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# Hand cleaning activities during COVID-19 pandemic and the manifestation on human skin: a retrospective study

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**ABSTRACT**

Hand sanitizing is a popular hand-cleaning technique during the pandemic.In the present article, a retrospective study by observational and quantitative data analysis involving 155 respondents were collected through questionnaires. The most intense methods of hand-cleaning activities (i.e. hand sanitizing, hand washing with soap, alcohol rubs, wet wipes, dried wipes and hand washing with water only) were investigated. Manifestation on human skin was evaluated personally by take into account to the real condition of the authors. Validity of the retrospective questionnaire was assessed by made comparison to the prospective journal which considered as the reference method. As the result, hand-washing with soap is the most preferred hand-cleaning method during pandemic (94 %, total sample population n = 155). Adverse event by the usage of alcohol might observed during the first 4.5 months of the pandemic period.

**ABSTRAK**

Sanitasi dengan handsanitizer merupakan cara membersihkan tangan yang populer selama pandemi. Dalam makalah kali ini, penelitian retrospektif menggunakan analisis data observasional dan kuantitatif yang melibatkan 155 responden diperoleh melalui kuesioner. Metode membersihkan tangan yang paling sering, (dengan handsanitizer, mencuci tangan dengan sabun, alkohol, tisu basah, tisu kering dan mencuci tangan hanya dengan air) diinvestigasi. Efek samping pada kulit manusia dievaluasi secara individu dengan melihat kondisi riil dari peneliti. Validitas dari retrospektif-kuisioner dinilai dengan membandingkannya dengan jurnal-prospektif yang dianggap sebagai pembanding. Hasilnya, mencuci tangan dengan sabun adalah metode pembersihan tangan yang paling sering dilakukan selama pandemi (94%, total populasi sampel n = 155). Efek samping akibat penggunaan alkohol dapat teramati pada 4,5 bulan pertama periode pandemi.

## INTRODUCTION

Corona virus disease 2019 (COVID-19) pandemic hits almost the whole part of the world. Indonesia is a country in the South East Asia that makes up tourist destinations as its national economic income.[1] Bali, Yogyakarta, Lombok, Toraja, Luwuk, and many other places are being the area for the international destinations with high traffic of tourist visitors. To keep the business runs, self-hygiene (in order to reduce the personal risk) and self-awareness (to increase the community safety) were became special concern for the Indonesian society and taken importantly, especially, during this pandemic era.

Hand sanitizing is a popular hand-cleaning technique during the pandemic. A recent report stated that the retail sale of personal hygiene product in Indonesia was elevated, not only for the hand sanitizer (200 %), but also for the liquid hand soap (285 %), liquid antiseptic (233 %) and wet wipes (151 %).[2] This phenomenon urges the authors to investigate the new consumption pattern

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intensities, the hand cleaning agents and the risk may be faced by society due to the new habits.

United State Centers for Disease Control and Prevention (CDC) explains although alcohol-based hand sanitizers can quickly reduce the number of germs in many situations, they should be used in the right situations.[3] It also mentioned that the hand sanitizer may not able to remove harmful chemicals like pesticides and heavy metals. On the otherhand, hand sanitizer is only effective for sanitizing when the alcohol concentration was sufficient i.e. between 65-95 %.[4] Ethyl alcohol or ethanol contained in hand sanitizers safe to be used for external exposure. However, a review study revealed that 17 publications were reporting serious adverse events including hypoglycemia, seizures, and death of children caused by the ingestion of ethanol-based products, that may be also applicable to hand sanitizers.[5]

In the present article, a retrospective study by quantitative data analysis involving 155 respondents were collected through questionnaires. The most intense methods of hand-cleaning activity were investigated. Manifestation on human skin was evaluated personally by take into account to the real condition of the authors. No clinical-interventions nor preclinical treatments were conducted in this study. The investigation by spreading questionnaire was limited only for market study.

## MATERIALS AND METHODS

### General design

This study employed an observational design with retrospective data collection. Validity of the retrospective questionnaire was assessed by made comparison to the prospective journal which considered as the reference method.

### Participants

The respondents were recruited through random sampling. The questionnaire (provided by using online formulary) spreads via Facebook (Fb Group) and Whatsapp (WA Group) communities in Indonesia. The inclusion criteria were determined as: Indonesian citizen whom stay in Indonesia during COVID-19 pandemic. Both male and female, by age range between 20-80 years are allowed to be participate. The exclusion criteria were determined as: Indonesian citizen whom stay abroad. Foreigners (non-Indonesian) residence in Indonesia during pandemic were also neglected in this study. As our finding, 155 out of 157 respondents comply with the inclusion criteria. Two respondents were identified as the outliers. Uneven number of the respondents were distributed in 13 out of 34 provinces in Indonesia. More than 60 % of the respondents live in the Java Island (centrum of the COVID-19 pandemic, during the first 4.5 months, in Indonesia).

### Desired outcomes

Data of the daily hand-cleaning intensities, the preferred methods for daily hand hygiene, and the total consumption of hand-cleaning agents were collected through questionnaire. Data of the manifestation on the human skin was collected through self-investigation (based on the author experience).

### Data analysis

Data were presented as frequency or percentage and descriptively analyzed.

## RESULTS

Hand-washing with soap was the most preferred (94.19 %; population n= 155) hand-cleaning method during COVID-19 pandemic in Indonesia (FIGURE 1). The hand sanitizing (48.39 %) and alcohol rubs (15. 48 %) were among the second and the third most frequent hand-cleaning methods, subsequently. Besides, few respondents were also clean their hands by using wet wipes (11.61 %), only with water (8.39 %), and with dried wipes (7.74 %). Since respondents may choose more than one hand-cleaning methods for this question, mix answers were possibly resulted.

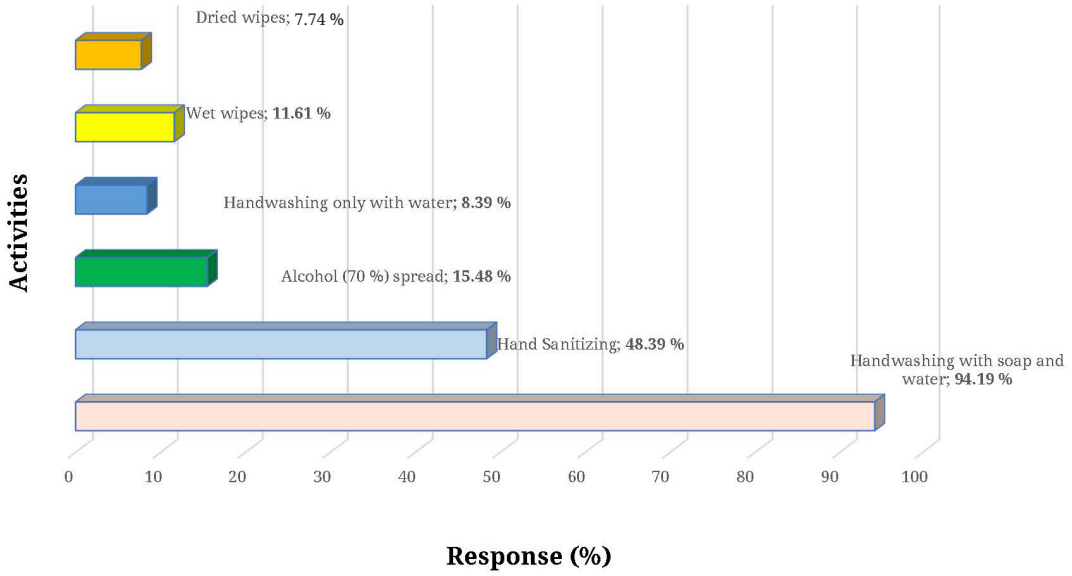



FIGURE 1. Frequent hand cleaning activities during pandemic in Indonesia. Out of 155 respondents (a). 94 % washed their hands with soap, (b). 48 % were also using hand sanitizer, while (c) about 15 % of the total respondents clean their hand with alcohol. Mix answers were possibly resulted.

It was quite surprising that the responses ratio between hand-washing with soap almost two folds (2x) higher than the hand-cleaning with sanitizer. On the other hand, cleaning with hand sanitizer gained three folds (3x) higher responses than hand-cleaning by alcohol rubs. It also received five folds (5x) higher responses than the hand washing without soap (water only). Even though hand sanitizer was composed by ethanol 70% (similar to the alcohol rubs), however, it contains glycerin as the moisturizing ingredient. Thus, it made less irritating compared to alcohol rubs.

During pandemic, the daily hand-cleaning intensity among respondents (n=155) were mostly around 5-10 times/day (63.23 %). About 27 % respondents tend to clean their hands >10 times/day. Interestingly none of them were cleaned their hand <3 times/day, as depicted in FIGURE 2. These data explained on how frequent the respondents get contact with the cleansing agents. The higher of the hand-cleaning intensity, the higher risk of manifestations to the skin are prone to be exist.

About 121 respondents revealed that monthly consumption of the liquid soap during pandemic was around 50-2500 mL/month, as shown in FIGURE 3A. Liquid soap for personal usage was around 50-450 mL/month (1 small bottle). In terms of family usage, monthly consumption of the liquid soap was around 500-2000 mL (1 - 2 big bottles). Most respondents were preferring big bottles for family usage. On the other hand, the hand-washing activity by using bar soap should not be neglected (FIGURE 3B). Besides liquid soap, around 49 respondents were also taking bar soap for their daily hand cleaning activity.

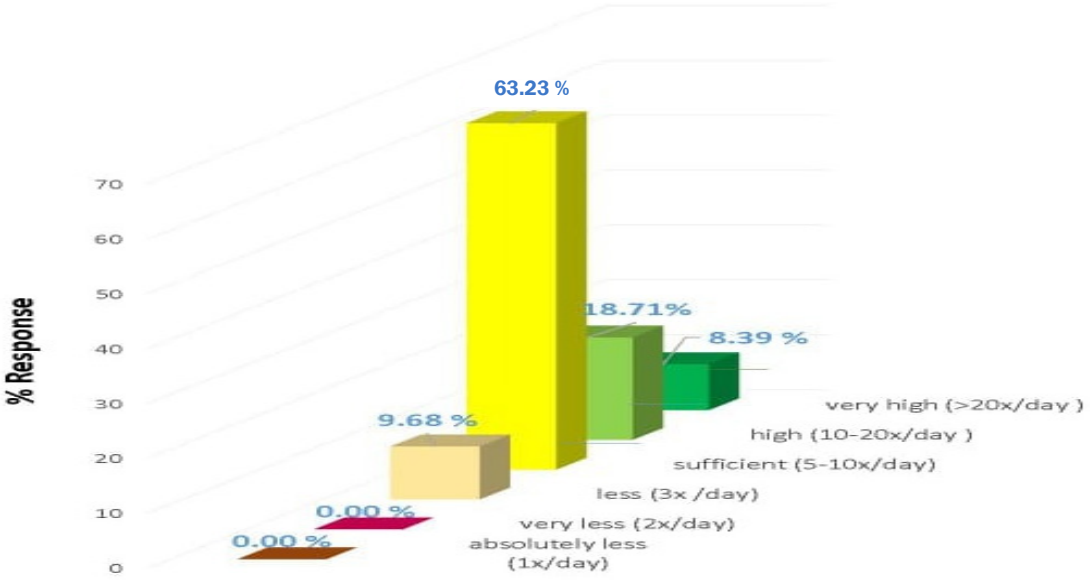



FIGURE 2. Daily hand cleaning intensity (n=155). Around 63.23 % washed their hands 5-10 times/day, while 27 % were ≥10 times/day. None of them clean their hand <3 times/day.

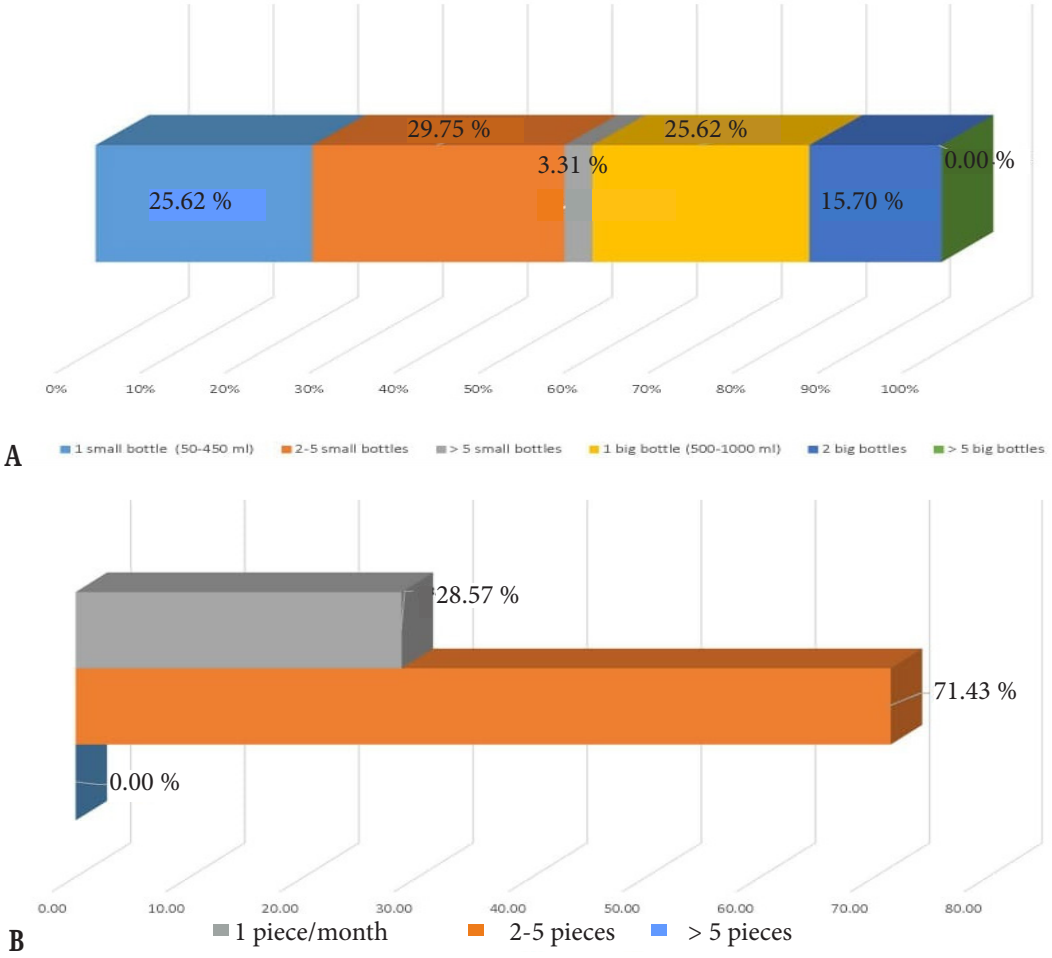



FIGURE 3. Monthly soap consumption. A) Liquid soap (mL/month) and B) Bar soap (pieces/month) consumption

According to the FIGURE 4, 118 out of 155 respondents (n=118) use hand sanitizer. Surprisingly most of them (83 %) were only consume 0.05 – 0.45 L hand-sanitizer per month. About 12.71 % took between 0.5 – 1 L of hand sanitizer. While 4 % of the respondents use >1 L/ month. This is quite surprising, because with a cleaning frequency of ≥ 5 times/ day the amount of hand sanitizer 0.45 L is too small to meet the monthly needs. Thus, we assumed that hand sanitizing is not the preferred hand-cleaning method among the respondents. This result was in line with FIGURE 1.

In general, 54 persons were also choosing alcohol rubs as their hand cleaning method. Most of them (83 % out of 54 respondents) were taken 50-450 mL alcohol/month (FIGURE 5). About 15 % of the respondents took 0.5 – 1 L/month. Interestingly, 2 % of the respondents took > 1 L alcohol/month for their hand cleaning purpose.

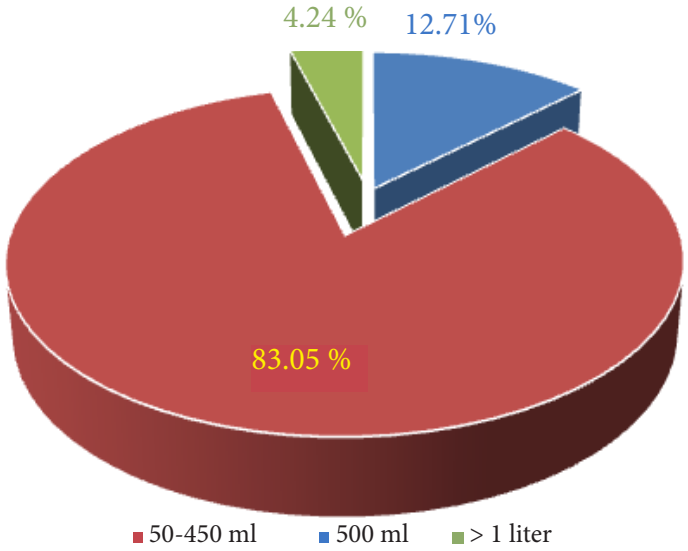



FIGURE 4. Monthly consumption of hand sanitizer during pandemic (n = 118).

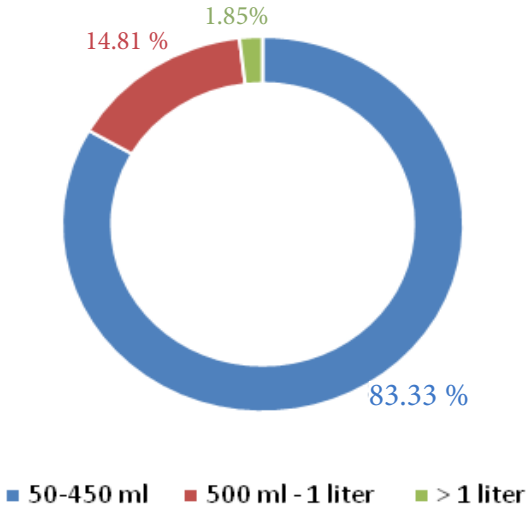
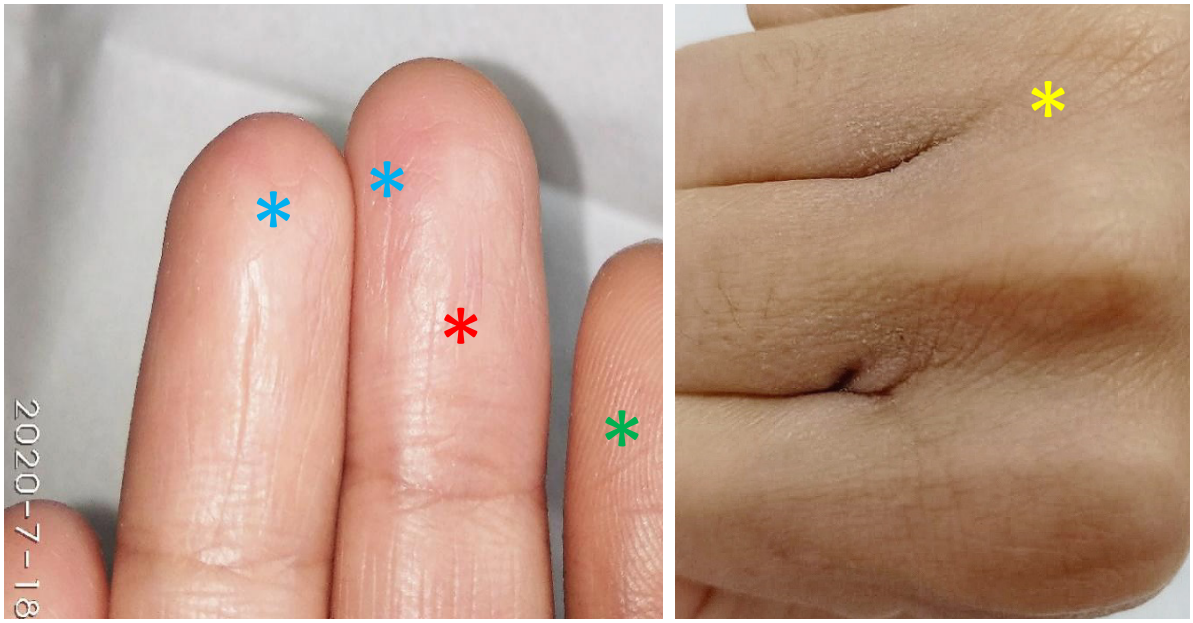



FIGURE 5. Monthly alcohol spread (rubs) consumption (n = 54).

## DISCUSSION

Indonesia is located in the tropical area. First, it is sun bathed for the whole year. Second, it has high humidity which should keeping the skin away from dryness and getting rash easily. The UV light ensure sufficient supply of vitamin D to the body. Aranow[6] reported that vitamin D can modulate the innate and adaptive immune responses. However, deficiency in vitamin D is associated with increased autoimmunity as well as an increased susceptibility to infection. Beside, personal self-hygiene by using soap and alcohol are believed to be able to protect us from the COVID-19 infection. World Health Organization stated that of the published studies available, many describe that nurses who routinely use alcohol rubs have less skin irritation and dryness than those using soap and water.[7] It was also mentioned that alcohol can work more effectively compare to the antimicrobial soaps in order to reduce bacterial and viral counts on the hands.[8]

Interestingly, based on the authors experience, intense hand-cleaning activity by using alcohol rubs during early COVID-19 pandemic in Indonesia quite the contrary to the previous statements (FIGURE 6A). The first COVID-19 in Indonesia was officially announced by Indonesian government at March 2, 2020.[9] While the retrospective data in the present study were collected between the end of June – the mid of July 2020. Simply, the authors have been applying self-hygiene (intense hand cleaning activity) for 4.5 months. As the result, it leads to skin irritation as depicted in FIGURE 6A and FIGURE 6B.




A B

FIGURE 6. A) Left picture: a normal hand's fingerprint was pointed by the green star. Broken fingerprints due to frequent alcohol rubs (> 20 times/day) pointed with the red star. Irritation (rash) on the finger skin pointed with the blue star. B) Right picture: dried skin on the hand caused by frequent hand soap (10-20x/day). The total duration of hand-cleaning activity with alcohol rubs and with soap were 4.5 months (during early pandemic in Indonesia).

Soap and hand sanitizer are hand hygiene products which generally tolerable to be used and normally less irritating. Since the COVID-19 outbreak occurred, the number of hand cleaning intensity, which also means constant-contact to the hand cleaning agents were increased. As a result, the potential risk to the skin reactions caused by the hand hygiene products was triggered.

There are two main common skin reactions caused by hand hygiene product. First is irritant-contact dermatitis. The symptoms of this reaction could be varied for everyone, from mild to severe. Second is allergic reactions.[10] As a surfactant, soap was able to reduce the surface tension of lipids and water on the skin. The cleansing ability of soap, on the other hand, has negative effects especially to disturb the protective barrier on the stratum corneum.[11]

The irritant-contact dermatitis usually occurs by the disrupted-function of defensive skin barrier. This condition leads to abnormal regulation of water and electrolytes movement in stratum corneum. In line with soap, frequent use of alcohol rubs has lipid-dissolving ability thus repeals the lipid content in the stratum corneum.[12]

The stratum corneum consists of: a). sebum (which lines the outermost), b). corneocytes (that bounds by epidermal tight junctions), and c). intracellular lipids (that essential to maintain skin moisture).[13] Further, the stratum corneum is often described as a brick and mortar structure; with cornecytes as the bricks and the intracellular lipid layers (that fill the space between the cornecytes) as the mortar. This arrangement is the main function of the skin as defensive-barrier toward allergen. Moreover, it also minimizes the water loss from the body[11] (FIGURE 7).

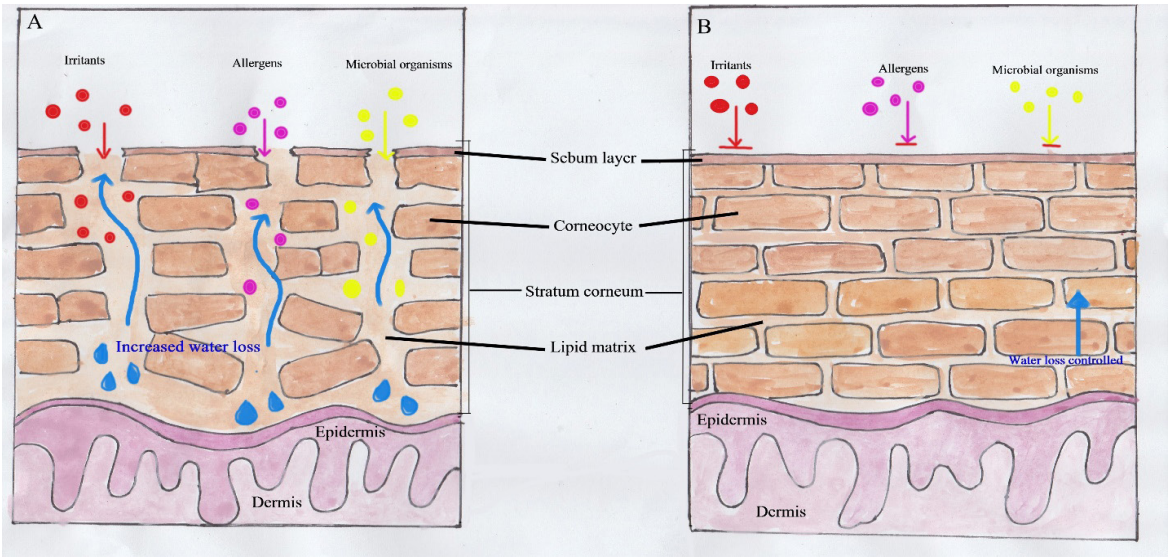



FIGURE 7. An illustration of A) the disrupted stratum corneum and B) the normal stratum corneum.[13] Healthy skin has natural barrier called stratum corneum (SC), an important part of the skin, that protects it from the evaporations (skin water loss), the irritants, the microbial invasions, and the allergens. SC mostly consists of corneocytes and intracellular lipids that kept the skin functions normally (B). Disrupted structure of the SC might causes an elevation of the trans-epidermal water loss, decreases the SC moisture, and increases the skin acidity.

To the authors experience, high frequent hand-cleaning activity (≥ 20 times daily) during early COVID-19 pandemic (4.5 months) with alcohol rubs and hand soap induced local skin irritation, as depicted in FIGURE 6A and FIGURE 6B. As the hand cleaning intensities were increased, the depletion of the skin layer occurred more progressively. Once the depletion is getting worse (reach the basal layer), e.g. due to high intensity of alcohol rubs (FIGURE 6A), the skin manifestations might arise. This situation can develop into worse conditions such as the occurrence of skin cracking to open wounds in the hand area.

In the normal stratum corneum the water-loss on the skin is under control. The sebum layer plays an important role at its inhibiting mechanism. However, in an abnormal condition (disrupted stratum corneum), the skin loses some sebum layers. As a result, an enhancement of the water loss is inevitable. Hence, it is logic that high frequency of hand cleaning by soap prone to lead skin dryness (FIGURE 6B).

Furthermore, disruption on the skin layer potentially causes skin irritants and microbial organisms to enter deeper layers of the skin.[13] This disruption could be reduced by avoiding traditional alkaline soap and replacing it with creamy soap.[14] Just like hand washing with soap, alcohol based hand sanitizers and alcohol rubs were also able to cause skin dryness and irritation by lipid-dissolving effects of the alcohol.[12]

Even though the WHO[7] explained that the modern alcohol-based hand rubs should not dry the hands since it is all contain skin softeners which help to prevent from drying. However, the COVID-19 pandemic was unpredicted while it spreads rapidly. This condition leads to the unprecedented rapid and high volume of alcohol as well as softeners demand, worldwide. Moreover, 95% of the chemical's raw materials in Indonesia is imported.[15] By the hit of COVID-19 pandemic, there might be a problematic situation, which good quality of alcohol rubs were hardly to obtain especially during early pandemic period. We experienced a moment in which alcohol and sanitizer ran out of supplied either in drug stores or in supermarkets. However, soap stock in supermarkets is enormous. The price for (both liquid and bar) soap is relatively normal. While the cost for alcohol and hand sanitizer were elevated significantly in some areas. This might be the reason that 94.19 % out of 155 respondents (FIGURE 1) prefer to make their frequent hand-cleaning activity with soap.

Formerly, we hypothesis the daily hand-cleaning intensity (FIGURE 2) might correlated to the typical-jobs of the respondents. However, since the government locked down (locally known as PSBB) several provinces in order to cope the spreads of COVID-19 (between April 26 – July 16, 2020), our early hypothesis could not be justified. Everyone was stayed at home which lead to less physically contact with others. While this study done between June 22 - July 7, 2020. Thus frequent hand-cleaning intensity should not correlate to the typical-job of the respondents.

The monthly consumption of the liquid soap (FIGURE 3A), bar soap (FIGURE 3B), hand sanitizer (FIGURE 4) and alcohol rubs (FIGURE 4) were indicating market demand on the mentioned products. Soap ranks as the most chosen method for hand-cleaning activity during early pandemic period. In conclusion, hand-washing is the most preferred hand-cleaning method during pandemic in Indonesia. The adverse event by the usage of alcohol rubs could be observed at the first 4.5 months of pandemic period.

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