

MKMI

MEDIA KESEHATAN MASYARAKAT INDONESIA

The Indonesian Journal of Public Health

Smoking Cessation Experience and Socioeconomic Status of Online Motorcycle Taxi Drivers in Surabaya

Knowledge, Motivation, and Attitudes of Truck Drivers Performing First Aid

Self-Efficacy in Relation to Personal Care and The Health-Related Quality of Life of Hemodialysis Patients

Innovation on Preventing the Covid-19 Spread Using "Cool" Personal Protective Clothing for Healthcare Workers

Differences in Help-Seeking Behavior in Adolescents with Anxiety Disorder During the COVID-19 Pandemic

Terakreditasi Nomor : 12/M/KP/II/2015
Bekerjasama dengan IAKMI

Volume 18 No 4, December 2022



BPJS Patients Satisfaction Analysis Towards Service Quality of Public Health Center in Surabaya

Didit Darmawan¹, Fayola Issalillah^{2*}, Rafadi Khan Khayru², Andi Raina Ananda Herdiyana³, Arif Rachman Putra¹, Rahayu Mardikaningsih¹, Ella Anastasya Sinambela¹

¹Program Study of Management, Faculty of Economics, Sunan Giri University, Surabaya, Indonesia

²Program Study of Medical Education, Faculty of Medicine and Health Sciences, Maulana Malik Ibrahim State Islamic University, Malang, Indonesia

³Department of Management, Leeds Beckett University

*Authors Correspondence: fayola.issalillah@gmail.com/085109214999

ARTICLE INFO

Article History:

Received Mar, 25th, 2022

Accepted Sept, 28th, 2022

Published online Dec, 30th, 2022

Keywords:

Patient satisfaction;

SERVQUAL;

CSI;

public health center;

BPJS health insurance;

ABSTRACT

Surabaya is a growing city and actively develop basic service innovations through Public Health Center (PHC) such as implementing E-Health services, *BPJS* p-care, including various quality health services and oriented in increasing patient, family, or public satisfaction in Surabaya. The purpose of the study was to identify the level of satisfaction of *Badan Penyelenggara Jaminan Sosial (BPJS)* and *non-BPJS* patients with the quality of health services at Manukan Kulon PHC. This research method was a cross-sectional study. The measuring satisfaction instrument used the patient satisfaction index (Customer Satisfaction Index (CSI)). Meanwhile, the satisfaction dimension used the SERVQUAL Principle by looking at the value of gap between expectation and reality from the aspects of responsiveness, tangibles, assurance, empathy, and reliability. The research sample was determined by simple random sampling and the total samples collected were 110 respondents (67 *BPJS* patients and 43 *non-BPJS* patients). The results showed that *BPJS* patients were more satisfied (CSI 83.9%) than *non-BPJS* patients (CSI 83.4%). Specifically, *BPJS* patients' satisfaction dimension gap related to responsiveness is (0.3), tangibles (-0.3), assurance (0.9), empathy (0.6), and reliability (-1.0). While *non-BPJS* patients have a satisfaction gap value for responsiveness (-0.1), tangibles (0.1), assurance (0.1), empathy (0.2), and reliability (0.1). This means that in general, *BPJS* and *Non-BPJS* patients are very satisfied with the health services of Manukan Kulon PHC. However, it is necessary to prioritize service improvement on the aspects of responsiveness, tangibles and reliability as expected by patients.

INTRODUCTION

Puskesmas, known as Public Health Center (PHC), plays an important role as a first-level health service with a purpose of maintaining the level of public health. Various health services at public health center have been provided based on service standard, including curative, rehabilitative, promotive and preventive. The target of this service was expected to cover all levels of society and meet the basic needs of public health.¹

As one of the big cities in Indonesia, PHCs in Surabaya have various developments of health facility in order to achieve optimal public health for their citizen. Currently, PHC in Manukan Kulon has existed since 1981 and has been equipped with supports, such as E-Health and *Badan Penyelenggara Jaminan Sosial (BPJS)* which can support the provision of health services. E-Health is an innovation of Surabaya Health Department in the form of integrated information technology that was launched on November 10, 2014.^{2,3} This program is more developed than the national health insurance application (*JKN mobile*) which introduced in 2017 and reported has data synchronization issues.² E-Health provides simpler registration service to PHC and can be accessed through the website on www.ehealth.surabaya.go.id, mobile application and outlet that are available at PHC in this city.⁴ Manukan Kulon PHC has the most E-Health users in 2018 with a total of 81,932. This program hopefully can overcome the entry load problem and queuing time as well as maintaining the quality of medical resumes which directly make it easier for patients to refer from public health center to hospital or vice versa.^{3,5}

In addition to E-Health, *Badan Penyelenggara Jaminan Sosial (BPJS)* is involved as one of the supporting health service components in Manukan Kulon PHC. *BPJS* is a Guaranteed health protection for Indonesian citizen who are members of this program. These members include everyone who pays according to the stipulation of contributions as well as certain people whose their contributions are paid by the government such as people who cannot afford or poor. *BPJS* services provided at PHC including outpatient costs, medicines and referrals to hospital. Unfortunately, this program still gets complaints from the public, especially policy issues that are not clear and considered unprofessional.⁶

The two supporting services at public health center, E-Health and *BPJS* health insurance, are expected to make it easier for patients to get health services. This is also expected to be one of the efforts in fulfilling the interest of health of every Indonesian citizen through facility and services throughout Indonesia as guaranteed in one of Indonesia regulation verse 34 paragraph 3. Always monitor which can be assessed from the level of patients' satisfaction.⁷

Patients' satisfaction is a condition that is felt by the patient after comparing the level of their expectations of the services provided with the reality that is felt after receiving the service. The level of satisfaction can be influenced by various factors, one of them is the quality of service from health facility. According to Maqsood et al. good service quality is very important in health facility because this factor has a positive effect on patients' satisfaction.⁸ Helia et al. also shows that the five aspects of service quality (responsiveness, tangibles, assurance, empathy and reliability) have an effect on patients' satisfaction at provincial hospital in DIY.⁹ Therefore, PHC is expected to provide quality services in order to fulfill patients' satisfaction.

Previous research related to the level of satisfaction of *BPJS* patients has been carried out several times in various regions. Research conducted by Astutik et al. showed that *BPJS* patient satisfaction had a significant Correlation to the service quality of PHC.¹⁰ Putri also found that the satisfaction level of *BPJS* patients was different from *non-BPJS* patients (general) at Boom Baru PHC in Palembang. *BPJS* patients are very satisfied (CSI = 80%) while regular patients are satisfied (CSI = 77%) with the gap for each dimension is positive which means the level of patients' satisfaction with the services provided by PHC has been fulfilled.¹¹ However, there has been no study on *BPJS* patients' satisfaction at PHC in Surabaya, especially Manukan Kulon PHC. Therefore, this study analyzed the satisfaction level of *BPJS* patients and *non-BPJS* patients based on the service quality of Manukan Kulon PHC in Surabaya.

MATERIAL AND METHOD

This cross-sectional study was conducted in December 2021 towards Manukan Kulon PHC patients as the population. Samples were taken from patients using E-Health and determined us-

ing Simple Random Sampling Technique with the minimum based on the Slovens Formula. The sample was 110 patients which divided into 67 patients with *BPJS* health insurance patients as group A and 43 patients without *BPJS* as group B. Ethical clearance of this study in the form of approval letter from chief of Manukan Kulon PHC and a contract sheet with the respondent as substitution of study ethical clearance during data collection. The questionnaire used in this study related to service quality as the independent variable and patients' satisfaction as the dependent variable. It is made based on 5 dimensions of SERVQUAL Parasuraman and has met the validity and reliability test standards. The questionnaire consisted of 20 items which are detailed as 4 items for each service quality dimension (responsiveness, tangibles, assurance, empathy, and reliability) and used the likert scale for patients' satisfaction (1 for strongly disagree until 5 for strongly agree).

The data obtained were analyzed using Customer Satisfaction Index (CSI) and service quality (SERVQUAL). CSI is calculated by the perception and expectation values of each item on the question, while the gap on SERVQUAL is obtained from the difference in perception and expectation of each component of the question and average value of gap in each dimension regarding the quality of service provided. The CSI method is more widely used in the assessment of service quality because it has greater influence on the level of patient satisfaction than other method like the Importance Performance Analysis (IPA) which focuses more on the value of the service itself. The calculation formula and its interpretation of each analysis method as follows:

$$CSI = \frac{T}{5 \times Y} \times 100\%$$

$$SERVQUAL = perception - expectation$$

T= Total of score

5= Maximum score of the measurement scale

Y= Total score of the expectation aspect

RESULTS

Patients' Characteristic

Based on the analyzed data in Table 2, most of the patients at Manukan Kulon PHC were women (*BPJS* 67.21%; *non-BPJS* 69.76%), aged 36 years old in the *BPJS* group (43.28%) and 25-35 years old in the *non-BPJS* group (46.51%). In addition, most of them are dominated by high school graduates (*BPJS* 38.80%; *non-BPJS* 34.88%) and unemployed which housewives make a major contribution to both groups (*BPJS* 62.68%; *non-BPJS* 43.18%).

The Satisfaction Level in *BPJS* Health Insurance Patients and Non-Insurance Patients Towards Service Quality of Manukan Kulon PHC

The measurement of patients' satisfaction is based on the CSI score derived from satisfaction dimension calculation, including aspects of responsiveness, tangibles, assurance, empathy, and reliability calculated according to the value gap between expectation and reality. According to the total expectation value (Y) and the total score (S) in Table 3, the patients' satisfaction of group A with *BPJS* health insurance patients were 83.91%. Meanwhile, the patients' satisfaction of group B patients without health insurance was slightly lower by 83.35%. These data show that the patients of Manukan Kulon PHC either *BPJS* or *non-BPJS* groups are very satisfied with the services provided.

Table 1. CSI Scale and SERVQUAL Score Interpretation

| Interpretation | CSI Score (%) | Interpretation | SERVQUAL Score |
|-----------------|---------------|--|----------------|
| Very Satisfied | 81 – 100 | Quality of service provided is beyond/better than the patient's expectations | (+) |
| Satisfied | 66 – 80.9 | Quality of service provided has met the patient's expectations | |
| Quite Satisfied | 51 – 65.9 | Quality of service provided has not met patient's expectations | (0) |
| Less Satisfied | 35 – 50.9 | Quality of service provided is beyond/better than the patient's expectations | (-) |
| Not Satisfied | 0 – 34.9 | | |

Source: Putri, 2021.¹¹

Table 2. The Description of Patients' Characteristic

| Variable | Group A | | Group B | |
|--------------------|---------------------------------|-------|---------------------------------|-------|
| | (BPJS Health Insurance Patiens) | | (Non-Health Insurance Patients) | |
| | n = 67 | % | n = 43 | % |
| Gender | | | | |
| Men | 22 | 32.83 | 13 | 30.23 |
| Women | 45 | 67.21 | 30 | 69.76 |
| Age (Year) | | | | |
| ≤ 24 | 14 | 20.89 | 4 | 9.30 |
| 25-35 | 24 | 35.82 | 20 | 46.51 |
| ≥ 36 | 29 | 43.28 | 19 | 44.18 |
| Education | | | | |
| Elementary School | 12 | 17.91 | 6 | 13.95 |
| Junior High School | 18 | 26.86 | 11 | 25.58 |
| High School | 26 | 38.80 | 15 | 34.88 |
| College | 8 | 11.94 | 10 | 23.25 |
| Unschoolled | 3 | 4.47 | 1 | 2.32 |
| Profession | | | | |
| Civil Servant | 12 | 17.91 | 11 | 25 |
| Private-Employee | 5 | 7.46 | 4 | 9.09 |
| Entrepreneurship | 8 | 11.94 | 10 | 22.72 |
| Unemployed | 42 | 62.68 | 19 | 43.18 |

Source: Primary Data, 2021

Table 3. The Satisfaction Level in BPJS Health Insurance Patients (Group A) and Non-Insurance (Group B) Towards Service Quality of Manukan Kulon PHC

| Dimension | Code | Group A | | | Group B | | |
|----------------|------|--|--------------|---------------|--|--------------|---------------|
| | | (BPJS Health Insurance Patients) | | | (Non-Health Insurance Patients) | | |
| | | Expectation | Perception | Score | Expectation | Perception | Score |
| Responsiveness | 1.1 | 4.09 | 4.50 | 18.40 | 4.25 | 4.08 | 17.34 |
| | 1.2 | 3.94 | 4.37 | 17.21 | 4.43 | 4.12 | 18.25 |
| | 1.3 | 4.18 | 4.42 | 18.47 | 4.06 | 3.91 | 15.87 |
| | 1.4 | 3.87 | 4.19 | 16.21 | 3.86 | 3.77 | 14.55 |
| Tangibles | 2.1 | 3.92 | 3.68 | 14.42 | 3.92 | 4.01 | 15.71 |
| | 2.2 | 4.10 | 3.69 | 15.12 | 4.17 | 4.23 | 17.63 |
| | 2.3 | 3.98 | 3.61 | 14.36 | 4.43 | 4.50 | 19.93 |
| | 2.4 | 3.87 | 3.62 | 14.00 | 4.00 | 4.14 | 16.56 |
| Assurance | 3.1 | 3.90 | 4.73 | 18.44 | 4.34 | 4.46 | 19.35 |
| | 3.2 | 3.79 | 4.80 | 18.19 | 4.22 | 4.38 | 18.48 |
| | 3.3 | 3.81 | 4.73 | 18.02 | 3.97 | 4.14 | 16.43 |
| | 3.4 | 3.54 | 4.70 | 16.63 | 4.43 | 4.66 | 20.64 |
| Empathy | 4.1 | 3.87 | 4.64 | 17.95 | 4.04 | 4.20 | 16.96 |
| | 4.2 | 3.99 | 4.54 | 18.11 | 4.07 | 4.45 | 18.11 |
| | 4.3 | 4.02 | 4.55 | 18.29 | 4.10 | 4.31 | 17.67 |
| | 4.4 | 3.79 | 4.50 | 17.05 | 3.99 | 4.12 | 16.43 |
| Reliability | 5.1 | 4.42 | 3.74 | 16.53 | 3.89 | 4.04 | 15.71 |
| | 5.2 | 4.58 | 3.73 | 17.08 | 3.71 | 3.81 | 14.13 |
| | 5.3 | 4.31 | 3.71 | 15.99 | 3.63 | 3.69 | 13.39 |
| | 5.4 | 4.53 | 3.82 | 17.30 | 3.97 | 4.14 | 16.43 |
| Total | | 80.5 | 84.27 | 337.77 | 81.48 | 83.16 | 339.57 |
| CSI | | $\frac{337.77}{5 \times 80.50} \times 100\% = 83.91\%$ | | | $\frac{339.57}{5 \times 81.48} \times 100\% = 83.35\%$ | | |

Source: Primary Data, 2021

The Satisfaction Gap Level in *BPJS* Health Insurance Patients and Non-Insurance Based on Five Dimensions of SERVQUAL

The SERVQUAL results which show the gap between the expectation of patients in groups A and B for the services provided and the perception that are felt after receiving services in accordance with Table 4. The *BPJS* group shows that the highest negative gap occurs in reliability dimension, specifically providing services suitable with patient needs (Code 5.2). Meanwhile, the highest positive gap is found in assurance dimension related to officer who is honest, friendly, polite and trustworthy (Code 3.4). In the *non-BPJS* group, the highest negative gap was found in the responsiveness dimension related to services which start on time (Code 1.2) while the highest positive gap was found in

the empathy dimension related to good attention from staff to patients (Code 4.2).

More detailed SERVQUAL analysis show that there is variance mean of level gap from each dimension. This is obtained from the difference between the average level of expectation and perception in accordance with Table 5. In general, many dimensions of service quality at Manukan Kulon PHC have exceeded patients' expectations either groups A or B. The highest value of positive gap is assurance dimension for group A and empathy dimension for group B. However, there are still some dimensions that have not met desired level of satisfaction which is presented by negative gap score. These dimensions include the dimensions of tangibles (-0.32) and reliability (-1.00) in group A and the dimension of responsiveness (-0.18) in group B.

Table 4. The Satisfaction Gap Level in *BPJS* Health Insurance Patients (Group A) and Non-Insurance (Group B) Towards 5 Dimensions of SERVQUAL from Manukan Kulon PHC

| Dimension | Code | Group A (<i>BPJS</i> Health Insurance Patients) | | | Group B (Non-Health Insurance Patients) | | |
|--------------|------|---|--------------|--------------|--|--------------|-------------|
| | | Expectation | Perception | Gap | Expectation | Perception | Gap |
| | | Responsiveness | 1.1 | 4.09 | 4.50 | 0.41 | 4.25 |
| | 1.2 | 3.94 | 4.37 | 0.43 | 4.43 | 4.12 | -0.3 |
| | 1.3 | 4.18 | 4.42 | 0.24 | 4.06 | 3.91 | -0.1 |
| | 1.4 | 3.87 | 4.19 | 0.32 | 3.86 | 3.77 | -0.1 |
| Tangibles | 2.1 | 3.92 | 3.68 | -0.24 | 3.92 | 4.01 | 0.1 |
| | 2.2 | 4.10 | 3.69 | -0.41 | 4.17 | 4.23 | 0.1 |
| | 2.3 | 3.98 | 3.61 | -0.37 | 4.43 | 4.50 | 0.1 |
| | 2.4 | 3.87 | 3.62 | -0.25 | 4.00 | 4.14 | 0.1 |
| Assurance | 3.1 | 3.90 | 4.73 | 0.83 | 4.34 | 4.46 | 0.1 |
| | 3.2 | 3.79 | 4.80 | 1.01 | 4.22 | 4.38 | 0.1 |
| | 3.3 | 3.81 | 4.73 | 0.92 | 3.97 | 4.14 | 0.1 |
| | 3.4 | 3.54 | 4.70 | 1.16 | 4.43 | 4.66 | 0.2 |
| Empathy | 4.1 | 3.87 | 4.64 | 0.77 | 4.04 | 4.20 | 0.1 |
| | 4.2 | 3.99 | 4.54 | 0.55 | 4.07 | 4.45 | 0.3 |
| | 4.3 | 4.02 | 4.55 | 0.53 | 4.10 | 4.31 | 0.2 |
| | 4.4 | 3.79 | 4.50 | 0.71 | 3.99 | 4.12 | 0.1 |
| Reliability | 5.1 | 4.42 | 3.74 | -0.68 | 3.89 | 4.04 | 0.1 |
| | 5.2 | 4.58 | 3.73 | -0.85 | 3.71 | 3.81 | 0.1 |
| | 5.3 | 4.31 | 3.71 | -0.60 | 3.63 | 3.69 | 0.1 |
| | 5.4 | 4.53 | 3.82 | -0.71 | 3.97 | 4.14 | 0.1 |
| Total | | 80.50 | 84.17 | 22.88 | 81.48 | 83.16 | 1.68 |

Source: Primary Data, 2021

Table 5. Average SERVQUAL for Each Dimension of Service Quality at Manukan Kulon PHC

| Dimension | Group A (<i>BPJS</i> Health Insurance Patients) | | | | Group B (Non-Health Insurance Patients) | | | |
|-------------|---|-------------|---------------|------|--|-------------|---------------|-------|
| | \bar{x} E | \bar{x} P | \bar{x} Gap | Rank | \bar{x} E | \bar{x} P | \bar{x} Gap | Rank |
| | Responsiveness | 4.02 | 4.37 | 0.35 | 3 | 4.15 | 3.97 | -0.18 |
| Tangibles | 3.97 | 3.65 | -0.32 | 4 | 4.13 | 4.22 | 0.09 | 4 |
| Assurance | 3.76 | 4.74 | 0.98 | 1 | 4.24 | 4.41 | 0.17 | 2 |
| Empathy | 3.92 | 4.56 | 0.64 | 2 | 4.05 | 4.27 | 0.22 | 1 |
| Reliability | 4.46 | 3.45 | -1.00 | 5 | 3.80 | 3.92 | 0.12 | 3 |

Source: Primary Data, 2021

DISCUSSION

The results showed that patients were very satisfied with the quality of service provided by Manukan Kulon PHC (CSI *BPJS* 83.91%; CSI *non-BPJS* 83.35%). It is different from another study on the satisfaction level of patients at Jagir PHC in Surabaya with CSI score by 74.8% which is classified as satisfied.¹² A high level of patients' satisfaction in Manukan Kulon PHC will make a positive influence on patients' trust and loyalty so that long-term visit will occur.¹³

In general, the average result of the gap for each dimension is positive which indicates the service provided are in accordance with the patient's expectations, namely the dimensions of tangibles, assurance, empathy, and reliability. Unfortunately, there is a negative gap on the responsiveness dimension. This occurs due to the influence of several factors such as those related to the lack of human resource management at PHC so that the response given is not based on the patients' expectations. If this is not handled immediately, it will affect the patients' decision to revisit this PHC.^{13,14}

Specifically, there are differences in the level of satisfaction in each dimension component. The responsiveness dimension related to the speed and accuracy of patient care which includes timely services, information conveyed clearly and easily to understand, officers who are responsive and quick to handle patients' complaint and service that consistent to schedule. Negative gap values are observed in several aspects of responsiveness in the non health insurance patients, such as explanation of service procedures that are difficult to understand (code 1.1), attitude and willingness in patient care (code 1.2), attitudes and response of doctors when facing patients' health problems (code 1.3) and explanation of drug information by pharmacists (code 1.4). Meanwhile, the *BPJS* group has positive gap value in all aspects of responsiveness. This indicates the need to improve related aspects of responsiveness, especially non health insurance patients because each component of this dimension has significant correlation with patients' satisfaction. Putri also found that responsiveness was in line with patients' satisfaction, where the faster the service was carried out, the more satisfied patients would be. On the other hand, patients become dissatisfied if the officers are not

responsive in providing services as happened at Manukan Kulon PHC.¹¹

Tangibles of service includes the quality of existing facility such as waiting room, availability of parking space, clean medical equipment, and clean as well as tidy staff clothes. Parasuraman explained that the tangibles dimension is the most important aspect in determining service quality. Unfortunately, the level of patients' satisfaction on this dimension has not been met, such as aspects of cleanliness and appearance of officers (code 2.1), cleanliness of waiting room (code 2.2), completeness of emergency equipment (medical oxygen regulator, wheelchairs, etc) (code 2.3) and availability of parking space. (code 2.4). Clean, complete and advanced facility, such as E-health as well as the cleanliness of existing staff can make patients comfortable so that satisfaction will be achieved. Meanwhile, Kitapci et al. added that patients who are not satisfied with the public health center facility can be caused by the waiting room which is not regularly cleaned and the number of trash bins is minimal so that the patient becomes uncomfortable.¹⁵

The assurance dimension relates to patients' trust, such as providing guarantee if there is an error during service, courteous and competent staff, available medicine according to standards and the cost of services according to the quality received by the patient. The results obtained in this study are correspondent with Putri who found that these dimensions have given satisfaction to *BPJS* and *non-BPJS* patients at Boom Baru PHC in Palembang.¹¹

The empathy dimension of service quality includes good attention from officers, good communication between patient and staff and the convenience provided during service in order to understand the patients' wishes. The results obtained are supported by Kitapci et al. where empathy is directly related to patients' satisfaction. Good relation between officers and patients will create sincere personal concern for patients so that satisfaction will be achieved.¹⁵

Reliability consists of appropriate, orderly, neat and uncomplicated services and based on the needs of patients. This study shows that *BPJS* patients' satisfaction is not achieved on this dimension due to several complaints which include lack of discipline in service time (code

5.1), complicated patients' registration (code 5.2), lack of doctor explanation about patients' condition (code 5.3), and queue occurred during drug collection and registration (code 5.4). This has an effect in achieving patients' satisfaction. Accurate service consistency is an important aspect of reliability. This dimension has correlation with patients' satisfaction.^{16,17} Accurate service on the patients' first visit will determine the level of patients' satisfaction which is supported by the ease and speed of the service. Patients' satisfaction that has not been achieved in the reliability dimension of *BPJS* group also occurs in other studies, such as Arma et al. This study shows that the complaints felt by *BPJS* patients include complicated patient registration, the doctor's arrival time is not on time and queue occur during Medicine Taking and registration.¹⁰ With the E-Health at Manukan Kulon PHC, these problems can be overcome by that technology which helps the service process faster.

These findings above have shown the importance of knowing every dimension of service quality on the level of satisfaction of *BPJS* and non-health insurance patients. Dimension that still have a negative average gap, such as tangibles, reliability for *BPJS* patients and responsiveness for non-health insurance patients, need urgent improvement. In addition, dimensions that already have a positive average gap, such as responsiveness, assurance, empathy for *BPJS* patients and tangibles, assurance, empathy, reliability for non-healthcare patients, are important to maintain the service quality according to related components.

CONCLUSION AND RECOMMENDATION

The satisfaction level of Manukan Kulon PHC patients either *BPJS* or *non-BPJS* patients is very satisfied with only dimensions of tangibles and empathy in the *BPJS* group and responsiveness in the *non-BPJS* group which still does not meet the expectations desired by the patient. Therefore, the development of service quality related to innovative facility such as E-Health, speed and accuracy of *BPJS* services, and good attention to patients so that the expected satisfaction target can be achieved. Indirectly, this will play a role in achieving the highest degree of public health in Indonesia.

ACKNOWLEDGMENTS

Many supports from various people have helped in this study. We would like to express our appreciation for the head of Manukan Kulon Public Health Center, Surabaya along all health workers who helped to carry out this study.

AUTHOR CONTRIBUTIONS

DD, FI, RKK and ARAH designed the experiments; FI, RKK, ARP, RM, and EAS performed the experiments; DD, RKK, ARAH analyzed the data; DD and FI wrote the paper. DD = Didit Darmawan; FI = Fayola Issalillah; RKK = Rafadi Khan Khayru; ARAH = Andi Raina Ananda Herdiyana; ARP = Arif Rachman Putra; RM = Rahayu Mardikaningsih; EAS = Ella Anastasya Sinambela.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Agustina R, Dartanto T, Sitompul R, Susiloretni KA, Suparmi, Achadi EL, et al. Universal Health Coverage in Indonesia: Concept, Progress, and Challenges. *The Lancet*. 2019. 393. [https://doi.org/10.1016/S0140-6736\(18\)31647-7](https://doi.org/10.1016/S0140-6736(18)31647-7)
2. Prabowo SA, Rizky M. Implementasi E-Health Sebagai Alternatif Antrian Online di Puskesmas Kalirungkut Kota Surabaya. *J Syntax Transform*. 2020;1(2):66–73. <https://doi.org/10.46799/jst.v1i2.19>
3. Pamungkas A, Priyadi B, Herawati A. Analisis Efektivitas Pengguna Program Mobile Jaminan Kesehatan Nasional di badan Penyelenggaraan Jaminan Sosial Kesehatan Cabang Semarang. *J Public Policy Manag Rev*. 2022;11(4):408–421. [10.14710/jppmr.v11i4.36200](https://doi.org/10.14710/jppmr.v11i4.36200)
4. Agastya KP, Fanida EH. Penerapan Layanan E-Health di Puskesmas Jagir Kelurahan Jagir Kecamatan Wonokromo Kota Surabaya. *J Fak Ilmu Sos dan Huk*. 2016;1(1). <https://doi.org/10.26740/publika.v4n5.p%25p>
5. Putri YA, Budiarto W. Literature Review: The Implementation of E-Health at Primary Healthcare Centers in Surabaya City. *J Adm*

- Kesehat Indones.* 2020;8(1).
<https://doi.org/10.20473/jaki.v8i1.2020.40-55>
6. Bintang HJ. Peran Hukum Kesehatan dalam Melindungi Peserta Program Badan Penyelenggara Jaminan Sosial Kesehatan (Studi di RSUD Dr. Pirngadi Medan). *J Huk Responsif*. 2017;4(4):34-47.
<https://jurnal.pancabudi.ac.id/index.php/hukumresponsif/article/view/625>
 7. Undang-Undang Dasar Pasal 34. Perekonomian Nasional dan Kesejahteraan Sosial. 1945.
 8. Maqsood M, Maqsood H, Kousar R, Jabeeb C, Waqas A, et al. Effects of Hospital Service Quality on Patients Satisfaction and Behavioural Intention of Doctors and Nurses. *Saudi J Med Pharm Sci*. 2017;3(Jun):556-567.
https://saudijournals.com/media/articles/SJMPS_36B556-567.pdf
 9. Asnawi AA, Awang Z, Afthanorhan A, Mohamad M, Karim F. The Influence of Hospital Image and Service Quality on Patients' Satisfaction and Loyalty. *Manag Sci Lett*. 2019;9(56). [10.5267/j.msl.2019.2.011](https://doi.org/10.5267/j.msl.2019.2.011)
 10. Astutik EE, Amrullah AE, Madijanto S. Hubungan Mutu Pelayanan Kesehatan dengan Kepuasan Pasien Peserta BPJS Rawat Jalan di Puskesmas. *J Kesehat dr Soebandi*. 2020;8(2):158-136.
<https://media.neliti.com/media/publications/468617-relationship-between-health-service-qual-34ef9ded.pdf>
 11. Putri UM. Analisis Kepuasan Pelayanan Puskesmas Terhadap Pasien BPJS dan Non BPJS Menggunakan Metode Servqual. *J Manaj Inform dan Sist Inf*. 2021;4(2):149-159.
<https://e-journal.stmiklombok.ac.id/index.php/misi/article/view/355>
 12. Dewi RM, Lukmandono L PA. Penentuan Prioritas Perbaikan Kualitas Public Service dengan Metode Customer Satisfaction Index, Importance Performance Analysis dan Potential Gain in Customer Value (Studi Kasus: Puskesmas Jagir Surabaya). In: Seminar Nasional Sains dan Teknologi Terapan. 2021;9(1):15-21.
 13. Darmawan D. The Effect of Customer Satisfaction on Trust and Customer Loyalty. *Management & Accounting Research Journal*. 2019;03(02):1-8.
<https://jurnal.ikbis.ac.id/global/article/view/237>
 14. Ferrinadewi E, Darmawan D. Perilaku Konsumen: Analisis Model Keputusan. Yogyakarta: Universitas Atma Jaya; 2004.
 15. Kitapci O, Akdogan C, Dortyol İT. The Impact of Service Quality Dimensions on Patient Satisfaction, Repurchase Intentions and Word-of-Mouth Communication in the Public Healthcare Industry. *Procedia - Soc Behav Sci*. 2014;148:161-169.
<https://doi.org/10.1016/j.sbspro.2014.07.030>
 16. Anjayati S. Review Artikel: Analisis Kualitas Pelayanan Terhadap Kepuasan Pasien di Puskesmas Menggunakan metode Servqual. *Nurs Care Heal Technol J*. 2021;1(1):31-38.
<https://doi.org/10.56742/nchat.v1i1.7>
 17. Supandri O, Ketaren O, Veronika LR. Perbedaan Kualitas Pelayanan pada Pasien BPJS dan Pasien Umum Rawat Inap di Rumah Sakit Muhammadiyah Medan Tahun 2019. *J Ilm Simantek*. 2019;3(2):48-60.
<https://simantek.sciencemakarioz.org/index.php/IJK/article/view/71>



What are the Obstacles in Achieving Ideal Family Size in Reproductive Age Couples?

Dian Jayantari Putri K. Hedo^{1*}, Nicholas Simarmata²

¹National Board of Population and Family Planning/Badan Kependudukan dan Keluarga Berencana Nasional (BKKBN), Indonesia

²Program Study of Psychology, Faculty of Medicine, Udayana University, Indonesia

*Authors Correspondence: putri.k.hedo@gmail.com / 081333890903

ARTICLE INFO

Article History:

Received Jul, 6th, 2022

Accepted Nov, 24th, 2022

Published online Dec, 30th, 2022

Keywords:

Family;
marriage;
contraception;
information exposure;

ABSTRACT

The world situation with full of demands and limitations during the current pandemic can bring negative impacts on family. Family face burdens of daily needs for family life's. Regarding to this condition, the ideal family size which is couple who has no more than two children, is an entity that needs to be considered to ensure the survivability of family. This study aimed to determine factors that related and predict the ideal family size for reproductive age couples in East Java. This study was quantitative study with cross-sectional approach. Data used in this study was secondary data from the Family Data Collection in 2021. Sampling technique was saturation sampling on reproductive age couples in 38 cities and regencies of East Java. Dependent variable was ideal family size. Independent variable was ideal age of marriage, participation in modern contraception, preferences for the ideal number of children, exposure to electronic media information, exposure to social media information, exposure to printed media information, and exposure to mass media information. Data analysis used multiple linear regression test. The study result stated variables that were related and had contribution in predicting ideal family size in reproductive age couples were ideal marriage age ($p=0.001$), participation in modern contraception ($p=0.001$), preference for ideal number of children ($p=0.001$), exposure to electronic media information ($p=0.018$), and exposure to mass media information ($p=0.009$). Based on these results, it is hoped that several intervention programs can be arranged by related institutions, targeted in the field that are in accordance with the study results.

INTRODUCTION

The current world situation is full of demands and limitations. Pandemic due to corona virus disease has become one of the triggering factors for various changes and upheavals.^{1,2} During the pandemic, there were restrictions in several sectors of life such as economic, educational, social, and environmental sectors. These conditions bring negative impact on society and family in particular.³

Various restrictions and changes in current daily life conditions lead family to face the needs and burdens of daily family life.^{4,5} In economic sector, there have been various changes and adjustments such as reduction in workforce, increase in basic necessities costs, increase in service providers expense, and reduction in workers' income.⁶ This situation brings impact on family's economic condition related to its ability to meet various needs of daily life and increase the burden of family expenses.⁷

Data on a global scale shows that it had negative cost of the global economy around 2 trillion dollars in 2021.⁸ 1 out of 5 workers around the world lost their job during the pandemic.^{9,10} Healthcare costs also increased globally. During the pandemic, there were almost 1 billion people who spent more than 10 percent of their household budgets on health.^{11,12} In Indonesia, the amount of workers affected by the COVID-19 pandemic in 2020 were 35 million people. Economic growth in Indonesia reached 0.5%. Poverty rate in March 2020 rose to 9.78% compared to March 2019 (9.41%). There were 70.53 percent of the population in Indonesia claimed to experience the decrease in income during the pandemic. There was an increase in the number of poor people from 3.02 million to 5.71 million people in Indonesia during the Pandemic.¹³⁻¹⁵ In East Java Province, there was an increase of 363.1 thousand poor people in the year before the pandemic so that the number of poor people in East Java during the pandemic reached 4,419.10 thousand people (11.09 percent). There were also 5,348 workers from 210 companies that were laid off and 32,365 workers from 555 employee companies were laid off during the pandemic.¹⁶ In health sector, there have been adjustments to the pandemic situation, such as limited health services, difficulty in accessing health facilities, and increase in health costs that

need to be paid by families as users of health services due to the massive spread of COVID-19 virus in the society.¹⁷

In this current condition, the ideal family size which is couple with no more than two children is entity that needs to be considered to ensure the survivability of family.^{18,19} In order to be able to adapt with the situation due to the current pandemic and to meet various needs of family life, a nuclear family size which consisted of the ideal number of children is needed. Family that has too many children (big size family) tends to have greater burden of living needs in various aspects of life that need to be met during pandemic, compared to family that has ideal family size that consist of one or two children.²⁰ In 2021, Indonesia had more than 10 million families with non-ideal family size in which they have more than two children in their family. Those families belong to various provinces in Indonesia including East Java. In East Java Province of Indonesia, there were more than 1 million families that had non-ideal family size in which they had more than two children in their family.²¹ Those families with more than two children tend to experience great challenges in meeting families' educational, health and economic needs.^{21,22}

Family tends to have ideal number of children and form ideal family size when they are exposed to several conditions. Couples who marry at the ideal age tend to have careful consideration in physical and psychological aspects in determining their family size.²³ Couples who use modern family planning contraception also tend to have ideal number of children by using modern contraception that have fairly high effectiveness.²⁴ The Amount of children and family size can also be determined by couples' preference about the number of children they want to have in their family.²⁵ Family exposure to information from various media also tends to be related to the family size formed by each family.²⁶ Family who is exposed to information about reproductive health, child growth and development, the impact and benefits of contraception, family planning, and other various informations related to family development tend to have ideal number of children.^{27,28}

Based on several previous explanations, the ideal family size is an important thing to be

studied further in order to help family in maintaining its life during difficult situation due to the recent pandemic. This study aimed to find out what factors are related and predict the ideal family size for couples in East Java.

MATERIAL AND METHOD

This study was quantitative study with cross-sectional design and conducted in May 2022. Data used in this study was secondary data gathered from the Family Data Survey of East Java Province in 2021 who involved 6,309,132 married couples of reproductive age across 38 cities and regencies in East Java. Data were selected through saturated sampling in which the number of samples taken in the study were equal to the number of total population. Data were analyzed by using multiple linear regression test and partial correlation test. Univariate data was presented to determine the frequency distribution, bivariate data was presented to determine the correlation between variables, and multivariate data was presented to determine the prediction of dependent variable based on independent variables in this study.

The secondary data was obtained from National Population and Family Planning Board. The original survey which was the Family Data Survey in 2021, had obtained ethical clearance from the National Population and Family Planning Board Ethical Review Committee. Since this study was a secondary analysis and the individual consideration such as name and address were not included, so the institutional review board approval was not required.

RESULTS

Table 1 showed that most of respondents were contraception user (64.01%). Most of the respondents were couples with children above 5 years old (70.44%). There were 87.97% respondents with prosperous economic status and had proper living condition (52.42%). Based on the education, respondents who had lower education than junior high school level were 33.31%, while the rest of them were respondents with higher education level than junior high school.

From Table 2, it was known that there were two variables that had not significant correlation with ideal family size. Exposure to social media

information ($p=0.958$) and exposure to printed media information ($p=0.273$) had significant levels more than 0.05 ($p>0.05$), it mean that exposure to social media information and exposure to printed media information did not have correlation with ideal family size after the other variables were controlled or made by constant. Ideal age of marriage ($p=0.001$), participation in modern contraception ($p=0.001$), preferences for the ideal number of children ($p=0.001$), exposure to electronic media information ($p=0.018$), and exposure to mass media information ($p=0.009$) less had significance level than significance value 0.05. It meant that all these variables had significant correlation with ideal family size.

Table 3 showed the results simultaneously that there was significant correlation between ideal age of marriage, participation in modern contraception, preferences for the ideal number of children, exposure to electronic media information, exposure to social media information, exposure to printed media information, and exposure to mass media information with ideal family size ($p=0.001$). There was strong correlation between ideal age of marriage, participation in modern contraception, preferences for the ideal number of children, exposure to electronic media information, exposure to social media information, exposure to printed media information, and exposure to mass media information with ideal family size by 99%. While the contribution of ideal age of marriage, participation in modern contraception, preferences for the ideal number of children, exposure to electronic media information, exposure to social media information, exposure to printed media information, and exposure to mass media information simultaneously to ideal family size was 99%, and 1% was influenced by variables that was not examined in this study.

From the results of data analysis, predictions of ideal family size could be made based on the ideal age of marriage, participation in modern contraception, preferences for the ideal number of children, exposure to electronic media information, and exposure to mass media information. Prediction through regression equation was $Y = 199,157 + 0.184 (X1 \text{ ideal age of marriage}) + 0.386 (X2 \text{ participation in modern contraception}) + 0.173 (X3 \text{ preferences for the ideal number of children}) - 0.076 (X4 \text{ exposure$

to electronic media information) + 0.096 (X5 exposure to mass media information). This meant that if variables of ideal age of marriage, participation in modern contraception, preferences for the ideal number of children, exposure to electronic media information, and exposure to mass media information were considered constant, the state of ideal family size would be 199,157.

Table 1. Characteristics of Respondents

| Characteristics | n = 6,309,132 | % |
|---------------------------------|---------------|-------|
| Contraception Use | | |
| User | 4,025,165 | 64.01 |
| Not User | 2,283,963 | 36.03 |
| Age of Couple's Children | | |
| Under 5 Years Old | 1,868,117 | 29.62 |
| Above 5 Years Old | 4,441,015 | 70.44 |
| Economic Status | | |
| Pre-Prosperous | 759,058 | 12.03 |
| Prosperous | 5,550,074 | 87.97 |
| Living Place Status | | |
| Proper | 3,307,390 | 52.42 |
| Not Proper | 3,001,742 | 47.58 |
| Education | | |
| Junior High School | 2,101,712 | 33.31 |
| Senior High School | 4,207,420 | 66.69 |

Source: Secondary Data, 2021

DISCUSSION

From the results of study, it was found that ideal family size was related and can be predicted with ideal age of marriage, participation in modern contraception, prefer-

ences for the ideal number of children, exposure to electronic media information, and exposure to mass media information simultaneously. All these variables had significant correlation with the ideal family size so that it can be used to predict it. Taken together, the ideal age of marriage, participation in modern contraception, preferences for the ideal number of children, exposure to electronic media information, and exposure to mass media information serve as factors that facilitate the existence of ideal family size in couples of childbearing ages.

Couples who marry at the ideal age, use modern contraception, have ideal child preferences, obtain information from electronic media and mass media, and tend to have ideal number of children. The results of this study were in accordance with study conducted by Arsyad and Nurhayati's which stated that age at first marriage, exposure to information media, and preferences to have ideal number of children are related to the number of children owned by couples.²⁹

In addition, other studies also stated similar results with the above results. This study stated that age at first marriage, education and information exposure, preferences to have ideal number of children, and use of contraception have significant correlation with couples' ideal number of children.^{30,31}

Table 2. Bivariate Analysis Results

| Variables | Control Variables | Sig. | R |
|--|------------------------------|-------|--------|
| Ideal Marriage Age (IMA) * Ideal Family Size | PMC, PIN, EMI, MMI, SMI, PMI | 0.001 | 0.698 |
| Participation in Modern Contraception (PMC) * Ideal Family Size | IMA, PIN, EMI, MMI, SMI, PMI | 0.001 | 0.914 |
| Preference for Ideal Number of Children (PIN) * Ideal Family Size | IMA, PMC, EMI, MMI, SMI, PMI | 0.001 | 0.596 |
| Exposure to Electronic Media Information (EMI) * Ideal Family Size | IMA, PMC, PIN, MMI, SMI, PMI | 0.018 | -0.415 |
| Exposure to Mass Media Information (MMI) * Ideal Family Size | IMA, PMC, PIN, EMI, SMI, PMI | 0.009 | 0.454 |
| Exposure to Social Media Information (SMI) * Ideal Family Size | IMA, PMC, PIN, EMI, MMI, PMI | 0.958 | 0.010 |
| Exposure to Printed-material Information (PMI) * Ideal Family Size | IMA, PMC, PIN, EMI, MMI, SMI | 0.273 | -0.200 |

Source: Secondary Data, 2021

Table 3. Multivariate Analysis Results

| Variables | p-value | B | Sig. | R | R ² |
|--|---------|--------|-------|-------|----------------|
| Ideal Marriage Age | 0.001 | 0.184 | | | |
| Participation in Modern Contraception | 0.001 | 0.386 | | | |
| Preference for Ideal Number of Children | 0.001 | 0.173 | | | |
| Exposure to Electronic Media Information | 0.018 | -0.076 | 0.001 | 0.999 | 0.997 |
| Exposure to Mass Media Information | 0.009 | 0.096 | | | |
| Exposure to Social Media Information | 0.958 | 0.003 | | | |
| Exposure to Printed-Material Information | 0.273 | -0.062 | | | |
| B Constant : 199.157 | | | | | |

Source: Secondary Data, 2021

Based on the results of this study, it was known that the ideal age of marriage had significant correlation with the ideal family size. Ideal age of marriage is also known as predictor of ideal family size. Couples who marry at the ideal age tend to have ideal number of children than couples who marry in too young or too old ages. In couples who marry in too young ages, the period of women pregnancy and childbirth are more and longer because they have longer period of fertility.

The results in this study were in accordance with the study conducted by Susanti, et al. the study stated that the age of marriage affects fertility and the rate of population growth which is the number of children owned by women of childbearing age aged 15-49 years old.³²

Based on the the results of study, it was known that participation in modern contraception had significant correlation with the ideal family size. Participation in modern contraception is also known as predictor of ideal family size. Couples who use modern contraception tend to have ideal number of children than couples who do not use contraception. Modern contraceptives used by couples help couples plan and have the ideal number of children, due to the high effectiveness of modern contraception.

The results in this study were in accordance with the study conducted by Mursyida et al. the study stated that contraception use affects couples' ideal number of children, along with the wife's age, education, occupation. The study stated that the use of contraception helps couples manage the number of children in an ideal manner.³³

Based on the results of study, it was known that preferences for the ideal number of children had significant correlation with the ideal family

size. Preferences for the ideal number of children are also known as predictors of ideal family size. Couples who prefer the ideal number of children tend to have the ideal number of children than couples who prefer many children. Couples who prefer the ideal number of children tend to be able to carry out their own plan and strategies in having children according to the ideal number that they want in family.

The results in this study were in accordance with previous study. The study stated that the number of children owned by women of childbearing age was influenced by fertility preferences, namely the preference for the number of children that they want to have in their family.³⁴

Based on the results of study, it was known that exposure to electronic media information and exposure to mass media information had significant correlation with the ideal family size. Exposure to electronic media information and exposure to mass media information are also known as predictors of ideal family size. Couples who are exposed to information that is presented through electronic media tend to have ideal number of children than couples who do not receive information or education. With information and education regarding the ideal growth and development of children, family development, maternal reproductive health, family planning programs, and other various informations related to children and family, it can support and facilitate couples in considering the ideal number of children and forming an ideal family size.

Results of this study were in accordance with the study conducted by Sitorus et al. The study stated that the number of children owned by women of childbearing age was influenced by exposure to information about family planning

programs obtained from reading newspapers, listening to the radio, and watching television.^{27,28}

The limitation of this study was about the lack of further exploration and deeper research topics with different and more holistic methods and approaches. It is hoped that research can be carried out with different methods and approaches such as a qualitative approach or by using primary data that gathered directly from the research subjects in the future.

CONCLUSION AND RECOMMENDATION

This study concluded that there were some variables that related and had contribution in predicting ideal family size in reproductive age couples such as ideal marriage age, participation in modern contraception, preference for ideal number of children, exposure to electronic media information, and exposure to mass media information. Based on this study, practical recommendation that can be proposed to the related institutions is to arrange several intervention programs targeted in the field that are in accordance with these study results.

Institution may consider to arrange programs that specifically address the issue of ideal family size by including variables related to ideal family size as explained in this study. Interventions related to ideal marriage age, participation in modern contraception, preference for ideal number of children that can be proposed are to intensify family preparation and planning programs through education, socialization, and intensive assistance directly by field workers or indirectly based on digital platforms. The intervention can be started from the initial phase by targeting teenagers and prospective brides, couples of childbearing ages, and pregnant women. Interventions related to exposure to electronic media information, and exposure to mass media information that can be proposed put target on institution's digital content in which the digital content can be made and contain massive education and socialization about family planning, delivered in creative and variative ways in terms of display, means of delivery, and the content itself.

AUTHOR CONTRIBUTIONS

DJPKH and NS conceived and designed the study; DJPKH conducted study conceptual-

ization and theory; NS analyzed the data; DJPKH wrote the paper. DJPKH = Dian Jayantari Putri K. Hedo; NS = Nicholas Simarmata.

CONFLICTS OF INTEREST

The authors declared no conflict of interest.

REFERENCES

1. Ryan BJ, Coppola D, Canyon D V., Brickhouse M, Swienton R. COVID-19 Community Stabilization and Sustainability Framework: An Integration of the Maslow Hierarchy of Needs and Social Determinants of Health. *Disaster Med Public Health Prep.* 2020;14(5):623–9. [10.1017/dmp.2020.109](https://doi.org/10.1017/dmp.2020.109)
2. Lades LK, Laffan K, Daly M, Delaney L. Daily Emotional Well-being during the COVID-19 Pandemic. *Br J Health Psychol.* 2020;25(4):902–11. <https://doi.org/10.1111/bjhp.12450>
3. Riany YE, Morawska A. Financial and Work Burden, Psychosocial Functioning, and Family Interactions During the COVID-19 Pandemic in Indonesia: Effects on Child Outcomes. *Child Psychiatry Hum Dev.* 2021;1–12. [10.1007/s10578-021-01251-1](https://doi.org/10.1007/s10578-021-01251-1)
4. Browne DT, Wade M, May SS, Jenkins JM, Prime H. COVID-19 Disruption Gets Inside the Family: A Two-Month Multilevel Study of Family Stress During the Pandemic. *Dev Psychol.* 2021;57(10):1681–1692. [10.1037/dev0001237](https://doi.org/10.1037/dev0001237)
5. Prime H, Wade M, Browne D. Risk and Resilience in Family Well-Being During the COVID-19 Pandemic. *Am Psychol.* 2020;75(5):631–643. [10.1037/amp0000660](https://doi.org/10.1037/amp0000660)
6. Nasution DAD, Erlina E, Muda I. Dampak Pandemi COVID-19 terhadap Perekonomian Indonesia. *J Benefita.* 2020;5(2):212-224. [http://doi.org/10.22216/jbe.v5i2.5313](https://doi.org/10.22216/jbe.v5i2.5313)
7. Feinberg ME, A. Mogle J, Lee JK, Tornello SL, Hostetler ML, Cifelli JA, et al. Impact of the COVID-19 Pandemic on Parent, Child, and Family Functioning. *Fam Process.* 2022;61(1):361–374. <https://doi.org/10.1111/famp.12649>
8. Kaye AD, Okeagu CN, Pham AD, Silva RA, Hurley JJ, Arron BL, et al. Economic Impact of COVID-19 Pandemic on Healthcare Facilities

- and Systems: International Perspectives. *Best Pract Res Clin Anaesthesiol*. 2021;35(3):293–306. [10.1016/j.bpa.2020.11.009](https://doi.org/10.1016/j.bpa.2020.11.009)
9. Dang HAH, Viet Nguyen C. Gender Inequality During the COVID-19 Pandemic: Income, Expenditure, Savings, and Job Loss. *World Dev*. 2021;140:105296. <https://doi.org/10.1016/j.worlddev.2020.105296>
 10. Eliza Littleton B, Stanford J. An Avoidable Catastrophe: Pandemic Job Losses in Higher Education and their Consequences. *Aust Inst [Internet]*. 2020;(September):2–5. <https://australiainstitute.org.au/report/an-avoidable-catastrophe/#:~:text=The new report%2C An Avoidable,compared to year-earlier levels.>
 11. Suthar S, Das S, Nagpure A, Madhurantakam C, Tiwari SB, Gahlot P, et al. Epidemiology and Diagnosis, Environmental Resources Quality and Socio-Economic Perspectives for COVID-19 Pandemic. *J Environ Manage*. 2021;280(November):111700. [10.1016/j.jenvman.2020.111700](https://doi.org/10.1016/j.jenvman.2020.111700)
 12. Moynihan R, Sanders S, Michaleff ZA, Scott AM, Clark J, To EJ, et al. Impact of COVID-19 Pandemic on Utilisation of Healthcare Services: A Systematic Review. *BMJ Open*. 2021;11(3):11–7. [10.1136/bmjopen-2020-045343](https://doi.org/10.1136/bmjopen-2020-045343)
 13. Saadah, Nababan D, Silviana, Arwaty D, Sukmawati F, Shaleh K. Analysis of Burden Sharing Between the Government and Bank Indonesia to Meet State Budget Financing for Handling COVID-19 and National Economic Recovery Program. *Rev Int Geogr Educ Online*. 2021;11(6):112–120. <https://doi.org/10.1111/famp.12649>
 14. Satriyati E, Biroli A. Kembali ke Rempah: Upaya Rumah Tangga Petani di Bangkalan Guna Peningkatan Kesehatan dan Penanggulangan Kemiskinan selama Pandemi Covid-19. *Pros Semin Nas Penanggulangan Kemiskin*. 2021;1(1):168–191. <https://conference.trunojoyo.ac.id/pub/index.php/semnaspk/article/view/45>
 15. Mahendradhata Y, Andayani NLPE, Hasri ET, Arifi MD, Siahaan RGM, Solikha DA, et al. The Capacity of the Indonesian Healthcare System to Respond to COVID-19. *Front Public Heal*. 2021;9(July):1–9. <https://doi.org/10.3389/fpubh.2021.649819>
 16. Adriyanto A, Maryanti, Pambudi KS. Impact of MSME Assistance Program by East Java Province to Resolve the Economic Impacts of Covid-19. *Ilomata Int J Soc Sci (IJSS)*. 2021;2(4):296–307. <https://doi.org/10.52728/ijss.v2i4.376>
 17. Martínez L, Short JR. The Pandemic City: Urban Issues in the Time of Covid-19. *Sustainability*. 2021;13(6):1–10. <https://doi.org/10.3390/su13063295>
 18. BKKBN. Peringati Hari Vasektomi se-Dunia, Kepala BKKBN Populerkan Susuk KB Satu Batang Hingga Vasektomi [Internet]. Berita BKKBN. 2020 [cited 2022 May 13]. 21–22. <https://www.bkkbn.go.id/berita-peringati-hari-vasektomi-se-dunia-kepala-bkkbn-populerkan-susuk-kb-satu-batang-hingga-vasektomi>
 19. Kurniawan R, Melaniani S. Hubungan Paritas, Penolong Persalinan dan Jarak Kehamilan dengan Angka Kematian Bayi di Jawa Timur. *J Biometrika dan Kependud*. 2019;7(2):113–121. <https://doi.org/10.20473/jbk.v7i2.2018.113-121>
 20. Sari DI, Wahyuni N, Sucipto CD, Indah DS. Hubungan Pengetahuan, Paritas, Pekerjaan Ibu dengan Keteraturan Kunjungan Ibu Hamil untuk ANC Selama Masa Pandemi Covid-19. *J Kesehat Prim*. 2021;6(1):22–31. <https://doi.org/10.31965/jkp.v6i1.530>
 21. BKKBN. 2021 Family Data Survey. Jakarta: Badan Kependudukan dan Keluarga Berencana Nasional; 2021.
 22. Budiman E, Kundre R, Lolong J. Hubungan Tingkat Pendidikan, Pekerjaan, Status Ekonomi dengan Paritas di Puskesmas Bahu Manado. *e J Keperawatan*. 2017;5(1):7. <https://doi.org/10.35790/jkp.v5i1.14815>
 23. Thomson S. Achievement at School and Socioeconomic Background an Educational Perspective. *npj Sci Learn*. 2018;3(1). [10.1038/s41539-018-0022-0](https://doi.org/10.1038/s41539-018-0022-0)

24. De Vargas Nunes Coll C, Ewerling F, Hellwig F, De Barros AJD. Contraception in Adolescence: The Influence of Parity and Marital Status on Contraceptive use in 73 Low-and Middle-Income Countries. *Reprod Health*. 2019;16(1):1–12. <https://doi.org/10.1186/s12978-019-0686-9>
25. Apriasih H, Danefi T. Faktor-Faktor yang Berhubungan dengan Partisipasi Akseptor Kb Aktif terhadap Penggunaan Kontrasepsi Jangka Panjang di Desa Cigalontang Wilayah Kerja Puskesmas Cigalontang Tahun 2018. *J Stikes Respati*. 2019;2(3):1–18. <https://doi.org/10.48186/bidkes.v1i10.101>
26. Islam J. Factors Influencing Family Size: A Critical Study on Khulna District of Bangladesh. *Br J Arts Humanit*. 2020;2(4):73–81. <https://doi.org/10.34104/bjah.020073081>
27. Santikasari S, Laksmi P. Hubungan Sumber Informasi dengan Pemakaian Kontrasepsi di Kelurahan Merak Tangerang. *J Ilmu Kesehat Bhakti Husada*. 2019;10(1):74–87. <https://doi.org/10.34305/jikbh.v10i1.87>
28. Sitorus MA, Siregar PA. Pengaruh Frekuensi Media Dan Keterpaparan Informasi Tentang Kb Terhadap Persepsi Jumlah Anak Ideal: Analisis Data Sdki 2017. *J Kesehat*. 2021;14(1):62-70. <https://doi.org/10.24252/kesehatan.v14i1.16929>
29. Sitorus MA, Simarmata R, Siregar PA. Analisis Preferensi Jumlah Anak Ideal di Provinsi Sumatera Utara: Analisis Data Skunder SDKI 2017. *Contag Sci Period J Public Heal Coast Heal*. 2020;2(2):87-98. <http://dx.doi.org/10.30829/contagion.v2i2.7989>
30. Arsyad SS, Nurhayati S. Determinan Fertilitas di Indonesia. *J Kependud Indones*. 2017;11(1):1-14. <https://doi.org/10.14203/jki.v11i1.65>
31. Jatmiko YA, Wahyuni S. Determinan Fertilitas di Indonesia Hasil SDKI 2017. *Euclid*. 2019;6(1):95-106. <http://dx.doi.org/10.33603/e.v6i1.1516>
32. Utomo SP, Aziz UK, Geografi J, Sosial FI, Malang UN. Mapping Effects of Education Level, Income and Age of Marriage on The Number of Children Born Allive in Kotalama Village, Kedungkandang District. *J Ikesma*. 2020;16(2):109–116.
33. Susanti R, Giyatri CD, AB I. Penerapan Metode Regresi Ridge dalam Mengatasi Multikolinieritas pada Tingkat Fertilitas Wanita Usia Subur. *Jl-KES (Jurnal Ilmu Kesehatan)*. 2021;5(1):91–102. <https://repository.unmul.ac.id/bitstream/handle/123456789/12894/214-723-1-PB.pdf?sequence=1>
34. Mursyida R, Mutiara E, Asfiryati A. Faktor-Faktor yang Memengaruhi Jumlah Anak di Desa Pusong Kecamatan Banda Sakti Kota Lhokseumawe. *J Healthc Technol Med*. 2018;4(2):232-245. <https://doi.org/10.33143/jhtm.v4i2.419>
35. Ahmad A. Preferensi Fertilitas Terhadap Jumlah Anak yang Telah Dimiliki oleh Wanita Usia Subur (WUS) Pengguna Kontrasepsi di Wilayah Kerja UPT Puskesmas Kasongan dan UPT Puskesmas Kasongan. [Skripsi]. Palangkaraya: Poltek-kes Kementerian Kesehatan Palangkaraya; 2021.



Sleep Quality Profile of Mining Workers Based on Pittsburgh Sleep Quality Index (PSQI)

Leonardo Lubis^{1,2}, Tiara Kusumawiyanti^{1*}, Gita Tiara Dewi Nasution¹, Febi Dwirahmadi³

¹Department of Biomedical Sciences, Faculty of Medicine, Universitas Padjadjaran, Bandung, Indonesia

²Indonesian Society of Exercise Physiology

³Centre for Environment and Population Health, School of Medicine and Dentistry, Griffith University, Brisbane, Australia

*Authors Correspondence: 2018unpad@gmail.com/085294083992

ARTICLE INFO

Article History:

Received April, 11th, 2022

Accepted Oct, 14th, 2022

Published online Dec, 30th, 2022

Keywords:

Sleep quality;

PSQI;

mining workers;

ABSTRACT

The number of work accidents in Indonesia and in the world is quite high, particularly in the mining sector. One of the factors that cause occupational accidents is poor sleep quality. Therefore good quality sleep is needed to reduce the risk of accidents. This study aims to describe the sleep quality of mining workers based on age, occupational category, and Body Mass Index (BMI). The research uses a descriptive design with a cross-sectional method. Data was collected from PT Borneo Indobara in 2020, as many as 120 workers. PSQI (Pittsburgh Sleep Quality Index) is used as an instrument. Then, sleep quality was reported in age, BMI, and occupational categories. The result shows that workers at PT Borneo Indobara are dominated by the age range of 21-40 years old (80%), working as operators (70.83%), and having normal BMI (56.67%). Most of the poor sleep quality is experienced by the worker with age range 18-20 years old (90.91%), working as a leader/officer (100%), and obesity as a BMI category (88.89%). Most of PT. Borneo Indobara employees have poor sleep quality based on the PSQI score, so that the management of PT. Borneo Indobara can use this research as employee evaluation data and can prepare treatment for the employees.

INTRODUCTION

Sleep is an unconscious state that can be awakened by sensory or other stimuli.¹ Healthy sleep consists of many dimensions, including adequate duration, good quality of sleep, appropriate timing, and the absence of sleep disturbances.² Good sleep quality is one of the important factors that contribute to physical function, psychological well-being, and quality of life. Sleep quality can be divided into objective and subjective sleep quality. Indicators of good subjective sleep quality can be seen from shorter sleep latency, adequate total sleep time, reduced wake-up time after sleep onset, and wakefulness during the day. The good subjective sleep quality can be measured with various instruments, one of them is the Pittsburgh Sleep Quality Index (PSQI).³ The PSQI consists of 19 questions, included in seven components to evaluate sleep quality and disturbances in the past month. The PSQI itself was developed by Buysse et al.⁴ Various factors affect sleep quality including physiological, psychological, and environmental influences,⁵ such as age, job category, and Body Mass Index (BMI).

In general, everyone needs adequate sleep about 7-8 hours per day as a homeostatic process. Lack of sleep at night is associated with daytime sleepiness, health problems, and safety concerns.⁶ A survey in America shows that 26% of workers experience excessive sleepiness during the day that interferes their daily tasks. A study of the relationship between Obstructive Sleep Apnea (OSA) and occupational accidents showed that OSA was the cause of daytime sleepiness increasing the work accidents by twofold.⁶ In the mining industry alone, according to data from the US Bureau of Labor Statistics (BLS) during 2010, there were fatal work accidents that caused 172 deaths and 15.500 accidents.⁷ Based on the 2019 Performance Report of the Ministry of Energy and Mineral Resources, in 2019, mining accident data in Indonesia reached 157 cases with 24 cases causing death.⁸ A study of sleep quality in truck drivers shows that good sleep quality is necessary and very important driving jobs, a kind of job that also exists in coal mining. Another study at a company in Kalimantan, Indonesia, shows that there is a relationship between sleep quality, fatigue, and work safety^{9,10} where fatigue is most likely to cause accidental death since fatigue impairs alertness

and the ability to move safely.¹¹ These occupational accidents and work-related illnesses can have an impact on an individual's economic, physical and emotional well-being. In addition, work accidents also affect productivity, economy, and society at large.¹²

The data shows a high rate of work accidents, especially in mining workers, where one of the factors that can cause work accidents is poor sleep quality, there has been no research on the sleep quality profile of mining workers in Indonesia. Thus, this study aims to describe the sleep quality of mining workers based on age, job category, and Body Mass Index (BMI).

MATERIAL AND METHOD

This study uses a descriptive design with a cross-sectional method on 120 mining workers of PT Borneo Indobara. The data used is a population sample. The inclusion criteria of the data are male workers with a minimum work duration of one month and filling out a complete questionnaire. The type of work carried out by mining workers at PT. Borneo Indobara is an exploration to find new mining points. After excavation, mining products are delivered to ports until they are distributed via large ships. All types of work use heavy equipment such as excavators, dump trucks, heavy dump trucks, and truck loads. All the work is made in two shifts, morning and night with three days of every week with one day off when changing shifts (each shift last for about eight to eleven hours per day).

The instrument used in this study was the Indonesian version of the PSQI (Pittsburgh Sleep Quality Index) questionnaire which has been validated. The questionnaire consists of 19 self-answered questions. These nineteen questions have seven components in which each component has a value ranging from 0-3 (0 = no difficulty, 3 = severe difficulty). This component contains subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleeping pills, and daily function disturbances. After that, the score for each component will be calculated to produce a global PSQI score with a range of 0-21.^{3,4} Data were analyzed using Microsoft Excel software in which the results are grouped into two, a total score of ≤ 5 (good sleep quality) and a total score of > 5 (poor sleep quality) based on gender, age, occupational category, and BMI. Also, this study

got approval from the Health Research Ethics of Universitas Padjajaran with ethical number 939/UN6.C.6.1/TU.00/2021.

RESULTS

This study involved 120 mining workers at PT Borneo Indobara as research subjects. Information on respondent characteristics used in this study was age, job category, and BMI. The description of the characteristics and sociodemography of the respondents is presented in Table 1. The Table 1 shows that the mining workers at PT Borneo Indobara are dominated by men with the highest age range 21-40 years old (96 people or 80%), followed by 18-20 years old (11 people or 9.17%), then > 40 years old (13 people or 10.83%). Based on the job category, there are 85 people (70.83%) worked as operators, 18 people (15%) as mechanics, 13 people (10.83%) as supervisors, and 4 people worked as leaders/officers (3.33%). For the BMI group, more than half of the workers have a normal BMI (68 people) and the fewest are workers with obesity with 9 people (7.50%).

The PSQI data were obtained based on 19 questions: usual bedtime, the time needed to fall asleep (less than 30 minutes or not), usual waking up time, hours of actual sleep, waking up in the middle of the night, waking up to use the bathroom, unable to breathe comfortably, coughing or snoring loudly, feeling too cold or too hot, having bad dreams, having pain, self-rate of the overall sleep quality, using medicine to sleep, trouble to stay awake while doing a daily activity, less motivated to get things done, and having a bed partner/roommate or not. The results displayed are based on the PSQI scoring system. In this study, we only describe sleep quality based on the PSQI scoring system.⁴ Based on Table 2, the result represents the mining workers at PT. Borneo Indobara are dominated by poor sleep quality workers that is as many as 92 people, while workers with a total PSQI score of > 5 who have good sleep quality are only 28 people.

From Table 3, it is clear that all age range categories have poor sleep quality based on the age distribution. The age range of 18-20 years

old has the highest percentage of poor sleep quality (90.91%) compared to the other age categories. Meanwhile, those with age > 40 years old have the highest percentage of good sleep quality (30.77%) compared to the age range of 18-20 years old or 21-40 years old. It is also found that all occupation categories are dominated by poor sleep quality. The highest percentage of bad sleep quality is in the leader/officer category compared to operator, mechanic, or supervisors where all of them have poor sleep quality (100%). The occupation category that has the highest percentage of good sleep quality is the supervisor's job category (30.77%). Based on the Body Mass Index (BMI), all BMI categories are mostly dominated by poor sleep quality worker in which the percentage of poor sleep quality is mostly owned by obese workers (88.89%), while the percentage of good sleep quality is mostly in the overweight category of workers (28.13%).

Table 1. Characteristics of PT. Borneo Indobara Workers

| Variable | n = 120 | % |
|------------------------------|---------|-------|
| Gender | | |
| Male | 120 | 100 |
| Age | | |
| 18-20 Years Old | 11 | 9.17 |
| 21-40 Years Old | 96 | 80 |
| > 40 Years Old | 13 | 10.83 |
| Type of Occupation | | |
| Operator | 85 | 70.83 |
| Mechanic | 18 | 15 |
| Supervisor | 13 | 10.83 |
| Leader/Officer | 4 | 3.33 |
| Body Mass Index (BMI) | | |
| Underweight (<18.5) | 11 | 9.17 |
| Normal (18.5-24.9) | 68 | 56.67 |
| Overweight (25-29.9) | 32 | 26.67 |
| Obese (≥30) | 9 | 7.50 |

Source: Primary Data, 2020

Table 2. Sleep Quality Distribution Based on PSQI Score

| PSQI | n = 120 | % |
|-----------|---------|-------|
| Good (≤5) | 28 | 23.33 |
| Poor (>5) | 92 | 76.67 |

Source: Primary Data, 2020

Table 3. Sleep Quality Frequency Distribution of Mining Workers Based on Gender, Age, Type of Occupation, and BMI

| Variable | Sleep Quality | | | |
|------------------------------|-----------------------------|-------|-----------------------------|-------|
| | Good (PSQI Total Score ≤ 5) | | Poor (PSQI Total Score > 5) | |
| | n | %* | n | %* |
| Age | | | | |
| 18-20 Years Old | 1 | 9.09 | 10 | 90.91 |
| 21-40 Years Old | 23 | 23.96 | 73 | 76.04 |
| > 40 Years Old | 4 | 30.77 | 9 | 69.23 |
| Type of Occupation | | | | |
| Operator | 21 | 24.71 | 64 | 75.29 |
| Mechanic | 3 | 16.67 | 15 | 83.33 |
| Supervisor | 4 | 30.77 | 9 | 69.23 |
| Leader/Officer | 0 | 0 | 4 | 100 |
| Body Mass Index (BMI) | | | | |
| Underweight (< 18.5) | 2 | 18.18 | 9 | 81.82 |
| Normal (18.5-24.9) | 16 | 23.53 | 52 | 76.47 |
| Overweight (25-29.9) | 9 | 28.13 | 23 | 71.88 |
| Obese (≥ 30) | 1 | 11.11 | 8 | 88.89 |

Source: Primary Data, 2020

*Notes: In Table 3, the result of the percentage is obtained based on segmental calculation. For example, in BMI, the percentage of obese respondents with poor sleep quality is calculated by:

$$\frac{\text{Number of Obese Respondents with Total Score > 5 or Having Poor Sleep Quality}}{\text{All Obese Respondents}} \times 100\%$$

then the calculation becomes $\frac{8}{9} \times 100\% = 88.89\%$. Likewise for other variables, it is also used the same calculation.

DISCUSSION

The results show that the majority of PT Borneo Indobara workers have poor sleep quality. This is due to various factors, some of them are age, job category, and BMI which can be seen in Table 3. Regarding the age category, the highest percentage of poor sleep quality is in the age range of 18-20 years old. This result is consistent with the research conducted by Song et.al in which the percentage of poor sleep quality is higher in the age category of ≤ 29 years old rather than in the age category of > 40 years old.¹³ Although it requires further research, one of the possible factors of these workers having poor sleep quality is due to electronic media used. Adolescents and young adults live in the digital era in which the use of electronic devices can interfere sleep, either directly or indirectly. Teenagers or young adults stay up late just enjoying their life with gadgets like chatting, playing games, or being online.¹⁴ The using of electronic device at 8-10 hours or close to bedtime indicates that teenagers and young

adults are exposed to light from gadgets before bedtime. Exposure to blue-light, which is short-wavelength light from electronic devices such as smartphones, tablets, or computers, is similar to exposure of the sunlight in the morning.¹⁵ When a person used electronic devices at the wrong time, such as when going to sleep, it can disrupt circadian rhythm by causing melatonin suppression due to exposure to light, causing a person to take longer to fall asleep and reduce total sleep time.¹⁵ The more time spent on electronic devices, the greater the decline in sleep duration and quality.¹⁵ Other studies state that people with 46 years old have a higher percentage of poor sleep quality than those with 18-45 years old.¹⁶ Sleep quality generally declines with age, especially in terms of sleep efficiency. Poor sleep is most common in older adults.¹⁷ Older people are likely to experience all the symptoms of poor sleep except daytime dysfunction. Since older adults may have reached retirement age, they tend to be more flexible to adjust daytime activities to their

energy levels compared to working individuals.¹⁸ One of the hormones that play an important role in maintaining circadian rhythms and sleep is melatonin.¹⁹ Melatonin itself begins to appear about 2-3 months after the baby is born where the peak of its production at the age of 2-4 years old. The concentration of melatonin in the blood then declines until puberty, when there is a signal to start of puberty. The steady decline in melatonin reaches levels in adults starting after puberty until late adolescence. Melatonin levels are stable at the age of 21-40, then there is a significant decline at the age of 40. People with age > 90 have melatonin level less than 20% compared to young adults.^{20,21}

Based on BMI, people with obesity have the highest percentage of poor sleep quality. These results are consistent with research conducted on hospital employees in Turkey,²² where the percentage of poor sleep quality is high in the obesity category. The study also explains the BMI value of respondents with poor sleep quality is higher. Other studies have also shown that increasing BMI is associated with poor sleep quality and short sleep duration and poor sleep quality is associated with obesity.²³ It is because lack of sleep can disrupt hormone levels such as leptin and ghrelin that affect glucose homeostasis and hunger regulation.^{23,24} Individuals with poor sleep quality are more likely to eat or snack when they wake up at night because their wake-sleep cycle is disturbed so it will cause an increase in BMI following the rising energy intake.²² In obesity, there are fat deposits in the upper respiratory tract which narrow the respiratory tract which can cause collapse and a decrease in muscle activity that causes hypoxia and susceptibility to Obstructive Sleep Apnea (OSA). This hypoxia will result in a decrease of oxygen in tissues and blood vessels and can cause sleep disturbances during breathing.^{25,26} Weight gain can increase the risk of OSA in healthy people and can accelerate the development of OSA, especially in overweight patients.²⁷

In the type of occupation category, it was found that the leader/officer has poor sleep quality with the highest percentage compared to operators, mechanics, and supervisors. The type of worker itself is divided into white-collar and blue-collar. Blue-collar workers have physically demanding jobs and work in unfavorable

conditions such as monotonous and repetitive work. They also require to lift heavy loads and to work in shifts. On the other side, white-collar workers have jobs that are mentally and emotionally demanding and usually do not work in harsh conditions and psychosocial stress, such as irregular and long working hours, full of pressure, and others. According to Sun et al, blue-collar workers have shorter sleep duration and decreased sleep quality than the white collar one.²⁸ Other research also states that white-collar workers are more physically inactive because their jobs tend to be sedentary passive behavior compared to blue-collar workers in which physically active workers have lower stress levels²⁹ and high work stress can cause poor sleep quality.^{30,31} All of these work requires high concentration and good physical fitness physically, emotionally, and to some extent, spiritually. That is why good quality sleep will greatly support the physiological process of recovery after doing the work.

The limitation of this study is that the number of respondents' sociodemographic distribution is not evenly distributed so it cannot describe the overall sleep quality of mining workers. Also, since this is a descriptive study, the information that leads to the conclusion of why mining workers have poor sleep quality is not really adequate. Thus, it still requires further analytical research on the specific factors that cause poor sleep quality in mining workers.

CONCLUSION AND RECOMMENDATION

Workers at PT. Borneo Indobara in 2020 majority has poor sleep quality. Most of the poor sleep quality is experienced by those who are 18-20 years old, working as the leader/officer, and having obese. For this reason, the management can use this research as employee evaluation data and prepare treatment for employees at PT. Borneo Indobara that has poor sleep quality, so the risk of occupational accidents can be reduced. It is necessary to conduct further studies on the analysis of factors that affect sleep quality and its relationship to productivity, health, and safety.

ACKNOWLEDGMENTS

The authors are grateful to the mining workers who are voluntarily participating in the study as a respondent and to PT. Borneo

Indobara that allowed the data collection process in the company, supporting financially and providing security during the research.

AUTHOR CONTRIBUTIONS

LL and TK managed the ethical clearance; LL designed the research design and conducted data collection; LL, TK, GTDN, and FD analyzed the data and write the manuscript. FD proofreading the manuscript. LL = Leonardo Lubis; TK = Tiara Kusumawiyanti; GTDN = Gita Tiara Dewi Nasution. FD = Febi Dwirahmadi.

CONFLICTS OF INTEREST

The authors declared no conflict of interest.

REFERENCES

- Hall JE. Guyton and Hall Textbook of Medical Physiology. 13th ed. Philadelphia: Elsevier, Inc; 2015.
- Chaput JP, Dutil C, Sampasa-Kanyinga H. Sleeping hours: What is the Ideal Number and How Does Age Impact This?. *Nat Sci Sleep*. 2018;10:421–430. [10.2147/NSS.S163071](https://doi.org/10.2147/NSS.S163071)
- Farah NMF, Yee TS, Rasdi HFM. Self-Reported Sleep Quality Using The Malay Version of the Pittsburgh Sleep Quality Index (PSQI-M) in Malaysian Adults. *Int J Environ Res Public Health*. 2019;16(23):1–10. [10.3390/ijerph16234750](https://doi.org/10.3390/ijerph16234750)
- Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a New Instrument for Psychiatric Practice and Research. *Psychiatry Res*. 1989;28:193–213. [10.1016/0165-1781\(89\)90047-4](https://doi.org/10.1016/0165-1781(89)90047-4)
- Potter, PA; Perry, AG; Stockert, PA; Hall A. Fundamentals of Nursing. 10th ed. Philadelphia: Elsevier Inc; 2020.
- Gharibi V, Mokarami H, Cousins R, Jahangiri M, Eskandari D. Excessive Daytime Sleepiness and Safety Performance: Comparing Proactive and Reactive Approaches. *Int J Occup Environ Med*. 2020;11(2):95–107. [10.34172/ijoem.2020.1872](https://doi.org/10.34172/ijoem.2020.1872)
- Of USB, Statistics L. Injuries, illnesses, and Fatal Injuries in Mining in 2010. 2013;2(1):1–8.
- Kementerian ESDM. Laporan Kinerja DJMB Tahun 2019. Jakarta: Kementerian Energi dan Sumber Daya Mineral. 2020; Available from: https://www.esdm.go.id/id/publikasi/laki_p
- Fletcher A. Staying Safe in the Jungles of Borneo: Five Studies of Fatigue and Cultural Issues in Remote Mining Projects. *Ind Health*. 2010;48(4):406–415. [10.2486/indhealth.mssw-04](https://doi.org/10.2486/indhealth.mssw-04)
- Mutifasari RS, Ramdhan DH. Association Between Sleep Quantity and Quality with Occupational Stress Among Truck Driver. *Malaysian J Med Heal Sci*. 2019;15(SP4):153–158.
- Widanarko B, Modjo R, Rantetampang J. Risk Factors Associated with Work-Related Fatigue Among Indonesian Mining Workers. Vol. 825, *Advances in Intelligent Systems and Computing*. Springer International Publishing; 2019: 1029–1037. https://doi.org/10.1007/978-3-319-96068-5_115
- International Labour Organization. Safety and Health at the Heart of the Future of Work. Building on 100 Years of Experience. 2019:75.
- Song TJ, Yun CH, Cho SJ, Kim WJ, Yang KI, Chu MK. Short Sleep Duration and Poor Sleep Quality among Migraineurs: A Population-Based Study. *Cephalalgia*. 2018;38(5):855–864. [10.1177/0333102417716936](https://doi.org/10.1177/0333102417716936)
- Das-Friebel A, Perkinson-Gloor N, Brand S, Dewald-Kaufmann JF, Grob A, Wolke D, et al. A Pilot Cluster-Randomised Study to Increase Sleep Duration by decreasing Electronic Media Use at Night and Caffeine Consumption in Adolescents. *Sleep Med*. 2019;60:109–115. [10.1016/j.sleep.2018.11.010](https://doi.org/10.1016/j.sleep.2018.11.010)
- Pham HT, Chuang HL, Kuo CP, Yeh TP, Liao WC. Electronic Device Use Before Bedtime and Sleep Quality Among University Students. *Healthc*. 2021;9(9):1–12. <https://www.mdpi.com/2227-9032/9/9/1091>
- Songkham W, Deeluea J, Suksatit B, Chaiard

- J. Sleep Quality Among Industrial Workers: Related Factors and Impact. *J Heal Res.* 2019;33(2):119–26. [10.1108/JHR-08-2018-0072](https://doi.org/10.1108/JHR-08-2018-0072)
17. Dong X, Wang Y, Chen Y, Wang X, Zhu J, Wang N, et al. Poor Sleep Quality and influencing Factors Among Rural Adults in Deqing, China. *Sleep Breath.* 2018;22(4):1213–1220. [10.1007/s11325-018-1685-8](https://doi.org/10.1007/s11325-018-1685-8)
 18. Gadie A, Shafto M, Leng Y, Kievit RA, Cam-CAN. How are Age-Related Differences in Sleep Quality Associated with Health Outcomes? An Epidemiological Investigation in a UK Cohort of 2406 adults. *BMJ Open.* 2017;7(7). [10.1136/bmjopen-2016-014920](https://doi.org/10.1136/bmjopen-2016-014920)
 19. Ostrin LA. Ocular and Systemic Melatonin and the Influence of Light Exposure. *Clin Exp Optom.* 2019;102(2):99–108. <https://doi.org/10.1111/cxo.12824>
 20. Aulinas A. Physiology of the Pineal Gland and Melatonin. Endotext. 2000.
 21. Bubenik GA, Konturek SJ. Bubenik and Konturek. 2011;13–19.
 22. Arslan M, Aydemir İ. Relationship Between Emotional Appetite, Eating Attitudes, Sleep Quality, and Body Mass Index in Healthcare Workers: a Multi-Centre Study. *Psychiatry Clin Psychopharmacol.* 2019;29(3):346–353. <https://doi.org/10.1080/24750573.2019.1627694>
 23. Mirdha M, Nanda R, Sharma HB, Mallick HN. Study of Association Between Body Mass Index and Sleep Quality Among Indian College Students. *Indian J Physiol Pharmacol.* 2019;63(1):8–15. [10.1016/j.sleep.2019.11.724](https://doi.org/10.1016/j.sleep.2019.11.724)
 24. Park SK, Jung JY, Oh CM, McIntyre RS, Lee JH. Association Between Sleep Duration, Quality and Body Mass Index in the Korean Population. *J Clin Sleep Med.* 2018;14(8):1353–1360. [10.5664/jcsm.7272](https://doi.org/10.5664/jcsm.7272)
 25. Dong Z, Xu X, Wang C, Cartledge S, Maddison R, Shariful Islam SM. Association of Overweight and Obesity with Obstructive Sleep Apnoea: A Systematic Review and Meta-Analysis. *Obes Med.* 2020;17(January):100185. <https://doi.org/10.1016/j.obmed.2020.100185>
 26. Sekhar Reddy, Parvaiz A. Koul, Moomin Hussain Bhat, Sanaullah Shah, Ganie MA. Comparison of Clinical, Biochemical, and Polysomnographic Parameters Between Obese and Nonobese Obstructive Sleep Apnea. *Lung India.* 2022;39(3):261–266. [10.4103/lungindia.lungindia.69921](https://doi.org/10.4103/lungindia.lungindia.69921)
 27. Tuomilehto H, Seppä J, Uusitupa M. Obesity and Obstructive Sleep Apnea - Clinical Significance of Weight Loss. *Sleep Med Rev.* 2013;17(5):321–329. [10.1016/j.smrv.2012.08.002](https://doi.org/10.1016/j.smrv.2012.08.002)
 28. Kim B, Yoon S, Kim J, Woo K-H, Cho S, Lee H, et al. Factors Related with Quality on Sleep of Daytime Workers. *Ann Occup Environ Med.* 2018;30(1):1–9. [10.1186/s40557-018-0271-7](https://doi.org/10.1186/s40557-018-0271-7)
 29. Dėdelė A, Miškinytė A, Andrušaitytė S, Bartkutė Ž. Perceived Stress Among Different Occupational Groups and the Interaction with Sedentary Behaviour. *Int J Environ Res Public Health.* 2019;16(23). [10.3390/ijerph16234595](https://doi.org/10.3390/ijerph16234595)
 30. Gu B, Tan Q, Zhao S. The Association Between Occupational Stress and Psychosomatic Wellbeing Among Chinese Nurses: A Cross-Sectional Survey. *Med (United States).* 2019;98(22):1–6. [10.1097/MD.00000000000015836](https://doi.org/10.1097/MD.00000000000015836)
 31. Xiao H, Zhang Y, Kong D, Li S, Yang N. The Effects of Social Support on Sleep Quality of Medical Staff Treating Patients with Coronavirus Disease 2019 (COVID-19) in January and February 2020 in China. *Med Sci Monit.* 2020;26:1–8. [10.12659/MSM.923549](https://doi.org/10.12659/MSM.923549)



Clinical Features of COVID-19 Patients at Udayana University Hospital During First Three Months of the COVID-19 Pandemic

Cokorda Agung Wahyu Purnamasidhi^{1*}, Ni Made Dewi Dian Sukmawati², Anak Agung Ayu Yuli Gayatri², I Made Susila Utama², I Ketut Agus Somia², Ketut Tuti Parwati Merati², Haruko Akatsu³

¹Tropical and Infectious Diseases Division Internal Medicine Department Udayana University/ Udayana University Hospital, Bali, Indonesia

²Tropical and Infectious Diseases Division Internal Medicine Department Udayana University/ Sanglah General Hospital, Bali, Indonesia

³International University of Health and Welfare School of Medicine, Narita, Japan

*Authors Correspondence: purnamasidhi@unud.ac.id/081337189997

ARTICLE INFO

Article History:

Received April, 13th, 2022

Accepted Nov, 15th, 2022

Published online Dec, 30th, 2022

Keywords:

COVID-19;
clinical characteristics;
epidemiology;
laboratory;

ABSTRACT

COVID-19 exhibits a wide variety of symptoms, ranging from mild, moderate, severe, and critical respiratory dysfunctions up to death. Therefore, this study aimed to examine the demographic, clinical, and laboratory profile of COVID-19 patients admitted to Udayana University Hospital, Bali, during the first three months of the pandemic. Data were collected from the electronic medical records of 236 patients hospitalized from April to June 2020. The samples had a mean age of 40 years old, and they consisted of 58.50% male. Based on the records, the common clinical characteristics included fever (52.5%) and cough (47.5%), followed by less common traits, such as sore throat (18.2%), dyspnea (10.2%), flu (8.9%), and headache (3.8%). Laboratory results during admission showed an average lymphocyte count of $2.16 \pm 2.19 \times 10^9$ cells/L and a neutrophil-lymphocyte ratio of 3.02 ± 3.41 . The majority of patients were private corporation employees (30.51%), followed by migrant workers (21.19%). Furthermore, a fatality rate of 1.69% was recorded in the study hospital. These results were expected to provide epidemiological knowledge of COVID-19 patients, which can help clinicians to anticipate possible outcomes during treatment.

INTRODUCTION

SARS-CoV-2 is a newly discovered zoonotic pathogen with various clinical symptoms ranging from the common cold to severe respiratory dysfunctions.¹ In December 2019, the first outbreak emerged in Wuhan, China,² but the origin of the virus is still unknown. Furthermore, the authorities found that all the 'initial' patients had contact with the Wuhan wet market. After this discovery, the government sealed off the market to prevent possible mass transmission in the region, specifically to people planning to shop in the area. The virus was then officially named SARS-CoV-2 a few months after its identification by Chinese healthcare authorities.

This virus has a high reproductive rate and is easily transmitted to other people. After a few months of its discovery, the World Health Organization (WHO) declared COVID-19 a Public Health Emergency of International Concern, and imperatively coordinated a global response to overcome the outbreak.⁴ It later became a pandemic, as CDC stated that a pandemic refers to 'an epidemic spreading over several countries or continents, usually affecting a large number of people.'⁵ Based on an in-depth study, COVID-19 was reported to be spread through human-to-human transmission via droplets, aerosol, or fomite. A previous study revealed that the virus has a mean incubation period of 6.4 days with a basic reproduction number of 2.24–3.58.⁶

COVID-19 can induce critical conditions in elderly patients as well as those with systemic comorbidities. Although the disease is highly infectious and still yet to be fully comprehended, data from WHO-China Joint Mission showed that approximately 80% of cases were in the "mild to moderate" categories. These levels of severity are often not life-threatening and do not require hospitalization. However, patients can still spread the virus to others, indicating that self-quarantine is mandatory. This home-care isolation is an important strategy to effectively prevent outbreaks and lower the rate of infection among aged people and patients with comorbid. The strategy involves providing space and resources in hospitals to people showing severe symptoms, which require active supervision.¹ In cases where patients are advised to undergo home-care isolation, a close

monitoring system and the readiness of emergency medical services need to be tested. Several studies showed that the majority of the cases had 'omittable' mild to moderate symptoms combined with a high reproduction number. This indicates that outbreak containment without strict social restrictions and extensive tracing is relatively impossible.

The first two COVID-19 cases in Indonesia were announced by the President on March 2, 2020, followed by the appearance of more positive patients, and this overwhelmed medical facilities. An effective decision regarding the management of the patients, specifically those in need of hospitalization, is crucial, considering the limited resources available.² Therefore, this empirical study aims to examine the epidemiology, clinical features, and management of all confirmed COVID-19 cases in Udayana University Hospital, Bali, Indonesia. The study hospital serves as a tertiary healthcare facility, which receives patients with the worst clinical severity within the area. Deep knowledge about these severe cases is expected to help clinicians in day-to-day practice in anticipating the worst possible outcomes during treatment.

MATERIAL AND METHOD

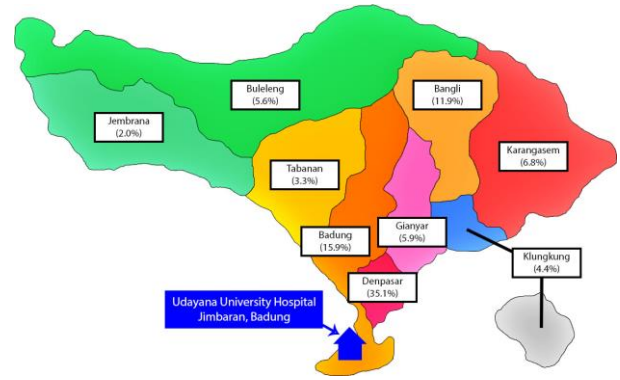
This study analyzed secondary data from electronic medical records of all 236 confirmed COVID-19 patients admitted to Udayana University Hospital, including deceased and discharged, by the end of June 2020. Furthermore, this report comprised the epidemiological, clinical, laboratory, and radiological characteristics, as well as the outcome of patients. It also comprised of the treatments given during admission and discharge, including antiviral therapy, antibiotics, anticoagulant, and ventilator support.

A descriptive analysis was carried out using SPSS Statistics 25 to present the final results of data collected during this study. All data were presented in numbers (percentage) or mean with standard deviation. Furthermore, ethical approval was obtained from the ethics committee of Udayana University with reference number 1010/UN1422VII14/LT/2020. Information about the subjects was kept highly confidential and only used in line with the ethical guidelines.

RESULTS

A total of 236 samples were included in the study over a year from April to June 2020. Patients were aged 18 – 75 years with a mean age of 40 years (SD ± 14.25). The results showed that males were more prevalent, and accounted for 58.5% of all patients admitted, as shown in Table 1. Furthermore, the majority of the samples in this study were Indonesian, accounting for 98.3% of the total population.

Udayana University Hospital was dedicated as a referral healthcare facility for isolating and treating COVID-19 patients. In the early three months of the pandemic, the hospital received patients from every regency in Bali with the majority coming from Denpasar (35.1%), followed by Badung (15.9%) and Bangli (11.9%). However, it is important to note that there were 50 international migrant workers, specifically from countries, such as America and Italy. They then spread to all regencies on the island, including Bangli (20%), Gianyar (14%), Buleleng (12%), Denpasar (12%), Karangasem (12%), Badung (10%), Klungkung (8%), Tabanan (6%), and Jembrana (4%), as shown in Figure 1.



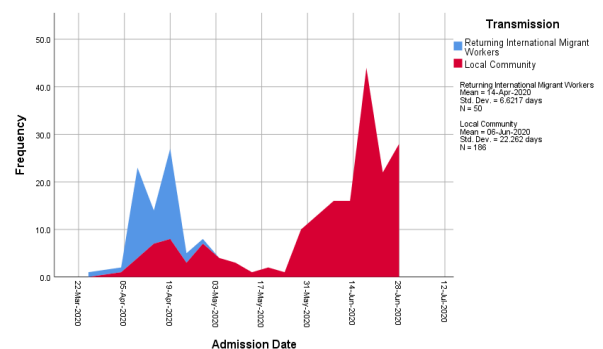
Source: Primary Data, 2022

Figure 1. District Origins of COVID-19 Patients Admitted to Udayana University Hospital Between April to June 2020

By the end of June 2020, a total of 232 patients had recovered, while 4 died. Various comorbidities contributed to the deaths of these 4 patients, including a 53-year-old female with Congestive Heart Failure (CHF); a 64-year-old male with severe comorbid pneumonia; a 62-year-old male with Coronary Artery Disease (CAD) and pneumonia; and a 59-year-old male with severe pneumonia and Type II Diabetes Mellitus, as shown in Table 2.

Table 3 shows the laboratory profile of patients admitted to Udayana University Hospital workers the first three months of the COVID-19 pandemic. Furthermore, all results were generally within the normal range.

Figure 2 shows the number of returning international migrant workers as well as the local community transmission between COVID-19 patients admitted to Udayana University Hospital during first three months of the COVID-19 pandemic.



Source: Primary Data, 2022

Figure 2. Number of Returning International Migrant Workers and Local Community Transmission between Patients

| Characteristics | n = 236 | % |
|---|---------|-------|
| Age Group (Years) | | |
| 18 – 20 | 4 | 1.70 |
| 21 – 40 | 125 | 53.00 |
| 41 – 60 | 80 | 33.90 |
| > 60 | 27 | 11.40 |
| Gender | | |
| Male | 138 | 58.50 |
| Female | 98 | 41.50 |
| Occupation | | |
| Private Employee | 72 | 30.50 |
| Migrant Worker | 50 | 21.20 |
| Healthcare Provider | 23 | 9.70 |
| Housewife | 19 | 8.50 |
| Public Worker | 14 | 6.40 |
| Traditional Market Seller | 11 | 5.10 |
| Student | 9 | 3.80 |
| Entrepreneur | 8 | 3.40 |
| Retired | 7 | 3.00 |
| State-Owned Corporation | 4 | 1.70 |
| Employee | | |
| Driver | 3 | 1.3 |
| Others | 13 | 5.5 |
| History of International Travel 14 Days Prior to Admission | | |
| Yes | 57 | 24.2 |
| No | 179 | 75.8 |

Source: Primary Data, 2022

Table 2. Clinical Profile of Patients

| Characteristics | n = 236 | % |
|----------------------------|---------|-------|
| Symptoms | | |
| Fever | 124 | 52.50 |
| Cough | 112 | 47.50 |
| Chest tightness | 24 | 10.20 |
| Sore throat | 43 | 18.20 |
| Cold | 21 | 8.90 |
| Headache | 9 | 3.80 |
| Anosmia | 9 | 3.80 |
| Muscle ache | 7 | 3.00 |
| Diarrhea | 1 | 0.40 |
| Comorbidities | | |
| Hypertension | 22 | 9.30 |
| Type 2 Diabetes Mellitus | 19 | 8.10 |
| Heart Problem | 6 | 2.50 |
| Malignancy | 1 | 0.40 |
| HIV | 1 | 0.40 |
| No Comorbidities | 194 | 82.20 |
| Therapy | | |
| Vitamin C | 236 | 100 |
| Azithromycin | 100 | 42.40 |
| Chloroquine | 58 | 24.60 |
| Levofloxacin | 41 | 17.40 |
| Oseltamivir | 35 | 14.80 |
| Anti-Coagulant | 17 | 7.20 |
| Tocilizumab (anti IL-6) | 7 | 3.00 |
| Ritonavir/Litonavir | 3 | 1.30 |
| Plasma Convalescence | 1 | 0.40 |
| Hospitalization | | |
| ≤ 14 days | 128 | 54.20 |
| > 14 days | 108 | 45.80 |
| Discharge Condition | | |
| Recover | 232 | 98.30 |
| Died | 4 | 1.70 |

Source: Primary Data, 2022

Table 3. Laboratory Profile of Patients

| Parameter | Value (Mean±SD) |
|---|-----------------|
| Hb (g/dL) | 13.93 ± 1.69 |
| Hct (%) | 42.44 ± 22.71 |
| White Blood Cells (× 10 ⁹ cells/L) | 7.52 ± 2.64 |
| Lymphocyte (× 10 ⁹ cells/L) | 2.16 ± 2.19 |
| Neutrophil Lymphocyte Ratio | 3.02 ± 3.41 |
| Neutrophil (× 10 ⁹ cells/L) | 4.86 ± 4.59 |
| Platelet (× 10 ⁹ cells/L) | 256.45 ± 90.77 |
| AST (U/L) | 36.14 ± 28.06 |
| ALT (U/L) | 39.22 ± 29.54 |
| BUN (mmol/L) | 11.88 ± 6.59 |
| Serum Creatinin (mg/dL) | 0.58 ± 0.14 |
| Random Blood Sugar (mg/dL) | 113.64 ± 37.62 |

Source: Primary Data, 2022

DISCUSSION

During the early stages of the pandemic, transmissions to and between medical workers spiked due to poorly imposed large-scale emergency biosecurity protocols within the medical environment and the community.⁴ There was also a national lack of disposable Personal Protective Equipment (PPE), as well as advanced screening, diagnostical, and therapeutic

medical equipment in regional hospitals due to a large patient influx to tertiary care hospitals around Bali. Furthermore, an ameliorated nationwide warning made by the ministry of health shaped the public perspective on the outbreak.³

After the first case, the Indonesian government implemented large-scale social restrictions by the end of March 2020.⁷ It was believed that during this period, there were few local transmissions in Bali. This was because the majority of patients admitted were migrant workers returning from other countries, indicating that the transmission occurred while working overseas. The international viral spreading was the most critical factor, specifically in a situation where tracking and testing were limited. After the discovery of transmission through migrant workers, airports were closed to further prevent the spread of the virus by hindering the entrance of potential carriers from other regions.⁸ However, by the end of May, travel restrictions were lifted, and this triggered a serious increase in the number of cases presented in June. Local transmissions were often seen at offices due to a change of setting to work-from-office, thereby forming new clusters.

The characteristics obtained in this study showed that travel and large-scale social restrictions influenced the number of cases. Close monitoring and large-scale restriction have been proven to lower the number of affected patients in the nation. The fluctuation of patients based on two major professions was presented in Figure 2. The graph showed that the first peak transmission of COVID-19 in April was mainly from returning migrant workers, and the second was from office employees, indicating local community transmission. During this period, COVID-19 had received a bad stigma from the population, and tracing had become an extensive project. This was because people were trying to hide their symptoms, thereby lying to healthcare and tracing workers. These factors made the contact tracing ineffective, and the testing of patients was not massive and extensive.

During the early phases of the COVID-19 pandemic, regional hospitals in all regencies were not ready and well-equipped to handle the

patients. Consequently, all COVID-19 cases were referred to Udayana University Hospital, which was dedicated by the government as a referral healthcare facility. The results showed that the majority of patients were from Denpasar, where they lived in highly-dense areas. A high number of cases were also recorded from Badung and Bangli.

This study revealed that most of the patients were admitted, tested, or seek proper medical treatment five to six days after the onset of symptoms. This factor was the constant elevation of cases, where pre-symptomatic could also spread the virus. An alternative argument proposed that this behavior was a form of denial from suspects, where they could not accept the possibility of being infected with COVID-19 due to the fear of shunning or isolation from social groups.^{9,10} This poses an obstacle to effective tracing, hence, there is a need to educate the community and straighten the negative stigma directed at patients.

Although the number of cases was elevating during the study period, the results showed a very low fatality rate of 1.6%. This was because the majority of patients were in their productive years (non-elderly), as well as only had mild to moderate symptoms and fewer comorbidities.^{6,11} Furthermore, the most common clinical features were cough and fever. All four fatal cases in this study showed severe symptoms as well as comorbidities, which required ventilator support. This finding is in line with a previous study that COVID-19 was only exceptionally deathly when the infection was severe, and patients with mild to moderate symptoms had a higher chance of recovery. Several studies revealed that infected people with comorbidities had a CFR of 1-3%.^{12,13} A dangerous interaction between COVID-19 and systemic conditions, such as diabetes mellitus, hypertension, as well as cardiovascular and pulmonary diseases, was reported to increase the risk of disease progression, eventually leading to death.¹⁴⁻¹⁶

This study has several limitations, which are related to selection bias. Furthermore, a report from a single data gathering site did not provide complete knowledge and cannot be generalized to the whole community.

CONCLUSION AND RECOMMENDATION

In the first three months of the COVID-19 pandemic in Bali, most of patients treated in Udayana University Hospital were male and private employees aged 21-40 years old with no history of international travel 14 days before admission. Furthermore, the majority had symptoms, such as fever (52.50%) and cough (47.50%). The duration of hospitalization was almost evenly spread between ≤ 14 days (54.20%) and >14 days (45.80%) with a case fatality rate of 1.70%. Further studies are advised to involve more hospitals/data-gathering sites to minimize selection bias.

AUTHOR CONTRIBUTIONS

CAWP: conceptualization, supervision; KTPM: conceptualization, writing-review, and editing; IKAS: validation, project administration; IMSA: validation, writing-review, and editing; AAAYG: writing-original draft; NMDDS: investigation, data curation; HA: supervision, writing-review. CAWP = Cokorda Agung Wahyu Purnamasidhi; KTPM = Ketut Tuti Parwati Merati; IKAS = I Ketut Agus Somia; IMSA = I Made Susila Utama; AAAYG = Anak Agung Ayu Yuli Gayatri; NMDDS = Ni Made Dewi Dian Sukmawati; HA = Haruko Akatsu.

CONFLICTS OF INTEREST

The authors declared that there is no conflict of interest before, during, and after the writing of this paper. This study did not utilize any sort of personal funding or grants.

REFERENCES

1. Wilder-Smith A, Freedman DO. Isolation, Quarantine, Social Distancing and Community Containment: Pivotal Role for Old-Style Public Health Measures in the Novel Coronavirus (2019-nCoV) Outbreak. *J Travel Med.* 2020;27(2):1-4. <https://doi.org/10.1093/jtm/taaa020>
2. Andriani H. Effectiveness of Large-Scale Social Restrictions (PSBB) Toward the New Normal Era during COVID-19 Outbreak: a Mini Policy Review. *J Indones Heal Policy Adm.* 2020;5(2):61-65. <http://dx.doi.org/10.7454/ihpa.v5i2.4001>

3. Covid-19-Indonesia: Puncak Gelombang Pertama “yang tak berujung”, Mengapa Protokol Kesehatan Sulit Dipatuhi? - BBC News Indonesia [Internet]. [cited 2021 Apr 6].
4. Papoutsis E, Giannakoulis VG, Ntella V, Pappa S, Katsaounou P. Global Burden of COVID-19 Pandemic on Healthcare Workers. *ERJ Open Res.* 2020 Apr 1;6(2):00195–2020. [10.1183/23120541.00195-2020](https://pubmed.ncbi.nlm.nih.gov/32570096/)
5. Centers for Disease Control and Prevention. Principles of Epidemiology | Lesson 1 - Section 11 [Internet]. [cited 2021 Jun 26].
6. WHO Indonesia. Media Statement: Knowing the Risks for COVID-19. World Health Organization. 2020.
7. Setiati S, Azwar MK. COVID-19 and Indonesia. 2020;(April).
8. WHO Team. Coronavirus disease (COVID-19): How is it Transmitted? World Health Organization. 2020.
9. Logie CH, Turan JM. How do We Balance Tensions Between COVID-19 Public Health Responses and Stigma Mitigation? Learning from HIV Research. *AIDS Behav.* 2020;24(7):2003–2006. [10.1007/s10461-020-02856-8](https://pubmed.ncbi.nlm.nih.gov/32570096/)
10. Rakesh S, and Madhusudan S. COVID-19 and Stigma: Social Discrimination Towards Frontline Healthcare Providers and COVID-19 Recovered Patients in Nepal. *Asian Journal of Psychiatry.* 2020. <https://pubmed.ncbi.nlm.nih.gov/32570096/>
11. NCIRD Division of Viral Diseases. Symptoms of Coronavirus. Centers for Disease Control and Prevention. 2020.
12. Khafaie MA, Rahim F. Osong Public Health and Research Perspectives Cross-Country Comparison of Case Fatality Rates of. *Osong Public Heal Res Perspect.* 2020;11(2):74–80. [10.24171/j.phrp.2020.11.2.03](https://pubmed.ncbi.nlm.nih.gov/32570096/)
13. Fanelli D, Piazza F. Since January 2020 Elsevier has Created a COVID-19 Resource Centre with Free Information in English and Mandarin on the Novel Coronavirus COVID-19. The COVID-19 Resource Centre is hosted on Elsevier Connect, the Company’s Public News and Information. 2020;(January).
14. Liu W, Tao ZW, Wang L, Yuan ML, Liu K, Zhou L, et al. Analysis of Factors Associated with Disease Outcomes in Hospitalized Patients with 2019 Novel Coronavirus Disease. *Chin Med J (Engl).* 2020;133(9):1032–1038. [10.1097/CM9.0000000000000775](https://pubmed.ncbi.nlm.nih.gov/32570096/)
15. Guo W, Li M, Dong Y, Zhou H, Zhang Z, Tian C, et al. Diabetes is a Risk Factor for the Progression and Prognosis of COVID-19. *Diabetes Metab Res Rev.* 2020;36(7):1–9. [10.1002/dmrr.3319](https://pubmed.ncbi.nlm.nih.gov/32570096/)
16. Schiffrin EL, Flack JM, Ito S, Muntner P, Webb RC. Hypertension and COVID-19. *Am J Hypertens.* 2020;33(5):373–374. [10.1093/ajh/hpaa057](https://pubmed.ncbi.nlm.nih.gov/32570096/)



Comparison of Reverse Osmosis and Non Reverse Osmosis Disinfection Methods for Drinking Water Depot

Muhamad Iqbal^{1*}, Ruslan La Ane²

¹Department of Environmental Health, Bandung Health Polytechnic, Bandung, Indonesia

²Department of Civil and Environmental Engineering, Faculty of Engineering, Ehime University, Matsuyama, Japan

*Authors Correspondence: muhamadiqbal@staff.poltekkesbandung.ac.id/0882001236953

ARTICLE INFO

Article History:

Received May, 18th, 2022

Accepted Nov, 21st, 2022

Published online Dec, 30th, 2022

Keywords:

Water;

DWP;

microbiology;

RO;

ABSTRACT

Drinking Water Depot (DWP) offers cheap and affordable drinking water, so it becomes an option for the society. However, the large number of public interest is not accompanied by qualified water quality. The test result by Bandung Public Health Office on DWP quality indicated that 55.22% were not eligible. The study aimed to determine the effective disinfection method to reduce microbiology in Reverse Osmosis (RO) and Non-RO methods. It was an analysis with a cross-sectional design. The population was all DWPs in Bandung and obtained 659 DWPs as samples. Sampling used two different tests and obtained 30 samples consisting of 30 DWP using RO and 30 Non-RO in average. Data analysis was done through univariate and bivariate using Wilcoxon Rank Sum test. The analysis result showed that polluted water raw quality was 48.33%; the bacteria reduction by RO method was 100% and Non-RO was 43.33%. The bivariate analysis result indicated that p-value was 0.033 which means that there was a difference between disinfection method using RO and Non-RO with the coliform presence. The RO disinfection is the best method which was able to be used by DWP owners. Thus, the society is suggested to choose DWP using RO disinfection method which verified by Public Health Department.

INTRODUCTION

Drinking Water Depot (DWP) is a business entity that manage drinking water for society's needs in bulk. DWP was established during economic crisis in 1998 to answer the problem of high demand for bottled drinking water. The society began to seek the alternative source of cheap water to meet the drinking water needs. DWP has grown rapidly and reached 659 DWPs in Bandung since 2017. The result of test conducted by Bandung Public Health Department indicated that from 134 DWPs, there were 74 DWPs (55.22%) contaminated with coliform and E. Coli.¹

Several factors affecting DWP drinking water quality are sanitation hygiene, raw water, and disinfection method. The hygiene standard is influenced by DWP location which must be pollution free, the quality of DWP equipment, clean and healthy behavior as well as procedures of DWP processing conducted.²

The treatment process determines the water quality which will be consumed, except water spring. DWP processing includes filtration and disinfection.³ Filtration is a separating process of suspended contamination and colloidal mixture including microorganisms. Meanwhile, disinfection is to eradicate pathogens. There are several methods used by DWP including using ozonation, ultraviolet, and reverse osmosis. Disinfection using ozone (O₃) takes place in the ozone mixing tank at least 0.1 ppm and the residual ozone immediately after filling is 0.06-0.1 ppm. Oxidizing ability of Ozone can kill various microorganisms, such as Escherichia bacteria, Salmonella enteritidis, and other pathogenic bacteria. Ozone will destroy as well as kill the outer microorganism cells (cell lysis).⁴

In addition to using ozone, disinfection is able to be conducted by Ultraviolet (UV) with a wavelength of 254 nm or a power of 2.537 degrees Angstrom can eradicate microorganism in 1 second. The disinfection quality using UV is strongly influenced by the water speed, the capacity or UV volume and the lamp intensity.⁵

Reverse Osmosis (RO) is the most promising membrane technology in reducing organic micro pollutant from drinking water treatment. RO filter becomes one of the most reliable filters. This process is able to remove about 80 to 99.8%

of contaminants contained in water. RO process uses high pressure, so the water can pass through the membrane. The RO membrane density is 0.001 micrometer.⁶ The osmotic pressure used in combination with other technology enables the water filter to produce the best healthy water. However, there is still thing that make it less effective in terms of time. Since the membrane in this technology is micro, the water which came out is also small. So, clogged membrane, dirty membrane, and broken membrane often occur.⁷

As demand for drinking water increases, the society takes advantage of DWP existence. In addition to being efficient and easy to get, the price is also affordable. The poor quality of treated water at the drinking water depot will affect the health status of people in the drinking water depot environment. So, it is the background for the growth and development of DWP, especially in Bandung city. The purpose of this study was to analyze the quality of the raw water sources used by drinking water depots, determine the most effective disinfection method to reduce coliform bacteria and provide advice to drinking water depot entrepreneurs regarding the selection of disinfection method.

MATERIAL AND METHOD

The study used quantitative with a cross sectional design to find out the comparison of using RO and Non-RO method on microbiological quality at DWPs. It was carried out at all Public Health Center in Bandung. There were 659 drinking water depots registered in all public health centers as the populations.

Samples were obtained through the results of calculation using the two-average difference test formula, then obtained sample size of 30 samples which consist of 30 DWPs using the RO disinfection method and 30 non-RO DWPs. The inspection method used was a membrane where the raw water and drinking water were passed into a membrane filter for 100 ml. The analysis technique used Wilcoxon Rank Sum Test.

Data were obtained by taking samples of raw water and water from the DWP processing process and then taking them to the laboratory for immediate examination. Water sample taken was 100 ml using sterile plastic. Then, laboratory test was done using membrane method,

namely raw water or drinking water was passed into a membrane filter. After that, it was incubated for 24 hours at 37°C. Laboratory measurement data were analyzed with application computer using Wilcoxon Rank Sum Test analysis and presented in the table. The use of Wilcoxon Rank Sum Test as statistical analysis is because the data is not normally distributed and the measurement results for the independent variables contain categorical data and there is numerical data for the dependent variable. It was conducted from July to August 2020 in Bandung City.

RESULTS

The field observation result showed that average number of DWP employees were 2-3 people with percentage of 66.67%. It indicated that DWPs in Bandung did business for a long time which is 7% DWP have operated more than 10 years. There are 3 types of raw water sources, namely spring, *Perusahaan Daerah Air Minum (PDAM)*, and well water (Table 1). Most owners of DWP used spring water (76.67%), but laboratory result showed *Perusahaan Daerah Air Minum (PDAM)* has the best quality (Table 2). The lack of DWP oversight by related offices is indicated with business license ownership by

35%, proper hygiene sanitation issued by public health department or local port health office by 30%, an overview of DWP production flow by 30%. The owner compliance levels in checking DWP microbiological quality every 3 months are 30% and 6 months is 41% (Table 1).

The laboratory examination result presents that microbiology in DWP raw water with spring is 56.67%, well water is 100%, and PDWP is 75% (Table 2). Then, DWP examination indicates that it used RO disinfection method and it is 100% eligible, while DWP using Non-RO is only 43.33% qualified (Table 3). The bivariate analysis result indicates that p-value is 0.033 for coliform which means that there is a difference disinfection method using RO and Non-RO on bacteria of 60 samples which have been tested in laboratory (Table 4).

Table 4 indicates the result of two different tests of average between Drinking Water Depot using RO and Non-RO disinfection method in reducing microbiological numbers in drinking water. The p-value for the presence of coliform and E. coli are 0.000. it can be concluded that there is a significant difference between Drinking Water Depot using RO and Non-RO disinfection method.

Table 1. Characteristics of Drinking Water Depot (DWP)

| Characteristic | RO | Non-RO | % |
|---------------------------------|----|--------|-------|
| Number of Employees | | | |
| 1 Person | 0 | 9 | 15 |
| 2 People | 22 | 18 | 66.67 |
| >3 People | 8 | 3 | 18.33 |
| Business Length (Years) | | | |
| <5 | 17 | 12 | 48.33 |
| 5 – 10 | 11 | 13 | 24 |
| > 10 | 2 | 5 | 11.66 |
| Raw Water Source | | | |
| <i>PDAM</i> | 9 | 3 | 20 |
| Spring Water | 19 | 27 | 76.67 |
| Well | 2 | 0 | 4 |
| Ownership | | | |
| Business License | 14 | 7 | 35 |
| Sanitary Hygiene Certificate | 10 | 8 | 30 |
| Standard Operational Procedure | 2 | 5 | 11.67 |
| Production Flow | 10 | 8 | 30 |
| Laboratory Test | | | |
| Last 3 Months | 10 | 8 | 30 |
| Last 6 Months | 16 | 9 | 41 |
| Information | | | |
| Participate Counselling | 19 | 16 | 58.33 |
| Get Guidance | 16 | 13 | 48.33 |
| Drinking Water Depot Management | 18 | 18 | 60 |

Source: Primary Data, 2020

Table 2. Raw Water Quality

| Indicator | Perusahaan Daerah Air Minum (PDAM) | | Spring Water | | Well Water | |
|-------------|---------------------------------------|----|--------------|-------|------------|-----|
| | n = 12 | | n = 46 | | n = 2 | |
| | n | % | n | % | n | % |
| Qualify | 9 | 75 | 26 | 56.52 | 0 | 0 |
| Not Qualify | 3 | 25 | 20 | 43.48 | 2 | 100 |

Source: Primary Data, 2020

DISCUSSION

The disinfection process aimed to eliminate microorganism in raw water. UV rays, ozone, and reverse osmosis can be used to kill microorganism in DWP raw water.⁸ The result indicated that coliform bacteria was still found in drinking water by Non-RO (UV and ozone), while RO did not contain pathogenic bacteria. The result of study is in line with Tomonic that RO disinfection method has a better quality in reducing microorganism than Non-RO method.⁹

The measurement in laboratory found that Non-RO disinfection method was still found microbiology. It is in line with Naratinova who stated that coliform is found in UV lamps which do not change > 36 months or 3 years.⁵ It is not in line with Jarvis who stated that UV-LED can reduce microbiology in water above 97% at wavelength of 275 nm by considering exposure time, lamp position, light intensity, and the resistance between light and water surface.¹⁰ The treated water quality in this study found that unqualified water was 56.7%. Several factors caused the poor quality of treated water using UV disinfection method was the contact time less than 1 second, so UV rays did not reach the entire water surface.

This result is not in line with Ding's finding that there is a decrease in spore after given injection of 1.5mg/L ozone and killed 99% of bacillus spore.¹¹ The flow rate of 4.17 ipm and ozone content of 2.79 ppm can reduce coliform in filtration system by 100%.¹² UV and ozone disinfection methods are still considered ineffective if they are not accompanied with cartridge filtration since these methods do not completely reduce the microbiological presence level in drinking water.¹³

Table 3. Drinking Water Depot (DWP) Quality

| Variable | RO | % | Non-RO | % |
|-------------|----|-----|--------|-------|
| Qualify | 30 | 100 | 13 | 43.33 |
| Not Qualify | 0 | 0 | 17 | 56.67 |

Source: Primary Data, 2020

Table 4. Two Different Tests of Average

| <i>Wilcoxon Runk Sum Test</i> | | |
|-------------------------------|----|---------|
| Indicator | n | p-value |
| Coliform | 60 | 0.033 |

Source: Primary Data, 2020

RO is the most effective disinfectant method to degrade microbiology in drinking water. The laboratory measurement result showed that 100% of water processed by DWP had a qualified drinking water based on Minister of Health Regulation No. 492 of 2010 about Drinking Water Quality Requirements. The RO effectiveness in degrading microbiology is in line with Fujioka that RO with bacteria removal rate ranging from 2.6 to 3.1-log (average = 2.9-log) and can reduce all coliform bacteria. It indicates that it is the best method applied in treating drinking water.¹⁴ The weakness of RO system is that the membrane is often clogged since the pore is tiny, so colloidal particles, suspended particle, bacteria, and virus cannot pass through the membrane pores. The blockage occurs in osmotic membrane because of deposition pores of membrane by organic substance with a low concentration of water salt.¹⁵ It makes the membrane to work extra in filtering in order to lighten the membrane work. So, pre-treatment is needed. According to Cornellsen, the importance of pre-treatment can reduce 10 times of dirt rate and eliminate blockage to membrane. So, it can reduce installation maintenance costs.¹⁶

Water source plays an essential role in water supply. According to Seo, water quality affects the coliform concentration which is mostly influenced by organic substance since good raw water quality optimizes the work of DWP equipment, so the water has good quality.¹⁷ Based on the result of laboratory examination on coliform, the unqualified raw drinking water depots of 60 samples is 48.33%. Well water is the worst choice since 100% unqualified, while spring water is 43.5% and PDAM is 25% unqualified (Table 2). The best water sources is

from PDAM since it has processed before distributed to customers, while spring and well water have no treatment.

The guidance conducted by related offices is not optimal. There is only 58.33% of DWP owners who get counseling and 48.33% receive coaching (Table 1). According to Villafuerte, it is important to supervise the DWP in order to know whether the water consumed is safe and healthy. Monthly and annual training or seminar must be conducted in operating DWP in order to ensure that consumers get the quality product and service. Furthermore, permits from relevant office and laboratory measurement related to the treated water quality must be carried out before DWP starts operating as well as strict surveillance in order to avoid contamination.¹⁸ If it is not supervised, a typical public health problem is going to arise.¹⁹ The low compliance of owner is proved by business license ownership by 35% and sanitation hygiene certificate by 30% (Table 1). The establishment of DWP without recommendation and permit from the relevant offices makes Health Department/Port Health Office difficult to supervise. The supervision conducted makes people feel safe, comfortable, and get optimal benefits of DWP services. The reason is that drinking water is primary human need which is broad, so the slightest risk must be avoided.²⁰

CONCLUSION AND RECOMMENDATION

The clean water treatment process is largely determined by the selection of the filtration method and the disinfection method. The method using Reverse Osmosis (RO) is the best method in reducing the presence of microbiology in drinking water compared to Non-RO methods. so it is recommended to every drinking water depot entrepreneur to use the reverse osmosis processing method.

Then for the Government, in this case the city health department, must monitor and evaluate the performance of the Drinking Water Depot, so that the quality of the treated water from the Drinking Water Depot can be maintained and ensure that the people who consume the water are not attacked by diseases originating from the Drinking Water Depot.

AUTHOR CONTRIBUTIONS

This article was written by MI in scientific paper writing; RLA proofreading and provided critical feedback of the manuscript. MI = Muhammad Iqbal; RLA = Ruslan La Ane.

CONFLICTS OF INTEREST

The author stated that there was no conflict of interest with funding sponsor and did not have role in study design; collection, analysis, or data interpretation, script writing, and decision to publish the result.

REFERENCES

1. Dinas Kesehatan. Laporan Tahunan Seksi Penyehatan Lingkungan. *Kota Bandung*. 2019.
2. Alfian AR, Firdani F, Sari PN. Why the Quality of Refill Drinking Water Depots is Bad (As a Qualitative Study). *J Kesehat Lingkung Indones*. 2022;21(1):106-110. <https://doi.org/10.14710/jkli.21.1.106-110>
3. Raksanagara AS, Fitriyah S, Afriadi I, Sukandar H. Aspek Internal dan Eksternal Kualitas Produksi Depot Air Minum Isi Ulang: Studi Kualitatif di Kota Bandung. *Maj Kedokt Bandung*. 2018;50(38):53-60. <https://doi.org/10.15395/mkb.v50n1.1143>
4. Sofia DR. Perbandingan Hasil Disinfeksi Menggunakan Ozon dan Sinar Ultra Violet Terhadap Kandungan Mikroorganisme pada Air Minum Isi Ulang. *Agroscience (Agsci)*. 2019;9(1):82. <https://doi.org/10.35194/agsci.v9i1.636>
5. Navratinova S, Nurjazuli N, Tarwatjo T. Hubungan Desinfeksi Sinar Ultraviolet (UV) dengan Kualitas Bakteriologis Air Minum pada Depot Air Minum Isi Ulang (DAMIU) (Studi di Kecamatan Pontianak Selatan Kota Pontianak). *J Kesehat Masy*. 2019;7(1):412-420. <https://doi.org/10.14710/jkm.v7i1.23011>
6. Ebrahimzadeh S, Wols B, Azzellino A, Martijn BJ, van der Hoek JP. Quantification and Modelling of Organic Micropollutant Removal by Reverse Osmosis (RO) Drinking

- Water Treatment. *J Water Process Eng.* 2021;42(June):102164.
<https://doi.org/10.1016/j.jwpe.2021.102164>
7. Hidayati FW, Jhoansyah D, Deni R, Danial M. Analisis Model Altman, Model Zmijewski dan Model Ohlson untuk Memprediksi Financial Distress. *J Indones Sos Sains.* 2021;2(2):230-240.
<https://doi.org/10.36418/jiss.v2i2.179>
 8. Mairizki F. Analisis Higiene Sanitasi Depot Air Minum Isi Ulang (Damiu) di Sekitar Universitas Islam Riau. *J Endur.* 2017;2(3):389-396.
<http://doi.org/10.22216/jen.v2i3.2428>
 9. Tominik VI, Hutabarat MSH. Analisis Uji Kualitas Bakteriologis Air Minum Isi Ulang (AMIU) Menggunakan Metode Mpn pada Pengolahan Air Sistem Reverse Osmosis (RO) dan Sistem Ultra Violet (UV). *Jurnal Kesehatan Saelmakers PERDANA* 2018;1:20-24.
<https://journal.ukmc.ac.id/index.php/joh/article/view/98>
 10. Jarvis P, Autin O, Goslan EH, Hassard F. Application of Ultraviolet Light-Emitting Diodes. *Water* 2019, 11, 1894. Published online 2019:15.
<https://doi.org/10.1016/j.watres.2016.03.003>
 11. Ding W, Jin W, Cao S, et al. Ozone Disinfection of Chlorine-Resistant Bacteria in Drinking Water. *Water Res.* 2019;160:339-349.
<https://doi.org/10.1016/j.watres.2019.05.014>
 12. Jannah FZ, Zuhri MS, Mulyadi E. Optimasi Kadar Ozon dalam Proses Disinfeksi Bakteri Optimization of Ozone Levels in the Process of Disinfection Coliform Bacteria in Drinking Water. *J Tek Kim.* 2021;15(2):59-65.
[10.33005/jurnal.tekkim.v15i2.2567](https://doi.org/10.33005/jurnal.tekkim.v15i2.2567)
 13. Jones CH, Shilling EG, Linden KG, Cook SM. Life Cycle Environmental Impacts of Disinfection Technologies Used in Small Drinking Water Systems. *Environ Sci Technol.* 2018;52(5):2998-3007.
<https://doi.org/10.1021/acs.est.7b04448>
 14. Fujioka T, Makabe R, Mori N, Snyder SA, Leddy M. Assessment of Online Bacterial Particle Counts for Monitoring the Performance of Reverse Osmosis Membrane Process in Potable Reuse. *Sci Total Environ.* 2019;667:540-544.
[10.1016/j.scitotenv.2019.02.339](https://doi.org/10.1016/j.scitotenv.2019.02.339)
 15. Couto CF, Santos AV, Amaral MCS, et al. Assessing Potential of Nanofiltration, Reverse Osmosis and Membrane Distillation Drinking Water Treatment for Pharmaceutically Active Compounds (PhACs) Removal. *J Water Process Eng.* 2020;33(July 2019):101029.
<https://doi.org/10.1016/j.jwpe.2019.101029>
 16. Cornelissen ER, Harmsen DJH, Blankert B, Wessels LP, Van der Meer WGJ. Effect of Minimal Pre-Treatment on Reverse Osmosis Using Surface Water as a Source. *Desalination.* 2021;509(January):115056.
<https://doi.org/10.1016/j.desal.2021.115056>
 17. Seo M, Lee H, Kim Y. Relationship between Coliform Bacteria and Water Quality Factors at Weir Stations in the Nakdong River, South Korea. *Water (Switzerland).* 2019;11(6).
<https://doi.org/10.3390/w11061171>
 18. Villafuerte LAJ, Vigonte F. Knowledge and Practices of Water Refilling Stations Owners and Operators: A Case Study. *SSRN Electron J.* Published online 2022.
[10.47895/amp.v47i2.1360](https://doi.org/10.47895/amp.v47i2.1360)
 19. Birawida AB, Selomo M, Mallongi A. Potential Hazards from Hygiene, Sanitation and Bacterium of Refill Drinking Water at Barrang Lompo Island (Water and Food Safety Perspective). *IOP Conf Ser Earth Environ Sci.* 2018;157(1):1-6.
<https://iopscience.iop.org/article/10.1088/1755-1315/157/1/012034>
 20. Suriata IN. Perizinan Usaha Industri Dagang Depot Air Minum di Kota Denpasar. *Public Inspir J Adm Publik.* 2021;6(1):42-54.
[doi:10.22225/pi.6.1.2021.42-54](https://doi.org/10.22225/pi.6.1.2021.42-54)
<https://doi.org/10.22225/pi.6.1.2021.42-54>