Characteristics of pediatric traumatic brain injury: study from Wongsonegoro Regional Public Hospital in Semarang

Andrew Robert Diyo[1], Nadisa Tiofunda Budiman[2], Natashia Olivia Christian[2], Riky Pratama[2]

[1]Department of Surgery, Wongsonegoro General Hospital Semarang/Faculty of Medicine Tarumanagara University Jakarta, Indonesia
[2] Faculty of Medicine Tarumanagara University Jakarta, Indonesia

Corresponding author: Andrew Robert Diyo
Email: andrewdiyo@gmail.com

Abstract

Background: Traumatic brain injury is one of the leading causes of morbidity and mortality in the world, as well as disability in the pediatric group. This study aimed to describe the characteristics of pediatric traumatic brain injury patients, considering the lack of data in Indonesia.

Methods: We conducted a descriptive-retrospective study at Wongsonegoro Regional Public Hospital Semarang. Data were extracted from medical records of patients admitted during the period of January 2017-December 2019 using a purposive sampling method.

Results: Out of 296 patients, most of the patients were male (59.13%; 66.30%). Based on age group, the highest percentage was found in the adolescent (11-18-year-old) (40.87%) in operative patients and 5-10-year-old (37.57%) in non-operative patients. The most common cause of traumatic brain injury in operative patients was falling from motor vehicle (37.39%) while in non-operative patients was falling while playing (32.60%). The most common type of injury in operative patients was epidural hematoma (49.57%) and in non-operative patients was brain concussion (53.59%). Most of the patients had minor head injury (75.65%; 81.22%). Most of operative patients spent 3-5 days (64.35%) in the hospital while most of non-operative patients spent 1-3 days (72.37%). Of all the subjects, the majority of patients recovered and discharged.

Conclusion: Falling from motor vehicle remains as the most common type of pediatric traumatic brain injury in this study. This study provides an overview of traumatic brain injury in children and shows the importance of enforcing driving rules and supervision by parents which play an important role in child safety. *(Health Science Journal of Indonesia 2021;12(1):1-5)*

Keywords: pediatric, traumatic brain injury, Indonesia

Abstrak

Latar belakang: *Cedera kepala merupakan salah satu penyebab utama morbiditas dan mortalitas di dunia, serta disabilitas pada kelompok pediatri. Penelitian ini bertujuan untuk mendeskripsikan karakteristik pasien pediatri dengan cedera kepala, mengingat minimnya data cedera kepala pada anak di Indonesia.*

Metode: *Penelitian ini merupakan penelitian deskriptif-retrospektif di RSUD Wongsonegoro Semarang. Data diambil dari rekam medis pasien anak yang dirawat selama periode Januari 2017-Desember 2019 dengan menggunakan metode purposive sampling.*

Hasil: *Dari 296 pasien, sebagian besar merupakan laki-laki (59,13%; 66,30%). Berdasarkan kelompok umur, persentase tertinggi pada kelompok operatif terdapat pada kelompok remaja (11-18 tahun) (40,87%) dan pada kelompok non operatif terdapat pada kelompok usia 5-10 tahun (37,57%). Penyebab tersering cedera kepala pada pasien operatif yakni jatuh dari kendaraan bermotor (37,39%) sementara pada pasien non operatif penyebab tersering berupa jatuh saat bermain (32,60%). Jenis cedera kepala tersering pada pasien operatif adalah Epidural Hematoma (49,57%) dan pada pasien non-operatif berupa commotio cerebri (53,59%). Kebanyakan pasien mengalami cedera kepala ringan (75,65%; 81,22%). Sebagian besar pasien operatif dirawat selama 3-5 hari (64,35%) sedangkan mayoritas pasien non operatif dirawat selama 1-3 hari (72.37%) Dari semua subjek, mayoritas pasien sembuh dan dipulangkan.*

Kesimpulan: *Jatuh dari kendaraan bermotor merupakan jenis cedera kepala yang paling umum ditemukan dalam penelitian ini. Studi ini memberikan gambaran umum tentang cedera kepala pada anak dan menunjukkan pentingnya penegakan aturan dalam berkendara serta pengawasan oleh orang tua yang berperan penting dalam keselamatan anak. **(Health Science Journal of Indonesia 2021;12(1):1-5)***

Kata kunci: *anak, cedera kepala, Indonesia*

Traumatic brain injury is one of the leading causes of high morbidity and mortality in the world. It is estimated that about 1.4 million people in the United States have experienced traumatic brain injury, of which 235,000 require treatment in a health facility, and 50,000 of whom have died.[1] Even in children and adolescents, traumatic brain injury is one of the main causes of disability and death worldwide. One report in Europe in 2006 stated that the average number of fatal and non-fatal head injury cases in children was between 0.5 and 5.2 per 1,000 children.[2] In Indonesia, it is reported that the average number of traumatic brain injury cases in Dr. Sutomo General Hospital from 2009 to 2013 was 1178 cases per year, with 6,1-11,2% mortality rates, while in Hasan Sadikin Hospital, the incidence of traumatic brain injury from 2008-2010 was 3578 cases.[3,4] A study by Putra, reported 186 cases of traumatic brain injury at the Umbu Rara Meha Waingapu Regional General Hospital for the period of January 1, 2017 to December 31, 2018.[5] '

In pediatric populations worldwide, the most common cause of traumatic brain injury in children aged 14 years is falling and in children aged over 14 years is traffic accidents, whether riding a motor vehicle or not.[6] Dewi et al.[7] reported 503 cases of pediatric traumatic brain injury at Cipto Mangunkusumo Hospital for the period of January 2004 until July 2005 with patients aged less than 15 years old. Most cases of pediatric traumatic brain injury are minor head injury that do not require hospitalization and can be immediately discharged after receiving initial treatment in the emergency unit, however, the prevalence of moderate to severe head injuries is not low either and has a risk of causing worse prognosis than patients with minor head injuries.[6] Such disorders will certainly have a profound effect, not only on the child's life, but also on the life of the family, especially the parents.

This study examines the characteristics of traumatic brain injury in pediatrics. Considering that there are still few reports and data on head injuries, especially in Indonesia, this study is expected to help describing the characteristics of traumatic brain injury.

METHODS

This study is a retrospective descriptive study using medical records in Wongsonegoro Regional Public Hospital Semarang. The study population included all pediatric patients (≤18 years) with traumatic brain injury at Wongsonegoro Regional Public Hospital Semarang. Wongsonegoro Regional Public Hospital Semarang was chosen for this study because the neurosurgical service at Wongsonegoro Regional Public Hospital Semarang covers several surrounding areas including Demak, Jepara, Grobogan, Pati, Blora and Rembang, thus having many referrals from those areas especially pediatric traumatic brain injury cases.

The study sample was taken using a purposive sampling method by including all pediatric patients (≤18 years old) with traumatic brain injury, who underwent surgery and who did not during the period of January 1, 2017 to December 31, 2019. The inclusion criteria for this study were traumatic brain injury patients aged ≤18 years old and were hospitalized. The exclusion criteria were incomplete medical records.

The statistical analysis of this study was in the form of a descriptive analysis which included gender, age, cause and type of injury based on ICD-10, Glasgow Coma Scale score, length of stay, and discharge condition in operative and non-operative patients. Data processing was carried out with SPSS version 25 and displayed frequency, percentage, and mean values.

This study was approved by The Ethics Committee of Wongsonegoro Regional Public Hospital with a letter number B/11055/070/X/2020.

RESULTS

This study was conducted by collecting medical records of pediatric patients with traumatic brain injury. Based on the data collected, the number of pediatric patients with traumatic brain injury was 296 patients. Of the 296 patients, there were 115 operative patients and 181 non-operative patients. In the operative group, it was found that the majority were male (n = 68; 59.13%) with most of them aged 11-18 years old (n = 47; 40.87%). The most common cause of injury was falling from motor vehicle (n = 43; 37.39%), with epidural hematoma being the most common type of injury (n = 57; 49.57%). Most patients presented with mild traumatic brain injury (n = 87; 75.65%), and of the 115 operative patients, 87 (75.65%) patients had a GCS score of 14-15. Most of the patients were hospitalized for 3-5 days (n = 74; 64.35%), and made full recovery and were discharged (n = 113; 98.26%), with only two (1.74%) patients in the operative group reported dead (Table 1).

Of the 181 non-operative patients, there were 120 (66.3%) male patients, where children (n = 68; 37.57%) and adolescents (n = 66; 36.46%) being the age group most often found in non-operative patients. In this group, falling while playing (n = 59; 32.6%) were the most common cause of injury. Of the several types of head injuries encountered, brain concussion was found in 97 (53.59%) patients. The majority of non-operative patients had GCS score of 14-15 (n = 147; 81.22%), with only 1 (0.55%) patients had GCS score of ≤8. Most non-operative patients were treated for 1-3 days (n = 131; 72.37%) and all patients fully recovered and were discharged (Table 2).

Table 1. Proportion of Traumatic Brain Injury Patients Based on Sex, Age, and Cause of Injury

	Operative Patients			Non-Operative Patients		
	n= 115	(%)	Mean	n=181	(%)	Mean
Gender						
Male	68	59,13		120	66,3	
Female	47	40,87		61	33,7	
Age Group						
<12 months	11	9,57	3,2 months	3	1,66	1,4 months
1 – 4 years	17	14,78	3,2 years	44	24,31	3,1 years
5 – 10 years od	40	34,78	7,4 years	68	37,57	7,5 years
11 – 18 years	47	40,87	14,1 years	66	36,46	14,6 years
Cause of Injury (ICD-10)						
Negligence (W04)	10	8,7		7	3,87	
Falling while playing (W09)	28	24,35		59	32,6	
Falling from bicycle (V18)	27	23,48		43	23,76	
Falling from motor vehicle (V28)	43	37,39		49	27,07	
Motor vehicle collision (V29)	7	6,09		20	11,05	
Slips (W01)	0	0		3	1,66	

Table 2.Proportion of Traumatic Brain Injury Patients Based on Type of Injury, Glasgow Coma Scale, Length of Stay, and Discharge Condition

	Operative Patients			Non-Operative Patients		
	n= 115	(%)	Mean	n=181	%	Mean
Type of Injury (ICD-10)						
Epidural Hematoma (S06.4)	57	49,57		9	4,97	
Subdural Hematoma (S06.5)	16	13,91		5	2,76	
Impression Fracture (S02.0)	19	16,52		5	2,76	
Subperiosteal Hematoma (R58)	13	11,3		0	0	
Subarachnoid Hemorrhage (S06.6)	0	0		11	6,08	
Intracerebral Hemorrhage (S06.3)	9	7,83		2	1,1	
Cerebral Concussion (S06.0)	0	0		97	53,59	
Cerebral Edema (S06.1)	0	0		13	7,18	
Cerebral Contusion (S06.2)	0	0		39	21,56	
Foreign Body (S01)	1	0,87		0	0	
Glasgow Coma Scale						
Mild (14–15)	87	75,65		147	81,22	
Moderate (9–13)	23	20		33	18,23	
Severe (≤8)	5	4,35		1	0,55	
Length of Stay						
1–3 days	1	0,87	3 days	131	72,37	2,9 days
3–5 days	74	64,35	4,9 days	12	6,63	4,6 days
>5 days	40	34,78	7,9 days	38	21	7,5 days
Discharge Condition						
Recovered	113	98,26		181	100	
Death	2	1,74		0	0	

DISCUSSION

Of 115 operative patients and 181 non-operative patients, most were male patients. From several previous studies conducted by Dewan, et al[6] Alhabdan, et al[8] and El-Menyar, et al[9] up to 80% of pediatric traumatic brain injury patients were male. The high incidence of traumatic brain injury in men may be related to the high use of motor vehicles, lack of road safety awareness, and may be attributed to adventurous and aggressive behavior.[3,10]

The number of adolescent patients (11-18 years) in the operative group in this study could be related to the cause of injury. In addition, in this study, it was found that traumatic brain injury caused by falling from motor vehicle was the most common cause in operative patients. In adolescent age group, the use of motor vehicle that are not accompanied by road safety awareness can increase the incidence of traffic accidents.[3] According to Riskesdas 2018 data, around 23.9% of people of all age group never use helmets while riding motorbikes[11] This is supported by a study conducted by Alhabdan, et al in which most traumatic brain injury patients were aged 15-18 years.[8]

In our study, it was found that most of the non-operative patients are children over 5 years old. Research conducted in Qatar and Nepal also found similar results, namely that the highest incidence of traumatic brain injury was found in children over 5 years old which may be due to the high use of motor vehicles in adolescent groups.[9,12] In addition, in children aged 5-10 years old, where the age range is school age and the high rate of traumatic brain injury in this group may come from accidents when children are playing in school without supervision[9,12] In this study, it was also found that in the non-operative patients, the cause of most injury was due to falling while playing (n = 59; 32.6%). This emphasizes the importance of supervision when children play, especially in school and home environments.

This study found that, in operative group, the most cases were epidural hematoma (n = 57; 49.57%) (Figure 1). The previous studies by Tallapragada, et al[13] and Udoh, et al[14] found that most of the operative measures were performed in cases of epidural hematoma. Meanwhile, in non-operative patients, the majority were cases of brain concussion (n = 97; 53.59%) (Figure 2). However, study by Maas, et al found that subarachnoid hemorrhage was the most common pathology encountered, followed by

cerebral contusion.[15] Another study from Dewan, et al[16] showed different results in that fracture and cerebral contusion were the most common pathologies found on head CT scan. Another result by El-Menyar, et al found that cerebral contusion is the type of injury that often occur in pediatrics.[9] These varying results may be due to differences in sociodemographic factors that can influence the incidence of head injury. In addition, the varying number of subjects may also affect the results of the research obtained, therefore further research is needed on this matter.

In the operative and non-operative patients, mostly presented with a GCS score of 14-15, with only 1 (0.55%) patients in the non-operative group came with a GCS score of ≤ 8. This is quite in line with the study by Putra and Dewan, et al, where patients admitted to hospital with traumatic brain injury were mostly with GCS score of 14-15 (67.70%).[5,6] Another study by Li, et al[17] reported that mild traumatic brain injury (GCS 14-15) is the most common condition encountered.

The length of stay in the hospital of 74 (64.35%) patients who underwent surgery was 3-5 days, followed by 40 patients (34.78%) who were hospitalized for more than 5 days. Whereas in non-operative patients, as many as 131 patients (72.37%) required a short hospital stay, namely 1-3 days. The length of stay of patients is very dependent on their condition when arriving in the hospital and during their treatment. Study by Bedry, et al[18] showed that the average length of stay in patients with traumatic brain injury was 4-7 days while another study by Tallapragada, et al[13] showed shorter length of stay of less than 2 days in 75% non-operative pediatric traumatic brain injury patients. The longer length of stay in patients who undergo surgery may be due to pre-operative management and post-operative care which takes longer time compared to patients who do not undergo surgical procedure.

In both groups, almost all patients recovered and discharged. Of the 115 patients in the operative group, two (1.75%) patients died, while in the non-operative group, all patients recovered and discharged. This shows that despite of the initial condition, with the right management, there is a chance of recovery in traumatic brain injury patients. On the other side, one patient came with significantly worse condition (GCS <8, extensive bleeding) leading to death despite adequate management. However, some complications during hospitalization may occur and have the opportunity to worsen patient's condition

such as sepsis and pneumonia as reported in the study by El-Menyar, et al.[9] where in this study, post-operative complication in which infection occurred in the other patient during hospitalization leading to death of the patient. This could be prevented by closer monitoring of operative patients and proper emergency medical services.

In conclusion, head injury patients were predominantly male in the adolescent age group due to falling from motor vehicles. Based on the type of injury, epidural hematoma and brain concussion were the most common type of injury. The majority of patients recovered and discharged. This study has several limitations in which we do not evaluate the delayed outcome that might occur and the use of purposive sampling might not represent the whole population. This study provides an overview of pediatric patients with traumatic brain injury in which the results are related to the importance of road safety awareness and supervision from parents in order to reduce morbidity and mortality in pediatric patients.

Acknowledgment

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Stigma during COVID-19 pandemic among healthcare workers in greater Jakarta metropolitan area: a cross-sectional online study

Ika Saptarini, Novianti, Anissa Rizkianti, Iram Barida Maisya, Suparmi, Ginoga Veridona, Ning Sulistiyowati, Sudikno

Center for Research and Development of Public Health Efforts, National Institute of Health Research and Development Ministry of Health, Republic of Indonesia

Corresponding author: Ika Saptarini
Email: dr.ikasaptarini@gmail.com

Abstract

Background: COVID-19, which started in Wuhan, has become a global pandemic leading to a new global risk to human health. Lack of information or misinformation about COVID-19 can lead to stigmatization, including for health workers. This study aims to determine the stigmatization among health workers during the COVID-19 pandemic within the Greater Jakarta Metropolitan Area.

Methods: This study was a cross-sectional study conducted online using Google Forms in the Jabodetabek area. The questionnaire's link was distributed through social media, including Whatsapp, Facebook, Twitter, and Instagram. The study sample is health workers who live in Jabodetabek and carry out health practices. Stigma is measured using four dimensions: personalized stigma, disclosure concerns, public attitudes, and negative self-image.

Result: The negative self-image dimension is the dimension most felt by health workers. More than half of health workers agreed that during the COVID-19 pandemic, they put their families at risk because of their status as health workers. The stigma of health workers who work in hospitals is higher than that of non-hospital health workers, such as health centers, clinics, and laboratories.

Conclusion: There was any stigmatization among healthcare workers in Greater Jakarta Metropolitan Area. Stigmatization was higher among healthcare workers who work in hospitals compared to those who work in non-hospitals. Some efforts should be made to reduce stigmatization among health workers, such as provide correct information to the public, equip health personnel with adequate personal protective equipment, and give incentives periodically to the health workers. *(Health Science Journal of Indonesia 2021;12(1):6-13)*

Keywords: stigma, COVID-19, healthcare workers, Greater Jakarta Metropolitan Area

Abstrak

Latar belakang: COVID-19 yang bermula dari Wuhan telah menjadi pandemi global yang mengancam kesehatan umat manusia. Kurangnya informasi atau informasi yang salah mengenai COVID-19 dapat menyebabkan adanya stigmatisasi termasuk terhadap tenaga kesehatan. Penelitian ini menilai adanya stigmatisasi terhadap tenaga kesehatan selama pandemi COVID-19 di wilayah Jabodetabek.

Metode: Penelitian ini merupakan penelitian potong lintang dan dilakukan secara daring menggunakan Google Form di wilayah Jabodetabek. Tautan pengisian kuesioner disebarkan melalui media sosial seperti Whatsapp, Facebook, Twitter dan Instagram. Sampel studi adalah tenaga kesehatan yang tinggal di Jabodetabek dan melakukan praktik kesehatan. Stigma diukur menggunakan empat dimensi yaitu personized stigma, disclosure concerns, concerns about public attitudes dan negative self-image.

Hasil: Dimensi negative self-image merupakan dimensi yang paling dirasakan oleh tenaga kesehatan. Lebih dari separuh tenaga kesehatan setuju bahwa selama pandemi COVID-19 mereka membahayakan keluarga mereka karena status mereka sebagai tenaga kesehatan. Stigma pada tenaga kesehatan yang bekerja di rumah sakit lebih tinggi disbanding tenaga kesehatan yang bekerja bukan di rumah sakit seperti puskesmas, klinik dan laboratorium.

Kesimpulan: Terdapat stigmatisasi pada petugas kesehatan di jabodetabek. Stigmatisasi lebih tinggi di antara petugas kesehatan yang bekerja di rumah sakit dibandingkan dengan mereka yang bekerja tidak di rumah sakit. Beberapa upaya yang perlu dilakukan untuk mengurangi stigmatisasi di kalangan petugas kesehatan, seperti memberikan informasi yang benar kepada masyarakat, melengkapi tenaga kesehatan dengan alat pelindung diri yang memadai, dan memberikan insentif kepada mereka secara berkala. (Health Science Journal of Indonesia 2021;12(1):6-13)

Kata kunci: stigma, COVID-19, tenaga kesehatan, jabodetabek

Novel Coronavirus disease (COVID-19), which began in Wuhan, China, has become a pandemic disease, leading to a new global risk to human health. COVID-19 is a novel infectious disease spread by coughing and sneezing, close personal contact with someone infected with the virus, and touching an object or surface contaminated with the virus. On 11 January 2020, after testing for pathogenic nucleic acids, China reported 41 cases of severe pneumonia due to infection of the new coronavirus (SARS-CoV-2) in humans for the first time. COVID-19 spread to more than one hundred countries, with a total of more than 5,000,000 people infected. World Health Organization declared a new coronavirus pandemic on 11 March, 2020.[1] The first case of COVID-19 in Indonesia was detected on 2 March 2020, involving two women contacted tourists from Japan.[2]

Greater Jakarta Metropolitan Area (Jabodetabek) is the biggest and the most strategic metropolitan in Indonesia. Thus, these areas tended to have high population densities. Greater Jakarta Metropolitan Area consists of Jakarta, Indonesia's capital, and eight other cities, including Bogor City, Bogor Regency, Depok City, Tangerang City, South Tangerang City, Tangerang Regency, Bekasi City, and Bekasi Regency.[3] Greater Jakarta Metropolitan Area is the area with the highest COVID-19 cases in Indonesia. The COVID-19 pandemic was centered in the Jakarta Capital Special Region (DKI Jakarta), which contributed over half of Indonesia's total number in the first month; two-thirds of the surrounding urban districts that make up the Greater Jakarta Metropolitan Area was included. Some health facilities for COVID-19 treatment were also built in Greater Jakarta Metropolitan Area, such as COVID-19 Emergency Hospital (Rumah Sakit Darurat Wisma Atlet) and field hospital. Some hospitals also function as a hospital for treating COVID-19 patients in this area.[4]

Scientists, researchers, and medical professionals worldwide are still working at a breakneck pace to figure out how to deal with this virus's novelty. Stigma is described as "the negative association between an individual or group of people who share certain characteristics and a specific disease" in the sense of health. Fear, anxiety, and a lack of information about a disease that causes severe symptoms or death can stigmatize patients who have the disease or treat them. Isolation, failure to provide service, abuse, and bullying are examples of stigmatized communities' discriminatory practices.[5] Previously, stigma has been associated with different infectious diseases such as Ebola, SARS, AIDS, and Tuberculosis. Stigma has arisen since specific populations are targeted as the reason for COVID-19 pandemic.[6] For example, in studies conducted in Taiwan and Hong Kong during the 2003 outbreak of Severe Acute Respiratory Syndrome (SARS), 20–49 percent of healthcare workers involved in the treatment of SARS patients was reported being shunned, avoided, or otherwise stigmatized by people in their group for fear of being infected with the SARS coronavirus.[8,9]

Healthcare workers had complex and contradictory thoughts and feelings about balancing their positions as healthcare professionals and family members, feeling professional obligation and fear of this emerging disease, related coronavirus patients, and remorse about potentially infecting their families. Working with potentially contagious patients resulted in a great deal of shame. Contagion elicits a wide variety of feelings, values, biases, stereotypes, and stigmas. Emotions play a crucial role in these situations, distorting expected or fact-based decisions. The obligation owed by physicians, nurses, and healthcare staff to their patients and the underlying behaviors induced by the contagion are incompatible.[10]

Healthcare workers were hailed as heroes in the national press and by government officials during the COVID-19 pandemic. People around the world have made public applause for healthcare workers a nightly ritual.[11] Is this to suggest that, unlike SARS, healthcare workers' stigmatization will not be a concern during the COVID-19 pandemic? The present study aimed to investigate healthcare workers' stigmatization during the COVID-19 pandemic in Greater Jakarta Metropolitan Area.

METHODS

A cross-sectional web-based survey was carried out by using google forms. Data collection was conducted from 30 April to 2 May 2020 to collect the information. The Institutional Review Boards approved this study of the National Institute of Health Research and Development, Ministry of Health. This study's sample was healthcare workers who lived in Greater Jakarta Metropolitan Area and running

healthcare services. A structural questionnaire link was sent to Greater Jakarta Metropolitan Area health workers through social media, including WhatsApp, Facebook, Instagram, and Twitter. Inclusion criteria were as follows: health workers aged 15 years old and above, living in Greater Jakarta Metropolitan Area and accessing the internet who voluntarily participated in this study. Prior to data collection, respondents were given a detailed summary of the survey and asked to sign an online informed consent form. Respondents were excluded if they could not complete the online survey independently. The respondents filled out a Google Form-connected questionnaire, which was then submitted to the final database and downloaded as a Microsoft Excel sheet. A total of 277 respondents provided complete information regarding the survey.

A self-made questionnaire was used to collect respondents' demographic information, including residence, gender, age, marriage. In addition, a new questionnaire was developed to measure stigma regarding COVID-19 pandemic among healthcare workers. Finally, a questionnaire trial was conducted to validate the questionnaire. Ethical clearance provided by the Ethics Commission of the NIHRD, MoH under the letter number of LB.02.01/2/KE/327/2020.

Measurement

Some previous studies showed that stigma was challenging to measure and analyze. It is difficult to determine which stigma construct is being assessed when items are written this way. One of the problems to measure stigmatization is the most suitable tools and practices in dealing with stigma?[12,13] We develop a new instrument to measure stigmatization among healthcare workers during COVID-19 pandemic. We adopted a short version of the HIV stigma scale to measure stigma among healthcare workers. First, the instrument including twelve questions. We conducted an instrument trial to assess the instrument validity and reliability. Then we conducted a validity and reliability test. Three questions were dropped due to poor validity. The final questionnaire consists of nine (9) questions regarding internalized stigma with fair internal reliability (Cronbach alpha, α:0.69). Stigma was measured in four dimensions: personalized stigma, disclosure concerns, concerns about public attitudes, and negative self-image. Nine questions were used to measure stigma, including two questions about personalized stigma, two questions

about disclosure concerns, two questions about public attitudes, and three questions about negative self-image. We make point one (1) if the respondent agrees and zero (0) if disagree. The stigma scale was a continuous variable, and it was calculated the sum of nine questions about stigma. Higher scores indicated higher levels of stigmatization levels.

We also collected some information regarding the associated stigma among healthcare workers, including demography variables (age, residence, gender, marital status), healthcare worker, workplace type, and vulnerable household member. The households are categorized to have a vulnerable group if there are any pregnant women, babies, children, or elderly.

Statistical analysis

All data were subsequently imported into and analyzed using STATA 15.1 SE. The results were presented in texts and tables. Univariate analysis was conducted to describe participant characteristics. Linear regression analysis was used to assess the strength of the relationship and monitor for possible confounding variables, and significance was set at a p-value. The p-value below 0.05 was considered to be associated with stigma regarding COVID-19 pandemic among healthcare workers. Before we construct the final model, a heteroscedasticity test was performed to assess data distribution. The heteroscedasticity test showed that data have homoscedasticity so that linear regression can be performed to the final analysis.

RESULTS

Characteristics of the respondents

Table 1 presents the demographic and work-related characteristics of the sample. Most of respondents highly represented groups of nurses (41.2%), midwives (18.8%), and doctors (18.1%). The majority of respondents (64.6%) were from outer Jakarta, female (84.1%), and being married (60.7%). More than half of the respondents (52.4%) were work in non-hospitals (primary health centers, clinics, and laboratories).

Table 1. Demographic and work-related characteristics of respondents (n=277)

Variables	n	%
Age group		
15-29 years	135	48.7
30-49 years	132	47.7
50+ years	10	3.6
Residence		
Jakarta	98	35.4
Outer Jakarta	179	64.6
Sex		
Male	44	15.9
Female	233	84.1
Marital status		
Never married	104	37.6
Divorce	5	1.8
Married	168	60.7
Type of healthcare worker		
Doctor	50	18.1
Nurse	114	41.2
Midwives	52	18.8
Others*	61	22.0
Type of workplace		
Hospital	132	47.7
Non-hospital**	145	52.4
Vulnerable household member		
Any	122	44.0
None	155	56.0

*Other: nutrition, laboratory staff, pharmacies

** Non-hospital: primary health center, clinic, laboratory

Stigma among healthcare workers regarding COVID-19 pandemic

We measured stigma in four dimensions (personalized stigma, disclosure concern, concern about public attitude, and negative self-image). Table 2 presents descriptive results regarding stigma among healthcare workers in Greater Jakarta Metropolitan Area. Negative self-image was the most dimension of the stigma that affecting healthcare workers. More than half (67.9%) respondents agree that they were endangering their families because of their profession as healthcare workers. Almost one-third of the respondents (28.2%) agree that people's attitudes to health workers make them feel worse about themselves. There were higher levels of agreement with questions about disclosure concerns. For example, 39% of respondents agree that healthcare workers worry that people will disclose their professional status. On the other hand, a few (16.3%) respondents agree to keep their professional status a secret.

Concern about public attitude also affects some healthcare workers. About one-fifth (23.5%) agree that people believe that health workers must have contracted COVID-19. Also, one fifth (21.7%) of respondents agree that community member ostracizes healthcare workers. A few respondents agreed on personalized stigma. For example, 16.6% of respondents agree that people avoid them due to their professional status. Also, 9.4% of respondents agree that they lose their friends due to their profession as healthcare workers.

Factors associated stigma among healthcare workers

Overall, the mean stigma score among healthcare workers in Greater Jakarta Metropolitan Area was 2.38 (SD: 1.98). The stigma score was higher among younger age groups, healthcare workers who lived in Jakarta, doctors, and healthcare workers who work in hospitals. We use linear regression to determine the factors associated with stigma among healthcare workers in Greater Jakarta Metropolitan Area. We found that type of workplace was associated with stigma among healthcare workers. Those healthcare workers who work in the hospital had an average of 0.80 units higher stigma scores when compared to those healthcare workers who work in non-hospital (primary health center, clinic, or laboratory). However, the average stigma of doctors and other types of healthcare workers was not significantly different. In addition, healthcare workers' average stigma was not significantly different regarding demography (age, residence, sex, marital status, and vulnerable household member).

Table 2. Frequencies and percent for survey measures

Variables	Frequency (%)	
	Agree	Disagreed
Personalized stigma		
Feeling that people avoid me	16.6	83.4
Losing friends and fear of rejection	9.4	90.6
Disclosure concerns		
Worrying that others will disclose my professional status	39.0	61.0
Keeping my professional status a secret	16.3	83.8
Concerns about public attitudes		
People believe that healthcare workers must have contracted COVID-19	23.5	76.5
Community member ostracizes healthcare workers	21.7	78.3
Negative self-image		
Endangering family because of my profession as a healthcare worker	67.9	32.1
Feeling guilty to the family due to my profession	15.9	84.1
People's attitudes to health worker make me feel worse about myself	28.2	71.8

*Other: nutrition, laboratory staff, pharmacies

** Non-hospital: primary health center, clinic, laboratory

Table 3. Multiple linear regression model predicting healthcare workers' stigma regarding COVID-19 pandemic

Variables	Mean (SD)	Coefficient	95% CI	p-value
Age group				
15-29 years	2.69 (2.07)	Reference		
30-49 years	2.14 (1.83)	-0.54	(-1.09 – 0.01)	0.055
50+ years	1.50 (2.01)	-0.79	(-2.25 – 0.67)	0.290
Residence				
Jakarta	2.68 (2.25)	0.45	(-0.07 – 0.97)	0.090
Outer Jakarta	2.22 (1.80)	Reference		
Gender				
Male	2.52 (2.31)	Reference		
Female	2.36 (1.92)	-0.06	(-0.78 – 0.66)	0.875
Marital status				
Never married	2.64 (1.98)	Reference		
Divorce	2.80 (2.59)	0.37	(-1.43 – 2.16)	0.689
Married	2.21 (1.95)	-0.16	(-0.72 – 0.40)	0.580
Type of health worker				
Doctor	2.64 (1.98)	0.56	(-0.21 – 1.34)	0.153
Nurse	2.49 (1.96)	-0.03	(-0.73 – 0.67)	0.934
Midwives	2.15 (1.94)	-0.02	(-0.76 – 0.72)	0.960
Others	2.16 (2.06)	Reference		
Type of workplace				
Hospital	2.80 (2.16)	0.80	(0.23 – 1.36)	0.006
Non-hospital	2.01 (1.72)	Reference		
Vulnerable household member				
Any	2.45 (1.93)	-0.15	(-0.62 – 0.32)	0.527
None	2.30 (2.05)	Reference		

DISCUSSION

Stigmatization of healthcare workers is linked to both mental and physical health. Healthcare workers who expected higher stigmatization levels showed higher psychological distress levels, which predicted higher somatic symptoms. Healthcare workers are at high risk to infected with the virus due to their professional status.[10] It is well known how healthcare staff and ambulance crews in some Latin American, African, and European countries became objects of stigma and prejudice in the most affected areas.[14] Some healthcare workers felt humiliated in Indonesia because of their status as healthcare workers, such as doctors and nurses, or served in the COVID-19 hospital.[15]

Even though healthcare workers have a higher risk of infection with COVID-19 than the general population, no health authority or government has recommended that healthcare workers be removed from their communities or families during the COVID-19 pandemic, to our knowledge. However, this situation made the healthcare workers experience a negative self-image, such as endangering their family and feeling guilty to their family due to their professional status.[11] This study found a similar finding that negative self-image among healthcare workers was the highest dimension of the stigma that affects healthcare workers.

This study also found that healthcare workers concern about public attitudes. How society treats healthcare workers during COVID-19 pandemics made them worse. That is people who tend to stigmatize (fear and avoid) healthcare workers. The breadth and limits of fear and avoidance are a topic that needs to be investigated further. People who have a high level of fear and avoidance of healthcare workers may also avoid other groups of people to fear becoming disease vectors (e.g., children or sickly-looking people).[11] During previous pandemics and outbreaks, such as the SARS outbreak, shunning, ostracism, and avoidance were common. We have not learned the lesson of pandemic-related stigmatization of healthcare workers. It is not enough to congratulate healthcare professionals. Precise, sensible public education campaigns about the risks that healthcare workers pose to the public are needed.[11]

In the multivariate linear regression model, we found that workplace type was associated with stigmatization among healthcare workers. Healthcare workers who work in hospitals had higher stigma scores than those who work in non-hospital. A possible explanation for this finding is that the hospital is a place to treat COVID-19 patients with severe symptoms. Since the beginning of the COVID-19 pandemic, healthcare workers have been under heavy workload conditions worldwide, especially in hospitals. Limited resources, longer hours, sleep, work-life balance disturbances, and occupational hazards associated with COVID-19 exposure have led to adverse psychological outcomes among healthcare employees regarding post-traumatic stress, insomnia, anxiety, and depression.[16,17] Healthcare workers, like everyone else, are vulnerable both to the disease itself and to rumors and incorrect information that necessarily increases their anxiety levels. Healthcare workers' anxiety was further impacted by growing stigmatization and loss of trust in their communities.[18] All of this causes the internalized stigma of healthcare workers who work in hospitals to be higher than those who work in non-hospitals.

This study also found that the average stigma of doctors and other types of healthcare workers was not significantly different. Regarding the demography factors, healthcare workers' average stigma also was not significantly different. The pandemic has placed extraordinary levels of psychological stress on healthcare workers. Healthcare workers are exposed to high-demand settings for long hours, living in constant fear of disease exposure while separated from family and facing social stigmatization. A previous study in Japan found that both frontlines who have direct exposures to patients with COVID-19 daily and non-front line healthcare workers expressed similar concerns regarding the COVID-19 pandemic.[19,20] Also, a previous study in Saudia Arabia found that demographic characteristics were not significantly associated with anxiety among healthcare workers. Psychological burdens such as anxiety can lead to feeling stigmatization among healthcare workers. In contrast, decreasing the emotional burden, especially social support, clear communication and distribution of tasks, flexible working hours, and the utilization of psychosocial and psychological help without stigmatization.[21]

There is a large amount of information that can cause confusion and panic among residents. WHO describes this as an infodemic.[22] Furthermore, The Indonesian government had identified more than 500 hoaxes related to the COVID-19 pandemic in social media. The government has made efforts to reduce hoaxes related to the COVID-19 pandemic through state-owned websites and social media. For example,

www.covid19.go.id has a hoax buster feature to give accurate information regarding COVID-19 pandemics. In addition, the government gives some incentives for healthcare workers who work in health facilities during the COVID-19 pandemic through the Ministry of Health. However, this incentive has some constraints that make healthcare workers unable to get it periodically in the implementation. Furthermore, psychological counselors/counseling psychologists should regularly visit medical workers to listen to their stories and support them.

In conclusion, there was any stigmatization among healthcare workers in Greater Jakarta Metropolitan Area. The average stigma score was higher among healthcare workers who work in hospitals than those who work in non-hospitals. Some efforts should be made to reduce stigmatization among health workers, such as provide correct information to the public, equip healthcare workers with adequate personal protective equipment, and give incentives periodically to them. In addition, policymakers should make some regulations to prevent mental health, such as giving regular psychological counseling and self-help service among healthcare workers.

Author contribution

Conceptualization: IS, N, NS, Sup. Data curation: IS, GV. Formal analysis: IS, GV. Funding acquisition: None. Methodology: IS, Sup, AR. Visualization: IS, AR, Writing – original draft: IS, AR, N, Sup, IBM, NS, Sud. Writing – review and editing: IS, N, AR, Sup, IBM, NS, Sud.

Competing interest

We declare that there is no competing interest in this study.

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First experience of using favipiravir in the first healthcare worker patient with moderate case of Coronavirus Disease 2019 (COVID-19) at Sulianti Saroso Infectious Disease Hospital, Jakarta, Indonesia: a case report

Pompini Agustina Sitompul, Nina Mariana, Adria Rusli, Titi Sundari, Rosa Marlina, Faisal Matondang, Haruyuki Dewi Faisal, Mohammad Syahril

Sulianti Saroso Infectious Disease Hospital, Jakarta, Indonesia

Corresponding author: Nina Mariana
Email: mynayla09@yahoo.com

Abstract

Background: During the early period of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) pandemic, there was no approved and definitive drug available for the treatment of COVID-19. Favipiravir, chloroquine, hydroxychloroquine was used for re-purposing drugs while their efficacy and safety remained a major concern for healthcare workers. Clinical trial to assess efficacy and safety were ongoing.

Case presentation: We present here the case of a 38-year-old woman, the first case of a healthcare worker diagnosed with COVID-19 who had moderate type, including first experience treatment with favipiravir in Sulianti Saroso Infectious Disease Hospital, Jakarta, Indonesia. We present the clinical characteristics, chest X-ray, clinical laboratory profiles, the treatment process with favipiravir and hydroxychloroquine as well as the clinical outcome of moderate type COVID-19 patient.

Conclusion: This case highlights that considering the use of emergency intervention outside of clinical trial in the COVID-19 population, the informed patient consent has been given and the use of emergency intervention was monitored. *(Health Science Journal of Indonesia 2021;12(1):14-9)*

Keywords: COVID-19, favipiravir, medical worker, case report, Jakarta

Abstrak

Latar belakang: Periode awal pandemi Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2), belum terdapat obat yang disetujui dan pasti tersedia untuk pengobatan COVID-19. Favipiravir, chloroquine, hydroxychloroquine digunakan sebagai obat dengan indikasi baru yang sementara efektifitas dan keamanannya menjadi perhatian para petugas medis.

Penyajian kasus: Disini kami melaporkan kasus wanita umur 38 tahun, merupakan kasus pertama seorang tenaga kesehatan Rumah Sakit terdiagnosis Coronavirus Disease 2019 (COVID-19) dengan penggunaan terapi favipiravir untuk pertama kalinya di Rumah Sakit Pusat Infeksi Sulianti Saroso, Jakarta, Indonesia. Berikut ini kami gambarkan karakteristik klinis, hasil foto thorak, profil laboratorium dan proses terapi menggunakan favipiravir and hidroxychloroquine serta hasil akhir pada kasus COVID-19 derajat sedang.

Kesimpulan: Kasus ini menggaribawahi bahwa pertimbangan penggunaan kegawatdaruratan obat antivirus diluar uji klinis pada populasi pasien COVID-19, pasien telah memberikan persetujuan dan penggunaan obat-obat tersebut dimonitor. *(Health Science Journal of Indonesia 2021;12(1):14-9)*

Kata kunci: Covid-19, favipiravir, tenaga kesehatan, laporan kasus, Jakarta

In December 2019, an outbreak of pneumonia caused by a novel coronavirus occurred in China, and spread rapidly to other countries.[1] As of March 2nd 2020, The Indonesian Government announced the first confirmed case, followed by reported total 5516 confirmed cases of COVID-19 with 496 deaths (8.9 %) from across all 34 provinces in April 2020.[2]

In Indonesia, the healthcare workers are greatly affected by the disease. Indonesian Medical Association (IDI) reported that at least 27 doctors have died due to the disease as of May 2020 and others contracted the disease with mild to moderate symptoms.[3] Preventing healthcare workers infections is important for reducing morbidity and potential mortality, maintaining health system capacity, and reducing secondary transmission.[4]

We need to find a specific treatment against COVID-19. Currently, there are no definitive antiviral drugs. Without effective treatment, moderate patients could convert into severe develop acute respiratory distress syndrome (ARDS) and multi-organ failure.[1]

Research is underway to identify therapeutics for COVID-19, including re-purposing medications.[5] Favipiravir, an antiviral drug targeting influenza viral RNA-dependent RNA polymerase (RdRP). It selectively inhibits RNA polymerase, which is necessary for viral replication.[5] Chang Chen et al, showed that favipiravir could be considered as a treatment in moderate COVID-19 patients.[1] Only a few favipiravir efficacy trials in COVID-19 have been reported in the literature to date, numerous other favipiravir COVID-19 trials are ongoing or as yet unreported.[6]

This case is about a first healthcare worker patient diagnosed with COVID-19 who had moderate type, including the use of favipiravir in Sulianti Saroso Infectious Disease Hospital, Jakarta, Indonesia. At the early period of pandemic, efficacy and safety of favipiravir remained a major concern. The use of emergency intervention outside of clinical trial in COVID-19 population, informed patient's consent has been given and the use of emergency intervention was monitored.[7] We present the characteristics of the vital signs, chest X-ray, clinical laboratory profiles, the treatment process with favipiravir and hydroxychloroquine as well as the clinical outcome of moderate type of COVID-19 patients who is also a healthcare worker.

CASE PRESENTATION

On April 13th 2020, a 38-year-old woman was admitted to Sulianti Saroso Infectious Disease Hospital, Jakarta, Indonesia, with a history (10 days) of intermittent fever, cough, sore throat, and rhinorrhea, followed by a 4-day-history of shortness of breath. She is a healthcare worker that had a history of taking care of patients with COVID-19 in an isolation ward. She worked 8-hour shifts and commuted between hospital and her home during her duty period.

The patient did not report any underlying medical condition such as diabetes or hypertension. She had a normal body mass index (BMI) and no history of dyslipidemia or hyperuricemia.

During our first clinical evaluation, physical examination revealed that the pulse rate was 110/minute, blood pressure 107/60 mm Hg, respiratory rate 30/minute, the body temperature 36.2⁰C and 98 % oxygen saturation on ambient air. She required 3 L/minute of oxygen via nasal cannula. An electrocardiogram (ECG) revealed sinus rhythm with QTc 388 Ms. A radiological finding in computed tomography (CT) showed ground-glass opacity, and chest x-ray showed pneumonia lower zone bilateral (Figure 1). Swab test for COVID-19 were taken on April 14th 2020, the real-time PCR on nasopharyngeal swab revealed the presence of SARS-CoV-2.

According to the blood test results, white blood cell count was normal (5 x 10^3/μL), lymphocyte count was 16 %, hemoglobin and platelet level were within normal limit, the neutrophil count was 75 %, albumin level was decreased to 2.8 g/L, and ferritin was slightly elevated to 85.8 ng/mL. All laboratory tests evaluating liver enzymes, kidney function was within the normal range. The other laboratory test showed in Table 1.

On April 16th 2020, the respiratory rate was increased to 36/minutes, while oxygen saturation was 97 % and 5 L/minute of oxygen via nasal cannula was required. The second swab test was still positive for SARS-CoV-2 infection.

On April 18th 2020, the respiratory symptoms were improved, while the third swab test was negative for SARS-CoV-2 infection. Physical examination revealed that the pulse rate was 70/minute, blood pressure of 120/60 mm Hg, respiratory rate of 20/minute, and the body temperature of 36.2⁰C.

Table1. Clinical manifestation, laboratory profiles, and the treatment process

Results	Referrence	Day 1 13/4/20	Day 2 14/4/20	Day 3 15/4/20	Day 4 16/4/20	Day 5 17/4/20	Day 6 18/4/20	Day 7 19/4/20	Day 8 20/4/20	Day 9 21/4/20	Day 10 22/4/20
Respiratory rate		30/mnt	30/mnt	30/mnt	36/mnt	36/mnt	20/mnt	20/mnt	20/mnt	20/mnt	18/mnt
Body Temperature		36.2 ^{0}c	36.2 ^{0}c	36.0 ^{0}c	36.0 ^{0}c	36.0 ^{0}c	36.2	36.1 ^{0}c	36.2 ^{0}c	36.0 ^{0}c	36.0 ^{0}c
Saturation		98 %	98 %	98 %	97 %	97 %	99 %	99 %	99 %	99 %	99 %
Oxygen Therapy		3 L	3 L	3 L	5 L	5 L	5 L	3 L	-	-	-
Electrocardiogram (ECG)		388 ms	-	-	-	-	-	-	-	438 ms	-
PCR Sars-Cov		-	positive	-	positive	-	negative	-	-	negative	-
C-reactive protein	< 5.00 mg/dL	5.45	-	-	-	-	-	-	-	-	-
D-Dimer	< 0.5 mg/L	0.6	-	-	-	-	-	-	-	-	-
Uric acid	2.0-7.0 mg/dL	4.8	-	6.2	-	-	-	8.2	-	-	-
Oxygen Therapy		3 L	3 L	3 L	5 L	5 L	5 L	3 L	-	-	-
Antiviral		Favp HCQ	Favp HCQ	Favp HCQ	Favp HCQ	Favp HCQ	Favp HCQ	Favp HCQ	HCQ	HCQ	HCQ
Adverse effect		-	-	-	-	-	-	Hyperu ricemia	-	-	-

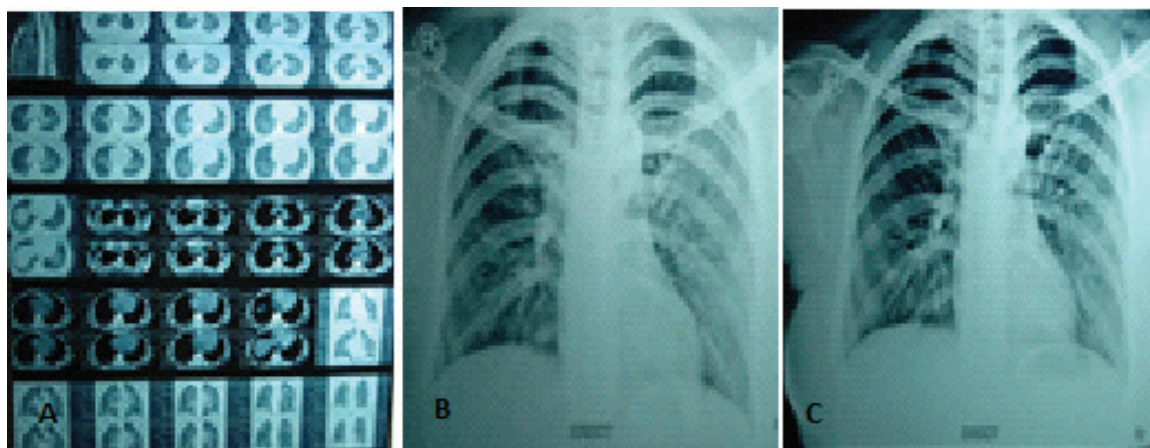Favp: Favipiravir; HCQ: Hydroxyl-chloroquine

Figure 1. Chest computed tomography (CT) scans and chest X-ray
A. CT scan on Day 1 of hospitalization (13/4/20)
B. Chest X-ray on Day 4 of hospitalization (16/4/20)
C. Chest X-ray on Day 10 of hospitalization (22/4/20)

She was treated with Favipiravir (1600 mg b.i.d on the first day, and 600 mg b.i.d afterwards, for 7 days), Hydroxyl-chloroquine (200 mg b.i.d for 10 days), Azithromycin (500 mg single dose for 5 days), N-acetylcysteine (1250 mg single dose for 10 days), Isoprinosine (500 mg q.i.d for 10 days) and others of supportive treatment. Clinical manifestation, laboratory profiles, the treatment process and an adverse effect showed in Table 1.

On April 21st 2020, the condition of the patient was improved and the respiratory symptoms disappeared, while 12-lead ECG revealed sinus rhythm with QTc 438 Ms. The last nasopharyngeal swabs were negative for SARS-CoV-2 infection. On the next day, the patient was discharged. However, there was an increase in uric acid level to 8.2 mg/dl.

DISCUSSION

Healthcare workers experience significant burden from corona virus infections, including SARS-Cov2.[4] Roger Chou et al, mentioned that certain exposure is

associated with increased risk. The use of Personal Protective Equipment (PPE) and infection control training are associated with decreased infection risk.[4] It is still questionable whether the COVID-19 infection acquired by the healthcare workers in Indonesia was obtained in the community or in the workplace, such as the hospital where they were on duty treating the patients.

In this case, the patients initially had an intermittent fever, cough, sore throat, and rhinorrhea which began at approximately 10 days, and then the symptoms progress into the second stage. Siddiqi et al, showed three escalating phases of COVID-19 disease progression.[8] According to Eastern Virginia Medical School (EVMS) Critical Care COVID-19 Management Protocol, the course of COVID-19 consists of 4 phase: incubation, symptomatic, early pulmonary phase, and late pulmonary phase.[9] The initial stage which is also known as viral response phase occurs at the time of establishment of disease with non-specific symptoms. In the second stage, the patients develop viral pneumonia and possibly hypoxia and required supplemental oxygen.[8] During the second stage of established pulmonary disease, the patient needs to be observed closely and managed wisely. The onset of fever and respiratory symptoms should also be closely monitored by healthcare workers.[8] Healthcare workers with fever and/or respiratory symptoms that are concerning for COVID-19 should be tested for SARS-CoV-2 as soon as possible. [10]

The patient was treated with favipiravir tablets combine with hydroxychloroquine in the treatment of pneumonia COVID-19. Mechanisms of action of hydroxyl-chloroquine are blockade viral entry by inhibiting glycosylation of host receptors, proteolytic processing and endosomal acidification.[5] This was followed by Favipiravir that selectively inhibits RNA polymerase, which is necessary for viral replication.[5] In addition, other drugs supported as a local standard of care (azithromycin, isoprinosine and other supportive treatment) for this infection. The time of improvement or recovery of respiratory symptoms and a negative swab test result was 6 days. In this case, isoprinosine was used to control of a viral infection involves the complex interplay between diverse cell types associated with Natural Killer (NK) cells.[11] Isoprinosine as an off-label drug in some countries.[11]

However, this case was the first moderate case of COVID-19 treated with favipiravir to a healthcare worker patient on April, in our hospital. We know that the last update stated hydroxyl-chloroquine had small or no effect on overall mortality, initiation of ventilation and duration of hospital stay in hospitalized patients.[12] By November 2020, the Food and Drug Control Agency of Indonesia revoked hydroxyl-chloroquine and chloroquine authorization for COVID-19 patient treatment. The number of clinical trials on favipiravir and other antiviral for COVID-19 has been increasing day by day especially in Indonesia. However, more evidence of the efficacy and safety of favipiravir are needed, while favipiravir seems to be safe and tolerable in short-term use.[13]

Hyperuricemia was detected in our patient. An adverse effect may be caused by administration of favipiravir that was assessed based on the Naranjo Probability Scale and WHO causality assessment scale. According to the scales of a causal, relationship between medication and adverse effect was probable.[14] Chang Chen et al showed that there were 32 adverse effects cases from 116 subjects in favipiravir group. Raised serum uric acid (16 %) were common in patients of Favipiravir group.[1,15] A recent review by Mishima et al revealed that favipiravir may increase blood uric acid level due to the reduction in uric acid excretion into the urine.[12] The clinicians should be more cautious when favipiravir was prescribed to patients with a history of gout, hyperuricemia, or kidney dysfunction.

Azithromycin, hydroxyl-chloroquine, favipiravir, could cause adverse effects, including QTc prolongation.[16-18] Therefore, the patient needed close monitoring during concomitant those drugs. In this case, after 7-day treatment, there was an increase in QTc interval (50 ms). The increase in the QTc interval was still within normal QTc values. However, we could not assume that there was no potential adverse cardiac effect due to the limitations of this single case report. The intensity of QT and arrhythmia monitoring should be considered in the context of potential drug benefit and safety.[19-22] Furthermore it is necessary to identify patients who have a risk of developing cardiotoxicities by their medical history such as history of heart disease, hypertension, obesity, diabetes, dyslipidemia, physical inactivity, or smoking.[23]

In conclusion, this case presented the first healthcare worker patient with a moderate type of COVID-19, including first treatment experience with Favipiravir. This case highlights that Considering the use of

emergency intervention outside of clinical trial in the COVID-19 population, the informed patient consent has been given and the use of emergency intervention was monitored. Particular attention should be paid to early diagnosis, early treatment with close monitoring and also adverse drug reactions when using concomitant medications, because COVID-19 patients with moderate clinical symptoms could fall into a severe or critical case.

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Do the acute lymphoblastic leukemia and non-hodgkin lymphoma patients have a worse prognosis of COVID-19 infection in children?: a case report

Nadirah Rasyid Ridha,[1,4] Bahrul Fikri,[1,4] Rahmawaty Rahimi,[1,4] Amiruddin Laompo,[1,4] Conny Tanjung,[2] Dasril Daud,[1,4] Nasrum Massi,[3,4]

[1]Department of Pediatrics, Hasanuddin University's Faculty of Medicine, Makassar, Indonesia
[2]Graduate School of Medicine, Hasanuddin University, Makassar, Indonesia
[3]Department of Microbiology, Hasanuddin University's Faculty of Medicine, Makassar, Indonesia
[4]Dr. Wahidin Sudirohusodo General Hospital, Makassar, Indonesia

Corresponding author: Nadirah Rasyid Ridha
Email: nadirah.bika@gmail.com

Abstract

Background: Coronavirus Disease 2019 (COVID-19) is a contagious disease caused by a new type of Coronavirus namely Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). Children with tumors or autoimmune diseases are more susceptible, because of suppression of their immune system, chemotherapy, radiotherapy, or surgery on tumors.

Case presentation: We present the clinical features 3 Acute Lymphoblastic leukemia and 1 Non-Hodgkin lymphoma patients who were infected with COVID-19 since July to August 2020 in our hospital. These were the first four cases identified as COVID-19 positive in Dr Wahidin Sudirohusodo Hospital. Case 1, 2, and 4 were diagnosed as moderate and common type of COVID-19, while case 3 was classified as severe type. They may be transmitted COVID-19 infection during hospitalization. All cases were recovered from COVID-19 after a combination therapy against virus, bacteria, and also respiratory support.

Conclusion: Our case series of four pediatric cancer patients showed a good outcome after prompt treatment, suggesting that malignancy in children may not be a contributor factor for COVID-19 recovery. *(Health Science Journal of Indonesia 2021;12(1):20-25)*

Keywords: COVID-19, acute lymphoblastic leukemia, non-hodgkin lymphoma, children

Abstrak

Latar belakang: *Covid-19 (Coronavirus disease 2019) adalah penyakit menular yang disebabkan oleh Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). Anak yang menderita kanker atau penyakit autoimun lebih rentan tertular karena penurunan system kekebalan tubuh, dampak kemoterapi, radioterapi, atau operasi tumor.*

Penyajian kasus: *Kami melaporkan 3 pasien leukemia limfoblastik akut dan 1 pasien limfoma non-Hodgkin yang terinfeksi Covid-19 sejak Juli-Agustus 2020. Kasus tersebut adalah 4 kasus pertama yang teridentifikasi Covid-19 di Rumah Sakit Dr. Wahidin Sudirohusodo. Kasus 1,2, dan 4 terdiagnosis positif Covid -19 derajat sedang, sedangkan kasus 3 tergolong berat. Mereka kemungkinan terinfeksi Covid-19 saat perawatan. Semua kasus dinyatakan sembuh dari Covid-19 setelah pemberian obat anti virus, antibiotik, dan alat bantu pernapasan.*

Kesimpulan: *Serial kasus dari 4 pasien kanker anak dengan outcome yang baik setelah pengobatan yang cepat mengindikasikan bahwa penyakit keganasan pada anak kemungkinan bukan faktor yang berkontribusi dalam kesembuhan Covid-19. **(Health Science Journal of Indonesia 2021;12(1):20-25)***

Kata kunci: *COVID-19, leukemia limfoblastik akut, limfoma non-hodgkin, Anak*

Coronavirus Disease 2019 (COVID-19) is a contagious disease caused by a new type of Coronavirus namely Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2).[1] This disease began with the emergence of unknown cases of pneumonia etiology in Wuhan, China at the end of December 2019 and has since been detected in over 100 international locations. On March 11th 2020, the World Health Organization (WHO) characterized COVID-19 as a pandemic.[2] COVID-19 spreads through rapid transmission, generally susceptible to crowds, and is characterized with a typical clinical symptoms that can be easily missed or misdiagnosed.[3-5] As of July 9th 2020, WHO reported 11,874,226 confirmed cases with 545,481 deaths worldwide (Case Fatality Rate / CFR 4.6%). Indonesia reported its first case on March 2, 2020. Cases are increasing and spreading rapidly throughout Indonesia. As of July 9, 2020, the Ministry of Health Indonesia reported 70,736 confirmed COVID-19 cases with 3,417 deaths (CFR 4.8%).[6]

Children with underlying diseases are more vulnerable to COVID-19.[7] Although children infected with COVID-19 are small portion of the confirmed cases, children with tumors or autoimmune diseases are more susceptible, because of suppression of their immune system, chemotherapy, radiotherapy, or surgery on tumors.[8] Additionally children with leukemia may have depressed bone marrow due to chemotherapy.[9] Leukemia itself or its treatments could develop an immune deficiency, malnutrition, and impairment of the mucosal membrane barriers which access for endogenous microbiological flora and other opportunistic pathogens. These will lead to severe infections of SARS-CoV-2.[10] However, some papers reported the mild or asymptomatic course of COVID-19 in paediatric oncology.[11] Here, we report four patients co-infected with SARS-CoV-2 within July–August 2020 at the paediatric ward Wahidin Sudirohusodo Hospital from 195 cancer patients (2%) and describe their medical histories, clinical diagnosis, changes in clinical parameters, and outcomes.

CASE PRESENTATION

Case 1

A 2-year and 8-month-old girl was admitted to the Department of Hematology and Oncology (HO) in our hospital on 8 July 2020 because of pale, fever, and joint pain for 5 months. She received a packed red cell transfusion two times, in February and June 2020. Physical examinations revealed pallor, hepatomegaly, splenomegaly, and lymphadenopathy.

There was bleeding manifestation by petechial rash on the trunk. On admission, her laboratory results were as follows: hemoglobin, 7.1 g/dL; white blood cell count, 156.000/μL with differential count: monocytes 27.6%, lymphocytes 70.1%; platelet count, 25.000/μL. We performed bone marrow puncture with the result of Acute lymphoblastic leukemia (ALL)-L1 and the immunophenotype corresponded to a B cell population. Based on the above data, the diagnosis of this patient was ALL-L1 high-risk group and hyperleukocytosis. She received chemotherapy with the Indonesian ALL Protocol 2018 regimen and hyperleukocytosis management on 21 July 2020. During the third day at the first week of induction phase, the patient showed symptoms of fever, cough, and dyspnea. Chest retraction and rales in both lungs were discovered. A Chest CT scan showed patch infiltrates in superior right lungs, indicating a possibility of pneumonia (Figure 1). The SARS-CoV-2 infection was confirmed by positive detection of the virus in the throat swab sample using the real-time reverse transcription-polymerase chain reaction (RT-PCR) method. The laboratory results on 20 July 2020, revealed reductions in white blood cells (WBCs) and absolute neutrophil count (ANC) in the blood. The patient was then diagnosed with COVID-19 and transferred to the isolation ward in the Department of Infectious Diseases. The symptoms were relieved after 3 days. The antibiotic of ceftazidime and amikacin were given as empirical antibacterial therapy and Oseltamivir as antiviral therapy. The patient discontinued receiving steroids due to her infection. However, the virus was sustained in the throat swab samples for several days. The patient was transferred to another isolation ward and continue chemotherapy. The SARS-CoV-2 was cleared from the patient on 10 August 2020 (Table 1).

Case 2

A 4-year and 2-month-old boy came to the emergency ward with chief complaint shortness of breath 6 days before admission and got worse 1 day before admission on August 4, 2020. Other symptoms were fever, cough, and poor appetite. He was admitted to the department of Hematology because of his past medical history of non-Hodgkin lymphoma (NHL) and routine control for chemotherapy since 19 May 2020. He has received the induction phase of chemotherapy by NHL protocol with a regimen of vincristine, cyclophosphamide, adriamycin, and methotrexate. As his clinical presentation revealed COVID-19 symptoms, we then did the chest CT-scan and the result showed a ground-glass opacity

(GGO) in both lungs, indicating the possibility of viral pneumonia (Figure 1). The SARS-CoV-2 was found in a throat swab sample by real-time PCR on 6 August 2020. Blood testing showed hemoglobin 12.2 gr/dl, leukocyte 11.100/µL, platelet 434.000/µL, reduction of lymphocyte 17.8%, monocyte 11 %. The patient was then diagnosed as having COVID-19 and transferred to an isolation ward of our department. In the isolation ward, the patient was treated with oxygen therapy by nasal catheter, antiviral therapy with Oseltamivir, levofloxacin, and amikacin. Because the patient still had minimal chest retraction, the levofloxacin antibiotic was continued until 14 days and his clinical condition gradually improved. A re-examination of the blood test on August 17th showed hemoglobin 10.5 gr/dl, leucocyte 11.100/µL, platelet 434.000/µL, increased lymphocyte 45.5%, monocyte 10.1%. The SARS-CoV-2 was cleared from the patient on 11 August 2020. (Table 1)

Table 1. Summary of Clinical manifestation, laboratory examination, and clinical outcome of the four pediatric malignancy with SARS COV-2 infection

Clinical Characteristic	Normal range	Case 1	Case 2	Case 3	Case 4
Diagnosis	No	ALL-L1 HR	NHL	ALL-L1 HR	ALL-L1 HR
Clinical type of COVID-19	No	Moderate	Moderate	Severe	Moderate
Nutritional status	Good nourished	Good nourished	Good nourished	Wasting	Good nourished
NLR	<3.13	0.04	3.8	21.1	0.05
ALC	> 1500	1064	1975	3331	4370
Chest CT	No	Yes, patchy infiltrate in right lobe	Yes, ground glass opacity	Yes, patchy opacity at both of lung	Yes, multifocal consolidation in the right lobe.
Clinical outcome		Recovery from COVID-19	Recovery from COVID-19	Recovery from COVID-19	Recovery from COVID-19

* NLR: Neutrophil Lymphocyte Ratio,
  ALC: absolute lymphocyte count
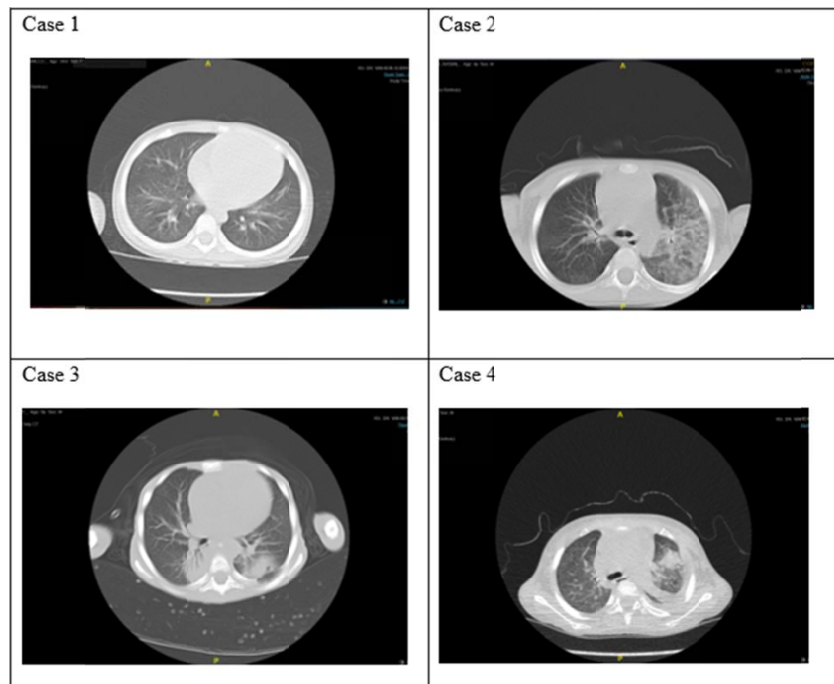 CT: computerized tomography

Figure 1. CT images of the four patients on diagnosed as SARS-CoV-2 infection

Case 3

A 6-year old boy was admitted to the HO Department in our hospital on 14 July 2020 to continue chemotherapy for Acute Lymphoblastic Leukemia LI High-Risk group with infiltration of blast cells in the pancreas. He initially received his first chemotherapy using the Indonesian ALL Protocol 2018 high-risk group on 3 June 2020 based on history taking, physical examination, complete blood count, and the result of bone marrow puncture. He was in wasting with acute upper respiratory infection, hypoalbuminemia, diaper rash, acute diarrhea without dehydration. One day after admission, the patient presented with short of breathiness, found rales in both lungs, and the chest CT imaging revealed parenchymal infiltration of the lung (Figure 1) and the diagnosis of this patient was community-acquired pneumonia. We administered a combination of antibiotics with ceftazidime and amikacin. On 16 August 2020, on his 62nd days of hospitalization, his condition worsen as reflected by desaturation. The laboratory results revealed WBC 7900/μL, lymphocyte 4.2%, Neutrophil Lymphocyte Ratio (NLR) 21.1, Absolute Lymphocyte Count (ALC) 331, hence, we tracked for the possibility of COVID-19 infection and planned to perform a throat swab. The SARS CoV-2 infection was confirmed by positive detection of the virus in the throat swab sample using the real-time reverse transcription-polymerase chain reaction (RT-PCR) method on 17 August 2020. The patient then was diagnosed as having COVID-19 and transferred to an isolation ward at our department. In the isolation ward, the patient was treated with combination therapy including oxygen delivery via a non-rebreathing mask, antibiotics therapy with meropenem, amikacin, and Oseltamivir. The virus was persistent in the sample from the throat swab in this patient, so the patient remained in the isolation ward. The SARS-CoV-2 in the throat swab disappeared from the sample on 30 August 2020, about 13 days after the first time of positive detection of the virus. (Table 1)

Case 4

A 4-year and 2-month-old boy was transferred from district hospital on 10 August 2020 with the main complaint of paleness in the last 2 weeks before admission. There was fever and shortness of breath for 2 days before admission also gum bleeding 4 days before admission. On physical examination the child was conscious, increased body temperature, lymphadenopathy, the liver was palpable at 8 cm

below costal arch margin and left lobe 7 cm below xiphoid process with supple, smooth surface, sharp edge with no tenderness. The spleen was palpable on Schuffner I. From the genital examination, there were palpable left testes with a size of 2x1x1cm, and right palpable testes with a size of 4x3x2cm. The laboratory results revealed leucocyte 169.000/μL, hemoglobin 3.8 gr/dl and platelet 2000/μL, differentiation: neutrophil 0 %, monocytes 54.4%, lymphocytes 60 %; NLR 0, ALC 27.937. Bone marrow puncture showed ALL-L1. We diagnosed this patient with ALL-L1 high-risk group and hyperleukocytosis. He has received chemotherapy with intrathecal methotrexate and oral dexamethasone, aggressive hydration and allopurinol. On the 5th day of hospitalization, the patient presented a cough and shortness of breath. The patient was suspected to be infected with COVID-19, and the chest CT imaging revealed multifocal consolidation in the right lobe (Figure 1). The SARS-CoV-2 was found in a throat swab sample by real-time PCR. The patient was then diagnosed as having COVID-19 and transferred to an isolation ward of our department. The patient received meropenem and amikacin as antimicrobial therapy and Oseltamivir as antiviral therapy. However, intravenous and oral chemotherapy was discontinued. Chemotherapy is an immunosuppressant that suppresses the immune system; however, in patients with COVID-19, immunity is significantly reduced, so iv and oral chemotherapy may worsen the illness. As a result, it was decided to temporarily stop the therapy until the patient recovered from COVID-19. The delay in chemotherapy will undoubtedly have an impact on the patients' outcomes, and it has created a new problem in the management of cancer patients. The SARS-CoV-2 in the throat swab was cleared from the sample on 27 August 2020 (Table 1).

DISCUSSION

Our study reported 4 cases of pediatric cancer with SARS-CoV-2 infection in Makassar, South Sulawesi Indonesia. All children infected with COVID-19 were successfully recovered from the infection with mild to severe symptoms. They showed symptoms of SARS-CoV-2 like fever and shortness of breathiness during hospitalization. Zimmermann *et al*[12] described that most common symptom COVID-19 in children is fever (50%) and cough (38%).[13] In our study, we found 3 out of 4 cases had history of fever. They developed fever and other symptoms related to

COVID-19 after chemotherapy, which might indicate that the SARS-CoV-2 nosocomial infection.[7,14]

Early studies showed reduction in lymphocytes during SARS-CoV-2 infection, and we observed the various range of blood laboratory results in our study. Case 3 had a decreased count of lymphocytes in the blood, which may be attributed to the severity of COVID-19. The cause of wasting in cancer patients is caused by a variety of factors. it is divided into two categories; nutritional deficiencies and malabsorption, and metabolic disorders. Wasting has an effect on therapy response, complications, quality of life, and patient survival. particularly in these cases, because in addition to cancer, they were also found to be COVID-19 positive. Therefore, we have to pay a close attention to nutrition management. Yang K, *et al*[3] described the results of meta-analysis that lower lymphocyte count was associated with increased mortality, ARDS, and severe COVID-19. The association seemed to be stronger in younger patients compared to older patients. In case 3, the condition of the patient classified severe COVID-19 and the need for ICU care. Case 1 and 4 had an increased count of lymphocytes in the blood, which may be attributed to their underlying disease, ALL. In ALL patients, we usually found an increase in lymphocyte count because of increased proliferation lymphoblast in bone marrow caused by malignancy. NLR and ALC in this case could not be utilized as a parameter to assess the severity of the disease, mainly because leukocyte in leukemia patients usually increased and can sometimes be hyperleukocytosis.[15] The diagnosis of COVID-19 was based on symptoms, lung X-ray/CT examination, and detection of the virus by real-time RT-PCR in throat swab samples from the patients.[16] The main basis for the diagnosis of infections with SARS-CoV-2 is real-time polymerase chain reaction (RT-PCR) on upper or lower respiratory secretions.[17]

Children with underlying diseases and suspected to be infected by COVID-19 should be observed with extended isolation time and tested with more nucleic acid detections. They should also receive early symptomatic treatment. Supportive treatment including sufficient fluid and calorie intake and additional oxygen supplementation should be used in the treatment of children infected with SARS-CoV 2. The aim is to prevent ARDS, organ failure, and secondary nosocomial infections. If a bacterial infection is suspected, broad-spectrum antibiotics such as second or third-generation cephalosporins may be used.[12] The most commonly used antibiotics in children were meropenem and linezolid.[18] And in our study, all of the cases received antiviruses like Oseltamivir and antimicrobial therapy such as ceftazidime, meropenem, and amikacin. During the observation, there were no side effects of the given medication, and the patients' tolerance was good.

Disease clusters and nosocomial infections have been reported. The proportion of nosocomial infections is high among diagnosed infections, and medical staff are at high risk of infection. One study on 44,672 patients showed that health workers accounted for 3.8% of the COVID-19 cases and five health workers died as a result of the infection.[19] Since the specific medicine for COVID-19 is still not available, the prevention of nosocomial infections will be the key. The high presence of the COVID-19 epidemic in the media is likely to improve the general public's awareness. People with symptoms indicating a SARS-CoV-2 infection should take protective measures during the hospital or clinic visit, such as wearing a mask, minimizing the time of stay in the hospital, and if possible, making remote medical consultations in advance.[20] Medical institutions should formulate infection prevention and control strategies, and strengthen the hospital's infection prevention and control efforts, such as the establishment of special departments for outpatients with fever, and a notification triage system. Triage of early identification among suspected cases can avoid excessive gathering of patients in the hospital. Isolation wards should be established for suspected and confirmed patients needing treatment. In hospitals without single isolation wards or negative pressure isolation, indoor ventilation measures should be taken timely, and the management of patients should be standardized in these wards. Using adequate disinfection procedures can reduce the possibility of hospital transmission of the virus. During the epidemic, the possibility of the outbreak of nosocomial infection, and establish an early warning mechanism. Emergency plans or measures should be developed to deal with nosocomial infections.[3,21]

The report's limitation was a small sample size, so it could not be statistically analyzed. It is suggested that a larger sample size and a better study design be used. The number of COVID-19 in children is much smaller than adult. Our case series of ALL and NHL pediatric patients showed a good outcome after prompt treatment, suggesting that malignancy in children may not be a contributor factor for COVID-19 mortality. COVID-19 is a deadly disease that can lead to death. Nevertheless, in this case report,

despite the fact that COVID-19 was confirmed in the cancer patients, they recovered after medication and observation. However, more research with more cases was required to support that claim.

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The association between anthropometric profiles and somatotype with 100 meter sprint amongst Indonesian sprint athletes

Eddy Purnomo[1], Novita Intan Arovah[2], Alfonsia Purnamasari[2]

[1]Faculty of Sport Science, Yogyakarta State University, Indonesia
[2]Department of Pharmacy, Pelita Harapan University, Indonesia

Corresponding author: Eddy Purnomo
Email: eddy_purnomo@uny.ac.id

Abstract

Background: One hundred meter sprint was influenced by various internal and external factors. Somatotype and anthropometry profiles are possibly to be one of the factors that predicts performance. The aims of this study were to assess the anthropometry and somatotype profiles obtained from an example of Indonesian team university male sprinters and to elucidated potential correlations between anthropometry profile and somatotype with the 100m sprint.

Method: It was recorded that 20 selected sprint athletes participated as representatives from Indonesia in the XVIII ASEAN University Games with an averaged age (20.0 ± 0.92 year old). Anthropometric assessment includes height, weight, skinfold (triceps, supra-spinale, subscapula, suprailiaca, abdomen, calf, front thigh and chest)), two bicondylar widths (humerus and femur) and two circumferences (biceps and femur). The somatotype assessment was based on the Health & Carter method. Body fat percentage was assessed using the equation determined by Berzerk et al. (1963). Body Mass Index is calculated from body mass divided by height squared (kg/m2). Multicorrelation matrix and simple linear regression were used to assess the potential correlation between somatotype profile and anthropometry with the 100m sprint.

Result: The average value of ectomorph-mesomorph-endomorph was 3.40-4.08-0.84 BMI at 20.6 0.6, while the fat percentage was 9.2 ± 0.8. There were no significant correlation and regression slope found between somatotype profile and anthropometry with the 100m sprint.

Conclusion: Most of the athletes representing Indonesia at the ASEAN University Games were mesomorphs and ectomorphs. They had low endomorph score fat percentage. Body shape requirements was not related to the 100m sprint. Further investigation is recommended to amplify the findings.
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Keyword: body composition, somatotype, sprinter

Abstrak

Latar belakang: *Lari seratus meter dipengaruhi oleh berbagai faktor internal dan eksternal. Profil somatotipe dan antropometri diperkirakan merupakan salah satu diantara faktor yang dapat memprediksi kinerja. Tujuan dari penelitian ini adalah untuk menilai antropometri dan somatotipe yang diperoleh dari sampel pelari putra perguruan tinggi Indonesia dan menjelaskan potensi korelasi antara antropometri dan somatotype dengan lari 100 meter.*

Metode: *Tercatat 20 atlet sprinter terpilih sebagai perwakilan dari Indonesia di ASEAN University Games XVIII dengan rata-rata umur (20.0±0.92 tahun). Penilaian antropometri meliputi tinggi, berat badan, lipatan kulit (trisep, supra-spinale, subskapula, suprailiaka, abdomen, betis, paha depan dan dada), dua lebar bicondylar (humerus dan femur) dan dua lingkar (bisep dan femur). Penliaian somatotipe didasarkan dari metode Heath & Carter. Presentasi lemak tubuh dinilai sebagai persamaan yang ditentukan oleh Berzerk et al. (1963). Indeks Masa Tubuh dihitung dari masa tubuh yang dibagi dengan tinggi badan kuadrat (kg / m2). Matrix multikorelasi dan regresi linear sederhana digunakan untuk menilai potensi korelasi antara profil somatotipe dan antropometri dengan lari cepat 100 m.*

Hasil: *Rata-rata nilai ectomorph-mesomorph-endomorph adalah 3.40-4.08-0.84. BMI di angka 20.6±0.6, sedangkan presentasi lemak di angka 9.2± 0.8. Tidak ada korelasi yang signifikan dan kemiringan regresi ditemukan antara somatotipe dan antropometri dengan lari 100 m.*

Kesimpulan: *Atlet yang mewakili Indonesia di ASEAN University Games sebagian besar mesomorph dan ectomorph. Mereka memiliki presentasi lemak skor endomorph rendah. Syarat-syarat bentuk tubuh tidak berkaitan dengan lari 100 m. Investigasi lebih lanjut direkomendasikan untuk memperkuat temuan.*
(Health Science Journal of Indonesia 2021;12(1):26-32)

Kata kunci: *antropometri, somatotipe, pelari*

The physical profile of athletes, both athletes in team sports and individual sports, needs to be possessed by each parent sport, especially athletes who always won in each sport at the national, regional and international level. When it is evaluated based on the achievements, especially measurable sports, in this case athletic especially sprint, the progress is increasing. This can be seen from the time records recorded. For example the 100m world men's sprint athlete reached 9.69 seconds, while the Indonesian sprint athlete reached only 10.13 seconds. This showed that the development of beginner, junior and senior athletes was going well. However, not many sports researchers are consistent with performance-related research. As we know, there is no record on the results of measuring the physical profile/physical characteristics, in this case the athlete's somatotype, especially the national sprint athlete. For example, Indonesian sprint athlete, Muhamad Zohri who is only 20 year old. Therefore, it needs to be executed by sports experts or sprint trainers.

Somatotype is a state quantification description of an individual athlete morphological status. As a description, the quantification will be the size of human body from the numbers 0.5 to 12. Somatotype classifies the human body into three basic components, Endomorph, Mesomoprh and Ectomorph.[1,10]

The difference between these three components lies in the state of fat and muscle. The endomorph represents an individual athlete's fat and number of fat, mesomorph describes the state of strong muscles, while ectomorph describes the state of lean muscles.

There are many events contested in track and field sports, such as running, jumping and throwing. However, each of these event requires a different body shape and physical characteristics. When viewed from the physical characteristics (stature) of a sprint athlete, it is clearly different when comparing long-distance runners to throwers, but it will be the same or almost the same for jumpers to jumpers. Sprint athletes are more muscular (hypertopic) in the buttocks (gluteal muscles) and chest-shoulders compared to long-distance runners who are much thinner/slimmer (thinner) and less muscular than sprint athlete.[2,3,6]\

Furthermore, the authors conducted further research on the state of body composition and physical characteristics of Indonesian student sprint athletes who were prepared to participate in the 18th ASEAN University games in Singapore on 2016. The reason

of conducting the research is that there was no data on anthropometric measurements and body composition of Indonesian student sprint athletes.

Therefore, measurement and understanding of physical characteristics, in this case the basic morphology of an athlete, is the basis on which a training process can be built. So that the coach will easily and quickly predict or select the sport to be fostered in the future. Thus, specific anthropometric characteristics are needed to be successful in certain sport event. In addition, it should also be noted that there are several differences in body structure and body composition of sprint athletes, both for distances of 100 m, 400 m, 110 m hurdles and 400 m hurdles which are very specific; It is different for long-distance running, jumping and throwing athletes. Thus, the requirements of the physical form or body of each sport leads to the selection of the most suitable body type for sports that can later achieve maximum performance, known as "Morphological Optimization".[2,4,5]

Therefore, as a sprint athlete trainer, you should understand how the athlete was being coached both in terms of physicality and body composition. Thus, the purpose of this research is to study the physical picture/body shape, in this case the somatotype and body composition of Indonesian student sprint athletes at a training center in Jakarta. And this is a picture of Indonesian sprint athletes today.

METHODS

This research was conducted in Jakarta at the training camp during preparation for ASEAN University Games held on 15 to 20 July 2016 in Singapore.

Study design and population

A cross-sectional study was conducted in the health room of the Jakarta Madya Stadium on June 2016 to the student sprint athletes who would be prepared for the ASEAN University Games. Population in this survey was 120 student athletes from all over Indonesia who were participating in the national training camp during preparation for the Asean University Games. The average age of athletes were between 20 and 22 years old, 50 female athletes and 70 male athletes. Especially for sprint athletes there were 30 participants consisting of 20 male athletes and 10 female athletes. Furthermore, the sampling technique in this study was purposive sampling,

namely all sprint athletes at the national training center preparation for the ASEAN University Games Singapore, totaling 20 samples. The inclusion criteria for the research sample were male athletes who joined the ASEAN University team in 2016, participated in running events, 100 m, 200 m, 400 m, 4x400 m, 4x100 m, 110 m hurdles or 400 m hurdles. While exclusion criteria are all male and female athletes from ASEAN University team representing all sports including long and middle distance.

Data collection and variable

Anthropometrical measurements:

Seven morphological body measures taken were: height, weight, body mass indexs, Humerus breadth, Femur breadth, Arm girth, Calf girth and eight folds of skin: triceps, supra-spinale, subscapula, suprailiaca, abdomen, calf, front thigh and chest. The height was measured using stadiometry to the nearest 0.5 cm and a bathroom scale was used to measure body mass to the nearest 0.1 kg.

This method is implemented for somatotype assessment with the equation used as follows:

Endomorphy $= -0.7182 + 0.1451 \times \Sigma SF - 0.00068 \times \Sigma SF^2 + 0.0000014 \times \Sigma SF^3$ where $\Sigma SF =$ (sum of triceps, subscapular and supraspinale skinfolds) multiplied by (170.18/height in cm). This was called height-corrected endomorphy and was preferred method for calculating endomorphy).

Mesomorphy $= 0.858 \times$ humerus breadth $+ 0.601 \times$ femur breadth $+ 0.188 \times$ corrected arm girth $+ 0.161 \times$ corrected calf girth $-$ height $\times 0.131 + 4.5$

Three different equations were used to calculate ectomorphy according to the Height -Weight Ratio (HWR): If HWR was greater than or equal to 40.75 then, Ectomorphy $= 0.732 \times$ HWR $- 28.58$. If HWR was less than 40.75 and greater than 38.25 then, Ectomorphy $= 0.463 \times$ HWR $- 17.63$. If HWR was equal to or less than 38.25 then, Ectomorphy $= 0.1$

Body Fat % : Body Fat % was calculated using the equation of Siri (1956). Durnin and Womersley (1974) technique was for calculating Body density. Body Fat% $=$ (495/Body density) $- 450$. Body Density or BD (gm/cc) $= 1,089733- 0,0009245$ ($\sum$ABC) $+ 0,0000025$ ($\sum$ABC)^2 $- 0,000079$ x age

Where:(A) $=$ triceps Skinfold

(B) $=$ Suprailliaca skinfold and

(C) $=$ Abdomen (larry G.Shaver 1982)

Lean Body Weight or LBW (kg) $=$ (Total Body Weight – Total Weight of Fat)

Total Weight of Fat $=$ (Weight x percent of fat)/100

BMI (Kg/m2) $=$ (Body mass in Kg) /(Stature in Meters)^2., (Meltzer et al., 1988)

Ideal Body Mass $=$ (Height -100)- 10%(Height-100)

Lean Body Mass $=$ 100%-TWF%. [6,11].

The dependent variable is university sprint athlers who represented universities in national or regional competitions at both Japan and Indonesia. While the independent variable is a variable related to body composition and somatotype characteristics of sprint athletes. Furthermore, the variable explanation can be seen in Table 3.

Data Analysis

Descriptive analysis of the variables were carried out with central trend (mean), dispersion data (standard deviation), kurtosis and skewness. Kurtosis and skewness were used to assess the shape of the distribution. To see the normality of the data was to look at Kurtosis and Skewness divided by the standard error and the resulting values of -1.96 and 1.96, this was considered sufficient to establish normality of the data. Age and anthropometric assessment were conducted along with the 100 m sprint performance (time in seconds). Multi-correlation matrix among anthropometric profiles and anaerobic performance (100 m sprint performance) based on Pearson correlation was used mainly to assess the association as well as simple linear regression between 100 m performance and the anthropometric measures. Data were analyzed using SPSS® version 25 (IBM Corporation, Armonk, NY, USA). The significant level for all studied variables was fixed at P<0.05, where the mean was more than the mode value.

RESULTS

Table 1 illustrates age, anthropometric profile and the 100 m running performance of all athletes. As seen in Table 1, the mean age was 20.08±0.92 years. All participants were considered as normal weight under the Asian body mass index criteria. They were also

considered as lean to normal based on fat percentage criteria within their age range. The somatotype showed a dominant trend toward mesomorph with only small tendency toward endomorph. They had a small variability in the 100 m running performance (SD=0.08 second) indicating that their anaerobic performance was relatively similar. The kurtosis and skewness of all variables indicated approximately normal distributed.

Table 2 summarises correlations among anthropometric profiles and the correlation with 100 m running performance based on Pearson correlation. As seen in Table 2, there was no significant correlation found between all anthropometric profiles and 100 m running performance. As expected, significant negative correlations was found between ectomorph and body mass index (r=-0.84, p<0.001), as well as between ectomorph and mesomorph (r=0.56, p= 0.011). A positive correlation was found between mesomorph and endomorph (r=0.90, p<0.001)

Table 1. Anthropometric parameters and 100 m running time of sprinters (n=20)

Variables	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Age(year)	19.00	22.10	20.08	0.92	0.93	0.32
Height (cm)	166.60	178.50	171.37	3.02	0.75	0.26
Weight (kg)	56.00	66.00	60.54	2.62	0.42	-0.22
Body mass index (kg/m2)	19.61	22.28	20.61	0.55	1.32	3.80
Humerus breadth (cm)	6.40	7.50	6.83	0.29	0.63	0.12
Femur breadth (cm)	8.70	10.60	9.40	0.56	0.83	-0.49
Arm girth (cm)	32.00	36.00	33.93	1.28	-0.23	-1.17
Calf girth (cm)	35.50	45.00	40.34	1.95	-0.15	1.95
Triceps (mm)	6.50	9.10	7.82	0.72	0.41	-0.33
Supra-spinale (mm)	6.30	8.60	7.27	0.68	0.70	-0.07
Subscapula (mm)	7.00	10.20	8.77	0.70	-0.23	1.58
Suprailiaca (mm)	8.70	13.80	11.38	1.48	-0.33	-0.73
Abdomen (mm)	14.20	16.50	15.52	0.68	-0.37	-1.13
Calf (mm)	4.50	6.60	5.60	0.61	0.25	-0.93
Front thigh (mm)	7.50	12.50	9.58	1.35	0.69	-0.17
Chest (mm)	10.60	15.80	13.33	1.42	0.07	-0.39
Fat (%)	7.67	10.70	9.15	0.82	0.30	-0.23
Endomorph	0.71	0.94	0.84	0.06	-0.42	-0.17
Mesomorph	2.84	4.92	4.08	0.57	-0.60	0.09
Ectomorph	2.44	3.92	3.40	0.34	-1.12	2.21
100 m running time (seconds)	10.60	10.90	10.79	0.08	-0.28	-0.32

Table 2. Multicorrelation matrix among anthropometric profiles with 100 m running time performance

	BMI	% Fat	Endomorph	Mesomorph	Ectomorph	100 m-run time
BMI	1.00					
% Fat	-0.44	1.00				
Endomorph	-0.04	-0.20	1.00			
Mesomorph	0.40	-0.37	0.90*	1.00		
Ectomorph	-0.84*	0.40	-0.18	-0.56*	1.00	
100 m-run time	-0.09	-0.10	-0.09	-0.13	0.10	1.00

Figure 1 further illustrates the scatter plots and regression slope between anthropometric profiles and the 100 m running time. Consistent with the finding in Table 2 and as seen in Figure 1, there was no significant regression slope found among relation between anthropometric profiles and 100 m running time.
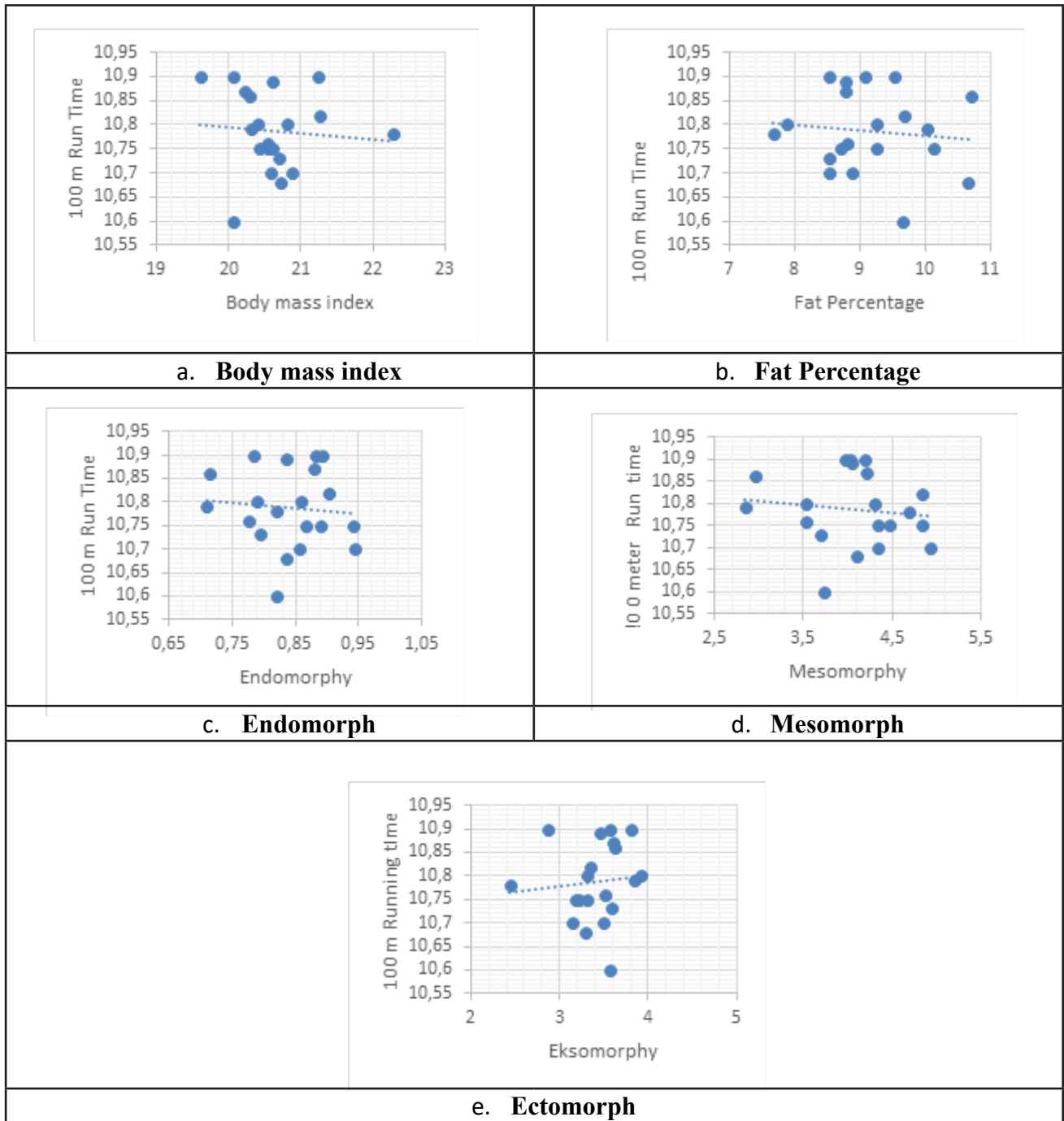
a. **Body mass index**	b. **Fat Percentage**
c. **Endomorph**	d. **Mesomorph**
e. **Ectomorph**	

Figure 1. Scatter Plot between Anthropometric Profiles and 100 m Running Performance

DISCUSSION

To the best of our knowledge, this study is the first to assess the anthropometric characteristics of sprint athletes representing Indonesia in regional competition event and to assess their potential relation to 100 m running performance among Indonesian sprint athletes, with a small sample, since the number of student-athletes selected to represent Indonesia was only 20 paraticipants.

Consistent with previous findings we found that our participants were predominantly mesomorph and ectomorph with low endomorph scores. Our participants also presented normal BMI based on Asian standard and low-fat percentage. The average somatotype values of the athletes in our study were 3.40-4.08-0.84 (ectomorph-mesomorph-endomorph). The endomorph value was, however, lower than those reported from Croatian sprint athletes with 2.1-5.0 -2.6.[1] The endomorph was also lower than those reported in amateurs athletes from Indian junior athletes with 2.53- 4.31-3.06,[2] as well as those reported from Japanese junior sprint athletes (2.47-3.77-3.11) and Indonesian amateurs (2.39-4.86-2.79).[3] To be noted that the performance of our sprint athlete was higher (10.79±0.08 second) than those reported from the study in Croatia (11.33 ± 0.53 second), while there was no running performance reported from the study in India, Indonesia and Japan. Apart from the difference in athletic ability explaining the difference of somatotype, the difference in race and age range may explain the diversity.

During the 100 m sprint event, myriad physiological and anatomical factors determined athletic performance through phases such as acceleration (0-30m), maximum velocity, (30-60m) and speed maintenance (60-100m).[4,9, 14,17,18] The factors include stride length, velocity or speed, energy production, as well as power.[4] The other two important anatomical predictors of 100 m running performance were anthropometry and somatotype. Anthropometry characteristic may affect sprint performance, as it may affect stride rate, thus taller athletes might be preferred.[5,7,15] Meanwhile, somatotype assesses body shape and it is rated from 1 to 7 on endomorph (roundness), mesomorph (muscularity) and ectomorph (leanness).[6,13,14] A growing body of evidence suggests that 100 m athletes should be high in mesomorph, low in ectomorph and endomorph.[7,8,12]

The anthropometric profile and the somatotype components in our study, however, were not related to their performance in 100 m sprint. The findings were in discrepancy. It was reported findings from previous studies that mesomorph was positively associated while ectomorph was negatively correlated with 100 m sprint performance.[6] The study also suggested that lower rates in endomorph and higher rates in ectomorph would be resulted in significantly better race performance. The discrepancies might be due to the lack of heterogeneity of 100 m performance in our samples. The differences also could be due to the difference in the race as previous studies conducted amongst Caucasians. Further investigations thus are required to confirm our findings with more heterogeneous samples.

In conclusion, our findings indicated that Indonesian university sprint athletes were predominantly mesomorph and ectomorph with low endomorph score as well as low-fat percentage. The anthropometric profile and the somatotype components, however, were not related to their performance in 100 m sprint. Further studies with more heterogeneous samples are recommended to confirm the findings.

Acknowledgment

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Do the port health officers at Soekarno-Hatta International Airports and Zainuddin Abdul Madjid International Airports have sufficient knowledge, attitude, and practice regarding emergency landing?

Herqutanto,[1] Albert Wijaya,[1] Budi Sampurna,[1,2] Manaor F.L. Napitulu[1], Ferdi Afian[1]

[1]Department of Community Medicine, Faculty of Medicine, Universitas Indonesia
[2]Department of Forensic Medicine, Faculty of Medicine, Universitas Indonesia

Corresponding Author: Albert Wijaya
Email: al.wijaya88@gmail.com

Abstract

Background: Emergency landing as an airport emergency requires quick and precise action by Port Health Office (PHO) as the medical coordinator. Medical treatment in an emergency landing is critical for the safety of disaster victims, based on the knowledge, attitudes and behavior of airport PHO officers. This study aimed to determine knowledge, attitude and behavior of PHO officers at Soekarno-Hatta International Airport (SOETTA) and Zainuddin Abdul Majid International Airport (ZAM) regarding emergency landings.

Methods: This is an observational study applying cross sectional design. Ninety-eight PHO officers from SOETTA airport and ZAM airport have participated, and their data was collected through questionnaires, and then analyzed based on knowledge, attitude, and practice toward emergency landing.

Results: The knowledge of SOETTA PHO officers was sufficient in 63.5% officers, while it was 79.2% in ZAM. SOETTA PHO officers' attitude was positive in 67.6% while in ZAM it was 54.16%. The behavior of SOETTA PHO officers was good in 55.4% officers while in ZAM it was 75%.

Conclusion: The level of knowledge of SOETTA and ZAM PHO officers regarding emergency landings was sufficient. The attitude of SOETTA and ZAM PHO officers regarding emergency landings was positive. The behavior of SOETTA and ZAM PHO officers was good for emergency landings. *(Health Science Journal of Indonesia 2021;12(1):33-38)*

Keywords: emergency landing, port health office, knowledge, attitudes and practice

Abstrak

Latar belakang: Emergency landing sebagai salah satu keadaan darurat bandara memerlukan tindakan yang cepat dan tepat oleh Kantor Kesehatan Pelabuhan (KKP) sebagai koordinator medis. Penanganan medis dalam emergency landing sangat menentukan keselamatan dan keamanan korban, yang berbasis pada pengetahuan, sikap dan perilaku petugas KKP bandara. Penelitian ini bertujuan untuk mengetahui tingkat pengetahuan, sikap dan perilaku petugas KKP Bandara Internasional Soekarno-Hatta (SOETTA) dan Bandara Internasional Zainuddin Abdul Majid (ZAM) terhadap emergency landing.

Metode: Penelitian ini adalah sebuah studi obervasional dengan disain potong lintang. Sembilan puluh delapan petugas KKP dari 74 bandara SOETTA dan 24 bandara ZAM diambil datanya lewat kuesioner. dan selanjutnya dinilai pengetahuan, sikap dan perilaku terhadap emergency landing.

Hasil: Sebanyak 63,5% petugas KKP SOETTA memiliki pengetahuan yang cukup sementara 79,2% petugas ZAM meiliki pengetahuan yang tergolong cukup. Untuk hasil sikap petugas KPP SOETTA yang tergolong positif 67,6% sementara di ZAM sikap petugas KPP yang tergolong positif 54,16%. Untuk hasil perilaku petugas KPP SOETTA yang tergolong baik 55,4% sementara di ZAM perilaku petugas KPP yang tergolong baik 75%.

Kesimpulan: Tingkat pengetahuan petugas KKP SOETTA dan petugas KKP ZAM terhadap emergency landing tergolong cukup. Sikap petugas KKP SOETTA dan ZAM terhadap penanganan emergency landing positif. Perilaku petugas KKP SOETTA dan ZAM cukup baik terhadap emergency landing. (Health Science Journal of Indonesia 2021;12(1):33-38)

Kata kunci: emergency landing; petugas KKP; pengetahuan, sikap dan perilaku

Emergency landing is one of airport emergencies that range from an imminent threat to safety and operation of the aircraft to the sudden need for passengers or crew to land immediately on the ground such as a medical emergency.[1-2] In emergency landing, fast and proper medical response is required by Port Health Office (PHO) officers. According to the Federal Emergency Management Agency (FEMA), prompt and proper action in emergency management is the state of being prepared and ready to respond to a disaster, crisis, or other types of emergency situations.[3] This vital capacity is built through planning and training. Therefore, a systematic approach should be applied to the management of emergency as a whole, and in particular in determining the necessary steps. [4,5] In Indonesia, recent case of emergency landing occurred on October 1st, 2019 by an Emirates Airline travelling on the Dubai-Auckland which experienced turbulence. The aircraft was forced to make an emergency landing at Ngurah Rai Airport, Denpasar, Bali. A total of 11 passengers were reported injured as a result of the incident and received treatment at the airport health port office, and 2 people were referred to BIMC KUTA Hospital.[6]

Every airport is required to have an Airport Emergency Plan (AEP) document to handle Emergency landing. In the process of making the AEP, airport administrators are required to coordinate with the Airport Emergency Committee (AEC). The PHO officers as an AEC during an emergency has duties to go to the emergency scene by ambulance, and act as a coordinator of medical activities. Medical treatment in emergency landing greatly determines the safety and security of the victim. This medical treatment is based on the knowledge, attitudes and behavior of PHO officers.[7-10]

Research conducted by Ezreqat et al (2017) at Saudi Arabia airport medical team to assess the knowledge, attitudes and behavior of medical teams towards disasters at airports such as Mass Casualty Incidents (MCI), found that the airport medical team as a whole had a high level of knowledge and good attitude towards MCI.

While there is no other research about airport medical team knowledge, attitudes and behavior regarding emergency preparedness, there is similar research conducted by Adenekan et al (2016) that showed the significance of knowledge, attitudes and behavior of medical teams regarding emergency preparedness in hospital. There was an overall deficiency in the respondent knowledge of emergency preparedness.

Their attitude was good and acceptable, but their practices in terms of the frequency of emergency drills and the frequency of regularly updating the emergency plans were grossly inadequate.

Until now there is no research yet that has been conducted to assess the knowledge, attitudes and behavior of PHO officers regarding emergency landings in Indonesia. This study aimed to determine the level of knowledge, attitudes and behavior of PHO officers at Soekarno-Hatta (SOETTA) International Airport in Jakarta and Zainuddin Abdul Majid (ZAM) International Airport in Lombok, West Nusa Tenggara Province, regarding emergency landings.

METHODS

This is an observational study applying cross-sectional design to determine the knowledge, attitudes and behavior of PHO officers at SOETTA and ZAM regarding emergency landings. Soekarno-Hatta International Airport was choosen for observation, because it is the busiest international airport at Indonesia in relation as the main entrance to the Indonesian state. There are also an emergency landing occurred at SOETTA on 04 May 2012 because it needed medical assistance and resulted in the death of the passenger.[11] Zainuddin Abdul Majid International Airport (ZAM) was choosen based on data from the Statistics Indonesia (BPS), as an international airport in Lombok with the largest increase in foreign tourist visits from year to year (year of year / YoY) mounting to 2.94%.[12]

The study was conducted in February 2020 using written questionnaires. The questionnaires were distributed at the airport's Port Health Office. There was a total of 98 subjects consisting of 74 subjects at SOETTA International Airport and 24 subjects at ZAM International Airport. The sample size for this study was calculated using sample size calculator to detect a significant difference between two proportions (https://epitools.ausvet.com.au/twoproportions). Considering there is no research data about the proportion of knowledge, attitudes and behavior of PHO officers, this study used the assumption of a good proportion at SOETTA Airport of 70% and the proportion of good knowledge, attitude and behavior at ZAM Airport by 30%. Using the formula of the calculation, minimum sample proportion needed for SOETTA airport was 60 subjects and ZAM airport 18 subjects. Thus the sample in this study has exceeded of the minimum sample.

The instrument used in this study was developed based on a questionnaire used in evaluating knowledge, attitudes and behavior regarding emergency situations. This questionnaire has been used by medical workers at airports in Saudi Arabia and hospitals in Africa.[13-14]

As an instrument of process for validation, the questionnaire was tested on PHO officers at equivalent International airport; i.e. Halim Perdana Kusuma International Airport in Jakarta. The questionnaire was filled in by 10 PHO officers who were involved in handling the emergency situation, represented by doctors, epidemiologists, nurses and ambulance drivers.

After the trial test, the questionnaire was evaluated and revised with the help of expert (Head of SOETTA KKP, Aerospace medicine specialist) for use in evaluating the knowledge, attitudes and behavior of SOETTA and ZAM PHO officers.

The final questionnaire consist of four different sections. In the first part, respondents were asked about their demographic data. Sections two to four discussed the knowledge, attitude and practice of the PHO officers regarding emergency landings. There are ten questions in each section. Questions about knowledge is include knowledge itself on aircraft type, coordination during emergency landing, location of decision, also priority of victims. For questions on attitudes, we asked the repondents agreement on different statements: whether health port an organization responsible for safety emergency landing, revisions to the Airport Emergency Plan are carried out periodically, where every PHO officers must know the airport emergency response plan. In terms of practice, respondents were asked to remember whether they had experience in emergency landing, had attended emergency landing simulation training, and participated in managing the emergency response medical team.

Research data that have been collected were analyzed descriptively. Measurement of the level of knowledge about emergency landing was obtained from 10 questions. Since there is no standard were available, the research team reached a consensus that if the answer to the questionnaire given was ≥80% correct, then it was categorized as "sufficient" and if it was <80% is categorized as "insufficient". An attitude measure using 10 questions about attitudes regarding emergency landings was used. If the answer to the questionnaire given was ≥80% correct, then it was categorized as "positive" and if it was <80% correct, then categorized as "negative". The behavior measurement is using 10 questions

about behavior regarding emergency landing. The behavior measurement used 10 questions about behavior regarding emergency landing. If the answer was ≥80% was correct, it was categorized as "good" behavior, and if it was <80% then categorized as "poor". Data analysis was performed using SPSS version 23. This research had been approved by the Ethics Committee of the Faculty of Medicine Universitas Indonesia with letter number: KET-10/UN2.F1/ETIK/PPM.00.02/2019.

RESULTS

Characteristics of respondents as follow: respondents in SOETTA were mostly women, while in ZAM, there were more male workers; most respondents were in the 25-45 years age group both in SOETTA and ZAM, with the mean age of port health officer in SOETTA were 41.6 years and in the ZAM 37.8 years; most respondents completed senior high school or completed higher education at both airports.

The results showed that both airports had the fewest percentage in medical work unit which compared to non-medic and paramedic. Most PHO officers at both airports have worked for more than 7 years and have received airport emergency training. The average lenght of work of PHO officers at SOETTA is 13.9 years, while in ZAM it is 12.8 years.

Table 1. Characteristic of the respondents (n=98)

Characteristic	SOETTA n (%)	ZAM n (%)
1. Sex		
Male	33 (44.6%)	14 (58.3%)
Female	41 (55.4%)	10 (41.7%)
2. Age		
<25 years	3 (4.1%)	3 (12.5%)
25-45 years	45 (60.8%)	17 (70.8%)
>45 years	26 (35.1%)	4 (16.7%)
3. Education		
≤ Senior high school	5 (6.8%)	2 (8.3%)
> Senior high school	69 (93.2%)	22 (91.7%)
4. Work unit		
Medic	18 (24.3%)	2 (8.3%)
Paramedic	22 (29.7%)	13 (54.2%)
Non-medic	34 (46%)	9 (37.5%)
5. Length of work		
≤7 years	20 (27%)	6 (25%)
>7 years	54 (73%)	18 (75%)
6. Training		
Yes	41 (55.4%)	18 (75%)
No	33 (44.6%)	6 (25%)

Generally, respondents at both airports had sufficient level of knowledge, with 63.5% of SOETTA PHO officers had sufficient knowledge, while in ZAM, is 79.2% PHO officers had sufficient knowledge.

Table 2. Knowledge of respondents towards emergency landing

Airport	Knowledge		Total
	Sufficient (%)	Insufficient (%)	
SOETTA	47 (63,5%)	27 (36,5%)	74
ZAM	19 (79,2%)	5 (20,8%)	24
Total	66 (79,2%)	32 (20,8%)	98

The attitude of SOETTA PHO officers was 67.6% positive, while in ZAM the attitude of port health officers was 54.16% positive. Thus, in general SOETTA Airport and ZAM Airport PHO officers had more positive attitude (64.28%) than negative attitude (35.72%). (Table 3)

Table 3. Attitudes of respondents towards emergency landing

Airport	Attitude		Total
	Positive (%)	Negative (%)	
SOETTA	50 (67,6%)	24 (32,4%)	74
ZAM	13 (54,16%)	11 (45,84%)	24
Total	63 (64,28%)	35 (35,72%)	98

This study indicates that the practices of SOETTA PHO officer was good in 55.4% respondents while in ZAM, 75% of PHO officers practices was classified as good. Thus, in general SOETTA Airport and ZAM Airport officers had good practice (60.20%) than poor (39.80%). (Table 4)

Table 4. Practices of respondents towards emergency landing

Airport	Practices		Total
	Good (%)	Poor (%)	
SOETTA	41 (55,4%)	33 (44,6%)	74
ZAM	18 (75%)	6 (25%)	24
Total	59 (60,20%)	39 (39,80%)	98

DISCUSSIONS

This research had discover a different situation, where more respondents at ZAM International Airport were men, while SOETTA International Airport have more women as the officers. Same case is found in a study who conducted by Ezreqat et al (2017) at Saudi Arabia airport medical team, where also found that there were more male workers. This situation might be happen because due to general culture about this duty is for male, especially since the characteristic of duty is spend more working hours at the airport, which may not be suitable for female workers.[12]

Based on the group of age, more respondents both airports were in 25-45 years old. The average age of respondents in this study was 41.6 years old at SOETTA and 37.8 years old at ZAM. Research by Ezreqat et al (2017) at Saudi Arabia airport medical team were found an average age of health workers on 36 years old. Respondents in this age group are in the best condition to receive the training in airport emergency handling, due to mature emotions and sufficient length of work since recruitment.

Educational characteristics of the respondents from the two airports showed that they mostly completed high school or higher. It has the same line with research by Ezreqat et al (2017), which only 14.7% have high school education and the remaining 85.3% have education above senior high school. This is significant with the phenomenon of demands in the health sector which requires a minimum formal education of a diploma or bachelor's degree in health.

Medical personnel and paramedics at both airports had the largest number, which 54.05% at SOETTA and 62.5% at ZAM. This result is similar with research who conducted by Ezreqat et al (2017) Saudi Arabia airport medical team 85.4% consisting of medical and paramedical. This is in line with the duties of the port health office engaged in the health sector. Meanwhile, PHO officers mostly have worked more than 7 years at both airports. The reason for this is because PHO officers were usually civil servants who worked in accordance with their assignments at the port health office. [13]

The results also shows that most of PHO officers had received airport emergency training. Supposedly all PHO officers have received training, so there was a gap for this condition. This could be because the training was not available every time (monthly/ yearly) so when it was time for the training, the officers were unable to attend.

The results of the research for respondents' knowledge of emergency landing at both airports were sufficient. Majority of respondents (63.5% SOETTA, 79.2% ZAM) already had sufficient knowledge. This is similar to a study by Ezreqat et al (2017) which found that 64.7% of health workers at Saudi Arabia airports have sufficient knowledge of Mass Casualty Incidents (MCI). The results of the

respondent's attitude towards handling emergency landing showed more positive attitudes, namely 67.6% at SOETTA and 54.2% at ZAM.

The research by Adenekan et al (2016) has assessed the knowledge, attitudes and practices of emergency medical officers in handling emergencies in hospitals. It found that 93.2% of respondents had a positive attitude towards handling emergencies in the hospital. Health workers believe they need to understand the emergency plan; emergency plan must be updated regularly; simulated drill exercises should be done frequently in the hospital. This is in line with the positive attitude of most PHO officers at both airports who agreed that the AEP revision should be carried out periodically. Drills (simulation exercises) is also must be carried out at the airport, with every PHO officer must know the airport emergency response plan. This thing could be interesting because PHO officers who have a positive attitude will encourage rapid response to emergencies, and when there is a spike in cases it can be adequately managed without causing chaos to the ongoing emergency response system. [13-14]

Overall respondent practices towards handling emergency landing were also good at both airports, 55.4% at SOETTA and 75% at ZAM respectively. These results were same as what it found on the knowledge and attitudes of PHO officers at both airports, the majority of which had sufficient knowledge and positive attitudes regarding emergency landings.

When compared to research by Adenekan et al (2016,) it was found that the practices of health workers in the hospital was still insufficient, this was due to a lack of emergency training or insufficient information that there would be training so that officers were not involved in it. Research by Moabi (2009) on the knowledge, attitude and behavior of health workers in hospitals in Africa towards disaster preparedness also found that the behavior of health workers was insufficient due to the lack of emergency simulation training. [15]

This study has several limitations. Fist the method used is a cross-sectional design with a self-administered questionnaire as an instrument. The limited time allocation can lead to the possibility that imperfections in filling out the questionnaire can also occur. Another limitation of the study is the possibility of information bias that comes from assessing respondent attitudes and practices. This arises because it relies heavily on filling anonymous questionnaires, thus relying on the honesty of respondents when filling in research data.

In addition, there are limitations due to the way of assessing attitudes and practices that is supposed to use the Objective Structured Clinical Examination (OSCE) method. Actually, the use of the word skill is more precise than practices, but because in this study it was not possible to measure skills, an assessment was made of the practices of officers in dealing with emergency landing.

In conclusion, the level of knowledge of PHO officers at SOETTA International Airport and ZAM International Airport on emergency landing are mostly sufficient. Most of the respondent's attitude towards handling emergency landing shows a positive attitude at SOETTA International Airport and at ZAM International Airport, also for the practices of the PHO officers at SOETTA International Airport and at ZAM International Airport mostly shows that they were good for the emergency landing. From this result, we can expect PHO officers at both airports to be ready and prepared regarding emergency landings.

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Performance of the tariff method and physicians in determining stroke as the cause of deaths using verbal autopsy in areas with a limited number of physicians: cases in Indonesia

Endang Indriasih,[1] Meiwita P Budiharsana[2]

[1]National Institute of Health Research and Development, Ministry of Health, Republic of Indonesia
[2]Faculty of Public Health, University of Indonesia

Corresponding author: Dr. Endang Indriasih, SKM., M.Si
Email: e_indriasih@yahoo.com

Abstract

Background: Physician-certified verbal autopsy (PCVA) is the primary method used to determine the cause of death in Indonesia, although it is very costly and problematic to use in areas where physicians are not widely available with most deaths occur at home. The Tariff method has been piloted to obtain an alternative approach that does not require a physician to determine the cause of death. This validation study presents how the Tariff captures the correctness and distinctiveness of stroke symptoms to the PCVA.

Methods: Medical records of 298 adult deaths that occured in four teaching hospitals in the Jakarta from January 1, 2015 to March 2017 were collected prospectively. Verbal Autopsy (VA) was applied using the 2014 WHO instrument diagnosed by a trained physician (PCVA) and by Tariff method. The validity of the VA was assessed by comparing the PCVA diagnoses with the Tariff diagnoses, referring to the best standard.

Results: Sensitivity, specificity and positive predictive value (PPV) of VAs using physician's diagnosis (PCVA) for stroke were 73.9%, 73.5% and 93.4% respectively. The corresponding sensitivity, specificity and positive predictive value (PPV) of VAs diagnosed by the Tariff method were 75%, 61% and 91%. The negative predictive values (NPV) of both techniques were low, 35.6% and 32.6% respectively.

Conclusion: The performance of the Tariff method for stroke was almost similar with PCVA, and with a narrower variation, or more consistent than PCVA. Therefore, the Tariff method is a potential alternative to be used on a large scale, because the difficult geographical conditions where physician are not widely available for causes of deaths with distinct signs and symptoms. ***(Health Science Journal of Indonesia 2021;12(1):39-46)***

Keywords: verbal autopsy, sensitivity, specificity, determining cause of death, physician, tariff method

Abstrak

Latar Belakang: *Autopsi verbal yang disertifikasi oleh dokter (PCVA) merupakan metode utama yang digunakan untuk memastikan penyebab kematian di Indonesia. Meskipun sangat mahal dan bermasalah untuk digunakan di daerah di mana dokter tidak banyak tersedia dan sebagian besar kematian terjadi di rumah. Metode Tarif telah diujicobakan untuk mendapatkan pendekatan alternatif yang tidak memerlukan dokter untuk menentukan penyebab kematian. Studi validasi ini menyajikan bagaimana Tarif menangkap kebenaran dan kekhasan gejala stroke dibandingkan dengan PCVA.*

Metode: *Rekam medis dari 298 kematian orang dewasa yang terjadi di empat rumah sakit studi di wilayah Jakarta pada 1 Januari 2015 hingga Maret 2017 dikumpulkan secara prospektif. Autopsi verbal (AV) dilakukan dengan menggunakan instrumen WHO 2014 yang didiagnosis oleh dokter terlatih (PCVA) dan metode Tarif. Validitas AV dinilai dengan membandingkan diagnosis PCVA dengan diagnosis metode Tarif, mengacu pada baku mutu.*

Hasil: *Sensitivitas, spesifisitas dan nilai prediksi positif (PPV) dari AV dengan diagnosis dokter (PCVA) untuk stroke adalah 73,9%, 73,5% dan 93,4%. Sensitivitas, spesifisitas, dan nilai prediksi positif (PPV) yang sesuai dari AV yang didiagnosis dengan metode Tariff adalah 75%, 61% dan 91%. Nilai prediksi negatif (NPV) dari kedua teknik itu rendah, masing-masing 35,6% dan 32,6%.*

Kesimpulan: *Untuk stroke, kinerja metode Tarif hampir sama dengan PCVA, dan dengan variasi yang lebih sempit, atau lebih konsisten dibandingkan PCVA. Oleh karena itu, untuk penyebab kematian dengan tanda dan gejala yang berbeda, metode Tarif merupakan alternatif potensial untuk digunakan dalam skala besar, di Indonesia dimana banyak wilayah dengan geografis sulit dan dokter tidak selalu tersedia.*
(Health Science Journal of Indonesia 2021;12(1):39-46)

Kata kunci*: autopsi verbal, sensitifitas, spesifisitas, penentuan penyebab kematian, dokter, metode tariff*

As a developing country, Indonesia has not fulfilled the WHO's minimum threshold of 23 physicians, nurses and midwives per 10 000 population.[1] To makes it worse, Indonesia's Civil Registration and Vital Statistics (CRVS) system is still in the process of being developed making to provide timely vital statistics, complete and accurate. Located between two continents, Asia and Australia, Indonesia consists of eight large islands and nearly 17,000 small islands stretching more than 5,000 kilometers from Sabang in northern Sumatra to Merauke in Papua. This geographical difficulty has direct negative consequences on the deployment of physicians and other type of health workers in remote areas. Indonesia's governments need to obtain reliable cause of death statistics from various parts of the country including areas without physician, to inform public health policy, respond to emerging health needs, and document progress towards Sustainable Development Goals (SDGs). Therefore, data is collected using the electronic questionnaires on mobile devices and computer algorithms to responses analyzing and estimate the probability causes of death have increased the potential of Computer-Certified Verbal Autopsy method such as Tariff, to be an alternative method to determine cause of death.

Researchers at the Institute for Health Metrics and Evaluation (IHME) develop the Tariff method with an algorithm approach to symptoms or symptoms are recorded in the verbal autopsy instrument. The Tariff method is transparent, intuitive, flexible and at more cost less than PCVA.[2] This application can be downloaded for free through the IHME website.[2] The National Institute for Health Research and Development (NIHRD) has been using this application since 2015 for system activities recording deaths in several areas such as South Kalimantan, Bali and West Nusa Tenggara (NTB).[3] The result showed that the officers at the Health Centre and the District Health Office were able to execute verbal autopsy (VA) using the computerized Tariff method. However, a study for validation of the method to determine cause of death using the Tariff method has never been carried out in Indonesia.

This study presents the strength and specificity of the tariff method to capture stroke symptoms that compared between PCVA and best standard for the method. Stroke is selected cases for point of interest in the validation test, because stroke was the highest cause of death (21.1%) at Indonesia in 2014.[4,5] The result of validation for the two methods in cause of death determining, will be valuable in to appropriate method regarding geographical condition and the limited number of physicians in Indonesia.

METHODS

This study used secondary data from the 'Validation study of determining the cause of death in stroke cases with a physician-certified verbal autopsy and a computer-certified verbal autopsy- tariff method compared to the gold standard'.[6] This study using a cross-sectional design, where sample selection was done purposively in two stages. The first stage is the selection of hospitals as research sample based on the number of deaths due to stroke reported to the DKI Jakarta Provincial Death Surveillance System. Four hospitals were selected in which two hospitals were tertiary hospitals and the rest were secondary hospitals, which all of them were equipped with CT scan facility, and three out of four are teaching hospitals. The second stage is the selection from causes of death in the selected hospital using the death surveillance list and the date when the event happened between January 1st 2015 - March 2017. The measurement for the stroke sample candidate is the death caused by stroke (based on the death surveillance record). The non-stroke sample was chosen if there is no stroke cases was recorded on the death surveillance. All samples were attached by searching their medical records at the sample hospitals, before doing home visit for a verbal autopsy interviews then.
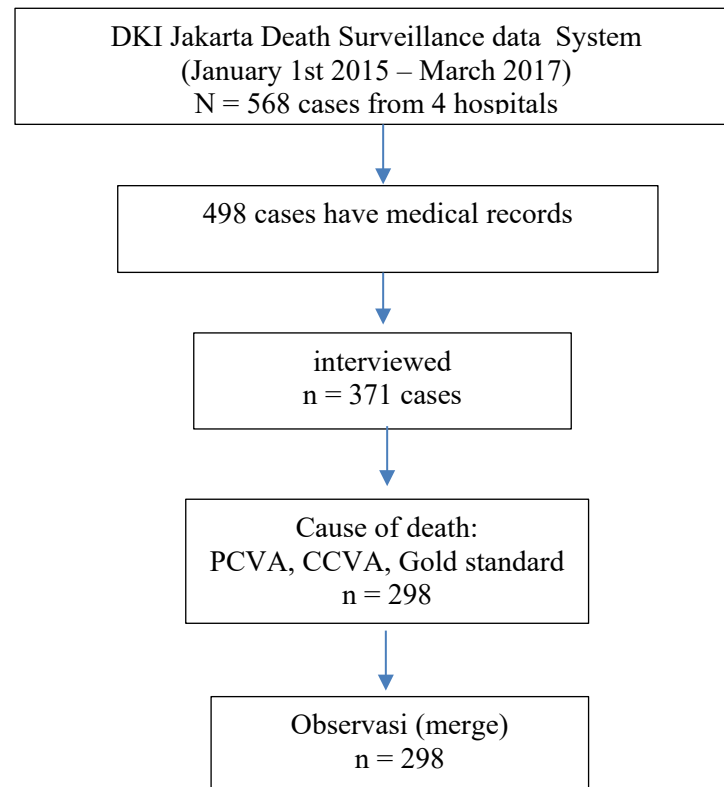
```
┌─────────────────────────────────────────────┐
│   DKI Jakarta Death Surveillance data System  │
│      (January 1st 2015 – March 2017)          │
│        N = 568 cases from 4 hospitals         │
└─────────────────────────────────────────────┘
                     │
                     ▼
┌─────────────────────────────────────────────┐
│        498 cases have medical records         │
└─────────────────────────────────────────────┘
                     │
                     ▼
┌─────────────────────────────────────────────┐
│                 interviewed                   │
│                n = 371 cases                  │
└─────────────────────────────────────────────┘
                     │
                     ▼
┌─────────────────────────────────────────────┐
│               Cause of death:                 │
│         PCVA, CCVA, Gold standard             │
│                  n = 298                       │
└─────────────────────────────────────────────┘
                     │
                     ▼
┌─────────────────────────────────────────────┐
│              Observasi (merge)                │
│                  n = 298                       │
└─────────────────────────────────────────────┘
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Figure 1. Data collection flow

270 cases did not full filled the inclusion of criterias, therefore were not included for further analysis. From 270 cases, 27% of cases were not verified because the un-retrieveable medical records (RM). There are exception for cases who also excluded because deceased's family had moved or not living in the same place (30.7%), and family refused (7.4%). Name of the deceased did not stay at the address as recorded in the medical record (28.9%) or the Tariff method could not determine the cause of death (undetermined cases) (5.9%). Interviews with the deceased family doing through with visited who made by trained interviewers using VA instruments, based on the death surveillance data, and every interviewers are graduates from public health and midwife academies. We used paper-based 2014 WHO VA instrument for adults[7] with additional stroke signs of vertigo, slanted lips and aphasia. Interviews were held only to witnesses, friends, or family that were assumed to know the stroke symptoms or earlier signs prior to the death.

In the begining, interviews were conducted two times by two trainned enumerators. First enumerator interviewed with the WHO instrument and the second enumerator interviewed with PHMRC instruments. As a matter of fact, many of the deceased families were unable for two time interviewed. Most of the interviews were conducted only by using WHO instrument since PHMRC instrument's questions were also covered in WHO instrument.

The gold standard

The gold standard to determine the underlying cause of death follows the procedure established by the Population Health Metrics Research Consortium (PHMRC).[8] Each medical record is reviewed by 2 to 3 physicians to determine the cause of death and it will be come the gold standard. Death caused by stroke was determined by these following clinical diagnosis criteria:

Stroke (A)

Level 1   Cases were confirmed by:
- A Computed Tomography (CT) scan or Magnetic Resonance Imaging (MRI);
- Sudden onset of paralysis, coma

Level 2A   Within the 28 days prior to death, rapidly developing signs of a focal or global loss of cerebral function lasting more than 24 hours (or leading to death) with no apparent cause other than that of vascular origin

Then the same medical records were reviewed by two trained and experienced physicians to determine certified cause of death, and if both physicians were concluded the same results, the cause of death was categorized as the cause of death at gold standard. If the result is disparate, the two physicians would have discussions to agree about the causes of death. If there is no agreement for the result, that case was reconciled to the third physician, until it would be used as the gold standard. The cause of death was coded according to the mortality tabulation, classified as a stroke or non-stroke case.

Physician-certified verbal autopsy

Every case of VA was reviewed by a general practitioner who has previous VA training on cause of death determination using ICD-10 codes, and in accordance to the WHO instrument method (without using algorithms), to determine the direct cause, antecedent causes and underlying causes.[6,9]

Tariff method-computer-certified verbal autopsy

Tariff method in this study were conducted using using Smart VA version-1.2.0 (published May 2017). Data

were inputted using PHMRC shortened instrument developed by PHMRC, IHME, Washington University, consisted of 143 questions includes both closed-ended questions and an open-ended narrative. Based on the response pattern in the VA instrument, the Tariffs subsequently summed and yielding an item-specific Tariff score for each death for each cause. The cause that claims the highest Tariff score for a particular death is assigned as the predicted cause of death for that individual. The tariffs, scores, and ranks are easily observable at each step, and users can easily inspect the basis for any cause decision.[2,10]

Analysis and data management

The physician is supposed to be able for determine from one to four causes of death, while the Tariff method could determine only one cause of death. We decide to choose for only physician's underlying cause of death to undergo a validation test, defined by 2 categories: the stroke (stroke reffer to ICD-10: I60-I69) and non-stroke. Validity test is held by measuring sensitivity, specificity, positive predictive value of the cause of death determined by physicians and Tariff computerized method.
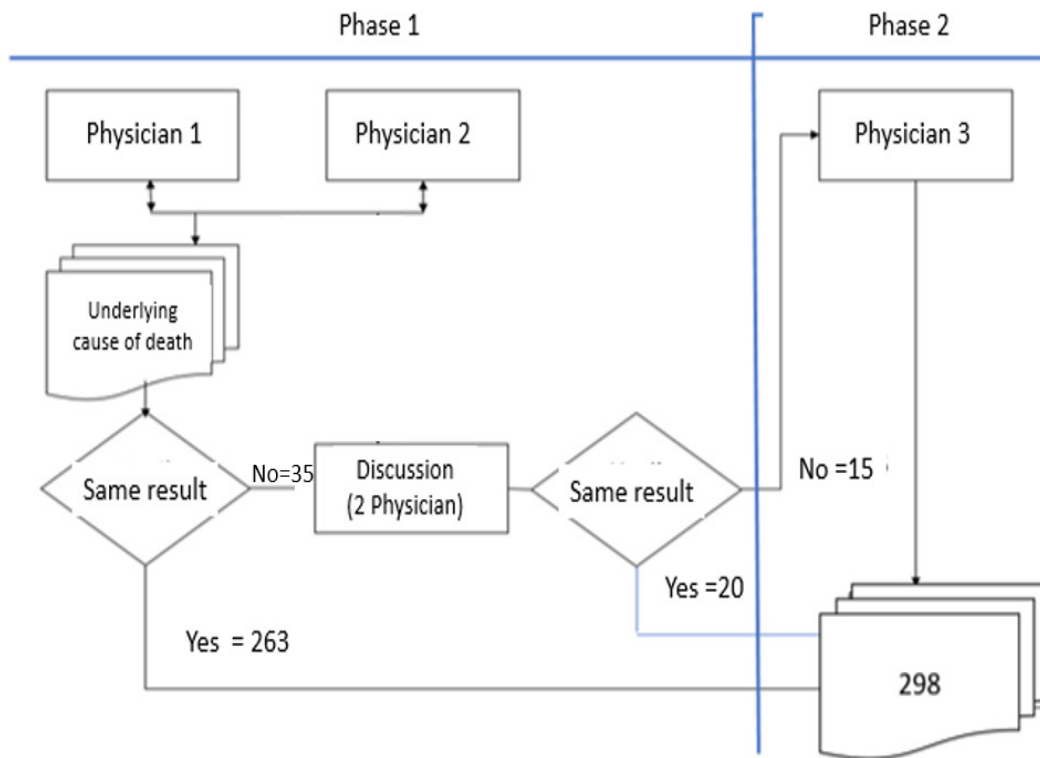

Figure 2. The gold standard mechanism of cause of death

The formulas for this calculation were defined as:

Sensitivity $= TP/(TP+FN)$;

Specificity $= TN/(FP+TN)$;

Positive Predictive Value or PPV $= TP/(TP+FP)$;

Negative Predictive Value or NPV $= TN/(FN+TN)$

Where TP=true positive, FP=false positive, TN=true negative, FN=false negative.

All analyses were carried out using Stata 10.

Ethical Declaration

This study had been approved by The Research and Community Engagement Ethics Committee Faculty of Public Health University of Indonesia with a letter number: 90/UN2.F10/PPM.00.02/2016.

RESULTS

The average time of interview for each case was approximately 30 minutes, where VA interview with the deceased family of these 298 cases was held after 1-27 months of death. There were 26,8% cases after 0-6 months, 24,2% after 7-12 months, 27,5% after 13-18 months and 21,5% more than 18 months after the events. However, the results of statistical tests between different interview period and the accuracy of physiscians or the Tariff method in determining the cause of death are not significant (P value=0,370 and P.value =0,317). About 49% respondents are children of the deceased, and 31.2% are the spouses. Age range for the deceased was 16-91years old (mean: 61 years old) old and 56% of them is male.

The cause of death was determined based on positive response on symptoms or signs that found on the deceased. The highest response on stroke cases (PCVA) was 'loss of consciousness more than 24 hours' (66%). Most of loss of consciousness occurred all of a sudden (73%) and continued up to the death time (91.6%). Positive response on 'paralysis' was about 63% cases, out of these 73% experienced hemiparesis (paralyzed on one side of the body). Vertigo was mentioned by 15% cases, asymmetrical lips (19%) and aphasia (27%). The medical record of the deceased (stroke patients) unraveled that: 69% had ever suffered from stroke, 77.2% ever suffered from hypertension, 23.5% ever suffered from a heart disease and 21.3% ever suffered from diabetes mellitus.

The result of all three cause of death methods (gold standard, PCVA and Tariff method) confirms that the major cause of death was stroke (84%) (ICD-10: I60-I69), followed by diabetes mellitus and ischemic heart disease (see Figure 3).

Table 1 shows the distribution of cases, of the 298 deaths, the stroke established as the cause of death by gold standard criterion in 249 cases. About 149 stroke diagnoses (out of 249) were established using CT scan results combined with clinical symptoms recorded on the medical record (level 1), while on the other 100 stroke cases diagnoses were determined without any CT Scan results (level 2a) but based on medical record notes on a loss or change of global and/or vocal cerebral function occurred 28 days before death. Total diagnoses made through PCVA were 198 stroke cases, while through the Tariff method or *SmartVA* were 206 stroke cases.
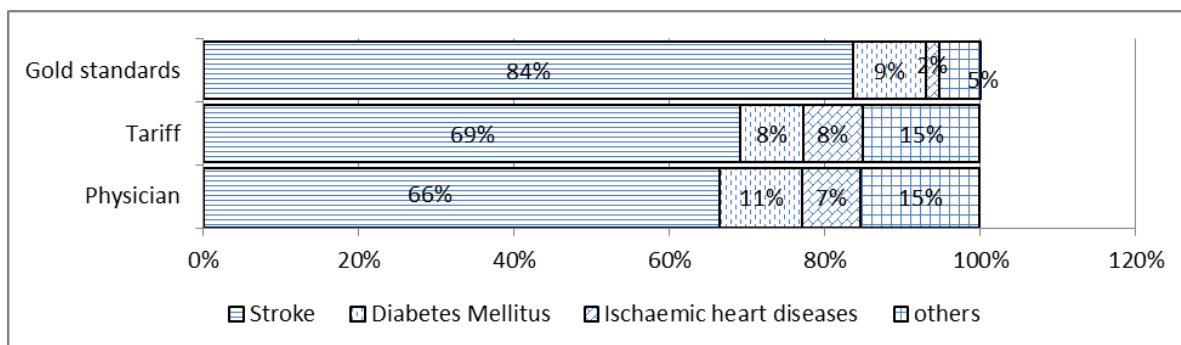

Figure 3. Variation in the proportion of each cause of death by methods

Tabel 1. Distribution of cases

	Gold standard					
	level 1			level 2a		
	stroke	non stroke	Total	stroke	non stroke	Total
PCVA						
Stroke	**122**	6	128	**63**	7	**70**
Non stroke	27	**15**	42	37	**21**	**58**
Total	**149**	**21**	**170**	**100**	**28**	**128**
Tariff method						
Stroke	**114**	8	122	**73**	11	**84**
non stroke	35	**13**	48	27	**17**	**44**
Total	**149**	**21**	**170**	**100**	**28**	**128**

Source : Indriasih E. [6]

Table 2 shows similar level of ability between PCVA and Tariff method in determining stroke as the cause of death in general, with sensitivity for PCVA at 74.3% (CI 95%: 68.4-79.6) and for Tariff method at 75.1% (CI 95%: 69.2-80.3). In comparison to the gold standard level (for 149 death cases) where diagnoses were established with *CT Scan* (level 1)*,* the PCVA's prediction was better than tariff computerized method. While for the other 100 cases without *CT Scan* (level 2A), merely based on a written record about the loss or change of focal and/ or global cerebral functions in the medical record within 28 days before the death, the prediction ability of PCVA was lower than the prediction ability of Tariff computerized method.

Table 2. Differences in prediction ability of PCVA and Tariff method in determining stroke as the cause of death, compared to gold standard clinical diagnosis

	PCVA		Tariff computerized method	
	%	CI : 95%	%	CI : 95%
General (N=298: stroke=249, non stroke=49)				
Sensitivity	74.3	(68.4 - 79.6)	75.1	(69.2 – 80.6)
Specificity	73.5	(58.9 - 85.1)	61.2	(46.2 – 74.8)
NPP	93.4	(89.0 - 96.5)	90.8	(86.0 – 94.4)
NPN	36.0	(26.6 - 46.2)	32.2	(23.2 – 43.2)
Gold standar Level 1 (N=170: stroke =149, non stroke=21)				
Sensitifitas	81.9	(74.7 - 87.7)	76.5	(68.9 -83.1)
Spesifisitas	71.4	(47.8 - 88.7)	61.9	(38.4 -81.9)
NPP	95.3	(90.1 - 98.3)	93.4	(87.5 -97.1)
NPN	35.7	(21.6 - 52.0)	27.1	(15.3 -41.8)
Level 2a (N=128: stroke =100, non stroke=28)				
Sensitifitas	63	52.8 - 72.4	73	63.2 - 81.4
Spesifisitas	75	55.1 - 89.3	60.7	40.6 - 78.5
NPP	90.0	80.5 - 95.9	86.9	77.8 - 93.3
NPN	36.2	24.0 - 49.9	38.6	24.4 - 54.5

Source : Indriasih E. [6]

DISCUSSION

The findings indicate that both PCVA and Tariff method have similar performance in determining stroke as the cause of death. This study yields a higher sensitivity in determining stroke as cause of death compared to similar research conducted by IHME.[11] Even when compared with the gold standard diagnoses that were made with CT scan result (level 1), the sensitivity result is still higher than the IHME study. The PCVA sensitivity result is closer to validation studies conducted in North India (75%) and China (81.5%).[12,13] It is assumed that higher level of gold standard (with CT scan) would be reflected in a better prediction of PCVA, but there is no effect on Tariff computerized method's performance. Because, even when family members were informed by the hospital about CT

Scan results that indicated a stroke had occurred, or other supporting diagnostic records were written in the medical record to confirm the occurrence of stroke, this additional information would just enrich the VA WHO instrument, but would not be useful for the Tariff PHMRC instrument. This situation makes PCVA performance (sensitivity level) better than Tariff's. Another possibility is that there are different procedures for determining the cause of death between cases. Ideally determine the cause of death based on all information obtained through VA interviews. This information can be provided from open, closed and open questions with narrative answers. There was a possibility that the physician more interested in reading narrative answers than closed answers, because diagnostic support information was in open answers and narration (free text). On the other hand, the gold level standard does not affect the results of determining the cause of death by the computer method of tariff, the possibility is that the consistency of the procedure is maintained with the algorithm.

In addition, a physician's text book knowledge and clinical experience also influence the variation of results (causes of death). While the Tariff score calculation is not influenced by physician's knowledge at all. In this study, the findings showed more cases of Gold Standard Level 1 (N=170: stroke =149, non-stroke=21), because the hospitals involved are tertiary and secondary level hospitals with CT scan units in Jakarta, the capital of Indonesia. In a larger scale or national level, it should be anticipated that we will see more Gold Standard Level 2a, because lack of hospitals with CT Scan units outside of Jakarta, especially in remote areas, borders and islands of Indonesia. In such difficult geographical condition, around 70% of mortality occur outside of the hospital, and many of these areas have no physicians available.

At present PCVA assessment is not implemented as regular routine program for vital statistics in Indonesia, eventhough PCVA was well known on limited research projects or verbal autopsy studies such as SRS or CRVS.[3,14] Thus, not all physicians can determine the cause of death using a verbal autopsy. Recent VA study which involving large scale of cases and spread out at 30 provinces was conducted by NIHRD in 2014.[5] PCVA training would need many factors to consider such as resources (financial, qualified trainer, efficient method, etc) and also other important factors after training. According to NIHRD experience, PCVA training was held for 3 days. In fact, only few cases were discussed during training period and the physician need more practice especially for spesific cases. Thus, after the training should be followed by evaluation and monitoring which can be facilitated in a networking at first period of PCVA practiced at Puskesmas. Recently there are more than 10.000 Puskesmas in Indonesia[15], then should be carefully considered if the training will be applied for all Puskesmas since the resources are limited and variation of cases might occurs in wide areas. That might occurs with the distribution of cases and large areas.

In a way, the findings pointed out that Tariff method which calculates a score, or "tariff" for each cause, for each sign/symptom, across a pool of validated verbal autopsy data presented a more reliable response pattern in a verbal autopsy compared to PCVA, which varied according to physician's knowledge, experience, CT Scan results, and supporting notes on additional symptoms within the last 28 days in the VA instrument. In addition, the use of the latest Tariff method version, results show a high sensitivity of 75.1%, which is higher than the previous IHME study results of 51.8%.[11]

In conclusion, based on the results, verbal autopsies using Tariff method have similar performance level with PCVA in diagnosing stroke as the cause of death. Verbal autopsies for stroke cases using Tariff method were feasible for Indonesia which has many difficult geographical areas and lack of physicians in remote, border and islands areas. Lack of physicians is not a barrier anymore if Indonesia uses the tariff method in the implementation of VA. The Tariff method is proven to be reliable, transparent and flexible and can be readily implemented by users without training in statistics or computer science. This validation study provides scientific evidence that Tariff method has adequate validity level, as high as PCVA and the gold standard, and in areas where there is no physician.

Authors' contributions

EI, conceptualized the framework. EI performed the PCVA method and Tariff algorithm in the field, under

the supervision of SK. EI drafted the manuscript in Bahasa and MB helped write the manuscript in English. EI accepts full responsibility for the work and the conduct of the study, had access to the data, and controlled the decision to publish. EI and MB are the corresponding authors. All authors have read and approved the final English manuscript.

Competing interests

The authors declare that none of them have any competing interests.

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The correlation of structural and binding affinity of insulin analog to the onset of action for diabetic therapy

Galuh Wening Permatasari[1], Didik Huswo Utomo[2,3], Dian Laila Purwaningroom[4], Djoko Soeatmadji[5]

[1]Indonesian Research Institute for Biotechnology and Bioindustry, Bogor, Indonesia
[2]Research and Education Center for Bioinformatics, Nusantara Institute for Life Science and Technology, Malang, Indonesia
[3]Department of Applied Biosciences, Nagoya University, Japan
[4]Department of Nursing, Faculty of Health Sciences, Universitas Muhammadiyah Ponorogo, Ponorogo, Indonesia
[5]Department of Internal Medicine Laboratory, Faculty of Medicine, Brawijaya University, Malang, Indonesia

Corresponding author: Galuh Wening Permatasari
Email: galuh.wening@gmail.com

Abstract

Background: These days, insulin analog production has been improved and becoming popular. The advantages of insulin analog have been extensively reviewed in terms of effectiveness compared to human insulin. Each of the insulin analog industries has claimed their safety and efficacy based on in vivo and in vitro to overcome type 2 diabetes. Hereby, we report on the identification of highly effective analog-based insulin on structure and binding affinity computationally, to confirm its potential and give a broader point of view to insulin analog users.

Methods: Five types of insulin analogs, Aspart, Glargine, Detemir, Lispro and Degludec, were analyzed. We grouped and clustered the sequence by alignment to identify the closeness and sequence similarity between samples, continued by superimposing analysis and undertaking binding affinity identification utilizing of a docking analysis approach.

Results: Lispro had the least sequence similarity to other types, close to Aspart (96%) and Glargine (90.5%), while Detemir and Degludec showed 100% similarity we decide to only use Degludec for the next analysis. Furthermore, Lispro, Aspart, and Glargine exhibited structural similarity strengthened by the lack of significant difference in the RMSD data. Importantly, Aspart had the highest binding affinity score (-66.1 +/- 7.1 Kcal/mol) in the docking analysis to the insulin receptor (INSR) and similar binding site areas to human insulin.

Conclusion: Our finding revealed that the strength of insulin analogs towards insulin receptors is identic with its rapid mechanism in the human body. *(Health Science Journal of Indonesia 2021;12(1):47-55)*

Keywords: Computation, Docking, Insulin analog, Sequence similarity, Structure

Abstrak

Latar belakang: Saat ini, produksi analog insulin meningkat dan menjadi popular. Keuntungan analog insulin telah ditinjau secara ekstensif dalam hal efektivitas dibandingkan dengan insulin manusia. Masing-masing industri analog insulin mengklaim keamanan dan kemanjurannya berdasarkan in vivo dan in vitro untuk mengatasi diabetes tipe 2. Kami melaporkan identifikasi insulin analog yang efektif berdasarkan struktur dan afinitas pengikatan secara komputasi, untuk mengonfirmasi potensi serta memberikan sudut pandang yang lebih luas kepada pengguna insulin analog.

Metode: Lima jenis analog insulin, Aspart, Glargine, Detemir, Lispro, dan Degludec, dianalisis. Kami membandingkan dan mengelompokkan urutan tersebut dengan penyelarasan untuk mengidentifikasi kedekatan dan kesamaan urutan antar sampel dilanjutkan dengan analisis superimpose dan melakukan identifikasi ikatan afinitas menggunakan pendekatan analisis docking.

Hasil: *Lispro memiliki kemiripan sekuen paling rendah dengan jenis lainnya, mendekati Aspart (96%) dan glargine (90,5%), sedangkan Determir dan Degludec menunjukkan kemiripan 100% sehingga kami menggunakan Degludec untuk analisis selanjutnya. Selain itu, Lispro, Aspart, dan Glargine menunjukkan kesamaan struktural yang diperkuat oleh rendahnya nilai signifikansi pada data RMSD. Perlu digarisbawahi bahwa Aspart memiliki skor afinitas pengikatan tertinggi (-66.1 +/- 7.1 kkal / mol) dalam analisis docking ke reseptor insulin (INSR) dan memiliki area pengikatan yang serupa dengan insulin manusia.*

Kesimpulan: *Penemuan kami mengungkapkan bahwa kekuatan insulin analog sejalan dengan laju mekanismenya di dalam tubuh manusia.* **(Health Science Journal of Indonesia 2021;12(1):47-55)**

Kata kunci: *Komputasi, Docking, Insulin analog, Kemiripan sekuen, Struktur*

Insulin analog manufacturing has been upgraded and the production of human insulin using recombinant DNA has become common. Historically, as well as studies of the advantages of an insulin analog, have been extensively reviewed regarding of effectiveness compared to human insulin.[1,2] The finding of insulin in 1922 in people with diabetes, marked a significant development in medicine and care. Long time before insulin was detected, it was thought that the pancreas secreted a compound that regulated the digestion of carbohydrates.[3] Whereas for years, owing to impurities and toxicities, need an efforts to prepare pancreatic extracts to reduce blood glucose have failed[4] The concept of isolating pancreatic islet extracts by inserting the pancreatic duct of dogs was developed by Frederick Banting, an orthopedic surgeon, who holding them intact until the acini deteriorated, leaving the islets for isolation. Working with John Macleod, by 1921, they revealed that the de-pancreatised dog developed diabetes and that the blood glucose was decreased by intravenous injection of their pancreatic extract, which called "Isletin".[4]

Since the preparation of insulin involved many regular doses, investigators is seeking ways to increase its time of action. Many researchers such as Hagedorn from Denmark also Scott and Fisher in Toronto developed insulin activities,[3] until the result is contributed to launch of industry for longer-acting animal insulin. Zinc insulin protamine itself is lasted for 24-36 hours. Meanwhile, Hagedorn's isophane neutral protamine is lasted for 24 hours and could be combined with the normal insulin. David Goeddel and his coworkers (of Genentech) prepared the first DNA Recombinant human insulin in 1978 by using and integrating the insulin A- and B- toexpressed in *Escherichia coli*. The agreementto commercialize rDNA insulin was eventually signed by Genentech and Lilly. In 1982, Humulin® R (rapid) and N (NPH, intermediate-acting), the first insulin using rDNA technology which is referred to as analog, were marketed.[1]

Insulin analogs are synthetically produced insulin variants that differ from those of native human insulin in the amino acid chain.[5] Insulin analog has two modes of operating time: fast-acting and long-acting. Rapid-acting analog insulins have a faster effect than short-acting insulins in humans or animals. The analogs may be taken either before or after a meal, although the latter are generally taken 15 to 30 minutes before the meal. For the person who needs more consistency in meal times, rapid insulin could be an appropriate choice. Genereally, long-acting analogs are taken at bedtime for once in a day and appear to have a comparatively smooth operation that lasts between 16 and 24 hours. For basal-bolus regimens of insulin delivery, both fast- and long-acting analog insulins are well adapted, but insulin analogs are not equivalent to other of insulin types. Their advantage is they are offer greater versatility.[6]

Positioned modification of amino acids in the insulin improved the pharmacokinetics and led to quicker absorption, an earlier peak of action, and a shorter duration of action.[7] The first short-acting insulin analog approved in 1996 was Lispro,[8] followed by Aspart in 2000[9] and Glulisine in 2004.[10] Two basal insulin analogs, Glargine, approved in 2000,[11] and Detemir, approved in 2005, are currently available on the market.[12] Glargine has glycine at position A21 instead of asparagine, a further two molecules of arginine at position B30, and a pH of 4.0. At the injection site, it forms microprecipitates which result in sustained absorption with little peak activity.[11,13] At location B29, Detemir has a 14-carbon fatty acid chain bound to lysine that delays its absorption.[12] The insulin analog usage in the clinical were obviously have more benefit to compare with the regular insulin. One of them is the deprivation of hypoglycemia and gaining weight evidence. The glargine and detemir insulin were approved to decrease the nocturnal hypoglycemia compare to regular insulin, by 42-48% and 34%, respectively.[14]

However, despite of the insulin analogues technology development, there are recently a cohort study

comparation of human insulin and insulin analogues administration. According to data, the senior patients with type 2 DM switching the plan from insulin analogues to human insulin and it showed only 0.14% glycemic changes with no manifestation of hypoglycemic or hyperglycemic.[15] Therefore, further consideration is needed in terms of human insulin usage, especially associated with the cheaper cost,[16] given that people can get the human insulin only for USD 25 per vial at Walmart.[17–20]

Our questions and hypothesis consider whether the insulin analogs' mode of action is related to its amino acid composition as well as its protein structure. Moreover, the affinity binding that form once after the insulin analogs docks with an insulin receptor would be a part of the factor that influences the rapid action of each analog. Hereby, we report about the identification of highly effective insulin analogs based on the structure and binding affinity with the receptor, a human insulin receptor, using an in-silico approach to confirm their potential and give a broader point of view for insulin analog users.

METHODS

Sample retrieval and protein modeling

The amino acid sequence of Aspart, Glargine, Detemir, Lispro and Degludec were retrieved from the drugbank database (https://www.drugbank.ca/), while the human insulin sequences (ID P01308) were retrieved from the Uniprot database (https://uniprot.org). The 3D structure of the human insulin receptor (hINSR) (ID 1GAG) and human insulin (hINS) (ID 3W11) were downloaded from the PDB database, while the insulin analog structures were built and constructed using I-TASSER software. The structure models were chosen based on the four considerations including (1) the highest rank of TM-score of the structural alignment between the query structure and template structures in the PDB database; (2) the lowest Root Mean Square Deviation (RMSDa) score which represents the smallest deviation between residues; (3) the highest IDENa, representing the highest similarity in terms of percentage of sequence identity; and (4) the highest Cov score that represents the coverage of alignment by TM-align.[21] The 3D structure for each insulin was compared using Superpose V.10 software to reveal the RMSD differences.

Similarity analysis for insulin sequence and 3D structure

To reveal the nucleotide sequence variation between canonical hINS and the insulin analogs Aspart, Glargine, Detemir, Lispro and Degludec, local blast was performed utilizing CLUSTAL-W and visualized using BioEdit software.[22] Clustering and phylogenetic tree construction for each insulin sequence were built using MEGA7 software to point out the similarity between the analog insulin. Using the Maximum Likelihood method based on the Tamura-Nei model, the evolutionary history was built.[23] The tree with the highest log probability was built and the percentage of trees in which the associated taxa is clustered next to the substation until itshown. By applying Neighbor-Join and BioNJ algorithms to a matrix of pairwise distances estimated using the Maximum Composite Likelihood (MCL) approach, initial tree(s) for the heuristic search were obtained automatically and then the topology with a higher log probability value was selected.

Later, the RMSD scores were evaluated by SuperPose V1.0 webserver (http://superpose. wishartlab. com/). SuperPose is designed to accommodate five categories of criteria for macromolecular superposition: (a) superposition of two or more molecules with the same sequence but with a significantly different structure; (b) superposition of two molecules with the same sequenc, but with a deeply different structure; (c) the overlap of two or more molecules of modestly different sequence, length and composition; (d) the overlap of two or more molecules of profoundly different lengths but identical structure or sequence; and (e) the overlap of two or more molecules of profoundly different sequence in similar structure.[24]

Molecular docking analysis

In order to understand the molecular interaction between human insulin, the insulin analogs and insulin receptors (IR) analysis was carried out using HADDOCK v2.2 software (https://alcazar.science. uu.nl/ services/HADDOCK2.2/).[26] The docking analysis was directed to specific site of hINSR located in the L1 region 705-715,[27] while hINS active sites were located in amino acid numbers from 1 to 21. The docking method was used to compare the binding affinities between insulin each analog in order to discover the most effective insulin analog. Results of docking and bonding interactions were visualized using PyMol software[25] and Discovery Studio R2 2017 software.

RESULTS

Sequence and pairwise alignment

There are five types of insulin analog sequences including Aspart, Glargine, Detemir, Lispro and Degludec were aligned to each other. The results shows that among the five types of insulin analogs, reach out the similarity for 99% (Figure 1). Among the insulin analogs, the differentiation was found in 21st amino acid of Glargine from asparagine (N) to glycine (G). Meanwhile, the sequence similarity between insulin analogs and canonical hINS revealed a quite big difference, around 70-80% from the form a pairalignment analysis. The conservation region from six insulin samples was 27 amino acids (see Figure 1) as follows: FVNQHLCGSHLVEALYLVCGERGFFYT. Also, the conservation sequence located in hINS and insulin analogs were identified at amino acid numbers 25 to

50 based on the hINS sequence. Moreover, the most noticeable difference among the sequences was in the C-terminal region of the insulin.

Further, the similarities value was calculated by form a pair alignment methods deciphering the closeness of each insulin analog. Degludec and Detemir had the highest values with scores of 1.0, which following by Lispro and Aspart with scores of 0.96. While Glargin and hINS had the highest score, which 0.3 compared to other insulin analogs with only 0.27. Visualization and construction of the phylogenetic tree definethe closeness for each insulin (Figure 2). There are two clusters built in the dendogram tree, that is Aspart and Lispro were in same cluster with 67 bootstrap values, while the second cluster consists of Degludec and Detemir supported by a subsidiary strength score of 35. Insulin Glargin was the closest one to the canonical human insulin as shown by the short distance in the phylogenetic tree. Those furthest from hINS were Insulin Lispro and Insulin Aspart.
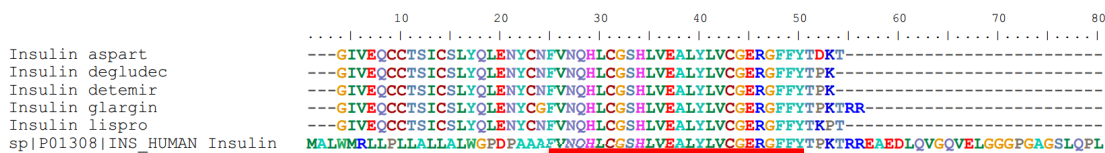

Figure 1. Local alignment between five insulin analogs and human insulin
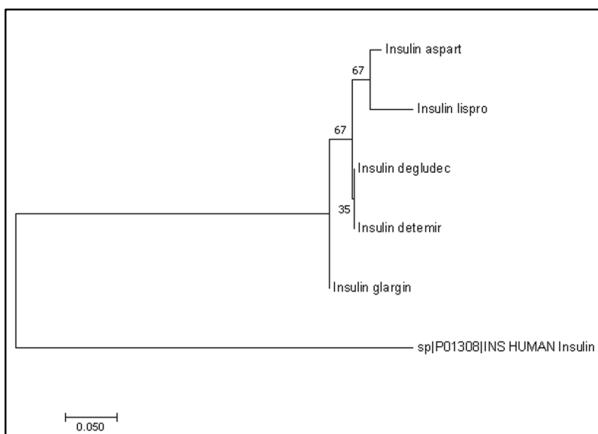

Figure 2. Phylogenetic tree of insulin analogs and human insulin

Root mean square deviation (RMSD) analysis of insulin analogs' structure

Because of the high similarities found in the Detemir and Degludec, we decide to choose for only one insulin analog. Insulin Detemir was eliminated from further analysis. The 3D structure analysis among insulin analogs and hINS generally shows a high similarity, as shown by the non-significant difference in the RMSD data. The range of RMSD scores for each insulin is 3.738 to 4.342. The highest RMSD was found in the Aspart vs Glargine at 4.342, while the lowest isAspart vs hINS at 3.738. The concrete researchfrom the sequence and structure similarity analysis are demonstrated in the Aspart and Lispro insulin which had high RMSD scores (4.05). A similar contrivancesupporting the sequence alignment and phylogenetic showedin Glargin and hINS with a low RMSD score (3.852). This contrivance also supported by superposing the visualization foreach insulin (Figure 3F).

Table 1. The RMSD score among insulin analogs and human insulin

| No	Protein A	Protein B	Local RMSD			
			Alpha carbons	Back Bone	Heavy	All
1	Aspart	Degludec	3.505	3.495	3.505	4.063
2	Aspart	Glargin	3.815	3.765	4.32	4.342
3	Aspart	Lispro	3.573	3.548	4.008	4.05
4	Degludec	Glargin	3.41	3.378	4.04	4.07
5	Degludec	Lispro	3.573	3.533	4.06	4.125
6	Glargin	Lispro	3.603	3.553	4.108	4.172
7	Lispro	Insulin human	3.597	3.55	3.958	4.015
8	Glargin	Insulin human	3.53	3.523	3.818	3.852
9	Degludec	Insulin human	3.555	3.568	3.935	4.028
10	Aspart	Insulin human	3.273	3.282	3.668	3.738
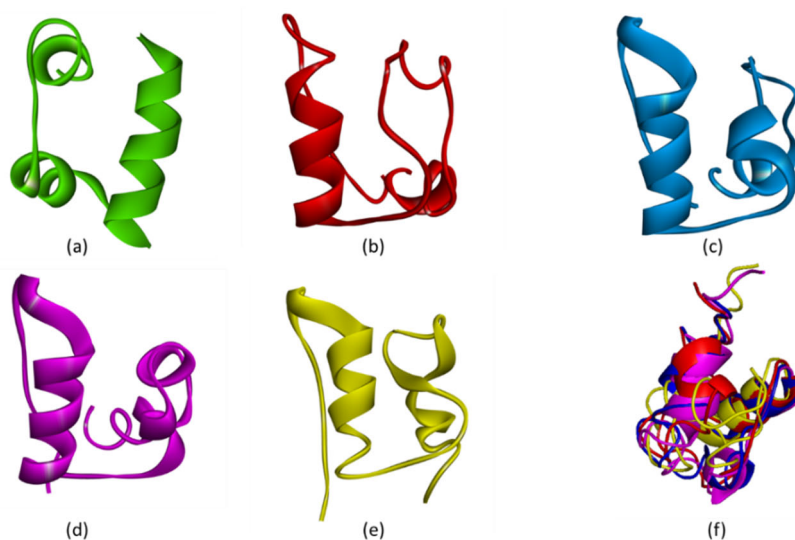
Figure 3. Visualization of 3D structure insulin analogs (a) human insulin (hINS), (b) insulin Aspart (c) insulin Degludec, (d) insulin Glargine, (e) insulin Lispro, (f) superimposition of insulin structures

Molecular docking analysis

Since molecular interaction is important to define the activity and efficacy of insulin to control glucose levels, binding affinity analysis is the next step then. In order to reveal the interaction strength formed by the insulin and insulin receptor, specific docking analysis was used to simulate the interaction. The Aspart and hINSR have the highest binding affinity (-66.9 +/- 6.2 kcal/mol), which higher than hINS-hINSR complex with -66.1 +/- 7.1 kcal/mol. The other insulin analogs' affinity was below from the hINS-hINSR. Despite differences in the affinity score after docking, the binding site for each insulin analog was almost similar to the others, as shown in Table 3, and the visualization of docking is shown in Figure 4. There were two interaction forces which occurred in the complex of insulin and hINSR, hydrogen and hydrophobic forces. The forces number is fairly similar, and it causes thatwe cannot conclude which forces dominate the interaction. The hydrogen-bond

(H-bond) is primarily an electrostatic relationship usually modeled by using Coulomb-type-equations, and a crucial component for this is the dielectric constant. Unfortunately, it is not an accurate and easy method for measuring the dielectric constant. In addition, the H-bond modeling, havea difficulty forthe high heterogeneity of various forms and strengths of H-bonds. As seen with water content of H-bonds,[28] hydrogen bonds (H-bonds even the atmosphere has an enormous effect.

Table 2. Binding affinity of insulin for human insulin receptor (hINSR) using molecular docking

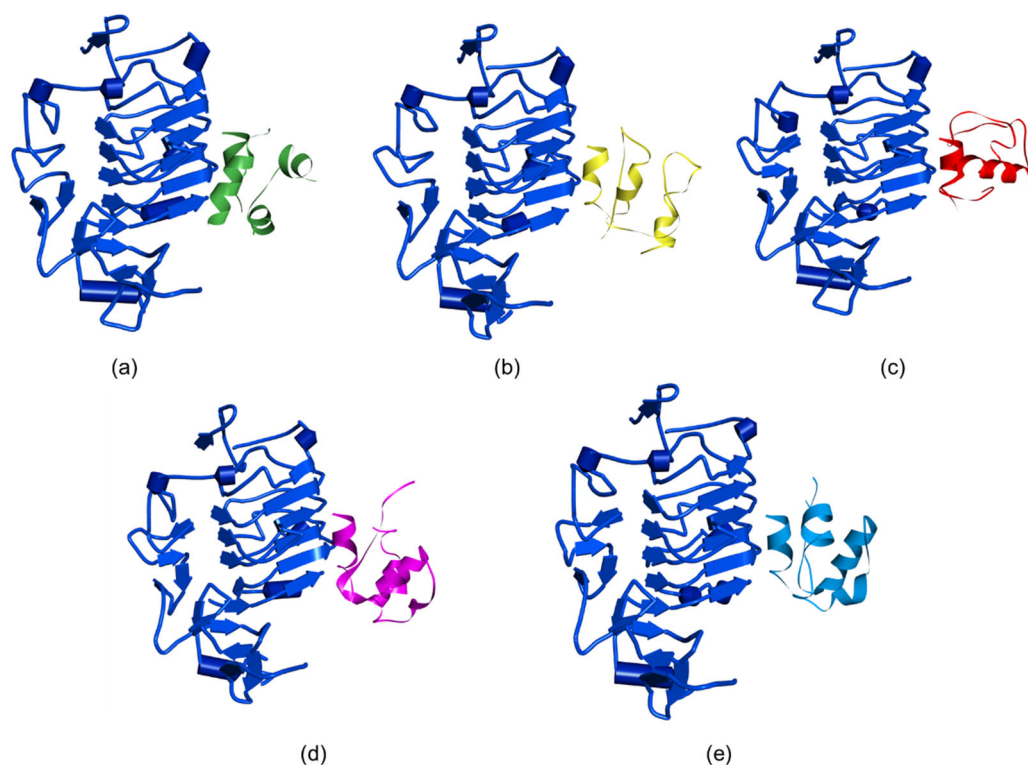| Receptor	Ligand	Binding Affinity (kcal/mol)
hINSR	hINS	-66.1 +/- 7.1
	Aspart	-66.9 +/- 6.2
	Glargin	-57.6 +/- 3.8
	Lispro	-60.4 +/- 3.3
	Degludec	-55.9 +/- 5.8

Figure 4. Visualization of docking results between hINSR (blue, ribbon) and (a) hINS (green), (b) Lispro (yellow), (c) Aspart (red), (d) Glargin (magenta), (e) Degludec (light blue)

Table 3. Molecular interaction analysis of insulin and human insulin receptor

Type of Bond	INSR-INS		INSR-Aspart		INSR-Glargin		INSR-Lispro		INSR-Degludec	
	INSR	**Insulin**	**INSR**	**Aspart**	**INSR**	**Glargin**	**INSR**	**Lispro**	**INSR**	**Degludec**
Hydro-phobic	HIS710, VAL712, GLU706	ILE10, VAL33, LEU16, SER12, LEU32, ALA29	PHE714, VAL715, VAL717,	PHE45, THR51, TYR47, CYS40, GLU17, ILE2, LEU36, LEU16, GLN5,	LEU709	GLU4, GLN15, LEU16, VAL39, PHE45, GLY44, TYR19, LEU36, ILE2, GLY1, PHE46	VAL715, PHE714, ARG14, VAL712, HIS710, GLU706	CYS6, HIS31, CYS28, THR51, GLY29, THR47, THR48, PHE45, LEU36, PHE46, ARG43, TYR37, GLY44	HIS710, PHE714, VAL713	PHE46, GLY44, TYR47, ILE2, PHE45, CYS11, VAL39, LEU16, ILE10, GLU17, TYR19
Hydrogen	VAL715, PHE714, ASN712, TYR708, PHE705, ASP707,	TYR14, LEU13, CYS6, GLU28, CYS11, HIS25, CYS11, HIS25, CYS22, GLU36, LEU26, SER24, GLY23	HIS710, ASN711, TYR708, ASP707, GLU706, PHE705	GLY1, THR48, GLU4, PHE64, ARG43, CYS6, TYR19, CYS11, GLN15, TYR14	ASN711, ASP707, GLU706, VAL715, PHE714, VAL713, ARG14, VAL712, HIS710	SER9, GLN5, LYS50, ARG52, CYS40, ARG43, THR48, GLU42, CYS6	VAL713, ASN711, ASP707	LYS49, GLU34, SER30, VAL33, GLY41, CYS40, GLY41, CYS40	GLU706, ASP707, VAL715, ASN711, VAL712, TYR708	THR48, GLY1, GLN5, ARG43, CYS6, GLN15, TYR14

DISCUSSION

Our finding is revealed that the difference among five insulin analogs sequences is located in the C-terminal region. This might be related to the C-peptide activity, which acted out as a peptide similar to a hormone, and most certainly affirms a receptor's presence. There must be a limited region of the ligand who acted out as an active site in the classic ligand-receptor interaction manner, to influence the binding receptor, which normally well preserved around species boundaries.[29] Based on the report from Shuai *et al*,[30] the C-peptide execute a crucial role in co-evolution and during evolution is had important sequence characteristics, which confirms the statement that C-peptide can behave as a hormone-like cytokine who have important functions in diabetes pathophysiology also care, and it can grow more like a biological factor with a major correlation and restriction in residue mutation. In addition, Ido *et al*,[31] to propose that the C-peptide midportion chain mainly conserved and contained a high proportion of nonpolar amino acids, who involved in the action of the ligand. Moreover, the C-terminal pentapeptide C-peptide coevolutionary residues 86 (Leu) and 87 (Gln) of human proinsulin might be involved in mysterious active sites of the C-peptide itself and engage in interaction with unique receptor.[32–34] Based on the literature, the C-terminal region in each insulin analogs might influence the activity related to the effectiveness or time-related response in human body.

To complete the data, we superimposed the protein structure for each insulin analog and calculated in RMSD. Based on Kufareva and Abagyan,[35] measuring the ligand's RMSD from its reference is located in the reaction complex after the optimum superimposition of the receptor molecules is the most common way to test the correctness of the docking geometry. The selection of this optimal superimposition is the first discretionary decision to be made by the evaluator, notably in the case where the receptor had to be modeled and the reference structure were substantially different. It is possible to measure the MSD for any form and subset of atoms; for example, CSD atoms in a whole protein, CSD atoms in all residues of a particular subset (e.g. transmembrane helixes, binding pockets or loops), all heavy atoms in a particular residue subset, or all heavy atoms in a small molecule ligand. Since the RMSD of each insulin analogs 3D structure varied and interestingly, the closest structure is Aspart

and hINS proved by lowest RMSD score, leads a hypothesis of similarity characteristics for those two insulin in terms of structure and mechanism of action.

In this study, we used the protein—protein docking analysis to make deeper the exploration of relationship between structural and functional of each insulin analog. Docking methods is a computational procedure, originally proposed by Kuntz *et al*. (1982)[36], which virtually attempts to predict a complex of (usually) two binding partners. These binding partners are usually biological macromolecules (such as proteins, DNA/RNA, peptides) or small molecules (e.g., endogenous ligands, drugs). Small ligand molecule is aligned within the binding cavity of the target protein for structure-based small-molecule docking and a basic scoring mechanism measures the docking position for corresponding. For each position, the scoring function is produce a classification, and the resulting values are used to rank for various positions and ligands. There are two separate steps in the docking process in a methodological sense: the generation of the position and the scoring. The first applies to the strategies used to establish multiple conformations of ligands and proteins, also to coordinate different conformations of ligands within the protein's binding site. For a quantitative estimate of the position's efficiency, the latter of the scoring is needed in the docking process.[36]

Based on the data, affinity binding seems to represent the mechanism of action for each insulin analog. The higher affinity score is related to the time effect for each insulin. Rapid acting insulins such as Lispro and Aspart apparently have the higher affinity scores than the long-acting insulin such as Glargine and Detemir. Based on the review by Evans *et al*. (2011)[7] Lispro has been found to be similar to all glucose infusion steps in type 2 diabetes patients, except for 0.5 mmol/l lower insulin glulisine glucose which outflow in type 2 obesity patients.[37] Another fast-acting insulin analog is Aspart, which the B-chain of insulin is altered. Insulin is substituted by an aspartic acid residue as part of the proline at position in 28.[38] The result is close to the Lispro in terms of reducing protein's self-association. The action is started fifteen minutes or less after the injection and the peak occurs 31 to 70 minutes after the injection; the action lasts between 4 and 6 hours. It decreases 27 mg/dL (1.5 mmol/L) of postprandial plasma glucose, 0.12 percent of HbA1c and 50 percent of hypoglycemic events. Insulin

Aspart has demonstrated quicker initiation of action and encouraged lower postprandial glucose levels relative to normal human insulin in clinical trials conducted, with non-pregnant healthy volunteers and patients with type 1 and type 2 diabetes.[39]

For the long-acting insulin, Glargine and Detemir, Glargin has another name, called Lantus. It is a basal insulin analog with a long-acting effect, to regulate the amount of blood sugar, and it's given once a day. It consists of microcrystals that slowly release insulin with a "peakless" profile, providing long-term action lasting 18 to 26 h.[40] Moreover, the second long-lasting rapid action insulin is Detemir,with the trading name is Levemir. It is an insulin analog in which the fatty acid (myric acid) at position B29 is bound to the lysine amino acid. Since it binds to albumin in the blood via its fatty acid at position B29, it is rapidly absorbed. Until it eventually dissociates itself from this complex.[5]

The identification results of insulin analog binding affinity and its structure might be important to explain about why the insulin analogs have their own time of action. The amino acid residues of each insulin analog could be modified in order to accelerate the action times, or delaying the peak time to adjust the patient necessity. Therefore, for future research in clinical study, the binding affinity data might be useful for clinical trial of the new residue sequence of insulin analogs.

In conclusion, the protein structures for each insulin analog shows if there is no significance differences, who assisted by pairwise alignment and RMSD score results. The interesting point is affinity binding of hINS and insulin analogs represents the rapid time action of each insulin. The higher the affinity score for hINSR and INS analog is the higher rate of action from insulin analog and vice versa. Lispro and Aspart insulin showing the high affinity binding towards insulin receptor emphasizing the fast-acting insulin, while the Glargin has lower affinity value represents the long-acting insulin.

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Helmet use behavior and its relation to head injury of road traffic accident in Indonesia (Basic Health Research, 2018)

Lusianawaty Tana[1], Delima[1], Nunik Kusumawardani[2], Lely Indrawati[2]

[1]Center for Research and Development of Health Resources and Services, National Institute Of Health Research and Development, Ministry Of Health, Republic of Indonesia
[2]Center for Research and Development of Public Health Efforts, National Institute of Health Research and Development, Ministry Of Health, Republic Of Indonesia

Corresponding author: Lusianawaty Tana
Email: lusianawaty@yahoo.com

Abstract

Background: Nationally, the prevalence of injuries tends to increase from 7.5% in 2007, 8.2% in 2013, and 9.2% in 2018. The main cause of injuries is motorcycle accidents (40.6%), which most occur on the highway (42.8%). This is a further analysis of Indonesia Basic Health Research (Riskesdas) 2018 data, to assess the role of sociodemography on helmet use behavior and head injuries due to traffic accident.

Methods: The 2018 Basic Health Research was a cross-sectional research, based on data from individuals aged 5 years old and above, who analyzed with helmet use behavior and the incidence of head injuries due to traffic accident as dependent variables. The independent variables consist of sociodemographic characteristics, the role of individual in accident, and the impact of the accident. The data were analyzed by bivariate and multivariate, and taking into account the complex sample in 5% confidence level.

Results: The results showed that 44.4% from 19122 individuals aged five years old and above had good behavior in using helmets. The determinants of helmet use behavior were age, gender, education, occupation, economic status, location and area of residence (adjusted OR 1.15—4.5; p≤0.02). The result from14.1% of respondents who had a head injuries caused by traffic accidents. The risk of head injuries due to traffic accidents was *1.17 times (95% CI 1.02—1.35; p 0.03)* in the unhelmeted group compared to the helmeted group.

Conclusion: Helmet use behavior is connected with the reduction of head injuries due to traffic accidents. Counseling and monitoring of helmet use is need to be improved, especially for the youth category. *(Health Science Journal of Indonesia 2021;12(1):55-65)*

Keywords: head injury, traffic accident, helmet use

Abstrak

Latar belakang: *Secara nasional**,** prevalensi cedera cenderung meningkat dari 7,5 % pada tahun 2007, 8,2 % pada 2013, dan 9,2 % pada 2018. Penyebab utama dari cedera adalah kecelakaan bermotor (40,6 %), dan kebanyakan terjadi di jalan raya (42,8 %). Ini merupakan analisis lanjut data Riset Kesehatan Dasar (Riskesdas) 2018 untuk menilai peran sosiodemografi terhadap perilaku penggunaan helm dan hubungan perilaku penggunaan helm dengan cedera kepala akibat kecelakaan lalu lintas.*

Metode*: Riskesdas 2018 adalah riset potong lintang. Data individu umur 5 tahun ke atas dianalisis dengan perilaku penggunaan helm dan kejadian cedera kepala akibat kecelakaan lalu lintas sebagai variabel terikat. Variabel bebas terdiri dari karakteristik sosiodemografi, peran individu dalam kecelakaan, dan dampak kecelakaan. Data dianalisis secara bivariat dan multivariat dengan memperhitungkan complex sample dan 5 % tingkat kepercayaan.*

Hasil*: Hasil menunjukkan bahwa 44,4% dari 19.122 individu umur 5 tahun ke atas mempunyai perilaku yang baik dalam menggunakan helm. Determinan perilaku penggunaan helm adalah umur, jenis kelamin, pendidikan, pekerjaan, status ekonomi, lokasi dan area tempat tinggal (adjusted OR 1,15-4,5; p≤0,02). Sejumlah 14,1% individu mengalami cedera kepala akibat kecelakaan lalu lintas. Risiko cedera kepala pada individu yang tidak menggunakan helm sebesar 1,17 kali (95% CI 1,02—1,35; p 0,03) dibandingkan dengan individu yang menggunakan helm.*

Kesimpulan*: Perilaku penggunaan helm berhubungan dengan penurunan cedera kepala akibat kecelakaan lalu lintas. Penyuluhan dan pemantauan penggunaan helm perlu ditingkatkan terutama pada kelompok remaja. (Health Science Journal of Indonesia 2021;12(1):56-65)*

Kata kunci*: cedera kepala, kecelakaan lalu lintas, penggunaan helm*

The national injury prevalence according to Indonesia Basic Health Research tends to increase increase from 7.5% in 2007 to 8.2% in 2013, and 9.2% in 2018 while the prevalence of traffic accidents was 2.2% in 2018.[1-4] The 2018 Basic Health Research data showed the highest prevalence of injury was in the younger age group with 12.2% at the age of 15–24 years and 12.1% at the age of 5—14 years. The proportion of road injuries according to all types of injuries was 31.4%.[3]

Age and gender are known to be the main determinants of injury in productive age.[5] The type of injury, cause of injury, and injured body parts contribute to the severity of the injury which is categorized based on the length of hospital stay. Injuries with longer hospital stays are head injuries, fractures, and eye injuries.[6]

The Central Bureau of Statistics reported an increase in the number of all types of motorized vehicles in the four years from 2009 to 2012 based on data from the Indonesian National Police Department. Motorcycles are the highest in number, which is an increase of 13.11 %[7]. Based on gender category, men is more often to injured at work, not only because the men is dominant to spend their time on the road than women, but also because of unsafe behavior or actions on the road. Deadly case from traffic accident injuries was significantly three times higher for men than women.[8,9] Human-caused factors is identified as the biggest factors for traffic injuries.[10]

In 2008, injuries were estimated to be the cause of death in 2.9 million people, counting for 10% of all deaths in the Asia Pacific region. This number is more than half of the deaths due to injuries in the world. The magnitude of injury in the Asia Pacific varies between countries. It is related to the cause of injury, age, gender, and income level.[11]

Study on 2006 – 2016 about traffic accident deaths in Iran showed that 19.5% of traffic accident deaths occurred among motorcyclists with an average age of 32.3 ± 18.5 years.[12] The main mechanism of the accident is relate between motorcycles and other vehicles, which mostly happen with cars (34.8%). The traffic accidents that occur in cities, is contribute for 40.7% of motorcyclists' deaths, with head injury as the main causes of death.

Systematic review of 53 studies concluded that despite differences in research methods, there were consistent results especially in mortality and head injury. The motorcycle helmets use can reduce the risk of death and head injury for about 72%. [13] In Thailand, if people who non-helmet users is started to wore a helmet, it could prevent 40% of road traffic potential death.[14]

However, many studies reported a different behavior about the helmet use. For example, the majority of adult riders and pillions wore a helmet (93.4% and 85.8%) in Malaysia.[15] Moreover, a study in Thailand's urban arterial road reported there are only 67% from motorcyclists who wearing the helmet.[16] In Mysuru city, India, only 19.5 per 100 person minute of observation among motorcyclists used effective helmets. [17]

Several causes is contributed to the non-helmet use, such as age, gender, geography, and behavior.[18] Teens and children, women, rural areas, and alcohol consumption is also connected with the non helmet use. [18] Other studies have shown that properly wearing a helmet with buttons is more efective at protecting motorcyclists than any type of helmet.[19] People who use helmets in motorcycle accidents have a less intracranial injury. [20]

The 2018 Basic Health Research is more detailed on injury data than the 2013 Basic Health Research. There is data on injuries due to traffic accidents, accident sites, and helmet use behavior. To find out the relationship between helmet use behavior and head injuries in road traffic accidents in Indonesia, it is necessary to conduct an assessment. Unfortunately, there is no data about the motorcyclists driver license or have a training for safety driving before their getting a driver license.

Further analysis of the 2018 Basic Health Research data was carried out to assess the relationship, between sociodemographic factors with helmet use behavior and helmet use behavior with head injuries in road traffic accidents in Indonesia. This analysis is expected to be useful for policy makers, to reduce traffic accident injuries in Indonesia.

METHODS

This was a further analysis of Basic Health Research (Riskesdas) 2018 data which was collected in a cross-sectional design survey in 34 provinces of Indonesia.[3,4, 21] The study about the population according to Indonesian residents, who selected sample residents has already interviewed at Riskesdas 2018. The inclusion is the criteria were aged 5 years

old and above and the exclusion criteria were people with incomplete or extreme data.

Based on data collected from Riskesdas 2018 household questionnaire (RKD.18.RT), Riskesdas 2018 individual questionnaire (RKD-18.IND), and the 2018 National Socioeconomic Survey (Susenas) questionnaire, to get the contributing factors of the helmet use behavior, we analyzed helmet use behavior as dependent variables and individual characteristics (age, gender, education, main occupation), location of residence (urban and rural areas), area of residence, and the socio-economic status, respondent's role at the accident, and the impact of the injury as independent variables. The education was divided into 3 groups: low education for junior high school graduates or below, intermediate for senior high school graduates, and high for university/academy graduates. The occupation based on the main job risk was divided into 7 groups: not working, study, entrepreneur, employee (government and non-government employee), laborers (laborers/drivers/household helpers), farmers/farm laborers, and others (including fishermen). The socio-economic status was divided into 2 groups based on quintile, which are high (quintile 5) and low (quintile 1-4).

Traffic accident injury was categorized for head injury and non-head injury. Helmet use behavior was defined as good if the respondent is always wears a helmet while riding motorcycle, and not good or poor if it occasionally or even never wear helmets. The area of residence or region was divided into the Sumatera area, the Eastern Region of Indonesia (Kalimantan, Sulawesi, Nusa Tenggara, Maluku and Papua), and the Java-Bali area. The respondent's role at an accident was divided into as a motorcyclist or not, also as a passenger of motorcycle or not. The worst possibilites from impact of injury could be a loss of limbs, disability or defective distinguished from whether if there was a loss of senses injuries or not, even a discomfort.

The analyzed data in a complex sample method, presented univariate, bivariate and multivariate with a significance level of 0.05 and 95% confidence of interval.

RESULTS

The total number of respondents included in the analyses was 19122, while the characteristic of respondents and injuries were shown in table 1.

The highest proportion of respondents was 15—24 years old group (38.5%), followed by 25—34 years old (20.7%), and the lowest was 55 years old and 5—14 years old (7%, and 8.1%). The male was higher than the female respondent (65.4% and 34.6 %), more than half of respondents were in low education (62.6%), most respondents were of low socio-economic status 72.1%. About 59% stayed in the Java-Bali region and 81% as a motorcyclist, only 20.7% as a passenger of the motorcycle. The uncomfortable permanent scars 14.3%, but vision dysfunction only 0.5% and loss of limbs 0.6%.

People aged ≥5 years old who suffered head injuries due to road traffic accidents were 14.1%. A total of 44.4% of people aged ≥5 years old always worn a helmet when riding a motorcycle on road, but 55.6% of them only occasionally worn helmet or even never worn a helmet when riding motorcycle.

The composite of sociodemographic characteristics to helmet use behavior was shown in table 2.

Determinants of helmet use behavior were age, gender, education, socio-economic status, main occupation, location of residence, and area of residence (Adjusted OR 1.15—5.43; p≤0.024).

The respondent with good behavior of helmet use was low in the 5—14 years old group compared with others age group (13.3%), where the male was higher than the female (46.1% and 41.2%), the high and intermediate group of education were higher than the low education group. More respondents with high socio-economic status had a good behavior of helmet use than the lower socio-economic status group (49.7% and 38.6%).

Based on the occupation, respondents with the main job as a farmer or a farm laborer were the lowest percentage of good helmet use behavior. The respondent who lived in urban had better behavior of helmet use than who lived in rural, and respondent who lived in Sumatera region was the worst respondents from other regions.

Determinants of head injury caused by traffic accidents were shown in table 3.

Determinants of head injury due to traffic accidents were helmet use behavior, residential area, respondent's role at the time of injury, the impact of injury (sensory dysfunction and permanent scars that interfere with comfort) with adjusted OR 1.1—3.5, p ≤ 0.05. Age, education, and main occupation were confounding factors.

Tabel 1. Proportion of respondent' characteristics, head injury, helmet use, activity during injury, and impact of injury in Indonesia

Variables	Proportion (%)	95% CI	Standard Error (%)
Age group (years)			
• 55-90	7.0	6.5—7.5	0.25
• 45-54	10.2	9.7—10.8	0.30
• 35-44	15.5	14.8—16.3	0.39
• 25-34	20.7	19.7—21.7	0.49
• 15-24	38.5	37.4—39.6	0.54
• 5-14	8.1	7.6—8.6	0.26
Gender			
• Male	65.4	64.5—66.4	0.50
• Female	34.6	33.6—35.5	0.50
Education			
• High	3.0	2.6—3.4	0.20
• Intermediate	34.4	33.4—35.5	0.55
• Low	62.6	61.5—63.6	0.56
Socio-economic status			
• High	27.9	26.8—29.1	0.59
• Low	72.1	70.9—73.2	0.59
Occupation (main job)			
• Not working	20.8	19.9—21.7	0.45
• Study	20.4	19.6—21.3	0.42
• Entrepreneur	15.0	14.2—15.8	0.40
• Employee	16.2	15.4—17.1	0.43
• Laborer	11.9	11.1—12.8	0.42
• Others	5.5	5.1—6.0	0.24
• Farmers/farm laborers	10.2	9.7—10.8	0.27
Location of residence			
• Urban	58.3	57.5—59.1	0.40
• Rural	41.7	40.9—42.5	0.40
Area of residence (region)			
• Eastern of Indonesia	23.0	22.4—23.6	0.30
• Java- Bali	59.0	58.2—59.8	0.40
• Sumatera	18.0	17.5—18.6	0.28
Head injury of traffic accident			
• Injured	14.1	13.4—14.8	0.35
• Not injured	85.9	85.2—86.6	0.35
Helmet use behavior			
• Good	44.4	43.3—45.5	0.56
• Poor	55.6	54.5—56.7	0.56
Standard of helmet usage [1]			
• Non-standard helmet	0.5	0.3—0.6	0.08
• Standard helmet but unbottoned	6.8	6.2—7.4	0.30
• Standard helmet and bottoned	92.7	92.1—93.3	0.31
Motorcyclist			
• Yes	81.0	80.1—81.8	0.43
• No	19.0	18.2—19.9	0.43
Passenger of motorcycle			
• Yes	20.7	19.8—21.5	0.40
• No	79.3	78.5—80.2	0.40
Vision disfunction			
• Yes	0.5	0.4—0.7	0.07
• No	99.5	99.3—99.6	0.07
Loss of limbs			
• Yes	0.6	0.5—0.8	0.08
• No	99.4	99.2—99.5	0.08
Uncomfortable permanent scars			
• Yes	14.3	13.6—15.1	0.39
• No	85.7	84.9—86.4	0.39

[1]n=16.892

Table 2. Association of sociodemographic factors with helmet use behavior in Indonesia

Sociodemographic Factors	Good Behaviour of Helmet Use (%)	Adjusted OR (95% CI)	p value
Age group (years)			
• 55-90	50.9	5.43 (3.90—7.56)	0.0001
• 45-54	52.2	4.87 (3.55—6.69)	0.0001
• 35-44	51.2	4.31 (3.17—5.86)	0.0001
• 25-34	51.8	3.89 (2.85—5.30)	0.0001
• 15-24	40.8	2.88 (2.22—3.74)	0.0001
• 5-14	13.3	1	
Gender			
• Male	46.1	1.23 (1.09—1.39)	0.001
• Female	41.2	1	
Education			
• High	66.2	2.47 (1.77—3.44)	0.0001
• Intermediate	56.5	1.84 (1.62—2.09)	0.0001
• Low	34.4	1	
Socio-economic status			
• High	49.7	1.15 (1.02—1.29)	0.02
• Low	38.6	1	
Occupation (main job)			
• Not working	38.3	1.29 (1.06—1.59)	0.01
• Study	33.5	1.67 (1.33—2.10)	0.0001
• Entrepreneur	56.1	1.87 (1.54—2.27)	0.0001
• Employee	65.6	2.18 (1.72—2.76)	0.0001
• Laborers	45.3	1.45 (1.16—1.81)	0.001
• Others	50.6	1.66 (1.29—2.15)	0.0001
• Farmers/farm laborers	28.6	1	
Location of residence			
• Urban	54.6	2.19 (1.95—2.45)	0.0001
• Rural	30.1	1	
Area of residence (region)			
• Eastern of Indonesia	42.7	1.25 (1.10—1.42)	0.001
• Java- Bali	47.2	1.20 (1.06—1.37)	0.006
• Sumatera	37.2	1	

Tabel 3. Determinants of head injury caused by traffic accident in Indonesia

Determinant	Head Injury (%)	OR (95 % CI)	p	Adjusted OR (95 % CI)	p
Age group (years)					
• 5-14	19.8	1.11 (0.80—1.55)	0.53	1.11 (0.80—1.55)	0.54
• 15-24	13.4	1.16 (0.92—1.47)	0.21	1.16 (0.92—1.47)	0.21
• 35-44	14.3	1.20 (0.95—1.52)	0.12	1.20 (0.95—1.52)	0.13
• 45-54	15.4	1.30 (1.00—1.67)	0.05	1.29 (1.00—1.67)	0.05
• 55-90	16.4	1.17 (0.89—1.54)	0.26	1.17 (0.89—1.54)	0.26
• 25-34	11.7	1		1	
Gender					
• Male	13.7	1.00 (0.86—1.17)	0.98		
• Female	14.9	1			
Education					
• Low	15.6	1.25 (0.79—1.98)	0.34	1.24 (0.79—1.96)	0.35
• Intermediate	12.0	1.00 (0.63—1.57)	0.99	0.99 (0.63—1.56)	0.98
• High	9.6	1		1	
Occupation (main job)					
• Not working	14.9	1.10 (0.81—1.48)	0.55	1.10 (0.81—1.48)	0.56
• Study	13.3	1.00 (0.73—1.39)	0.99	1.00 (0.72—1.39)	0.99
• Entrepreneur	13.3	1.09 (0.82—1.45)	0.55	1.09 (0.82—1.45)	0.56
• Farmers/farm labores	18.2	1.31 (0.94—1.80)	0.11	1.29 (0.94—1.77)	0.11
• Laborers	13.1	1.12 (0.81—1.55)	0.49	1.12 (0.81—1.55)	0.48
• Others	14.4	1.19 (0.81—1.75)	0.38	1.18 (0.80—1.74)	0.40
• Employee	10.1	1		1	
Socio-economic status					
• Low	14.8	1.11 (0.94—1.31)	0.23	1.10 (0.93—1.31)	0.25
• High	12.3	1		1.00	
Location of residence					
• Rural	15.5	0.97 (0.84—1.13)	0.74		
• Urban	13.1	1			
Area of residence (region)					
• Sumatera	15.5	1.19 (1.01—1.40)	0.04	1.18 (1.00—1.39)	0.05
• Eastern of Indonesia	17.2	1.38 (1.19—1.59)	0.001	1.37 (1.18—1.59)	0.001
• Jawa-Bali	12.5	1		1	
Helmet use behavior					
• Poor	15.5	1.18 (1.01—1.36)	0.03	1.17 (1.02—1.35)	0.03
• Good	12.1	1		1	
Motorcyclist					
• Yes	12.9	0.81 (0.47—1.39)	0.44	0.75 (0.63—0.89)	0.001
• No	19.0	1		1	
Passenger of motorcycle					
• Yes	18.7	1.08 (0.65—1.81)	0.77		
• No	12.9	1			
Vision disfunction					
• Yes	40.6	3.85 (2.06—7.17)	0.001	3.52 (1.97—6.29)	0.0001
• No	14.0	1		1	
Loss of limbs					
• Yes	18.9	0.74 (0.34—1.61)	0.45		
• No	14.1	1			
Uncomfortable permanent scars					
• Yes	20.3	1.73 (1.46—2.06)	0.001	1.72 (1.45—2.05)	0.0001
• No	13.1	1		1	

Respondents with poor helmet use behavior had a higher risk about 1.17 times to head injury due to traffic accidents than respondents with good helmet use behavior, and respondents who stayed in Sumatera and Eastern of Indonesia region had a risk of about 1.18 times and 1.37 times to head injury due to traffic accidents than respondents stayed in Java-Bali region.

The respondent's role at the time of injury was one of the determinants of the traffic accident head injury with an adjusted OR of 0.75).

The sensory dysfunction and permanent scars that interfere with comfort, is related to traffic accident of head injury (Adjusted OR 3.52 and 1.72).

DISCUSSION

This analysis found that age is one of the determinants factors of helmet use behavior. In this study, the porportion of respondents in 5-14 years old group were the highest proportion to head injury due to traffic accident than others group. It is different from the 2018 Basic Health Research report that the high proportion of head injury in Indonesia was in the older age groups which were 64-74 years old (16%) and 75 years old and above (17,1%) while in the age 5-14 years group was only 11.4% and the lowest was in the 25-34 years and in the 15-24 years group (8,7% and 9%).[3] A police department's report cited in a study on demographic transition and epidemiology 2019 showed most traffic accident victims in Indonesia were aged 15-19 years.[22] Another study of traffic accidents during Eid Mubarak 2013 also showed a similar figure in the 15-24 years group.[23]

Different thing is happen in this analysis than the other two studies mentioned above as it, included younger age respondents that five years old and above and had specific data on head injury motorcyclist in traffic accidents, and helmet use behavor. The other two studies is learn about injuries of a traffic accident in common, not only focus about the head injury.

Negussie A, et all[24] reported that 71.9% of 171 injured patients admitted to the hospital were causes by accidental injuries, mostly in ≤ 24 years old group (48.2%), and 51.4% causes by the road traffic accident injuries. Nevertheless, in terms of the impact of death, traffic accidents were included in the main causes of death for young people aged 15-29 years.[25]

In this research, only 44.4% of individuals had good helmet use behavior and were very low in the 5-14 age group (13.3%). Christopher A German [18] reported that teens and children were contributing to non-helmet use. Meanwhile, Michelle C. Fong [26] reported that only 16.2% (out of 1632) motorcyclists observed were using helmets (28.7% adults and 0.4% children). More motorcyclists (54.8%) had never or only occasionally used helmets while riding.

The use of the helmet in Vietnam was better; more than 90% of adults and 30—50% of children used helmets.[27] Similar to Vietnam, the majority of adult riders and pillions in Malaysia used helmets (93.4% and 85.8%), and only 30.5% of children used helmets.[15] Observation in Thailand showed that 67% motorcyclists used helmets, while the proportion of adult motorcyclists wearing a helmet was 2.8 times higher than children.[16]

The differences between these studies might be due to different research methods. The 2018 Basic Health Research was a cross-sectional study and data on helmet use behavior was collected by interviewing respondents without observation, so the proportion obtained was relatively lower than other ASEAN countries except for Lao. ¯

A study in Lao by Michele showed a very low proportion of helmet use. It might be due to the motorcyclist's poor understanding of their country's regulation on motorcycle ridership and helmet use. Lao's law regulates a maximum of three person per in one motorcycle but the study observed 24 motorcycles (2.8 %) with four persons and 3 motorcycles (0.4 %) with five persons in each motorcycle.[26]

Limitation of this analysis was the lack information on respondent's attitude towards helmet use. Michele's study showed that most motorcyclists indicated that they did not like the feel of wearing helmets or their appearance when wearing helmets. It was also found that almost half of the motorcyclists did not have helmets for their children, or thought that their children were too young to use helmets.[26]

Alain Chichom-Mefire[28] conducted a prospective cohort analysis of the characteristics and patterns of accident injuries in motorcyclist and passengers in urban areas, which found that almost all respondents did not use helmets. Drivers are more risky to suffer head and neck injuries than passengers.

Motorcyclists and passengers had the same risk of lower leg injuries, because died in the emergency room were 3-4 % and more riders died than passengers. Neck and head injuries were the main causes of death, serious injuries, and disability among motorcyclists. The use of helmets in motorcyclists can reduce almost 40% of deaths and reduced up to 70% risk of serious injury.[13,14, 25]

The proportion of helmet use was higher in people with high socio-economic status than the low and medium status, because higher socio-economic status individu are more likely to buy a helmet. Unfortunately there was no further explanation related to the data source. Another study found that 29 % of motocyclists said if they did not buy helmets for their children, because a helmets were too expensive or helmets were difficult to obtain.[26]

In Indonesia, motor vehicles of various types had increased from 2009 to 2012, particularly motorcycles by 13.11 %.[7] There was 27 % increase in the number of two-wheeled motorized vehicles in the world according to WHO data 2010 and 2013.[25] Meanwhile, in high-income countries, the vehicles are increasing, but less than half of them have implemented minimum vehicle safety standards, while in middle-income countries where most vehicle manufacturers located, they do not implement those standards at all.[25]

Regulations on safe behavior on the road are important factors that can improve the behavior of road users, and will reduce road accidents.[29] Changes in behavior of road users to a better way need to be supported by law enforcement and good understanding of the regulation itself. Helmet use behavior is one of the risk factors for road injuries besides vehicle speed, alcohol consumption, and others. This is shown by the positive impact of the regulation application from each risk factor which will reduce accidents, injuries, and deaths.[29] Enforcement of effective regulations to increase helmet use will reduce head injuries.[13]

In conclusion, as many as 44.4% of individuals aged $\geq$ 5 years old had good helmet use behavior, while Determinants of helmet use behavior were age, gender, education, occupation, socio-economic status, location of residence, and area of residence. As many as 14.1% of individuals suffered head injuries due to traffic accidents. Poor helmet use behavior was associated with an increase of 1.17 times head injury due to traffic accidents is compared to good behavior (adjusted OR 1.17; 95% CI 1.02—1.35; p 0.03).

Recommendation

Necessary for tighter supervision from the police indirectly is a way to encourage both motorcycle riders and passengers to use helmets when riding, also motorcyclists should have riding licenses and be trained on how to ride safely before getting the license.

Author contribution

The authors are LT, DD, NK, and LI with LT and DD as main contributor.

Competing interest

We declare that there is no competing interest in this study

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