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Evaluation of the Quality of Pumpkin Seed Flour and Capsules as Food Supplements

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ABSTRACT

Pumpkin seeds contain a variety of useful nutrients, so they become a food supplement. This study aimed to evaluate the quality of pumpkin seed flour and capsules. This study used the experimental method. The pumpkin used came from a local market in Makassar City. Cleaned pumpkin seeds-then dried in the sun for ± 7 hours. After that, put them in the oven at a temperature of 70-75°C for 3 hours. Next, blended them until they became smooth flour and sieved through a 70 mesh sieve. Put the flour into a capsule shell size 00. The quality of pumpkin seed flour and capsules is tested at the Neutraseutical Laboratory and the Integrated Laboratory of Hasanuddin University. The evaluation of flour quality was carried out with 3 indicators which are the moisture content test, the incompressible density test, and the flow time test. Meanwhile, the evaluation of capsule quality was also carried out with 3 indicators, which are the time disintegration test, the weight diversity test, and the shelf-life test. Based on the evaluation of flour quality, pumpkin seed flour meet the required standards for the moisture content test (3.57%) and the incompressible density test (0.2427 g/cm3), but did not meet the required standards for the flow time test. Furthermore, pumpkin seed capsules meet the required standards for the three indicators tested, namely, the weight diversity (according to Pharmacopeia 1 edition 3), the time disintegration (6 minutes) and the shelf-life (115 days). Pumpkin seed flour and capsules can be used as food supplements because they meet the required standards to evaluate quality.

INTRODUCTION

Pumpkin has about 825 species.[1]It is easy to grow in tropical and subtropical areas, including in Indonesia. Pumpkin is a fruit that is usually used as a vegetable in people's daily consumption. Delicious pumpkin flesh is often processed into cakes. Unfortunately, pumpkin seeds are often thrown away. There are people who process pumpkin seeds into snacks such as kuaci. But most often, pumpkin seeds are considered as waste. There is still very little use of pumpkin seeds as agro-industry products.[2]

Actually, Pumpkin seeds contain so many benefits. Both macronutrients and micronutrients. In addition, pumpkin seeds also contain high antioxidants. Many studies show that the antioxidant content in pumpkin seed extract can improve fertility, prevent atherosclerosis (hardening of the arteries), high blood pressure and heart disease by improving fat metabolism.[3] Pumpkin seeds can be used as food or medical purposes to treat enterozoa and prostate problems.[4]

Pumpkin seeds contain very interesting nutraceuticals and the oil is used as a functional food to improve conditions of hypertension, diabetes and cancer.[5] Pumpkin seeds are good source of protein and have pharmacological activity.[6] Pumpkin seeds contain good exogenous amino acids as well as omega-3 and omega-6 fatty acids which are needed for hormonal balance, brain function and skin health.[7] Pumpkin seeds contain alkaloids, steroids and phenol as well as hydroquinone compounds and also ethyl acetate which can inhibit bacterial growth.[8] Pumpkin seed oil has the potential as an antihypertensive.[9]

With these various benefits, pumpkin seeds have potential to be developed into functional food or supplements at affordable prices.[10] The nutraceutical content in pumpkin seeds makes it very potential to be developed into innovative products.[11] Studies have also shown that pumpkin seed extract supplementation can lower blood pressure,[12] as well as can be function as cardioprotective.[13]

Food supplements are products which developed to complement nutritional needs. Food supplements contain several nutritious ingredients, such as vitamins, minerals, amino acids or other substances. Food supplements can be derived from plants or non-plants. However, these ingredients when given in certain concentrations will provide nutritional value or physiological effects.[14] Food supplements are usually packaged in capsule form. Capsules are solid preparations which consist of drugs in hard or soft shells and soluble. The active ingredients are put into capsules with the aim of masking unpleasant tastes and odors. Besides, by packing the active substance ingredients in capsules, it will make it easier to use and accelerate the absorption.[15]

Pumpkin seeds can be developed into a food supplement by packing the flour into capsules. Thus, it is hoped that the nutraceutical content of pumpkin seeds can be useful for maintaining health. This study aimed to evaluate the quality of pumpkin seed flour and capsules so that their potential can be assessed as a food supplement.

MATERIAL AND METHOD

Tools and Materials

The tools used were glass, moisture balance, blender, stopwatch, hot plate, oven, 70 mesh sieve, flow tester, analytical scale and tweezers. The materials used were fresh pumpkin seeds, distilled water, and capsule shell size 00.

Making Pumpkin Seed Flour

The pumpkin seed flour was made at the Culinary Laboratory of the Faculty of Public Health, Hasanuddin University. The pumpkin seeds were collected from pumpkins sold at the local market-which then washed and cleaned. Pumpkin seeds were dried in the sun for 7 hours and then baked in the oven at a temperature of 70-75°C for 3 hours. Pumpkin seeds were then blended until they became smooth flour and sieved through a 70 mesh sieve.

Pumpkin Seed Flour Quality Test

The quality test of pumpkin seed flour was carried out at the Pharmacy Laboratory of the Faculty of Pharmacy, Hasanuddin University. The quality tests which have been carried out, it consisted of tests for moisture content, incompressible density and flow time. The moisture content test was carried out with a moisture meter (G-Won Hitech) at a temperature of 105°C for 5 minutes. The incompressible density test was carried out by weighing the weight of the sample then put it into a measuring cup to see the vol-

ume. The flow time test was carried out by pouring 100 grams of granules (flour) into a funnel with the end of the stem closed, the lid was opened and the granules were let flow until they ran out. After that, the length of time was recorded by using a timekeeping device (stopwatch).

Pumpkin Seed Capsule Quality Test

The Capsule Weight Uniformity Test was carried out by using 20 capsules, which were weighed one by one-the results should be no more than 2 capsules which weight deviated from the average content weight of more than 10% and none of the capsule which weight deviated from the average content weight-or, were greater than 25%.

The time disintegration test was carried out by inserting 900 mL of Aquadest into a 1000 mL beaker glass. The disintegration temperature was set at 37°C ± 2°C. Put 6 capsules to be tested in each of the basket tubes. Inserted the 10 mesh gauze as described in the basket series, this gauze was placed on the surface of the top plate of the basket series. The basket was put into a 1-liter glass beaker containing distilled water. Ran the appliance for 30 minutes then lifted the basket and observed all the capsules. All capsules must be crushed, except for the part of the capsule shell. The requirement for disintegration of traditional medicine for hard capsules is < 30 minutes. Based on the results of the examination carried out at the Nutriseutical laboratory of the Faculty of Pharmacy, Hasanuddin University, the time disintegration of pumpkin seed capsules was 6 minutes. Shelf-life is the time lapse between food ingredients being produced until they are unacceptable to consumers due to quality deviations. The shelf-life test of pumpkin seed capsules was carried out at the Integrated Laboratory of the Faculty of Public Health, Hasanuddin University.

RESULTS

Based on the results of the tests, pumpkin seed flour in this study has a moisture content of 3.57% and an incompressible density of 0.2427 g/ml (Table 1). Based on Table 2, it can be seen that pumpkin seed capsules have atime disintegration of 6 minutes, good weight uniformity, and shelf-life of 115 days.

Table 1. Quality of Pumpkin Seed Flour

Ingredient	Parameter	Measurement Results	Interpretation
Pumpkin Seed Flour	Moisture Content	3.57%	Meet the Required Standards (Qualified)
	Incompressible Density	0.2427 g/ml	Meet the Required Standards (Qualified)
	Flow Time	Not Flowing	Cannot be Measured

Source: Primary Data, 2021

DISCUSSION

Moisture content is water content based on dry weight. Good moisture content ranges from 1-5%.[16] Granules that have a moisture content of less than 5% will be stable and good during storage. If the moisture content is too high, the flour will become moist and easily damaged, so the shelf-life will be shorter. The Calculation of water content or moisture content is based on the calculation of dry weight where the weight of water in the sample is divided by the weight of dry sample. The requirement for good moisture content is 1-5%. The water content of pumpkin seed flour in this study is low because it has been dried before (only 3.57%). The longer the drying time, the lower the moisture content. The process of formulating plants into functional food should always consider this water content test. For example, a study conducted on the formulation of soursop juice effervescent preparations, found that the water content in the formulation ranged from 0.19-0.28%.[17] Meanwhile, a study conducted on the formulation of dry aloe vera extract, found that the water content in the formulation ranged from 0.20-0.21%.[18] The water content in pumpkin seed flour is higher than in effervescent preparations because of the different processing methods. But the water content of this pumpkin seed flour is lower than carrageenan-based capsules from seaweed which has a water content of 14.2%.[19]

Table 2. Quality of Pumpkin Seed Capsules

Ingredient	Parameter	Measurement Results	Interpretation
Pumpkin Seed Capsules	Time Disintegration	6 Minutes	Meet the Required Standards (Qualified)
	Weight Uniformity	Not more than 2 capsules, each of which the weight of the contents deviates from the average weight of contents by more than 10% and not one capsule whose weight deviates from the average weight of contents by more than 25%.	Meet the Required Standards (Qualified)
	Shelf-Life	115 Days	Meet the Required Standards (Qualified)

Source: Primary Data, 2021

Density is the mass per unit volume of a substance at a given temperature. This property is one of the simplest physical properties and is used to determine the purity of a substance. This recent study showed that pumpkin seed flour has a density of 0.2427 g/ml which means fulfilling the requirement for incompressible density >0.21 g/ml.[20]

The flow time test was carried out to determine the time required for pumpkin seed flour to flow through the test equipment. To our best knowledge, it is the first study to examine flour flow from the seeds. Several factors that affect whether or not flour is easy to flow are the size and shape of the particles, surface area, density, strength, and stiffness.[21] The results of the flow time test in this study show that pumpkin seed flour cannot be measured because it contains oil so it is cohesive. Therefore, pumpkin flour granules do not meet the standards 1 set by Aulton (1988). Pumpkin seeds contain oil which causes the flour to be hygroscopic. Because of this, the flour becomes lumpy and cannot flow. Flow time is one of the important factors that ensure uniformity of weight. However, in this study, pumpkin seed flour which has become capsules does not experience weight deviation outside the determined standards.

The Time Disintegration is very important in determining the quality of a supplement. In order for the active substance to be properly absorbed, the capsule must disintegrate in body fluids to be dissolved afterwards. The time disintegration is influenced by the type and amount of crushing materials.[22] The fast time disintegration is also affected by the granules. Another factor related to time disintegration is hardness. The time disintegration of pumpkin seed capsules is faster than dried yogurt capsules. Dried yogurt capsules have an average time disintegration of 9 minutes.[23] Likewise with carrageenan-based capsules from seaweed, the capsules have a longer time disintegration than pumpkin seed capsules which is an average of 13.35 minutes.[19]

Weight uniformity is an important parameter because it reflects the level (dose) of active substance in the capsule. However, one of the factors that support the effectiveness of food supplements is the accuracy of the dosage of the active substances contained in it.[24] Weight uniformity is an aspect that is studied in the pharmaceutical field because it is related to drug effectiveness. Several studies, for example, found that pharmaceutical preparations did not meet the required standards for this weight uniformity. For example, a study conducted in Bandar Lampung, found that 95.24% of powder preparations did not meet weight uniformity.[25] Likewise, a study conducted in Mataram found that all tested pulveres mixtures did not meet the required standards for weight uniformity according to the Indonesian Pharmacopoeia III.[26] A study conducted in Makassar, found that the results of the weight uniformity test of the hard gelatin capsule on dosage preparations showed that there were capsules that had weight deviations.[27]

Shelf-life indicates the potential for a material

to be stored for a certain period of time. This shelf-life relates to the possibility of a product being produced in large quantities and commercialized. The results show that pumpkin seed capsules have a fairly good shelf-life, almost for 4 months. This shows that pumpkin seed capsules have the potential to be a food supplement. Different foodstuffs have different shelf lives. The shelf life depends on the type of food. Foods of animal origin usually have a shorter shelf life. For example, the shelf life of high lysine on milk fish with liquid evaporation and the addition of anti-microbial as well as antioxidant compounds from betel leaf during 8 weeks. The study showed that betel capsules and liquid smoke were proven to inhibit microorganisms.[28] Meanwhile, yogurt which developed from cow's milk then packaged in capsule form, has a shorter shelf life for 24 days.[23]

The shelf life of Lycopene from Maltodekstrin Coated Tomatoes in capsule packaging found that the shelf life of capsules differed based on temperature. The higher the storage temperature, the shorter the shelf life of Lycopene Capsules.[29] Another study found that the shelf life of Lycopene for Tomatoes (Lycopersicum Psyforme) mixed with Maltodekstrin in capsules was 12.93 weeks.[30] The shelf life of Purple Sweet Potato Anthocyanin Extract (Pome Batat L.var.Ayamurasaki) mixed with Maltodekstrin in capsule packaging ranges from 134-4747 days.[31]

CONCLUSION AND RECOMMENDATION

Based on the results of research on the quality of pumpkin seed flour and capsules based on several parameters, it can be concluded that pumpkin seed flour and capsules can be used as a food supplement. It is necessary to study other methods to develop the potential of pumpkin seeds as an abundant biological resource in Indonesia.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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Ergonomic Risk, Muscle Tension, Lactic Acid, and Work Performance on Transport Workers at Fish Auction

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ABSTRACT

One of the main occupations in fish auction facilities was transport worker. Manual handling activities are a leading cause of workplace injuries such as strains and back injuries. This study aims to analyze the association between ergonomic posture with muscle tension, lactic acid buildup, and work performance. This study was carried out in November 2020. The instruments in this study were portable electromyography, lactate analyzer, REBA Assessment sheet, and questionnaire. The analysis was performed with statistical test using Fisher Exact Test. This study is analytical survey research with cross-sectional study design with 51 respondents selected using convenience sampling method. Based on the data obtained, it was found that 36 respondents (70.59%) did not work ergonomically. The result of the analysis is that there is an association between ergonomic posture and muscle tension (p=0.000) and lactic acid buildup (p=0.002), but there is no association between ergonomic posture and work performance (p=0.761). It is necessary to improve the quality of fish auction facilities services by providing ergonomic transportation aids such as lifting trolleys and training related to the dangers of ergonomic risk factors at fish auction facilities.

INTRODUCTION

Indonesia is the biggest archipelago country in the world. The total area of Indonesia is around 7.81 million km[2]. The total area of the ocean is 3.25 million km[2]. Meanwhile, 2.55 million km[2] is the Exclusive Economic Zone, and about 2.01 million km[2] is islands. With the vast marine area, Indonesia has enormous marine and fishery potentials. Fisheries are one of the sectors that are relied upon for national development.[1]

In operational activities, the process of transporting fish from the pier to the fish auction facilities is assisted by transport workers operating around the port. After going to sea, fishermen land their cargo of fish at the dock, and transport workers help bring it to the fish auction facilities, fish market, or fish processing place.[2] Problems in transport workers are closely related to ergonomic problems. Ergonomics, according to the Occupational Safety and Health Administration (OSHA), is an association between humans and work environment that does not cause a disturbance. In conclusion, ergonomics means the occurrence of a healthy, safe, and convenient working environment for humans.[3] A combination of men, machine, and the environment should take into account the real capabilities of the person who work in the system.[4] Maintaining a physical workplace environment as ergonomic as possible can help employees to achieve higher performance.[5]

Transport workers do their work manually. Manual material handling is an activity or work in the handling or movement of materials carried out in a job manually. Activities in manual material handling include carrying, lifting, lowering, pushing, and pulling loads.[6] The recommended load for manual lifting from NIOSH Lifting Equation is 51 pounds (23 kg), which represents the maximum recommended load weight to be lifted under ideal conditions.[7] Loads that are too heavy can cause injury to the spine, muscle tissues, and joints due to excessive movement.[8] It is recommended to lift weights to 10 kg from knuckle to shoulder height at one lift per minute within acceptable limits.

Lifting weights with excessive bending can result in a higher spinal load and result in Low Back Pain (LBP).[9] Additionally, the study result by Antwi-Afari et al. shows that the increase in lifting load significantly increases electromyography activity.[10] Another abnormality is Muscle and Bone Disorders (MSD) such as back pain, tendonitis, herniated disc, and carpal tunnel syndrome. Gradual-onset injuries that usually occur after repeated micro-trauma to a specific body part can lead to cumulative trauma disorders.[11] Workers who are still growing and carry heavy loads are at high risk for bone damage and impaired growth.[12] However, the severity of the injury depends on several factors, such as the dependance on the duration, frequency, and/or magnitude of exposure to each.[13]

Fish Auction Facilities where the research is conducted is one of the biggest and most famous facilities on Java Island. The process of loading and unloading of fishing boats requires a lot of transport workers to be involved. Based on the pilot study, workers complained of dehydration, muscle aches in their limbs, and excessive fatigue. Muscle aches or pain are caused by metabolic waste such as lactic acid in muscles and extracellular fluids, irritating the ends of the sensory fibers.[14] In addition, workers also complained of muscle stiffness as a result of wrong working positions. Workers do not understand the correct working position for lifting and transporting and how to reduce/control work fatigue. A study showed a high-risk work posture associated with MSDs complaints.[15]

The previous explanation shows that the importance of the study is the possibility to identify ergonomic factors among transport workers at TPI. At the end of the article, there are efforts or recommendations to reduce ergonomic hazards. This study aimed to investigate the correlation between ergonomic posture with muscle tension, lactic acid buildup, and work performance.

MATERIAL AND METHOD

This cross-sectional, quantitative study was developed with transport workers in November 2020 at Fish Auction Facilities in Pati, Central Java. This study sample is the total population (n = 51). Samples of the population that are selected non-randomly in this way are termed convenience samples as they are easy to recruit. Transport workers who were present on site for job opportunities were included in the study. The independent variable is ergonomic posture. The dependent variable includes muscle tension, lactic acid buildup, and work performance.

The instrument to measure ergonomic posture in this study was Rapid Entire Body Assessment (REBA). REBA was used to assess and analyze posture. REBA is also extensively used to analyze lifting assignments. The value of REBA indicating low risk is 2-3, medium risk 4-7, and high 8-10. Observations were made by recording all worker activities to get their posture. Then, the video was cut within the framework of each job. The first step was the assessment of the body part belonging to group A (trunk, neck, legs) and group B (upper arm, lower arm, right wrist, and left wrist) added by a force/load score. Furthermore, the total score of group B was summed with the coupling/grip score. The total final value of groups A and B is score C. The scores of static postures and/or repetitive actions (more than four times per minute) or the change in posture faster in Table C were summed with activity scores to obtain the final value of REBA. Additionally, a lactate analyzer was used to measure lactic acid levels. Lactate levels were grouped into normal ($\leq$ 2 mmol/L) and not normal (> 2 mmol/L). Lactate testing was performed directly after the respondents finished their work to get blood lactate concentrations during higher work rates.

Another instrument used was portable Electromyography (EMG) to measure muscle tension. EMG was used to display real-time muscle activity. EMG signal could be used to determine the muscle-fatigue conditions.[16] Surface EMG was recognized as an effective and useful tool to evaluate the appropriateness of therapy by providing reliable and unique information on biomechanical and musculoskeletal dysfunction. Surface EMG w commonly used to study the loading of the forearm. Muscle tension is classified as relaxed ($\leq$ 3 microvolts) and not relaxed (>3 microvolts).

Work performance was measured using questionnaire. Work performance data were obtained from the results of self-assessment based on how many workers can afford to transport in a day. One aspect of work performance that can be calculated is quantity. The estimation used to judge quantity varies among industries. Quantity is the achievement of workers who have far exceeded the target or expectation.[17] In this study, workers who were able to transport more than 500 kg of fish were included in the high work performance category. Meanwhile, workers who

transport fish less than 500 kg are categorized as having low work performance.

SPSS software was used to perform the statistical analyses. The data obtained were then analyzed using Fisher's Exact Test with a significance level of $p < 0.05$. The protocol of this study was approved by the Research Ethics Committee of the Faculty of Public Health, Diponegoro University, Number 16/EA/KEPK-FKM/2020. Written informed consent was obtained from all respondents.

RESULTS

The characteristics of all respondents in this study are shown in Table 1. A total of 51 transport workers were included in this study, and all of them were males. Based on the data obtained, it was found that 15 respondents worked with medium-risk of posture while 36 respondents (70.59%) worked in high-risk posture. Based on the level of lactic acid, 52.94% of the respondents had normal lactic acid levels.

Based on Table 2, it is known that 7 workers have ergonomic postures or 46.67% have relaxed muscle tension. Meanwhile, 8 workers have a medium risk of ergonomic postures or 53.33% have non-relaxed muscle tension. Online one worker has a high-risk ergonomic posture or 2.78% have relaxed muscle tension while 35 workers have high-risk postures or 97.22% have non-relaxed muscle tension. The results of the statistical test using the Fisher's Exact Test showed a significance value of 0.000 (< 0.05) which indicates that there is an association between ergonomic posture and muscle tension.

Table 1. Frequency Distribution of Ergonomics Posture, Muscle Tension, Lactic Acid Buildup, and Work Performance

Characteristics	n = 51	%
Ergonomic Posture		
Low Risk	0	0.00
Medium Risk	15	29.41
High Risk	36	70.59
Muscle Tension		
Relax	8	15.69
Not Relax	43	84.31
Lactic Acid Buildup		
Normal	27	52.94
Not Normal	24	47.06
Work Performance		
Low	19	37.25
High	32	62.75

Source: Primary Data, 2020

The result of statistical tests using Fisher's Exact showing a significance value of 0.002 (< 0.05) which indicates that there is an association between ergonomic posture and lactic acid buildup. Table 2 shows that more workers have ergonomic postures, namely 13 people, or 86.67% have normal lactic acid buildup, compared to 2 workers (13.33%) with ergonomic postures who have normal lactic acid buildup. Less than half of the workers have non-ergonomic postures, namely 14 (38.89%) with normal lactic acid buildup while 22 (61.11%) workers with non-ergonomic postures do not have normal lactic acid buildup.

Based on Table 2, it is known that most workers with good ergonomic postures have high work performance as many as 10 people (66.67%). Likewise, most workers with non-ergonomic work postures still have high work performance as many as 22 people (61.11%). The results of the statistical test obtained a significance value of 0.761 (> 0.05) which indicates that there is no association between ergonomic posture and work performance.

DISCUSSION

The current study findings showed an association between ergonomic posture and muscle tension (Table 2). In general, ergonomics can be defined as fitting a job to a person by adjusting work elements to the human body which is expected to make them work more efficiently and productively. In addition to the lack of tools in lifting and carrying activities for transport workers at fish auction facilities, inappropriate and repeated work positions contribute to muscle fatigue which in turn can result in musculoskeletal disorders including muscle injury and low back pain.[18] Heavy physical work, climatic factors, awkward postures, whole-body vibrations, slips, and falls, and working in a cold environment contribute to multifactorial back pain.[19] Transport workers at fish auction facilities work at night when cold temperatures can cause complaints of stiffness & lack of muscle coordination.[20] Work-related MSDs can be prevented using the ergonomic principle because it helps reduce muscle fatigue by reducing the workload on the muscles or improving the working postures to minimize awkward positions.[21]

One of the strategies to prevent complaints is to work using an assistive device. Improvements can be made by designing a tool such as trolleys to move materials easily and safely, thereby minimizing the number of material damage. In addition, trolleys can transport materials more effectively and efficiently. This strategy can also reduce musculoskeletal complaints, slow down the rate of fatigue, decrease cycle times, and ultimately increase overall productivity.[22,23]

Regarding the association between ergonomic posture and lactic acid buildup (Table 2), the finding of this study suggested an association. This is in line with the research by Yudisianto that there was a weak positive correlation between the work position and physical fatigue in the circular loom and jumbo bag sub units at PT X with a coefficient value of 0.354.[24] Complaints in the musculoskeletal system are influenced by the abnormal work of muscles as a result of an unnatural work attitude, the impact of which can cause muscle fatigue and pain or discomfort. Pressure on the soft tissue can block blood flow and result in reduced oxygen and carbon dioxide build-up and produce lactic acid waste. This situation leads to discomfort or pain sensation.[25]

Table 2. The Association Between Ergonomic Factors and Muscle Tension, Lactic Acid Buildup, Work Performance

Variable	Ergonomic Posture				Total		p-value
	Medium Risk		High Risk				
	n = 15	%	n = 36	%	n = 51	%	
Muscle Tension							
Relaxed	7	46.67	1	2.78	8	15.69	0.000
Not Relaxed	8	53.33	35	97.22	43	84.31	
Lactic Acid Buildup							
Normal	13	86.67	14	38.89	27	52.94	0.002
Not Normal	2	13.33	22	61.11	24	47.06	
Work Performance							
Low	5	33.33	14	38.89	19	37.25	0.761
High	10	66.67	22	61.11	32	62.75	

Source: Primary Data, 2020

The longer a job is, the less energy is produced, so there will be residual combustion in the form of lactic acid. Accumulation of lactic acid itself can be a biomarker of muscle fatigue. Glycolysis makes pyruvate production where, when pyruvate production exceeds the oxidation process, the pyruvate will turn into lactic acid which in turn reduces muscle power.[26] One of the ways to recover lactic acid levels is by stretching muscles or sitting for a while between working and recovering. Resting plays a key role to overcome fatigue. With resting, the body can get a supply of oxygen to oxidize lactic acid to pyruvic acid again.[27]

The results of this study revealed an association between ergonomic posture and work performance (Table 2). Findings from another study show that an increase in REBA scores will cause a decrease in the productivity of traditional coconut fiber peeler workers because of increased work fatigue due to a bad (non-ergonomic) working position.[28] Work performance can be a factor to determine work productivity. Ergonomically designed work positions, work equipment, and work areas aim to create a safe, comfortable work environment and are expected to improve work performance which leads to increased productivity.[29] An experimental study with an ergonomic factor intervention has shown a significant increase in productivity in the intervention group.[30] In this study, other factors that were not investigated could contribute to the work performance of the transport workers.

Ergonomic work position and work design as well as adequate rest time are also a form of prevention of Cumulative Trauma Disorders (CTDs) which is a common occupational disease in various fields of work. CTDs are MSDs that are formed due to repetitive physical movements, exceeding capacity with awkward postures from work activities, causing fatigue and getting worse due to lack of recovery time for the body, causing permanent injuries such as disorders of tendons and nerves.[31] Intervention with an improvement of working conditions and the combination of giving static stretching and McKenzie exercise can reduce physiological responses and increase work productivity in workers in the incense printing section.[32]

CONCLUSION AND RECOMMENDATION

This study contributes to the importance of controlling ergonomic risk factors in informal sectors. There is an association between ergonomic posture with muscle tension and lactic acid buildup in transport workers. It is recommended that management of TPI together with higher education propose potential strategies, education and training options, workplace design models, and specific manual handling equipment.

AUTHOR CONTRIBUTIONS

Bina Kurniawan and Zen Rahfiluddin conceived and designed the experiments; Bina Kurniawan performed the experiments; Bina Kurniawan and Yuliani Setyaningsih analyzed the data; Nurjazuli contributed reagents and materials; Bina Kurniawan wrote the paper.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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Homemade Cloth Face Masks Identification in Indonesia

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ABSTRACT

The World Health Organization (WHO) and the Indonesian government have advised the use of cloth face masks by medical and non-medical personnel to prevent Covid-19 transmission. However, many people find it difficult to wear these masks when doing various activities outside their home. The cloth face masks used in Indonesian communities vary significantly in models, materials, and number of layers with a significant number providing discomfort to people. Therefore, this research aims to identify the factors that influence the comfort of cloth face mask model circulating in the public. Phenomenological research design through completed participant observation and open-ended inter-view with seven lecturers and three education personnel were used to obtain more in-depth data. The results showed that despite the availability of various models in circulation, none were comfortable to use while talking and breathing. On the other hand, their straps use a lot of materials causing pain in the earlobe. Therefore, people prefer irrespective disposable masks of their ability to pollute the environment when not properly disposed. In conclusion, it is necessary to have a homemade cloth face mask that provides comfort to people.

INTRODUCTION

Since the outbreak of the Coronavirus in Wuhan, China spread to various parts of the world, masks have become one of the personal protective equipments.[1] This need is also felt by people in Indonesia. In March 2020, the virus came into Indonesia.[2] The Indonesian government established various rules to make sure Indonesian people want to wear masks.[3] Because of this rule, Indonesian people got panic buying to buy masks in large quantities for the benefit of each person and masks were difficult to find because there was less stock in the market, so the price of masks got higher.

The high price of disposable masks causes people not willing to buy masks.[4] The impact is that more people do not use masks and end up being exposed. On the other hand, people who can buy masks prefer to buy masks that recommended by the World Health Organization (WHO) that it is expensive.[5] Meanwhile, people who are less able to choose in using temporal masks because the government has set very strict rules.[6]

Surgical and N95 masks are the ideal types that recommended by WHO.[7] However, due to limitations, they are mainly intended for medical personnels, therefore non-medical personnels are advised to use cloth face masks.[8] Conversely, these masks are expensive and unaffordable for greater percentage of non-medicals.[9] This led to the manufacture and sale of cloth face masks from cotton or other materials consist of 2 to 3 layers with various models and shapes.[10] These layers aim to prevent people from easily inhale droplets from others.[11]

Cloth face masks help to reduce transmission rates, therefore they are highly recommended for non-medical society around the world.[12] However, in reality, many people are not comfortable using any type of mask.[13] The majority believe that mask causes difficulty in breathing, discomfort, and sweating.[14] Meanwhile, others find it difficult to cover from the bridge of their nose to the chin, thefore it does not optimize the function of face mask.[15]

This research is important due to the continuous use of face masks in the new normal era in Indonesia, despite the discovery of a vaccine. Several preliminary studies only examined the absorption of several types of fabric against droplets or spray of saliva when coughing or sneezing,[16] and the filtration test of certain fabrics.[10] Furthermore, studies have been done on the models that are practically used regardless of their ability to provide comfort and discomfort.[17] This prompted the research on the comfort provided by the three models of cloth face masks commonly worn by people in public.[18] The models were selected and analyzed with data obtained after one-month observation. The comfort referred to in this research includes breathing and talking properly while wearing the face mask as well as ease in using the material and straps for long-term period.[18] Based on the outlined problems above, this research aims to identify the face mask model that is comfortable and often used by Indonesians.

MATERIAL AND METHOD

This is phenomenological research which identifies individual perceptions and experience in using the cloth face mask for better understanding. It also explores in-depth information on participants' experiences while using one of the three models of cloth face masks during outdoor activities (Table 1). Furthermore, complete participant observation and open-ended interviews were conducted to obtain and explore in-depth data. This research involved seven lecturers and three education staff that actively worked at the university during the pandemic. The participants consisted of seven women and three men that were involved based on the criteria determined by the authors which is workers at university of Surabaya aged 25 to 45 years and willing to become participate in this research. The interviews were conducted when participants wore cloth face masks which models had been determined based on the results of the observations. However, this data collection method was difficult because not all participants used these types of masks though, the majority utilized those that are disposable. The restrictions on meeting times, lockdowns, and the use of various mask types prolonged the data collection time by approximately 12 months.

Figure 1 shows the steps used to conduct this research which starts with field observations to determine the model of cloth face masks that often used by the community. The second step is to conduct initial observations as well as analyzing the three models of masks to determine their comfort level. The third step is to examine

the criteria for the participants, while the fourth step is to develop interview and observation guidelines to avoid deviating from the research objectives. The fifth step is to collect data using open-ended interviews and observation, while the sixth is to analyze the data by coding, reducing, and presenting. Before the data is presented, triangulation is carried out by informants and experts from the health and fashion fields. the triangulation stage was carried out to ensure the validity and reliability of the research results.[19] The final step is to draw conclusions from the research findings. This qualitative research relies on the accountability of data sources and the authors' reliability and validity of interpretations.

RESULTS

The observation results showed the public mask models are 2-ply and 3-ply cloth face masks as illustrated in Table 1. The most people frequently use the 3 models of cloth face masks (Table 1) for outdoor activities.

Furthermore, a total of 10 participants that had used one of the models were interviewed for in depth data. Interview results found that all cloth mask models in the market place are uncomfortable to wear. The participants interviewed results showed that dentified models of cloth face masks that are comfortable to wear is cloth face masks comfortably used in talking, and when used to breathe, they did not stick to the nostrils. On the other hand, the comfort of a cloth face mask depends on the main material and strap. So the models, the main material and supporting materials are the determining factors in the comfort of a cloth face mask while talking and breathing.
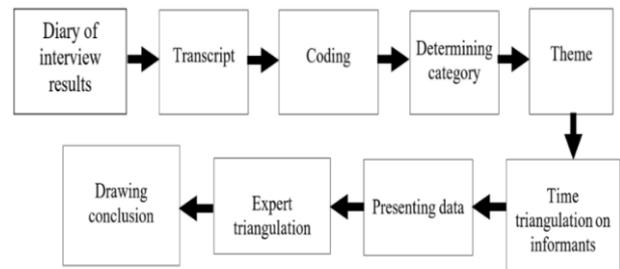
Source: Adapted from Coates, Jordan, Clarke[19]

Figure 1. Research Flow

Table 1. Comparison of Three Models of Cloth Face Masks Often Used by the Public

Model	Mask Model 1	Mask Model 2	Mask Model 3
Description	This face mask is made of cotton with a mixture of polyester. It consists 2 of plies clothes with a hole created on the inside to insert a tissue. Therefore, overall, this mask consists of 3 plies, 2 made of cloth and 1 tissue. This model is widely used because it is practical, and the tissue inside is replaceable.	This model is made of 100% polyester, which cannot be easily wrinkled, is resistant to bacteria, and is impermeable to water. It is often used by the public during activities even though it is not recommended by WHO.	This model is made of cotton, and based on observation, the public widely uses it due to the hygroscopic characteristics of cotton.

Source: Primary Data, 2021

DISCUSSION

This section discusses the results of initial observations carried out on three models of face mask cloths generally used by the public (Table 1). It also explains the interview results from users regarding identifying masks that are comfortable to wear in terms of breathing and talking. Then, the interview results and discussion to identify models of cloth face masks that are comfortable to wear. The manual analysis discussed two major themes during interview with the participants. The following provide a detailed description of the interview results and observations.

Uses of Cloth Face Masks

The first theme discussed by participants during interviews on the use of cloth face masks is about the comfort when talking and breathing. The three main keywords are discussed as follows.

The first is masked price. In the question on why participants use cloth face masks, 9 out of 10 stated that they wore them during the pandemic and in the new normal era. According to Cheng, Lam, and Leung, the government-mandated medical and cloth masks to be worn outside home due to the outbreak.[20] However, the price of medical masks at the early of the pandemic was unaffordable and very limited.[21] Therefore, the use of face masks is as follows:

"At the early stage of the pandemic, the medical masks were unaffordable, therefore, cloth face masks were an alternative. Furthermore, assuming the government mandated the use of medical face mask by its self at unreasonable prices would cause financial disruption. Many medical personnels in hospitals require it as personal protective equipment. Meanwhile, for the general public, medical masks are only worn during an emergency. Therefore, the use of cloth face masks is highly recommended because this is not only about affordable price, they can also be used repeatedly in accordance with the washing process recommended by WHO." (PP_4TECH, PP_6TECH, and PP_3STAFF)

"Furthermore, it also follows fashion trends where the motifs and colors are matched with clothes and colors. Apart from preventing the possibility of contracting the virus, it also acts as a fashion style today." (PP_1TECH, PP_2TECH, PP_5TECH, PP_7TECH, PP_1STAFF, PP_2STAFF, dan PP_3STAFF).

The cloth face masks currently circulating in the public at affordable price has not been tested to determine their filtration and comfort level.[22] This causes all female participants to buy almost all models of cloth face masks in the market either via online or offline shops to select those that are suitable and comfortable to use. On the other hand, almost all participants stated that they care about the environment by buying cloth face masks. The authors recorded the participants' answers as follows:

"There are various models of cloth face masks in the market which are 2 and 3 plies. The price of a 3-ply is more expensive than a 2-ply. However, people are always curious to try new models to choose the most suitable ones for the pandemic." (PP_3TECH, PP_4TECH, PP_5TECH, and PP_2STAFF).

"Of the various models of cloth masks that have been purchased, none is comfortable to use." (PP_1TECH, PP_2TECH, PP_3TECH, PP_4TECH, PP_5TECH, PP_6TECH, PP_7TECH, PP_1STAFF, PP_2STAFF, and PP_3STAFF).

"This is because they have their advantages and disadvantages." (PP_4TECH, PP_5TECH, PP_7TECH).

"Some are comfortable to use while speaking they sag and repeatedly have to be corrected. Meanwhile, some do not sag while speaking, while others stick to the nostrils, making the wearer uncomfortable." (PP_1TECH, PP_2TECH, PP_3TECH, PP_4TECH, PP_5TECH, PP_6TECH, PP_7TECH, PP_1STAFF, PP_2STAFF, and PP_3STAFF).

"Buying cloth masks does not only save money but it also helps to reduce mask waste."

The use of cloth face masks as a substitute is one way to overcome the problem with the current high price.[23] Furthermore, the mandatory use of medical masks also leads to additional expenses every month.

The second major is a daily activity. Daily activities during the pandemic require everyone to maintain healthy life.[24] The use of masks during activities is indeed uncomfortable for all participants, however, they must wear during activities outside the home. About 7 out of the 10 participants are lecturers that actively teach during the pandemic. Three of them teach face-to-face (offline) in practicum courses, while the other 4 were mostly online teachers. For the 3 lecturers that taught practicum, the authors noted the following:

"It is almost impossible to meet students at the university during pandemic. However, practicum courses should be done because many students found it difficult to understand some of the courses when it

was explained via online, even though the lecturers had used video calls to teach them individually. Conversely, students' works were less optimal and failed to achieve learning outcomes, thereby limited face-to-face meetings are needed. Therefore, the lecturer ensured that students come to university for a limited number and time. They are required to wear masks and wash their hands or use hand sanitizer before entering class. At the practicum, the lecturers carry out various explanation strategies to ensure students understand the courses. However, they tend to experience discomfort when using a cloth face mask after talking for approximately 2 to 6 hours. Sometimes, students suddenly take off their masks to get air which tends to touch contaminated surfaces. This makes lecturers even more worried because the practicum room uses air conditioner. The cloth masks used also prevent free breathing by sticking to the wearer's mouth and nostrils while talking and breathing. This makes lecturers during offline teaching feel less comfortable in using cloth masks and holding the surface many times to correct its position." (PP_1TECH, PP_2TECH, and PP3TECH).

Furthermore, 4 lecturers that teach online stated that the following:

"Non-practical or theoretical courses can be carried out online and anywhere. However, most lecturers prefer to teach online from their houses because they feel freer and do not need masks for protection. Furthermore, it enables them to speak freely without worrying about the possibility of the cloth face mask dropping from its initial position. Meanwhile, lecturers have many activities to carry out at the university, apart from teaching, therefore, they visit 3 times a week using the cloth face masks in which additional tissue is given. However, they are also worried about the activities carried out outside the home despite using cloth masks with several layers. Meanwhile, some removed and placed their cloth face masks on the table when eating and drinking, even though it was in a room with a lot of people." (PP_4TECH, PP_5TECH, PP_6TECH, and PP_7TECH).

On the other hand, three education staffs use masks while working at the university. At the early stage of the pandemic, the education staff is responsible for the administrative and management processes at the university three days a week to assist with the administrative needs of students and lecturers, thereby they tend to interact with many people very often. However, after more than a year of the pandemic, some of them are coming every day with their noses and mouths covered with cloth masks. The author following:

"The cloth face masks worn by the lectures inside and outside the office were either bought or produced by themselves. Meanwhile, when praying indoors, the majority take off their masks. This is due to various reasons, such as the cloth face mask is stuffy when used to breathe." (PP_1STAFF), "it doesn't need to be worn as long as there are not many people." (PP_2STAFF), "and there is no need to wear it because others already have it on their faces." (PP_3STAFF). "The models, layers, and forms of cloth masks used vary with a greater percentage using those made of cotton. This is because they are worried about the difficulty of being heard by other people, the masks' ability to stick to the nose and mouth when speaking. This makes them always hold its surface when talking." (PP_1STAFF, PP_2STAFF, and PP_3STAFF).

The authors also found another fact while observing the seven lecturers and three education staffs from different universities. They never change their cloth face masks during their activities which lasted for more than four hours. Only those that wore a tissue-covered cloth mask tend to replace the tissue. According to Yudhastuti, cloth face masks have to be changed at least every four hours,[25] because its their filtration power is lower than medical masks.[22] Furthermore, most of the participants took off their masks while eating in one room and placed them on tables contaminated with virus and bacteria without knowing them. This is an important note because the cloth face masks need to remain hygienic and stored in a sterile place before it is reused.[23]

Covering the face flaws is the last major. The interview showed that the comfort of cloth face masks when it is used to talk and breathe, covers the face flaws. Most of the participants stated that the mask helped them when dealing with other people. The following observations were noted:

"At the beginning of the pandemic, wearing a cloth face mask was excruciating because the significant amount of those manufactures then made it difficult for people to talk and breathe. However, over time, the mask designs improved with the inception of various motifs. This is one of the factors promoting the current increase in the buying and usage of this commodity. Conversely, masks with various models, designs, and motifs are very helpful in covering the flaws of the participants. Some of the reasons provided by the participants for using cloth masks are

as follows: the motif matches with their cloth." (PP_2TECH).

"It makes them more handsome and beautiful in front of students when teaching online or offline, without wearing make-up" (PP_2TECH, PP_3TECH, PP_4TECH, and PP_7TECH), "it covers flaws on the nose and acne on the face." (PP_3STAFF) "Some of them take advantage of the motifs to increase their confidence even though they sometimes feel stuffy. This often occurs in participants that use glasses which often fog up when talking and breathing. Furthermore, female participants were happy to wear cloth face masks because they did not have to bother using lipstick and could do without make-up. However, others complained that the lipstick often stuck or got smudged inside the mask, thereby making it dirty and irritating to be reused." (PP_1TECH, PP_2TECH, PP_3TECH, PP_4TECH, PP_5TECH, PP_6TECH, PP_7TECH, PP_1STAFF, PP_2STAFF, and PP_3STAFF).

Based on observations, most participants preferred unique mask motifs and colors that matched with their clothes. According to them, embroidery, animated images, batik, and flowers are attractive motifs because they tend to cover face flaws and increase their confidence. Unfortunately, these masks provided discomfort when talking and breathing with cavities or gaps, enabling easy entrance of droplets or viruses. The observations recorded are as follows.

"There are various advantages and disadvantages attached to the cloth face masks. The disadvantages are it is unable to cover the nose perfectly, and the gap is found between the mask and the nose due to the short width from the nose bridge to the chin. Therefore, when the mask is pulled up to cover the bridge of the nose, the chin is not covered and vice versa. Besides, some models are too thin, hence the mask is automatically inhaled and covers the nostrils when breathing. This causes the wearer to rush in griping the surface of mask to breathe properly. The advantages of cloth face masks are in the motifs and colors."

Based on the interviews and observations, it is found that there are advantages and disadvantages associated with the cloth face masks circulating in the public. Some models are comfortably used in talking, and when it is used to breathe, they stick to the nostrils. Meanwhile, other tends to change position when it is used to talk, hence the participants have to adjust it many times. This means that the outer surface is often touched by the hands, which are various dangerous. Therefore, there

is a need for a comfort test on cloth face masks before they are sold for people to be comfortable in using them in the future.[17]

Materials and Models of Cloth Face Mask

The materials and straps determine the comfort associated with a cloth face mask. The participants often expressed two keywords during the interview which are the material and the model of mask and its strap.

Based on the material used, the results of more in-depth interviews were obtained when the participants were asked questions on the materials used in cloth face masks. All stated that cotton is a comfortable material and further questions were used to explore their understanding. Some of these questions include what kind of best cotton material that ideal for cloth masks, how it is chosen, and the process needed to ensure the material is 100% cotton. The participants' answers were recorded as follows:

"Cotton is a material that easily absorbs sweat and comfortable when it is worn." (PP_1TECH and PP_2TECH).

"The comfortable material for cloth face masks is 100% cotton without any mixture." (PP_3TECH and PP_5TECH).

According to PP_4TECH, "this material is comfortable to wear and not stuffy when breathing. Organic and bamboo cotton is comfortable to use for cloth face masks because both are natural fiber, and the price is quite expensive." (PP_6TECH and PP_7TECH).

"It is comfortable to use, not easy to wrinkle, and has cute motifs." (PP_1STAFF and PP_2STAFF).

Based on the records, all participants stated that the comfortable material to use for cloth face masks is 100% cotton. The following provides adequate insight into the process adopted by participants in choosing comfortable materials.

"When making online shopping, participants read a lot of reviews from previous buyers and recommendations from friends. Furthermore, they also asked the seller through online chat media about the material details. Therefore, even after reading the details in the pictures listed on the marketplace, they still tend to ask the seller for several questions before buying. Some bought directly from offline shops to test the material before paying. This was because they were not sure that the masks are sterile. Furthermore, all participants had different opinions in determining whether the material was 100% cotton. Some stated

that they were sure of its texture by referencing the seller. However, it felt uncomfortable when it was worn, especially during outdoor activities in the middle of the day. Others stated that they were hesitant because they only read from the labels on the brands." (PP_1TECH, PP_2TECH, PP_3TECH, PP_4TECH, PP_5TECH, PP_6TECH, PP_7TECH, PP_1STAFF, PP_2STAFF, and PP_3STAFF).

"Meanwhile, not all of the participants bought cloth face masks, those who had the right material manufactured it at home." (PP_1TECH, PP_5TECH, and PP_3STAFF).

Furthermore, when the authors asked for details about the materials used for cloth face masks, it was also recorded that many participants discussed how to take care of it by using washing machine and environmental friendly methods. 3 of 10 participants were environmentally conscious, the interview results are recorded as follows:

"The appropriate cloth face masks are made from cotton that support activities during the pandemic by easing breathing and absorbing sweat. In contrast, medical masks are comfortable and only worn once, hence it pollutes the environment. Although some manufacturers and sellers of medical masks say that they can be washed many times, this can reduce the filter's power against droplets or incoming air. Cloth face masks were preferred because they are easy to take care and it can be washed together with clothes in the washing machine. Furthermore, it can be used many times and are easy to care." (PP_1TECH, PP_2TECH, PP_3TECH, PP_4TECH, PP_5TECH, PP_6TECH, PP_7TECH, PP_1STAFF, PP_2STAFF, and PP_3STAFF).

According to Wang et al., cloth face masks need to be washed using warm water at a temperature of 56°C for 30 minutes.[27] Many people do not understand the techniques used to take care of it, assuming it is just by washing.[28] It is important to note that it needs to be ironed at a certain temperature for the mask to be sterile again.[29]

Furthermore, based on materials and models of cloth face mask strap, the supporting materials of cloth face masks, such as the strap, are also the main focus in interview. Based on the observations, many models of cloth face mask straps circulate in the public such as head loop, which women usually use with hijab, ear loop, and those crossed in the back of head area. Furthermore, elastic, and inelastic cylindrical materials were used for the straps. Based on

these observations, the interviews were conducted on the materials and models of the mask straps to determine the participants' opinions. It was recorded as follows:

"The rubber strap on a medical mask is always comfortable to wear in the ear. Conversely, the cylindrical rubber strap on the cloth face mask has a hard surface which painful when it is used in the ear." (PP_1TECH, PP_2TECH, PP_3TECH, PP_4TECH, PP_5TECH, PP_6TECH, PP_7TECH, PP_1STAFF, PP_2STAFF, and PP_3STAFF).

"Usually, this hard cylindrical rubber is used to make accessories." (PP_1TECH, PP_4TECH, PP_5TECH, PP_6TECH, PP_7TECH, and PP_2STAFF).

"Head loop straps are not practical because they have to tie the top and bottom twice, however, this is suitable for women with hijab." (PP_2TECH).

The regular and flat rubber is more comfortable to use, although it hurts after prolonged usage." (PP_3STAFF).

"The strap with the same material as the cloth face mask is comfortable and not practical because it is inelastic." (PP_2TECH).

"The material and model of the strap need to be flexible with face and head shape to avoid hurting them." (PP_1TECH, PP_2TECH, PP_3TECH, PP_4TECH, PP_5TECH, PP_6TECH, PP_7TECH, PP_1STAFF, PP_2STAFF, and PP_3STAFF).

The explanation above shows that the comfort of a cloth face mask depends on the main material and strap. The participants often complain about pain in the ears, face, and back of the head due to the strap. Therefore, they understand the main and supporting materials that are comfortable to use. This is in accordance with the research carried out by Rizki and Kurniawan, which stated that cloth face masks need to be made of cotton that easily absorbs sweat for comfort.[30] Also, based on the research carried out by Bae et al., a cotton face mask cannot be just one layer so it requires additional materials,[31] such as spunbond non-woven polypropylene which has ability to hold droplets and comfortable to use during activities.[32] In other words, the models, the main and supporting materials are the determining factors in the comfort of a cloth face mask while talking and breathing.

In addition, the comfort of wearing masks is also determined by cultural psychology, cultural behavior, and understanding in public level that wear masks can maintain better

physical and mental health during the COVID-19 pandemic. Somers described that understanding cultural differences does not only provide insight into the COVID-19 pandemic, but also helps the world to prepare for future crisis.[33] Kemmelmeier and Jami added that masks are also a key tool in the fight against airborne pathogens during the COVID-19 pandemic in the developed countries,[34] but the use of masks experiences resistance which is influenced by existing cultural patterns.[35] Although, its use in the public can maintain better physical and mental health during the COVID-19 pandemic.[35]

CONCLUSION AND RECOMMENDATION

Participants' statement regarding cloth face masks spread in the public are still not comfortable to wear for activities, so this was the basis for the development of the first model of cloth masks in this study. These discomforts are indicated when it is used to speak, it moves or sags, and the discomfort associated with breathing and talking. Therefore, second and third cloth face mask models are designed by researchers that prioritizes the comfort of its users during the COVID-19 pandemic and new normal era. With the last cloth face mask model, people are expected to be comfortable in using them to carry out their various activities.

Further research needs to be carried out to examine the pattern of cloth face masks to be tested on the community using materials recommended by this study. This is to ensure people wear the masks comfortably without feeling pain. Eventually, they comfortably use it for activities without fear of having difficulty to talk and breath. On the other hand, the comfort of wearing masks is also influenced by collectivistic culture, cultural behavior, and understanding to wear masks that it can maintain better physical and mental health in the public level during the COVID-19 pandemic.

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AUTHOR CONTRIBUTIONS

Siti Zahro and Hany Mustikasari conceived and designed the experiments; Siti Zahro performed the experiments; Siti Zahro and Hany Mustikasari analyzed the data; Hany Mustikasari contributed to prepare experiment materials; Siti Zahro wrote the paper.

CONFLICTS OF INTEREST

The authors declare no conflict of interest. The sponsor in this study had no role in the design of the study; in the collection, analysis, or interpretation of data; in the writing of the manuscript and in the decision to publish the results.

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Determinants of Approval Claims at Hospital Among COVID-19 Patients

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ABSTRACT

The COVID-19 pandemic is an issue that is being faced by Indonesia and even most countries in the world. The impact due to the COVID-19 pandemic is disruption of hospital with cash flow. It was caused by the delay in hospital payment of claims which are not approved by *Badan Penyelenggara Jaminan Sosial* (*BPJS Kesehatan*). Siloam Sentosa Hospital Bekasi provides services for COVID-19 patients. However, out 81 claims of COVID-19 patients in August-October 2020, there were 65 claims (80.25%) not approved by BPJS Kesehatan. The purpose of this study was to analyze the factors that affect the approval claims among patients with COVID-19 at Siloam Sentosa Hospital Bekasi. This type of research was descriptive analysis with a quantitative approach. The research popula-tion was 108 claims and the sample used the total population. A Logistic regression test was used to analyze the data. The results of the study explained the completeness of claims, the quality of the medical resume, the completeness of filling out the epidemiological investigation form, and the quality of clinical coding that affected the approval claims. The study showed 21.5% of other factors that are not examined can affect the approval claims. Socialization of policies related to payment of claims to hospitals as well as monitor and evaluate from both hospitals and *BPJS Kesehatan* need to be improved to prevent claims that are not approved.

INTRODUCTION

Since March 11, 2020, the World Health Organization (WHO) has declared that Coronavirus Disease (COVID-19) is a pandemic. It is called a pandemic because as happened on March 31, 2020, more than 720,000 cases were reported and more than 203 countries were affected by COVID-19. COVID-19 by SARS-COV2 is very easily spread through small droplets from the nose and mouth when coughing or sneezing.[1,2] In Indonesia, the first case of COVID-19 appeared in March 2020. Since that moment, the spread of COVID-19 has been increasingly widespread until now. Currently, the number of positive cases of COVID-19 in Indonesia has reached 4.26 million with death cases reaching 144 thousand.[3]

Regarding the finance of COVID-19 claims, the government has issued various policies with reference to the Regulation of the Minister of Health Number *59 of 2016/PERMENKES RI No. 59 Tahun 2016* concerning Exemption of Payment for Certain Emerging Infectious Diseases of patients. Meanwhile, during the pandemic, claims for financing from health facilities were verified by *BPJS Kesehatan*.[4] The policy regarding the claim process for the COVID-19 hospital service payment in Indonesia was originally stated in *KMK No. HK.01.07/MENKES/238/2020* which was published on April 6, 2020 and revised with *KMK No. HK.01.07/MENKES/446/2020* which was published on July 22, 2020, and lastly on April 5, 2021, with *KMK No. HK.01.07/MENKES/4344/2021* which replaces the previous KMK.[5] These changes were made as a form of improvement and follow-up to the previous policy.

The total claims to *BPJS Kesehatan* up to the end of December 2020 were 433,077 with a claim fee for 27 trillion rupiahs. The number of claims increased from March to August and peaked in September, covering both inpatient and outpatient claims. From October to December, there was a decrease in the number of claims. The problem with submitting COVID-19 claims is a mismatch between the hospital and BPJS Kesehatan so that payments are delayed. On November 8, 2020, *BPJS Kesehatan* stated that there were still 37% of claims that were still delaying payment due to disputes.[4]

The claims approved in this study refer to *KMK No. HK.01.07/MENKES/4344/2021* which applies nationally regarding the Expired Period of Claims for COVID-19 Patient Service Fees that expedite verification and accelerate claim payments, it is expected that hospitals that provide COVID-19 services to submit claims: 1) Month of service in 2020: no later than May 15, 2021; 2) Month of service January-19 April 2021: no later than May 31, 2021; 3) Month of service > April 19, 2021: no later than 2 months since service health is complete given.[6]

The results of the analysis conducted by BPJS Health stated that claims that were not approved could be caused by 1) The identity is not in accordance with the provisions; 2) the criteria for the participants of the covid guarantee do not comply with the provisions; 3) the laboratory investigations are not in accordance with the provisions; 4) the isolation procedure is not in accordance with the provisions in the Guidelines of COVID-19 Disease Control and Prevention; 5) incomplete claim file; 6). the diagnosis of comorbidities/complications is part of the main diagnosis (signs and symptoms); 7). the comorbid diagnoses are not in accordance with the provisions; 8). the hospitalization is carried out outside the isolation room; laboratory investigations are not in accordance with the provisions, 9). the radiological investigations are not in accordance with the specific provisions; 10). the claims are not appropriate due to problems with the application (e-claim).[4,7] Other studies also conclude that membership verification, administrative verification, and service verification have an effect on approval claims.[8–12]

Siloam Sentosa Bekasi Hospital is a hospital in Bekasi City and also handles COVID-19 cases. From August to October 2020, 16 claims of COVID-19 patients were approved (19.75%), while 65 claims (80.25%) were not approved. The purpose of this study was to analyze the factors that influence the approval claims of COVID-19 patients at Siloam Sentosa Hospital Bekasi.

MATERIAL AND METHOD

This study used a quantitative analysis approach. The design of this study was cross-sectional. This study was conducted at Siloam Sentosa Hospital Bekasi in April – September 2021. This study has passed the ethical review by the Research Ethics Commission of Universitas Esa Unggul with letter number 0384-21384 /DPKE-KEP/FINAL-EA/UEU/XI/2021. The population in this study were all claims of COVID-19 patients in January and February 2021 which

were 108 claims. The sample used in this study is a saturated sample where all members of the population are used as samples. So that the sample in this study amounted to 108 claims.

Data collection techniques using document review checklists to analyze patient claims according to research variables. The independent variables are the completeness of the claim file, the quality of the medical resume, the completeness of filling out epidemiological investigation form and the dependent variable are the approval claim of COVID-19. The data analysis was carried out first by describing the results of each variable then statistical tests using logistic regression were used to analyze the effect of the independent variables with the dependent variable.

Furthermore, the presentation of the data is made into frequency distribution tables for descriptive analysis and tables to see the effect between variables on bivariate analysis. In addition, the table is equipped with narration to explain the data analysis.

RESULTS

Approval claims are categorized into approved and disapproved. It is categorized as approved if the claim submission is appropriate and does not pass the expired date of the COVID-19 patient service payment claim until May 31, 2021. Based on Table 1. the approved claims are 68 claims (62.96%) and disapproved are 40 claims (37.04%).

The completeness of claims for COVID-19 patients is categorized as complete if the claim file was received and not returned by the *BPJS Kesehatan* categorized into complete and incomplete. Can verifier including medical resume, notes of the ward signed by the hospital leadership, laboratory results, radiology results, other supporting results, prescription medicines/medical devices, hospital bills, patient identity card, and death certificate if the patient dies. Based on Table 2 the completeness of claims on laboratory results was the lowest with 84 claims (77.78%) followed by radiology results with 98 claims (90.74%).

The completeness of the epidemiological investigation form is categorized into complete and incomplete. Categorized as complete if the

components on the epidemiological investigation form are complete including patient identification (name, id no, date of birth, gender), important reports (clinical information, laboratory examination, contact/exposure factors, close contact list of cases, patient records), authentication (name of health provider, name of interviewer), and good filling (no correction and no blank space). Based on Table 2. the completeness of important reports was the lowest complete with average of 99 claims (91.67%) followed by patient identification, authentication, and good filling with average of 106 claims (98.15%).

Table 1. Distribution of COVID-19 Claims Approved at Siloam Sentosa Hospital Bekasi in January and February

Claims	n = 108	%
Approved	68	62.96
Not Approved	40	37.04

Source: Primary Data, 2021

Table 2. Distribution of COVID-19 Claim and Epidemiological Investigation Completeness at Siloam Sentosa Hospital Bekasi in January and February

Description	Form Completeness			
	Complete		Incomplete	
	n	%	n	%
Claim				
Medical Resume	104	96.30	4	3.70
Notes of the Ward	104	96.30	4	3.70
Laboratory Results	84	77.78	24	22.23
Radiology Results	98	90.74	10	9.26
Other Supporting Results	104	96.30	4	3.70
Prescription Medicines	106	98.15	2	1.85
Hospital Billing	104	96.30	4	3.70
Patient Identity Card	104	96.30	4	3.70
Death Certificate	105	97.23	3	2.77
Epidemiological Investigation				
Patient Identification	106	98.15	2	1.85
Important Reports	99	91.67	9	8.33
Authentication	106	98.15	2	1.85
Good Filling	106	98.15	2	1.85

Source: Primary Data, 2021

The quality of the medical resume is categorized into qualified and not qualified. It is categorized as qualified if the components on the medical resume are filled in and matched, there are no blanks or none that are not appropriate, including the completeness and consistency in disease diagnosis with record review, the recording consistency review, and the recording practice review. Based on Table 3. the completeness and consistent disease diagnosis record review with was the lowest qualification with average of 91 claims (84.26%) followed by recording consistent review with average of 96 claims (88.89%).

Clinical coding quality was categorized into qualified and not qualified. It can be categorized as qualified if the elements of reliability (entrance diagnosis, main diagnosis, entry diagnosis code and main diagnosis), validity (code accuracy) and completeness (completeness of diagnosis filling). Based on Table 3. validity and completeness were the lowest qualification with average of 100 claims (92.59%) followed by reliability with average of 101 claims (93.52%).

The results of hypothesis testing using logistic regression show the completeness of the claims, the quality of medical resume, the completeness of filling out epidemiological investigation form, and the quality of clinical coding affected the approval claim (*p-value* < 0.05). The Nagelkerke R-Square value shows 0.785 which means that the completeness of the claim, the quality of medical resume, the completeness of filling out epidemiological investigation form, and the quality of clinical coding affect the approval claim factor which is 78.5%. So the percentage of other factors that can affect the approval claim is 21.5%.

Partial completeness of claims, quality of medical resumes, completeness of filling out epidemiological investigation forms, and quality of clinical codes significantly affected the approved COVID-19 claims. The highest significance value on the completeness of the claim (*p-value* = 0.000) (Table 4.). The model of factors that affect the approval claims of COVID-19 in this study can be formed as follows:

Approval Claim =
$-8.251 + 3.111$ (*Completeness of the claim*)
$+ 3.025$ (*Quality of medical record*)
$+ 2.815$ (*Completeness of filling out the epidemiological investigation form* $+ 2.596$ (*Quality of clinical coding*)

Table 3. Distribution of COVID-19 Medical Records and Clinical Coding Quality at Siloam Sentosa Hospital Bekasi in January and February

Description	Claim Quality			
	Qualified		Not Qualified	
	n	%	n	%
Quality of medical record				
Completeness and Consistency Disease Diagnosis Record Review	91	84.26	18	16.67
Recording Consistency Review	96	88.89	12	11.11
Recording Practice Review	105	97.22	3	2.78
Quality of clinical coding				
Reliability	101	93.52	7	6.48
Validity	100	92.59	8	7.41
Completeness	100	92.59	8	7.41

Source: Primary Data, 2021

Table 4. Analysis Model Determinants of Approval Claims among Patients with COVID-19

Variable	B	*p-value*	OR	95% CI	
				Lower	Upper
Completeness of the claim	3.111	0.000	22.448	4.446	113.335
Quality of medical record	3.025	0.007	20.597	2.317	183.132
Completeness of filling out the epidemiological investigation form	2.815	0.003	16.687	2.548	109.270
Quality of clinical coding	2.596	0.014	13.408	1.707	105.329

Source: Primary Data, 2021

DISCUSSION

The policies issued by the Indonesian government in the payment of COVID-19 claims that continue to change have confused hospital management. The technical verification of COVID-19 claims in the policy requires hospitals to complete the requirements according to the latest policies, which sometimes socialization of the policy is not optimal. The impact is clear that the claim is not approved and reimbursement to the hospital is delayed.[13,14] This also happened at the Siloam Bekasi Hospital where the completeness of the claim is a problem that is very concerned at the hospital.

The results of this study explain that the completeness of claim affects the approval claim with an OR of 22.448 (95% CI 4.446-113.335). This means that complete claims significantly affect on approval claims with a tendency of 22 times greater than incomplete claims. The results are in line with a previous study conducted by Muroli, et.al which stated that the claim was incomplete and can affect a pending claim with a p-value of 0.016 and an OR of 5.542 at RSAB Harapan Kita.[8] A study by Ayu Fiska Putri and Savitri Citra Budi, also proved that there is an affect of completeness of claim requirements on claim approval by BPJS Kesehatan verifier at RSUP dr. Soeradji Tirtonegoro Klaten.[15] The dissimilarity of perception from internal hospitals to the policy for completeness of claims requested by BPJS Kesehatan often causes claims to be incomplete.[16]

The results of this study explain that the quality of medical records has an effect on the approval claim with an OR 20.597 (95% CI 2.317-183.132). This means that a qualified medical record could significantly affect approval claims with a tendency of 21 times greater than the not qualified medical records. The role of health information management professionals is very important in maintaining the quality of medical records.[17] The quality of medical records describes the quality in the hospital, so that the health information management professional in analyzing medical records plays a role so that the documented records are complete and accurate.[18]

The results of this study explain that the completeness of filling out the epidemiological investigation form has an effect on the approved claim with an OR 16.687 (95% CI 2.548-109.270). This means that the complete form could have a significant effect to approved claims with a tendency of 17 times greater than the incomplete forms.

The results of this study explain that the quality of clinical coding has an effect on the approval claim with an OR 13.408 (95% CI 1.707-105.329). This means that a qualified clinical coding could significantly affect approval claims with a tendency of 13 times greater than the not qualified clinical coding. One of the competencies of health information management professionals in hospitals is to ensure the quality of clinical coding is good because it will have an impact on claims that will be paid by BPJS Kesehatan to the hospital.[19] The accuracy of the clinical code entered by the health information management professional is often constrained when the claim file and supporting documents for establishing a patient's diagnosis are incomplete.[20] The financing of health services using Case Based Groups (CBG) is largely determined by clinical data (especially diagnostic codes and medical procedures) that are entered into the INA-CBG software for the process of selecting the diagnosis code and its actions. The amount of the claim paid depends on the generated code grouping. So the deficiency in the quality of this diagnostic code will have a major impact on hospital revenues.[21]

CONCLUSION AND RECOMMENDATION

The completeness of the claims, the quality of the medical resume, the completeness of filling out the epidemiological investigation form, and the quality of clinical coding that affected the approval claims which had an effect value of 78.5%. The research suggests that a discussion forum should be held between the health information management professional team (case-mix) and doctors managed by hospital management as a strategy to disseminate policies so that the completeness, consistency and accuracy of filling out medical resumes can run well. Furthermore, health information management professionals must to cross-check the completeness of claims, especially on laboratory and radiological results.

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AUTHOR CONTRIBUTIONS

Peter Herey and Nauri Anggita Temesvari contributed to research conceptualization; Peter Herey collected and validated the data; Peter Herey and Nauri Anggita Temesvari analyzed the data; Nauri Anggita Temesvari wrote the manuscript. All authors have read and agreed to the published version of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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Measuring Performance of Padang Panjang Public Hospital in Achieving Its Targets Using the Balanced Scorecard Method

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ARTICLE INFO

ABSTRACT

The Balanced Scorecard is widely used in various institutions, including hospitals because it can measure performance in a comprehensive, coherent, balanced, and measurable manner. Performance measurement at Padang Panjang Public Hospital so far focused on the financial aspect. This study aims to measure the performance of Padang Panjang Public Hospital in achieving its target with the Balanced Scorecard method. There are 14 indicators of performance that are measured in this study, namely economic ratio, efficiency ratio, and effectiveness ratio that describe performance from a financial perspective; customer satisfaction, complaint handling, customer retention, and market share that describe performance from a customer perspective; BOR (Bed Occupancy Rate), ALOS (Average Length of Stay), Bed Turn Over (BTO), and Turn Over Interval (TOI) which describe performance on the internal business process perspective and employee turnover, employee training, and employee productivity which describe performance from a learning and growth perspective. This is a mixed-method study, whereby the quantitative phase is followed by the qualitative phase. Quantitative data was taken and processed from hospital documents in 2018 and 2019. Each performance indicator is assessed by comparing it with its target. Interviews were conducted to get an explanation of the results obtained. Five of the fourteen performance indicator measurements have not reached the target, namely efficiency ratio, effectiveness ratio, BOR, employee training, and employee productivity. To improve performance, the hospital can focus on employee performance which will affect other performance indicators by providing education, training as well as employee job satisfaction.

INTRODUCTION

The Balanced Scorecard is a performance measurement method that is widely used by organizations around the world either profit or non-profit organizations including hospitals.[1] This is because the Balanced Scorecard is different from traditional performance measurement that focuses on finance only which is short-term value and does not describe the overall performance of organization. The Balanced Scorecard measures performance in a comprehensive, coherent, measurable, and balanced manner through four perspectives, namely financial perspective, customer perspective, internal business process perspective as well as learning and growth perspective as introduced by Kaplan and Norton more than 30 years ago.[1,2]

Hospital is a complex organization that consists of human resources with various educational and professional backgrounds which provide various types of services, either medical or non-medical. Hospitals also require a large amount of capital in their operation and must continuously adapt to the development of science and technology.[3] To assess the performance of the hospital with all its complexities, performance measurement is needed. Performance measurement is a method or tool used to record and assess the achievement of the implementation of activities through the results displayed in the form of products, services, or a process based on the goals, objectives, and strategies that have been made so that the organization progress can be known.[4] The Balanced Scorecard can be applied to measure hospital performance and as a material consideration in making policy and preparation for further work plans.[5]

Padang Panjang Public Hospital is owned by the regional government of Padang Panjang City. Performance measurement in Padang Panjang Public Hospital so far focused on the financial aspect. This can be seen in the Government Agency Performance Annual Reports which just provide hospital financial data.[6] As a *Badan Layanan Umum Daerah (BLUD)*, it is also necessary to know the hospital performances from the non-financial aspect according to the regulation.[7]

Based on data from the finance department,

the revenue of Padang Panjang Public Hospital has decreased in 2019. Likewise, the achieved revenue against the target tends to decrease annually. In 2017 the revenue exceeded the target (103%) then the number continued to decline in the following year, so it only reached 86% in 2018 and 2019. This could be caused by performances of non-financial aspects because they can influence each other.[2] To get an overview of the overall performance (financial and non-financial), it is necessary to measure performance with the Balanced Scorecard method.

This study aims to measure the performance of Padang Panjang Public Hospital in achieving its target with the Balanced Scorecard method. It is hoped that this research can provide input and material evaluation for Padang Panjang Public Hospital in improving and maintaining hospital performance, so that they can provide the best quality services for society.

MATERIAL AND METHOD

This research was based on a mixed-method study design that was carried out sequentially, preceded by quantitative research and then followed by qualitative research. Quantitative research is required to cultivate numbers through mathematical calculation and statistics.[8] The data was taken and processed from available documents at the hospital which contained data in 2018 and 2019. The performance measurement indicators are divided into four perspectives (financial, customer, internal business process as well as learning and growth) according to the Balanced Scorecard method. Determination of these indicators by considering several existing studies regarding performance measurement of hospitals with the Balanced Scorecard.[4,5,9,10,11,12] The achievement of each performance indicator is analyzed by comparing it with the target or standard.

The purpose of qualitative research is to get an explanation of the result that has been obtained.[8] Therefore, we have interviewed some informants. They are the director of the hospital (IF.1), the head of the administrative division (IF.2), the head of the service division (IF.3), and the head of the finance department (IF.4).

RESULTS

Financial Perspective

Financial perspective performance is mea-

sured using economic ratios, effectiveness, and efficiency ratios.[11,12] Table 1 presents the measurement result.

The economic ratio was economic. It means that the hospital was able to manage its expenses so that it did not exceed the budget that had been set. The efficiency ratio that assessed the level of hospital independence was inef-ficient. It means that the income earned by the hospital from its services had not fully covered its expenses. The effectiveness ratio that as-sesses the level of income achievement was still not effective. It means that the achievement of income was still lack.

The economic ratio was economic, but the efficiency ratio was not efficient yet. It means that the hospital had not been able to finance itself for its routine operational costs, so there were amount of debts while the funds from the state budget (*Anggaran Pendapatan Belanja Negara/APBN)* could only be used to purchase facilities and infrastructure, as stated by the informant as follows:

"Since the BLUD status, the hospital has not received fund from the local government, so all hospital operating costs must be financed itself. ....actually, the hospital have not been able to..., so we have debt. ....funding from the APBN could only be used to purchase equipment and building construction." (IF.4).

The effectiveness ratio has not been achieved due to decreased hospital income. This could be influenced by a decrease in income from services to patients because the largest income of hospital comes from there according to the informant's statement as follows:

"Hospital revenue mostly comes from patient care, which is 98%." (IF.4).

Customer Perspective

Customer perspective performance was measured using indicators of customer satisfaction level, complaint handling, customer retention, and market share.

a. Patient Satisfaction

Patient satisfaction is only known in 2019 when a satisfaction survey was conducted by the hospital, while it is not known in 2018 because there was no measurement of patient satisfaction. The result of patient satisfaction in 2019 was 98.62%. That has reached the standard (≥80%).[7] It means that the majority of patients were very satisfied with the services they received. The patient satisfaction survey was held in four service units of the hospital which are emergency, outpatient, inpatient, and support services (Table 2). Each service unit had some elements of assessment. The lowest assessment element was found in outpatient services and supportive services. Those are waiting time for the doctor's examination and waiting time for support service processes.

Table 1. The Financial Perspective Performance Measurement

Indicator	Target*	Formula*	Result			
			2018		2019	
Economic Ratio	> 100% Economic	$\dfrac{\text{Expense Budget}}{\text{Expense}} \times 100\%$	$\dfrac{52.078.807.873}{46.664.742.167} \times 100\%$	= 111.60% Economic	$\dfrac{52.557.826.509}{45.657.963.589} \times 100\%$	= 115.11% Economic
Efficiency Ratio	< 90 % Efficient	$\dfrac{\text{Expense}}{\text{Income}} \times 100\%$	$\dfrac{46.664.742.167}{45.143.487.303} \times 100\%$	= 103.37% Inefficient	$\dfrac{45.657.963.589}{45.109.911.067} \times 100\%$	= 101.21% Inefficient
Effectivity Ratio	> 100% Effective	$\dfrac{\text{Income}}{\text{Income Target}} \times 100\%$	$\dfrac{45.143.487.303}{52.000.000.000} \times 100\%$	= 86.81% Ineffective	$\dfrac{45.109.911.067}{52.000.000.000} \times 100\%$	= 86.75% Ineffective

Source: Processed from secondary data from Financial Report of Padang Padang Public Hospital, 2018 & 2019
Based on income from hospital services and routine hospital operational expenses (excluding APBN)
*Mahmudi, Manajemen Kinerja Sektor Publik, 2015

Table 2. Patient Satisfaction Survey in Service Unit

Service Unit	Index of Satisfaction (%)	Description
Emergency	99.56	Assessement elements are between 97.37% and 100%
Outpatient	98.33	Assessement elements are between 86.03 % and 100%, the lowest is the waiting time for doctor's examination
Inpatient	99.40	Assessement elements are between 95.89% and 100%
Supportive	98.10	Assessement elements are between 73.50% and 100%, the lowest is the waiting time for support service process

Source: Secondary data from Community Satisfaction Survey Report of Padang Panjang Public Hospital, 2019

Based on information obtained from informants (IF.3), waiting time for services was influenced by the accumulation of the number of patients on certain days and the availability of several polyclinic services that were not held every day.

"There was an accumulation of patients on certain days... so we will add the day of specialist doctors' services, opening afternoon polyclinics, doctor's schedule adjustment". (IF.3).

b. Complaint Handling

Complaint handling is measured based on the number of written complaints that are reported to the customer service management unit and have been responded or followed up by the hospital management compared to the number of all written complaints reported in the same year.[7] The standard percentage of complaint handling was ≥60%.[7] Based on data in the complaint service unit of Padang Panjang Public Hospital, there were only 2 complaints in 2018 and 3 complaints in 2019 from patients that had been recorded and all of them had been handled. It can be measured that the handling of complaints at the Padang Panjang Public Hospital was 100%. It means that all written complaints were handled by the hospital. There was a possibility that there were unwritten complaints based on the confession from the complaint service unit it self and the informant (IF.3), some cases were handled directly and not recorded. Because of that, it could not be known with certainty how many total complaints were received. Even so, the informant (IF.3) emphasized that every incoming complaint was handled.

"We handled complaints on a case-by-case basis. ...not all complaints were recorded, because some complaints were handled directly, so they were not recorded." (IF.3).

c. Customer Retention

Customer retention is calculated by comparing the number of old patients with the total visits in one year.[9] Customer retention at Padang Panjang City Hospital is shown in table 3. It has exceeded the target/standard (60-70%).[14] It means that the hospital was able to retain old customers (patient loyalty is high). On the other hand, there was a decrease in patient acquisition. Patient acquisition is the percentage between the number of new patients and the total number of patients.[9] However, there was an increase in the total number of patient.

d. Market Share

Market share reflects the proportion of businesses controlled in a market segment. The measurement of hospital market share in this study was used to determine the number of patients based on the area that can be achieved by the hospital. Hospital market share wass calculated based on the percentage of patient visits from outside the city.[15] The target market share is an increase in the percentage. Table 3 shows the market share has increased which means that the hospital has dominated the segment of patients who come from outside the city.

Internal Business Process Perspective

Performance of internal business processes is measured using the indicators of Bed Occupancy Rate (BOR), Average Length of Stay (ALOS), Bed Turn Over (BTO), and Turn Over Interval (TOI).[12]

$$BOR = \frac{\text{Total Number Inpatient Days}}{\text{Number of Beds} \times \text{Period}} \times 100\%$$

$$ALOS = \frac{\text{Total Inpatient Days of Care}}{\text{Total Number of Patient Discharges (Life and Death)}}$$

$$BTO = \frac{\text{Total Number of Patient Discharges (Life and Death)}}{\text{Number of Beds}}$$

$$TOI = \frac{(\text{Number of Beds} \times \text{Period}) - \text{Total Number Inpatient Days}}{\text{Inpatient Discharges (Life and Death)}}$$

The internal business process perspective performance is shown in Table 4. The value of BOR did not meet the target and showed a decrease, while ALOS, BTO, and TOI were in target. The following is the opinion of the informant regarding that Hospital's Bed Occupancy:

"We found that specialist doctors often suggest patients out to other hospitals instead of doing treatment at the Padang Panjang public hospital." (IF.1 & IF.4).

Further analysis is needed to find out about the BOR value as stated by the informant below:

"First, a problem analysis must be carried out to find out why the BOR value was low." (IF.1).

Learning & Growth Perspective

Performance in the learning & growth perspective was measured using the indicators of employee turnover, employee training, and employee productivity.

The internal growth & learning perspective performance measurement is shown in Table 5.

The employee turnover showed an increased But, that was still in accordance to the standard (<10%).[16]

Employee training was low. The informant said that the training for its employees has been fulfilled. The hospital also held training internally and training for every new employee. However, the overall amount of employee training have not reached the standard (≥60%).[7]

"For employee training that must have such as BTCLS in the ER generally, it had been done. We also held in-house training such as PPI, BTCLS, ATCLS, and PPGD…We also held training for every new employee." (IF.2).

Employee productivity has decreased where there has been an increase in the number of employees while income has decreased. The following are the opinions of informants regarding employee performance.

"…Indeed, an increase in the number of employees should be accompanied by an increase in income, but of course, there are some factors can influence it. And the real goal of this hospital is not to make a profit." (IF.2).

"The incentives were low, then we have added them so that employees will be happy and satisfied… Because satisfied employees will certainly affect their work." (IF.1).

Table 3. Customer Retention and Market Share

Year	Old Patient	New Patient	Patien from the Outside City	Total Patient	Customer Retention	Customer Acquisition	Market Share
2018	66,318	8,203	33,547	74,521	89%	11%	45 %
2019	83,979	8,413	52,323	92,392	91%	9%	57 %

Source: Processed from Secondary Data from Medical Record Report of Padang Panjang Public Hospital, 2018 & 2019

Table 4. The Internal Business Process Perspective Performance

Year	Number of Beds	Total Inpatient Days	Total Inpatient Days of Care	Inpatient Discharges	BOR (Target: 60-85%)	ALOS (Target: 3-12 Days)	BTO (Target: 40-50 Times)	TOI (Target: 1-3 Days)
2018	150	31,373	23,155	7,562	57.30 %	3.06	50.41	3.09
2019	150	30,335	22,358	7,253	55.41 %	3.08	48.35	3.37

Source: Secondary data from Medical Record Reports of Padang Panjang Public Hospital, 2018 & 2019

Table 5. The Learning & Growth Perspective Performance Measurement

Formula	2018	2019
Employee Turnover = $\dfrac{(\text{Incoming Employee} - \text{Leaving Employee})}{\frac{1}{2}(\text{Employee in Early Year} - \text{Employee in the End of Year})} \times 100\%^*$	$\dfrac{(21-13)}{\frac{1}{2}(438-446)} \times 100\% = 1.81\%$	$\dfrac{(44-30)}{\frac{1}{2}(446-460)} \times 100\% = 3.09\%$
Employee Training = $\dfrac{\text{Employee Training in Hours}}{\text{Number of Employee} \times 20 \text{ Hours}} \times 100\%^{**}$	$\dfrac{2.083}{446 \times 20} \times 100\% = 23\%$	$\dfrac{2.269}{467 \times 20} \times 100\% = 24\%$
Employee Productivity = $\dfrac{\text{Total Income}}{\text{Total Employee}}^{***}$	$\dfrac{45.143.487.303}{446} = 101,218,581$	$\dfrac{45.109.911.067}{467} = 96,595,099$

Source: Processed from Secondary Data from Human Resources and Finance Department of Padang Panjang Public Hospital, 2018 & 2019
*Hasibuan, Manajemen Sumber Daya Manusia, 2019
**Kemenkeu RI, Peraturan Direktorat Jenderal Perbendaharaan Nomor Per-22 PB/2020, 2020
***Rizki, et al, Balanced Scorecard sebagai Pengukur Kinerja pada RSUD Prof. Dr. MA. Hanafiah MS Batusangkar, 2019

DISCUSSION

The learning and growth perspective provides the infrastructure for achieving the goals of the other three perspectives.[10] This includes employee. Employee or Human Resource (HR) is one element in the organization that has an important role. Hospital as a service organization, good employee performance will affect the hospital service process. One of the measures of employee performance used in this study is the level of training. Informants claimed that the training for employees has met the standards, but after the measurements, it is proven that employee training was still very low. This shows the advantages of the Balanced Scorecard performance measurement which was measurable.[2]

Employee performance will affect performance from other perspectives. In this case, employee training can affect service and financial performance. According to Hasibuan, employee training will increase Efficiency and effectiveness of service, as well as increase income and greater competition.[17] Research by Dalimunthe, et al and Faridayanti, et al have proved that there is a significant effect between job training on the work productivity of nurses, high training will increase nurse productivity.[18,19]

Performance in the learning and growth perspective is input, the internal business process perspective is a process (service process), then the expected output in this case is the performance from the customer and financial perspective.

In this study, internal business processes are shown in terms of BOR, ALOS, BTO, and TOI. The concern is that the bed utilization rate has not been achieved. As stated by the informant, this could happen because the actions of specialist doctors that often suggest patients out, even though they should be able to be treated at Padang Panjang Public Hospital. So, that bed occupation is influenced by employees (in this case, specialist doctors). There are many other factors that affect bed occupation. Based on research by Rosita and Tanastasya, the influential factors of BOR are internal and external hospital factors. The internal factors are culture, value systems, leadership, management systems, information systems, infrastructure, human resources, marketing, image, and others. Meanwhile, the external factors are geographical location, socio-economic conditions of consumers, community culture, suppliers, competitors, local government policies, regulations, and others.[20] These factors can be investigated further by the hospital.

From a customer perspective, some points that need to be improved are waiting times for services and handling complaints (recording). It surely should be a concern for the hospital. To find objective data regarding service waiting times, both the waiting time for doctor services and waiting times to support services must be measured, because this is a part of the hospital performance assessment. Besides that, the hospital needs to measure customer satisfaction every year in accordance to regulation.[7]

Financial performance is a result of the real-

ization of performance in fulfilling customer needs, implementing productive and effective internal business processes, and developing productive and committed personnel.[10] Although hospitals with BLUD status are not required to generate profits, but hospitals must be productive to provide quality services for the society. The hospital's ability to finance operating expenses from the income it generates is part of the hospital's performance assessment by regu-lation.[7] Based on this research, the financial performance of Padang Panjang Hospital has not reached the expected results. The efficiency and effectiveness ratio reflects the hospital's financial independence. The declining in revenue could be affected by the declining performance of the internal business process perspective (BOR). Based on research by Sirait showed that service performance (BOR, TOI, and ALOS) and financial performance have a significant influence on hospital financial independence.[21] Also, research by Putri and Fauzi proved that BOR has a significant effect on financial performance.[22] In line with this, research by Astuti and Hariani concluded that BOR is one of the main factors that need attention to increase hospital financial independence.[23]

By the results of this study, it can be seen that five of the fourteen performance indicators measured have not reached the target which are the efficiency ratio, effectiveness ratio, BOR, employee training, and employee productivity. It must receive attention to improve hospital performance, considering that all aspects of these indicators are interrelated.

The author views that to achieve optimal hospital performance, the hospital management needs to start from the learning and growth aspect. In this case, it is employee performance, that is how to make the existing human resources in the hospital provide better and more productive services. Optimal employee performance is the most important requirement in achieving the hospital goal, to provide quality health services for the society. Employee performance also have a positive and significant effect on patient satisfaction as proven in the research by Setyorini, et al.[24] It is necessary to increase employee performance with education and training in their field of service. Research by Faisal and Murkhana has proved that trained employee can improve quality.[25] In addition, the most important thing in employee performance is employee satisfaction. Research by Rahmah, et al on health workers (nurses) has proved that there is a significant effect between job satisfaction and nurse performance.[26] Likewise, Fitriati's research also indicated that job satisfaction can improve employee performance. The research also proved that job satisfaction mediates the effect of empowerment and competence on employee performance.[27] That shows employee job satisfaction is an influential factor in overall employee performance.

CONCLUSION AND RECOMMENDATION

Based on the results of the study, it can be concluded that there are some performance indicators at Padang Panjang Public Hospital that have not achieved the target. To improve its performance, the author recommends that hospitals can start by increasing employee performance in the form of building employee capabilities and commitment through education and training for employees as well as employee satisfaction.

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AUTHOR CONTRIBUTIONS

Rahmi Hafianti, Yuniar Lestari and Erlinengsih conceived and designed the experiments; Rahmi Hafianti performed the experiments; Rahmi Hafianti, Yuniar Lestari and Erlinengsih analyzed the data; Rahmi Hafianti, Yuniar Lestari and Erlinengsih contributed materials and analysis tools; Rahmi Hafianti wrote the paper."

CONFLICTS OF INTEREST

The authors declare that there is no conflict of interest in influencing the representation or interpretation of reported research results.

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