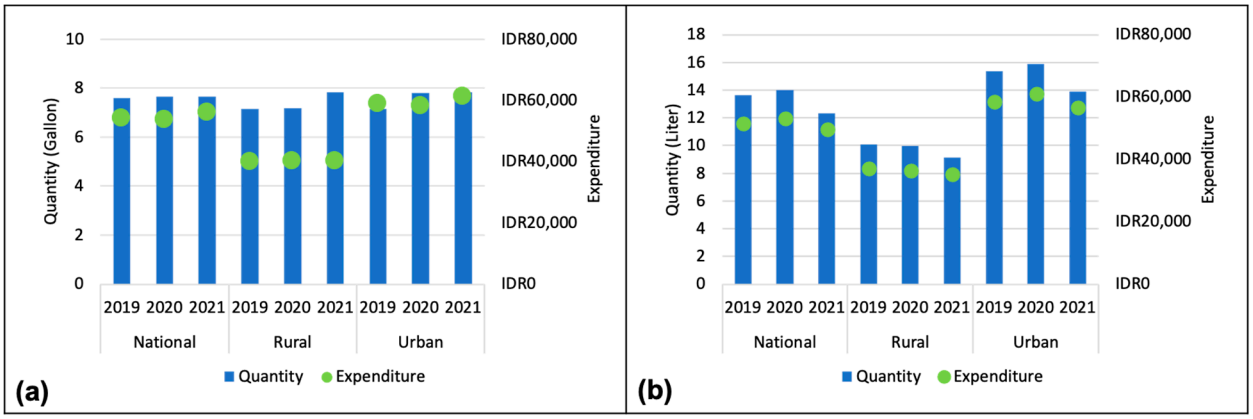

Figure 8. Changes in quantity and expenditure of (**a**) 19 L-bottled water; (**b**) liter-bottled water, in the pandemic in comparison with before the pandemic based on household expenditure category (refer to Table 1 for the description of the *n* values). Notes: IDR = Indonesian Rupiah. Source: SUSENAS 2019–2021, authors' calculations.

At the national level, the average expenditure on bottled water in smaller sizes (up to 1.5 L) increased in 2020, driven by higher consumption quantities (Figure 8b). In 2021, there was a decrease in the average quantity of consumption, followed by a decrease in average expenditure. This could be attributed to reduced mobility during the COVID-19 pandemic, leading to a decrease in the purchase of smaller-sized bottled water for traveling.

Overall, the findings indicate substantial changes in water and hygiene product use during the pandemic. There was an increase in the frequency and quantity of hand soap, body soap, shampoo, and clean water consumption. The availability of hand soap at handwashing facilities also showed a substantial increase. Expenditure on bath soap, toothpaste, toothbrushes, and shampoo increased over time. Piped water consumption

exhibited varying trends between urban and rural areas, with a decrease in quantity but an increase in expenditure. The consumption and expenditure of bottled water, both in larger and smaller sizes, increased in most areas, except for rural areas where a decrease in quantity was observed. These findings highlight the impact of the pandemic on water and hygiene behaviors, reflecting the increased emphasis on cleanliness and hygiene practices during this period.

3.4. Factor Associated with Water and Hygiene Product Use

Table 3 presents the results of (multivariate) logistic regression analysis on the factors influencing the increase in water and hygiene product use during the pandemic. Age significantly affected the increase in water use and hand sanitizer use. For each one-year increase in age, there was a 2.1% higher likelihood of using more water and a 3.8% lower likelihood of using more hand sanitizer. However, age did not significantly influence the use of more hand soap, body soap, and shampoo. This suggests that older respondents preferred washing hands with water rather than using hand sanitizer. Older individuals tended to wash their hands in various situations due to a higher perceived personal risk of COVID-19 infection [43]. On the other hand, younger individuals may have preferred hand sanitizer due to lifestyle factors and convenience. Access to handwashing facilities plays a role in this preference [44].

Table 3. Factors influencing higher quantity use of water and hygiene product, odd ratio (confidence interval).

Variables	M1 Clean Water OR (CI)	M2 Hand Soap OR (CI)	M3 Hand Sanitizer OR (CI)	M4 Body Soap OR (CI)	M5 Shampoo OR (CI)
Sex [a]					
Male (ref)	1	1	1	1	1
Female	1.099 (0.809–1.494)	1.084 (0.717–1.638)	1.083 (0.622–1.886)	0.872 (0.648–1.172)	0.867 (0.642–1.170)
Age [b]	1.021 ** (1.005–1.037)	0.998 (0.978–1.018)	0.962 *** (0.938–0.986)	1.009 (0.995–1.024)	1.003 (0.989–1.018)
Education [a]					
Up to high school (ref)	1	1	1	1	1
University	1.077 (0.603–1.923)	1.215 (0.602–2.453)	2.288 ** (1.020–5.134)	0.846 (0.479–1.496)	0.926 (0.518–1.654)
Occupation [a]					
Unemployed (ref)	1	1	1	1	1
Health personnel	1.661 (0.389–7.092)	0.465 (0.0958–2.262)	0.604 (0.0571–6.387)	1.695 (0.449–6.403)	0.896 (0.247–3.247)
Worker and Merchant	1.210 (0.604–2.423)	0.991 (0.402–2.442)	0.780 (0.262–2.325)	0.910 (0.484–1.712)	1.489 (0.784–2.828)
Civil Servant	0.929 (0.496–1.739)	1.230 (0.526–2.876)	0.752 (0.267–2.120)	0.934 (0.524–1.663)	1.247 (0.694–2.239)
Others	0.628 (0.322–1.225)	0.853 (0.357–2.040)	0.682 (0.238–1.953)	0.879 (0.469–1.648)	1.021 (0.538–1.940)
Working pattern [c]					
WFO (ref)	1	1	1	1	1
WFH and WFO	1.122 (0.683–1.843)	1.131 (0.586–2.184)	0.788 (0.352–1.763)	0.680 (0.423–1.093)	0.756 (0.468–1.220)
WFH	0.910 (0.596–1.390)	1.043 (0.595–1.827)	1.528 (0.701–3.329)	0.895 (0.593–1.350)	0.899 (0.595–1.358)

Table 3. *Cont.*

Variables	M1 Clean Water OR (CI)	M2 Hand Soap OR (CI)	M3 Hand Sanitizer OR (CI)	M4 Body Soap OR (CI)	M5 Shampoo OR (CI)
Monthly Income [c]					
≤0.5 M (ref)	1	1	1	1	1
0.5 M–1 M	1.218	1.096	0.451	1.328	1.569
	(0.501–2.962)	(0.384–3.126)	(0.144–1.410)	(0.560–3.148)	(0.649–3.794)
1 M–2 M	1.674	1.439	1.539	1.040	2.057
	(0.684–4.099)	(0.510–4.059)	(0.445–5.324)	(0.448–2.419)	(0.859–4.925)
2 M–3 M	1.216	3.319 *	1.744	1.004	1.224
	(0.525–2.815)	(0.969–11.36)	(0.437–6.961)	(0.452–2.231)	(0.540–2.772)
3 M–4 M	1.265	1.300	1.437	1.153	1.223
	(0.564–2.835)	(0.481–3.509)	(0.417–4.952)	(0.534–2.492)	(0.556–2.692)
4 M–5 M	0.958	1.615	2.533	0.901	1.316
	(0.418–2.194)	(0.549–4.753)	(0.591–10.85)	(0.406–2.000)	(0.584–2.966)
5 M–6 M	1.157	1.152	2.329	1.262	1.523
	(0.491–2.726)	(0.396–3.356)	(0.535–10.15)	(0.553–2.879)	(0.663–3.497)
6 M–7 M	0.892	2.263	2.905	0.748	0.655
	(0.364–2.184)	(0.633–8.084)	(0.554–15.24)	(0.316–1.772)	(0.267–1.602)
7 M–8 M	1.542	2.776	0.994	1.242	1.205
	(0.622–3.824)	(0.770–10.01)	(0.260–3.800)	(0.528–2.921)	(0.508–2.855)
8 M–9 M	0.840	0.928	1.789	0.558	0.719
	(0.334–2.114)	(0.293–2.936)	(0.352–9.094)	(0.228–1.366)	(0.287–1.805)
9 M–10 M	1.160	1.947	5.803	0.546	0.806
	(0.461–2.920)	(0.548–6.919)	(0.608–55.41)	(0.229–1.303)	(0.331–1.959)
>10 M	0.870	1.234	2.381	0.733	0.774
	(0.408–1.854)	(0.480–3.173)	(0.703–8.059)	(0.355–1.511)	(0.367–1.629)
Household size [b]	1.053	1.049	1.136	1.023	1.019
	(0.985–1.126)	(0.947–1.162)	(0.969–1.332)	(0.972–1.078)	(0.971–1.069)
Compliance index [b]	4.386 ***	13.552 ***	10.083 ***	6.680 ***	9.594 ***
	(1.453–13.24)	(3.589–51.17)	(2.074–49.02)	(2.186–20.42)	(2.917–31.55)
Perception index [b]	4.587 *	4.869 *	89.892 ***	8.530 **	24.957 ***
	(0.855–24.60)	(0.741–31.97)	(9.243–874.2)	(1.497–48.58)	(3.657–170.3)
Constant	0.047 ***	0.074 ***	0.031 ***	0.042 ***	0.006 ***
	(0.009–0.238)	(0.012–0.476)	(0.003–0.298)	(0.008–0.220)	(0.001–0.037)
Observations	889	889	889	889	889

Notes: The coefficients represent odds ratio of increase in water and hygiene product use during the pandemic. A 95% confidence interval in parentheses. Ref: reference category. Dummy variable [a], continuous variable [b], categorical variable [c]. Significance level at $p < 0.01$ ***, $p < 0.05$ **, $p < 0.1$ *. Source: online survey result, authors' calculations.

Respondents with a university education were 2.3 times more likely to increase their use of hand sanitizer during the pandemic compared with those without a university education. Higher education levels generally correspond to higher mobility and better access to hand sanitizer [45,46]. This finding could also be attributed to the understanding of hand sanitizer efficacy among individuals with higher education. However, education did not have a significant effect on water and other hygiene products. Similar findings were observed in a study conducted in Indonesia in 2020, where the educational characteristics of the respondents were limited and dominated by the highly educated [19].

The increased use of water and hygiene products was positively influenced by respondents' perception of COVID-19 and their compliance with health protocols. Respondents who perceived COVID-19 as dangerous and believed they were susceptible to infection were more likely to increase their use of water and hygiene products during the pandemic. Moreover, higher compliance with health protocols was associated with a higher likelihood of increased water and hygiene product use. These findings align with a similar study conducted in Indonesia [19].

Other socio-demographic variables such as gender, occupation, working pattern, income, and household size did not significantly affect the likelihood of increasing water and hygiene product use during the pandemic. The increased use of water and hygiene

products was not strongly influenced by economic status, work location, or household size but rather by adherence to health protocols and the level of concern about COVID-19.

4. Conclusions, Limitations, and Future Research Directions

This study's findings support the hypothesis that the pandemic has led to increased hygiene practices, particularly handwashing, in line with health protocols. This has resulted in a higher consumption of water and hygiene products. Socio-economic factors such as sex, income, occupation, working pattern, and household size did not significantly influence this increase. Instead, it was influenced by respondents' perception of COVID-19 (perceived danger and susceptibility to infection) and their compliance with health protocols. Age and knowledge about the efficacy and safety of hand sanitizer also played a role. Future research should explore lifestyle choices related to hand sanitizer preference and access to clean water during and after the pandemic. These findings highlight the importance of addressing COVID-19 perception in promoting better hygiene practices, and also raise concerns about increased water usage, domestic water pollution, and wastewater management during and after COVID-19.

This study reveals that access to improved drinking water sources in Indonesia remained stagnant throughout the pandemic, while there was an increase in the consumption and expenditure of bottled water. In developing countries like Indonesia, bottled water often comes in the form of refillable bottled water that has questionable quality, posing considerable health risks [47]. This presents a formidable challenge to Indonesia's pursuit of the global SDG 6 objective. Access to improved drinking water is fundamental to achieving the goal of "safely managed drinking water" as outlined in SDG 6.1.1. Moreover, the increased reliance on bottled water may stem from individuals perceiving it as safer or more convenient. However, it is crucial to emphasize that the escalated consumption of bottled water results in a proliferation of plastic waste, incurring both economic and environmental costs.

Conversely, this study highlights enhancements in handwashing facilities, soap availability, and the utilization of hygiene products during the pandemic. These discoveries contribute to the advancement of SDG 6.2.1, specifically addressing the "sanitation and handwashing facility" progress in Indonesia. Additionally, comprehending the role of SDG 6 in managing the COVID-19 pandemic, its influence on progress, and the imperative steps for accelerating SDG 6 development within this context holds paramount importance.

This study's robustness lies in its integration of an online survey with an analysis derived from a comprehensive national socio-economic survey, bolstering its reliability. However, it is crucial to acknowledge the limitations of the online survey, which primarily attracted highly educated and middle- to upper-class respondents due to the recruitment methods used. Furthermore, the overrepresentation of respondents from Java Island may restrict the generalizability of the study's outcomes to the broader Indonesian population. Caution is warranted when extrapolating these results. Another limitation pertains to the self-reported nature of the survey, as some respondents may have tailored their responses to present themselves as more 'hygienic,' potentially impacting the data. Nevertheless, the study's reliability is strengthened by its incorporation of insights from the comprehensive national socio-economic survey, ensuring a more holistic understanding of the subject matter.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/w15193405/s1, Table S1: Demographics of Web-based Questionnaire Respondents; Table S2: Web-based Questionnaire Results; Table S3: Descriptive Statistics and Mann-Whitney Tests of SUSENAS Data; Table S4: Web-based Questionnaire Form.

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Data Availability Statement: The data that support the findings of this study are available from the corresponding author, [A.K.], upon reasonable request.

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