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Variation of Driving Skill among Elderly Drivers Compared to Young Drivers in Japan

Variasi Kemampuan Mengemudi pada Pengemudi Lanjut Usia Dibandingkan dengan Pengemudi Muda di Jepang

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Abstract

This study analyzed driving skill among Japanese elderly drivers compared to young drivers and see which less skilled that might impact road accident risk in highway. Subjects included young and elderly drivers, consisting of 10 college students (20 – 24 years old) and 25 elderly drivers (14 men and 11 women) coming from The Silver Manpower Centre, an organization for elderly > 60 years. Elderly drivers were divided into two age groups, namely elderly 1 aged 60 – 65 years (10 persons) and elderly 2 aged > 65 years (15 persons). Driving performance was evaluated by using driving game simulator in laboratory. Analysis was conducted on consistency in the lane, lane-changing skill, traffic sign compliance, right-turning skill, braking and driving speed. Statistical analysis was performed using ANOVA test. Generally, performance of elderly 2 was lower than the young almost in all parameters including consistency in the lane (p value < 0.007), traffic sign compliance (p value < 0.011), right-turning skill (p value < 0.001) and braking (p value < 0.001). In the lane-changing skill, young drivers showed significantly higher score (p value < 0.007) than both elderly groups in which elderly 1 (p value < 0.004); elderly 2 (p value < 0.001). The group > 65 years old were likely to be wrong on seeing traffic signs due to visual limitation and long response of compliance.

Keywords: Driving skill, elderly drivers, young drivers

Abstrak

Penelitian ini menganalisis kemampuan mengemudi pada pengemudi lanjut usia (lansia) dibandingkan dengan usia muda di Jepang dan melihat keterampilan mengemudi yang kurang sehingga dapat memengaruhi risiko kecelakaan di jalan raya. Subjek penelitian adalah pengemudi usia muda dan lansia, terdiri dari 10 mahasiswa (20 - 24 tahun) dan 25 pengemudi lansia (14 laki-laki dan 11 perempuan) berasal dari The Silver Manpower Center, organisasi bagi lansia > 60 tahun. Pengemudi lansia dibagi menjadi dua kelompok, yaitu lansia 1 berusia 60 - 65 tahun (10 orang) dan lansia 2 berusia > 65 tahun (15 orang). Kemampuan mengemudi dievaluasi dengan simulator permainan mengemudi dalam laboratorium. Analisis dilakukan pada konsistensi dalam jalur, perubahan jalur, kepatuhan pada rambu lalu lintas, kemampuan berbalik kanan, mengerem/akselerasi, dan kecepatan mengemudi. Analisis statistik menggunakan uji ANOVA. Secara umum, kemampuan pengemudi lansia 2 lebih rendah dibandingkan usia muda hampir di semua parameter, meliputi kekonsistenan dalam jalur (nilai $p < 0,007$), kepatuhan pada rambu lalu lintas (nilai $p < 0,011$), kemampuan berbalik kanan (nilai $p < 0,001$), dan keterampilan mengerem/akselerasi (nilai $p < 0,001$). Dalam keterampilan mengubah jalur, pengemudi usia muda menunjukkan skor signifikan (nilai $p < 0,007$) lebih tinggi dari kedua kelompok pengemudi lansia dimana lansia 1 (nilai $p < 0,004$); lansia 2 (nilai $p < 0,001$). Pengemudi > 65 tahun cenderung salah dalam melihat rambu lalu lintas karena terbatasnya penglihatan dan lamanya respons dalam mematuhi.

Kata kunci: Kemampuan mengemudi, pengemudi lanjut usia, pengemudi muda

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Introduction

Driving is a complex task involving integration of visual, cognitive, and physical motor skills. Driving is important for maintaining independence, and driving cessation is linked to isolation, depression, and associated with functional impairment on older people. However, elderly drivers are at a higher risk of road accident because they have limitations in visual, cognitive and motoric skills. Driver deaths per crash involvement as fragility sign remains fairly stable, then started to increase steadily at the age of 60 years among men and women, with a steep increase at the age of 80 years or older. The relative risk for older male driver is about 2.2 times and 1.8 times for older female driver than younger driver.¹ Older drivers, with or without visual impairment, are rated as being less safe than younger and middle-aged drivers with normal vision.² In other words, elderly drivers have a higher risk of road accident than young drivers.

The characteristics of elderly drivers on ordinary roads include drive slowly; keep longer than normal distance from drivers in front of them; tend to bear more to the left within their driving lane; have a tendency to drive in the outer lane; and tend to be unstable while driving in a junction that is when encountering merging traffic patterns.³ The characteristics tend to increase the risks of road accidents for elderly drivers, which are on the rise.

Some references contend, however, that elderly drivers' performance is not always worse than young drivers. In general, the older subjects' performance do not differ from that of their younger counterparts except when the single- or dual-task involves routine modification in car-following.⁴ It showed in the previous study that an unexpected result was that young drivers had significantly higher fatigue proneness scores than older drivers aged older than 65 years. It also found lower thrill seeking scores in elderly drivers due to elderly drivers' driving-routines that were typically shorter in both time and distance than younger drivers' routines.⁵ The previous study which involved 10,856 elderly drivers as subjects in 35 prefectures across Japan also revealed that elderly drivers had short time in driving.⁶ Approximately, 75% of them drove less than one hour per driving instance for daily activities, and almost 90% drove in express ways a few or no times per year. However, these presumably risk-lessening facts did not translate into a lower road accident risk for elderly drivers. In line with data of this study, there was also found an inconsistent relation between distance driven per year and crash rates called as 'low mileage bias', such that older drivers driving fewer kilometers per year were less safe than other drivers driving much higher times and distances.^{7,8} Indeed, older drivers still have a higher risk of road accident than young drivers.

Driving performance was used as the outcome mea-

sure rather than crash rates because it provides objective assessment obtained under real world driving conditions. State records are subject to biases because crashes are not recorded if police do not attend the accident scene and there are differences in the type of information recorded between jurisdictions. In addition, if crash record was collected by self-assessment, so there was also recall bias and the slightly number of accidents among the elderly.

Drivers' skill should be tested by driving on the road or on circuits like those used for driver's license examinations. However, as safety, time, and economic factors given, the test can also be done in a laboratory room. Driving simulator can provide a safe, economical, and viable alternative to assess the driving performance of elderly drivers.⁹ Moreover, it can be used as initial screening, in which recommendations for further driving assessment can be prescribed for those problematic or unsafe elderly drivers. Therefore, this study aimed to analyze elderly drivers' performance with parameters including maintaining lanes, lane changing, traffic sign compliance, right-turning skill, braking/acceleration and driving speed as well as to see which less skilled that could impact their road accident risk by using driving simulator then compared the results to the younger drivers.

Method

Subjects included Japanese young and elderly drivers. Ten young subjects were college students (5 males and 5 females), aged 20 – 24 years ($= 22.4 \pm 1.35$). As many as 25 elderly subjects (14 males and 11 females) came from the Silver Manpower Centre, an organization for people older than 60 years old. The elderly subjects were divided into two groups of age, namely elderly 1 aged 60 – 65 years old (10 persons, 5 males and 5 females, $= 62.8 \pm 1.48$), and elderly 2 aged older than 65 years old (15 persons, 8 males and 7 females, 66 – 77 years old, $= 70.33 \pm 3.11$).

Elderly drivers were grouped by age in consideration of the United Nations (UN) "Population Aging Report" (2009), which presented evidence that today's 60-year-olds are often very different from their parents at the same age. The use of such aging indicators is often justified on the grounds that these fixed ages (60, 65 or 80 years depending on the study) correspond to the ages of eligibility for certain social programs, such as pension systems benefits. Elderly drivers aged 65 – 89 years made significantly more at-fault safety errors during multitasking than middle-aged drivers.¹⁰ Therefore, based on UN categorized and safety risk of elderly drivers, this study divided elderly groups starting at the age of 60 years and 65 years or older.

Driving performance was evaluated through a driving game simulator in a laboratory room. The driving game



Figure 1. Driving Simulator Game in Laboratory

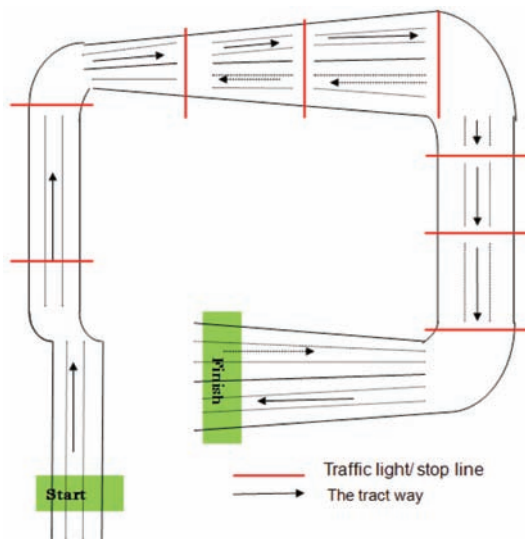


Figure 2. Driver's Skill Test Track

simulator was shown in Figure 1. The luminance level in the experiment room was 270 – 300 lx for measures at the Liquid Crystal Display (LCD) of 46 inch, and the room temperature was 23°C with 50% relative humidity.

The track was simulated city road in Japan, specifically, in the Shinjuku area of Tokyo where drivers must bear to left side of the road. The track was shown in Figure 2, which consisted of eight traffic lights/stop lines (red line) requiring participants to stop properly as a response. The track started as one-way and consisted of three lanes. After a right turn on, there were two way roads of four or six lanes, and then it changed again to a one way road with three lanes after a right turn. The last track had no traffic light/stop line. The subjects were required to drive at a speed of 40 – 60 km/h and were not to go over the maximum speed of 60 km/h.

After subjects were instructed about the track, they were allowed to try the track out until they were ready to start their skill performance test. Subjects then had to

run the track for five laps.

The six parameters measured were maintaining lane position, lane change/deviation, traffic sign compliance, right-turning skill, braking/acceleration, and driving speed (Table 1). All parameters were evaluated as scores for driving safety criteria on a 10-point scale based on driver licensing standards.⁸ There were score 1 – 3 as critical error (instructor had to take action); score 4 – 5 as poor driving and observation skills; score 6 – 8 as an average driving skills but with some bad habits and 9 – 10 as good to excellent driving and observational skill.

The assessment by filling out the assessment form was conducted. Initially, all parameters were worth a maximum score of 10. Then, during the driver's performance test, if subjects made one mistake, they would receive -1 and so forth continuously until the test was over. The final score was obtained by deducting the sum total of the minuses received per parameter from the maximum of 10. The same assessment procedure applied for each of the five laps.

First assessment was maintaining lane on a straight stretch of road where subjects were asked to always drive in the second lane from the left throughout the whole track. This measured how the subjects maintained the center of the lane, particularly on a straight stretch of road. Second assessment was lane-change deviation, and lane-changing skill was assessed from a one-way stretch of road to a two-way stretch or from four to six lanes. It measured the deviation when they had changed the lanes. Third assessment was traffic sign/signal compliance where subjects were assessed for traffic sign/signal compliance for signs/signals, such as traffic light, stop line, and stop sign. There were eight traffic signs/signals on the track and subjects had to react properly when passing those signs/signals. Right-turning skill required assessment for right turn maneuvering before and through T junctions. Turns should not be too wide and drivers must continue to follow the lane, maintaining a relatively stable speed, while braking/acceleration required assessment on how they control the accelerator and brake pedals. Subjects had to maintain speed between 40 km/h and 60 km/h. Last assessment was driving speed where subjects were assessed for driving speed. Subjects should not go over the maximum speed of 60 km/h. After collecting data and information about assessment of parameters, then its was analyzed by using SPSS, Version 20.0 by ANOVA.

Results

Table 1 and Figure 3 showed that the scores of young drivers were significantly higher than those of their seniors (elderly 2) almost in all parameters including maintaining lanes (p value < 0.007), traffic sign compliance (p value < 0.011), right-turning skill (p value < 0.001), and

Table 1. Anova Test Results

Driver's Skill Performance	Comparison of Age Groups		SE	F	Sig	95% CI	
						Lower Bound	Upper Bound
Maintaining lane position	Young	Elderly 1	0.408	1.084	0.128	-0.170	1.890
		Elderly 2	0.372		0.007*	0.289	2.169
Lane-changing deviation	Young	Elderly 1	0.423	5.478	0.004*	0.635	2.925
		Elderly 2	0.279		0.001*	1.409	2.817
Traffic sign/signal compliance	Young	Elderly 1	0.467	8.675	0.399	-0.460	1.900
		Elderly 2	0.426		0.011*	0.254	2.409
Right-turning skill	Young	Elderly 1	0.519	1.785	0.084	-0.165	2.685
		Elderly 2	0.364		0.001*	0.910	2.777
Braking/acceleration	Young	Elderly 1	0.307	2.292	0.075	-0.071	1.551
		Elderly 2	0.430		0.001*	0.774	2.982
Driving speed	Young	Elderly 1	0.592	5.355	1.000	-1.656	1.336
		Elderly 2	0.541		1.000	-1.099	1.633
Time of experiment	Young	Elderly 1	13.340	6.953	0.001*	-96.198	27.722
		Elderly 2	15.051		0.001*	-192.449	-111.648

Note: *have significant difference with CI=95%

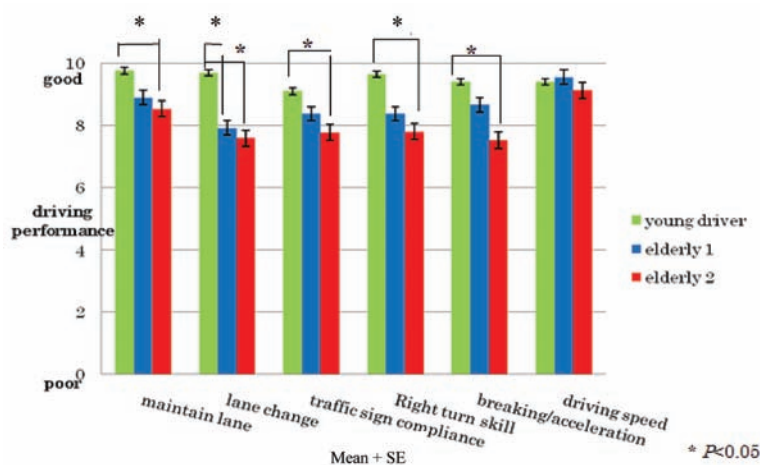


Figure 5. Each Score of Driving Skill Performance between Young and Elderly Drivers

braking/acceleration skill ($p < 0.001$). In the lane-changing skill, young drivers showed significantly higher scores than both groups of elderly drivers, which is elderly 1 (p value < 0.004); elderly 2 (p value < 0.001). On the other hand, there was no significant difference found in term of driving speed between young and elderly drivers.

Young drivers needed less time than older drivers to finish the driving skill performance test. This represented a significant difference between young drivers and both groups of elderly drivers (p value < 0.001) (Figure 4).

Discussion

Although this study was carefully prepared, there were some limitations that need to be acknowledged and addressed. The driver's skill performance test was conducted by means of a driving simulator in a laboratory rather than an actual driving situation. The immediate problem was that subjects had to become familiar with the simulator technology before the test began. Younger

drivers were accustomed to this kind of technology, while this was not the case with older drivers. Although all subjects were afforded practice time before taking the test, handling the simulator steering wheel turned out to be a problem, especially for elderly drivers. Young drivers only needed 10 minutes to practice while their counterparts needed ± 1 hour to get accustomed to the technology before taking the test. Nevertheless, final results showed that almost all scores were significantly higher for young drivers as compared to elderly drivers.

Since the number of lanes on the simulated road was not always the same, driver's performance in maintaining lane parameter was affected as this parameter measured the driver's ability to keep his/her car central to the same lane as he/she proceeded along the simulated course. In order to minimize the amount of deviation when lane numbers changed along the course, or when it changed from a one-way to two-way pattern, another driver's skill performance parameter was added to cover lane chang-

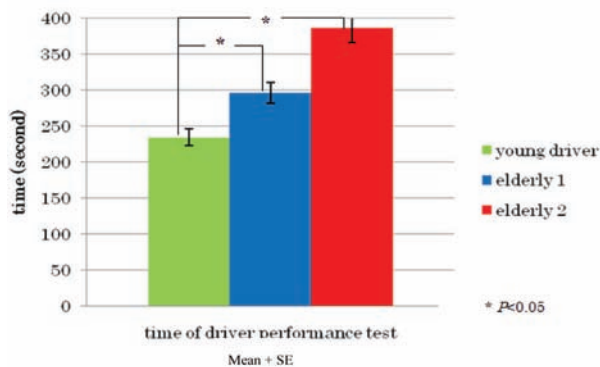


Figure 4. Time of Driver's Performance Test between Young and Elderly Drivers

ing. This study found that elderly drivers were frequently out of lane, confused of traffic signs/signals, and responded late in maintaining lanes as lane and traffic patterns changed. This result confirmed with characteristics of elderly drivers on road. It defined elderly drivers tend to bear more to the left within their driving lane and they tend to drive in the outer lane.

This poor performance in maintaining lane and lane changing parameters among elderly drivers was caused by their lower visual abilities and cognitive difficulty in judging, and responding to the change in road conditions. This study confirmed the finding reporting that young (18-25 years) and middle-aged drivers (26-64 years) made significantly more correct decisions performance in intersection than did young-old (65-73 years) and old-old (74+ years) drivers. Older drivers had especially low accuracy scores and failure to detect the pedestrians that might have led to decide the intersection was clear and the turn maneuver was safe to complete. Besides, it also found older participants tend to miss relevant vehicles that were relatively large and conspicuous (visual angles = $2.23^\circ \times 1.97^\circ$ and $4.2^\circ \times 2.25^\circ$).¹¹ Executing a maneuver that requires precise tracking of vehicle position (e.g., turning or merging) in the presence of potential conflicts (e.g., a pedestrian crossing the intersection) is dependent on the driver's ability to divide attention effectively.¹²

In order to measure driver's skill performance in traffic sign/signal compliance, this study required each subject to stop properly behind the stop line eight times in which there were eight traffic lights/stop signs each lap. Accordingly, since there were five laps, they had to stop 40 times. However, elderly drivers often had difficulties in seeing and recognizing traffic signs correctly. Consequently, since they were instructed to strictly obey a sign/signal, they had to make a sudden stop (about 1.5 times) for their inability to respond within the normal flow of driving. Some subjects even had to back up their simulated vehicles (about 3.5 times) because they went

over the stop line or stop signs at the intersection. This condition confirmed the interactions between visual (traffic sign/signal awareness), cognitive (processing information requiring subjects to make a stop), and motor skills (decreasing the speed and pushing the brake pedals smoothly).

The previous study confirmed the result of UFOV for elderly drivers older than 65 years had prolonged reaction for color and shape stimuli and this has caused many no reaction errors.¹³ The older drivers appeared to rely heavily on the traffic control devices (e.g., lights) in the intersection to make decisions, often to the exclusion of other important objects, such as pedestrians and vehicles. Both older and younger drivers used the traffic light as a basis for a turn decision, if one was present at the intersection. However, younger drivers appeared to scan additional locations in the images before making a turn decision.¹¹ Furthermore, elderly drivers were shown to have more difficulty seeing stimuli in the upper peripheral view, which contributed to traffic sign over-sighting.

As recognized during practice time, elderly drivers experienced difficulty in handling the driving simulator steering wheel that elderly drivers had the tendency to slow down in order to proceed carefully through the turn because the steering mechanism felt lighter than a real car's steering. However, in spite of their slow, careful approach, they still could not maintain lanes properly. This steering disparity was not a problem for the young drivers as their right-turning skill performance was good. However, by comparison, elderly drivers older than 65 years had significant under-scoring in right-turning skill only since this required higher steering control (Figure 3).

The other study also proved driver's skill performance rating including in terms of the steering operation when turning left and right; in the normal operation errors between the driving conditions with and without paced auditory serial addition test (PASAT) were significantly different for the young aged and older group. This suggested that distraction during driving induced a lack of smoothness in the driving, resulting driving operation errors.¹⁴ Besides, these differences between the young and elderly might be caused by differences of familiarity with driving simulators. The high transferability of observations was between simulated and on-road driving assessment.⁹ Further enhancement of driving simulators is expected to make simulated driving more closely resemble real driving, which can make it a cost effective alternative to road testing.

Regarding braking and acceleration skills, the young drivers performed better than the elderly. Young drivers had smooth speed control at around 40 km/h. However, young drivers often operated over the maximum speed, so the time they needed to finish the driving skill performance test was significantly less than elderly subjects

(Figure 4). This tendency was also found in the previous study which reported that elderly drivers aged 55 – 65 years took longer in braking and stopping maneuvers.¹⁵ Meanwhile, another study proved that the elderly (65 and 89 years old) drove slower and showed decreased speed variability during distraction compared to middle-aged drivers (40 and 64 years old).¹⁰ They also tend to “freeze up”, spending significantly more time holding the gas pedal steady. Erroneous stepping on the accelerator and brake pedals was one of the most common causes of accidents among elderly drivers. Therefore, an onboard alarm automatically triggered when vehicle acceleration increased too rapidly (or when accelerator pressure as compared to brake pedal pressure is too great) could be a good control on wrong pedal accidents.

Conclusion

In general, elderly drivers' skill performance is worse than the young drivers'. This is proven by significant differences between young and elderly drivers in almost all parameters, and also in line with the results of previous studies. However, this does not mean that young drivers have a consequentially low accident risk. Since the result of this study shows that elderly drivers have poorer driving performance than young drivers, it can be concluded that they are drivers at higher risk on the road. Still, traffic sign/signal oversight and prolonged response times in complying with these signs or signals are potential risk factors.

Recommendation

Based on the results, it is important to improve safety for elderly drivers since their all variation of performance is declining. Meanwhile, the extension of their driving license needs to be considered for test drive and vision test again. Mandatory in-person license renewal per year or the need to pass a vision test is associated with significant reductions in population-based fatal crash involvement rates for drivers aged 85 years and older.¹⁴ Besides, it needs performance predictor-based cognitive measures to consider crash involvement among older drivers. High-risk older drivers can be identified through brief, performance-based measures as administered in Motor Vehicle Administration setting.¹⁶ If they do not meet the requirements for renewal driver's license, so counseling and motivation need to be provided to avoid stress because they cannot drive anymore. Otherwise, if the elderly drivers are still allowed to drive, there should be special vehicle which can improve their attention, such as a warning system to reduce the speed before the stop signs or traffic lights.

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Rural-Based Health Promotion Model for Pregnant Women in Banyumas District

Model Promosi Kesehatan Ibu Hamil Berbasis Pedesaan di Kabupaten Banyumas

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Abstract

Previous studies show that knowledge of prenatal care in rural areas remains low affecting on bad behavior, so developing health promotion models is needed to improve prenatal care knowledge, attitude and behavior. This study aimed to develop health promotion model of prenatal care in rural area based on needs assessment. Study was conducted on June 2015 by qualitative approach involving first 16 pregnant women in third trimester with risky pregnancy as key informants and 16 family members living with them and know their daily life, 27 midwives and 3 religious leaders as additional informants. Data collection techniques were in-depth interviews and observation for pregnant women and family, then focus group discussion for midwives and religious leaders. Analysis used was Miles and Huberman model by data reduction, data display and conclusion. Based on needs assessment, health promotion media is needed by book for pregnant women with attractive design that features images, colors and complete explanation. Book is selected because of pregnant women's preference and needs, characteristics of rural areas and infrastructure availability. Prenatal care materials need to be added from book containing child and maternal health including prenatal checkup by midwives, danger pregnancy signs, causes, consequences, prevention, recommended and unrecommended food, breast care ways, pregnancy exercise and fetal development.

Keywords: Health promotion models, prenatal care

Abstrak

Pengetahuan pelayanan prenatal di wilayah pedesaan masih rendah yang berdampak pada perilaku buruk sehingga mengembangkan model promosi kesehatan dibutuhkan untuk meningkatkan pengetahuan prenatal, sikap dan perilaku. Penelitian ini bertujuan mengembangkan model promosi kesehatan pelayanan prenatal di wilayah pedesaan berdasarkan penilaian kebutuhan. Penelitian dilakukan pada Juni 2015 dengan pendekatan kualitatif melibatkan 16 ibu hamil pertama di trimester ketiga dengan kehamilan berisiko sebagai informan kunci dan anggota keluarganya serta 27 bidan dan 3 tokoh agama sebagai informan tambahan. Teknik pengumpulan data adalah wawancara mendalam dan observasi untuk ibu hamil dan keluarga, kemudian focus group discussion untuk bidan dan tokoh agama. Analisis menggunakan model Miles dan Huberman dengan melakukan pengurangan data, tampilan data dan kesimpulan. Berdasarkan penilaian kebutuhan, media promosi kesehatan dibutuhkan melalui buku untuk ibu hamil dengan desain menarik berfitur gambar, warna dan penjelasan lengkap. Buku dipilih karena kecenderungan dan kebutuhan ibu hamil, karakteristik wilayah pedesaan dan ketersediaan infrastruktur. Buku yang memuat kesehatan ibu dan anak perlu menambahkan bahan pelayanan prenatal meliputi pemeriksaan prenatal oleh bidan, tanda kehamilan berbahaya, penyebab, konsekuensi, pencegahan, makanan rekomendasi dan tidak, cara menjaga payudara dan latihan kehamilan serta perkembangan janin.

Kata kunci: Model pelayanan kesehatan, pelayanan prenatal

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Introduction

Maternal mortality rate (MMR) in Indonesia increased based on results of Indonesia Demographic Health Survey (IDHS) from 228 per 100,000 live births in 2009 to 359 per 100,000 live births in 2012.¹ This is still far from target of the Millenium Development Goals (MDGs), which was 102 per 100,000 live births in 2015. If MMR is differentiated by maternal characteristics, it is higher in rural area.²

Data from Banyumas District Health Office (DHO) showed that in 2012, MMR was 116.81 per 100,000 live births.³ In 2013, it increased to 126 per 100,000 live births occurred in rural areas namely Pekuncen, II Kembaran, and Banyumas Health Care with the highest number of cases amounted to three cases in which eclampsia and hemorrhage were the major causes of maternal mortality respectively 8.13% and 7.27%.⁴

Pregnant women in rural areas had low prenatal care behavior and lack of knowledge (51.9%).⁵ Therefore, promotional efforts should be made to improve the knowledge, attitudes, and behaviors of mothers in prenatal care. The beginning stage is to identify the needs for the promotion according to expectations and the resources owned by the community. Characteristics of rural communities are mutual cooperation, geographic location difficult to reach, most basic education, low income, lack of information technology, the promotion done should be easy, interesting and innovative.⁶

Because of high MMR occurred in rural areas and their characteristics were different from urban communities, it is necessary to develop a health promotion model of prenatal care by focusing on the needs of rural communities. Therefore, this study was conducted in Banyumas District that included rural areas with high maternal mortality cases in order to find the right model of health care promotion in rural communities.

Method

This study was conducted on June 2015 using a qualitative approach. Technique of data collection was conducted through in-depth interviews to key informants namely 16 pregnant women and family who lived together with pregnant women and three religious leaders. The selected key informants were pregnant women in the first pregnancy who had entered third trimester with risky pregnancy. Data collection techniques to 27 midwives as additional informants were carried out by focus group discussion as well as observations on facilities and infrastructures owned by key informants. Locations of study were in II Kembaran and Banyumas Health Care. Instruments in this study were guide to in-depth interviews, focus group guide, and the observation sheet to observe the infrastructure owned by the informant at home. The data validity used a triangulation among preg-

nant women, families of pregnant women, midwives, and religious leaders. Analysis of data using Miles and Huberman model was to manually perform data reduction on the results of in-depth interviews from the field, by selecting the keywords of any statements made by informants. Keywords of each informant then presented in the forms of quotes, tables and charts to facilitate understanding of the researchers in collecting information. The next step was to draw conclusions based on valid evidence and the inconsistency of results of the data collection.

Results

Key informants in this study aged less than 25 years. Pregnant women were mostly graduated from junior high school. Risky pregnancies owned by pregnant women were chronic energy deficiency (CED), hemoglobin (Hb) below 12 g/dL (2 women), antepartum bleeding, anemia, and unwanted pregnancies at too young age. Last education adopted the main informants was elementary, junior high, or high school. The informants' jobs were mostly as housewives and employees. The last education of informants' families and religious leaders was elementary or high school by working as laborers, employees and housewives. Last education of midwives was the third degree of diploma (D3).

Based on Table 1, there were informants who disagree of taking a nap as a form of prenatal care because of myth they believed that nap, especially at the old age, would make childbirth come late. It was expressed in the following quotes:

"No, [I am] afraid that childbirth would be late..." (IM)

"Yes, if [we are] having old pregnancy, [we] should make many moves, so the baby is strong and healthy. There are many [pregnant women] whose pregnancy is weak due to lack of move. Giving birth further will come soon, not be late..." (KS, Family)

Based on in-depth interviews on key informant result showed in the Table 2, there were still key informants who had not done prenatal care, such as taking a nap, taking sexually transmitted disease tests, doing breast care and attending maternal classes.

Food taboos according to myth was the shrimp, catfish, *petai* (beans with pungent odor, widely eaten raw or cooked), *jengkol* (beans usually larger than *petai* of which also are eaten raw or cooked), anchovies, salted fish, eels, *so* leaf, crackers, ice, and heart vegetable. According to the midwife, the explanation was that these food contain high nutrition as done during classes and counseling of pregnant women, but they were not consuming because of the influence of parents.

"During the pregnant women's class, we already told them that those (food) are okay to be consumed even (the

Table 1. Overview of Key Informants' Pregnancy Care Knowledge

Pregnancy Care	Informants' Knowledge
Minimum knowledge of prenatal care	Minimum performed every month Minimum every month on the first and second trimester, twice a month during the third trimester
Knowledge of tetanus toxoid immunization	Minimum every month on the first and second trimester, every week during the third trimester Ever heard of, but do not know the type of immunization given and its benefits Knowing immunizing pregnant women namely TT immunization, but do not know the benefits
Knowledge of providing Fe tablets	Knowing immunization for pregnant women, namely TT and knowing its benefits which is to prevent tetanus Knowing benefits of consuming Fe tablets are: a. Having normal blood pressure, b. Having fresh body, and c. Preventing bleeding during childbirth
Knowledge of the daily care of pregnant women	Plenty of rest Morning walk Bath
Knowledge of maternal class	Knowing maternal class, but do not know the benefits Knowing the benefits of maternal class are: a. Having fresh body, b. Having strong pregnancy, c. Knowing the problems of pregnancy, d. Knowing how to do pregnancy exercise, and e. Knowing childbirth
Knowledge of breast care	Not knowing the treatment of breast Knowing breast care for breast hygiene and facilitate breastfeeding. The treatment methods are: a. Squeezing the nipple using baby oil or olive oil, and b. Rubbing the breast as usual
Knowledge of sexually transmitted disease tests	Never knowing that treatment
Knowledge of the food consumed by pregnant mothers	Nutritious food like vegetables and fruit for the growth of the fetus More nutritious food than ever before and eating more often, so that the fetus can develop well All food except the taboo food for pregnant women for good fetal development No changes in diet and told to consume meal to raise the weight so that the fetus is growing properly
Knowledge of the danger signs of pregnancy	Membranes rupture Bleeding Swollen feet No fetal movement High fever

food) have nutrition for pregnant women. Sometimes (they are) already counseled, but when at home, they obey their grandmothers like that.” (Midwives SL)

Habits according to myth were hanging pins and nail clippers/folding scissors on the clothes, letting hair at sunset, furnace cleaning during late pregnancy, bathing her nephew every Friday *kliwon* (Javanese date), and should not take a nap, go out at night, sit in front of the door, or put something in her pocket.

According to informants, pregnant women who disagree of taking a nap believed it would make childbirth time come late.

“No. [I am] afraid that childbirth would come late...” (IM)

It was also supported by the midwife's statement, the myth of the pregnant women were not allowed to nap for too long by their parents as they were afraid that their babies might be fat.

“If taking a rest, [the pregnant women] are sometimes not allowed to take a nap too long because afraid of *kleme* (the babies get much fat).” (PI, midwife)

Traditions of *ngupati* and *mitoni*, according to the midwife, are Javanese traditions which do not affect the health of the mothers/fetus, but there are cases of preg-

nant women do not consume the medicine while sick because the money is saved for seven months tradition, at the end the babies passed away.

“In the past, there was a case of mother with a virus or something, thus she should have checked up regularly to the doctor, but because of [her] seven months old [pregnancy], [she saved] her fund for *mitoni*, so she did not buy medicine for the virus, at the end her baby passed away. Therefore, the medicine should not be stopped.” (Midwives PI)

Results of in-depth interviews were illustrated in the Figure 1. Based on Figure 1, the key informant resources in accessing information about prenatal care were personal and media resources. Personal source derived from formal personal resources namely midwives, and informal personal resources namely parents, husbands, brothers, neighbors and friends. While the media resources coming from the printed media were Maternal and Child Health book as accessible by all key informants and electronic media, namely television and the internet.

Factors inhibiting pregnant women in prenatal care were access to health services that far, weather, myths wrong and family support. Service centers, which are located not strategic or difficult to achieve by mothers preg-

Table 2. Overview of Key Informants' Pregnancy Care Behavior

Pregnancy Care	Informants' Behavior
Pregnancy examination	Examining every month Checks every month on the first and second trimester, every two weeks on third trimester Checks every month on the first and second trimester and every week on third trimester Double-checking at the age of 1 to 6 months and every month at the age of 7 to 9 months
Tetanus toxoid (TT) injection	Not yet injecting TT Already injecting TT
Fe tablet consumption	Consuming Fe, but not from the beginning of pregnancy and always completed Consuming from the beginning of pregnancy and always completed Consuming from the beginning of pregnancy and never be completed
Daily care	Always brush teeth every day and take a bath twice a day, morning walks and rest Always brush teeth twice a day, take a bath, and walk in the morning, but not taking a nap
Maternal class	Not attending maternal classes Attending maternal classes
Sexually transmitted disease tests	Never do the tests
Breast care	Not yet doing breast care Already doing breast care
Consumption of nutritious food	Consumption of vegetables, fruits and potluck dishes. Consumption of vegetables, fruits, and side dishes which are: a. Soybean cake b. Soybean curd c. Fish d. Chicken e. Sea food f. Chicken liver/beef

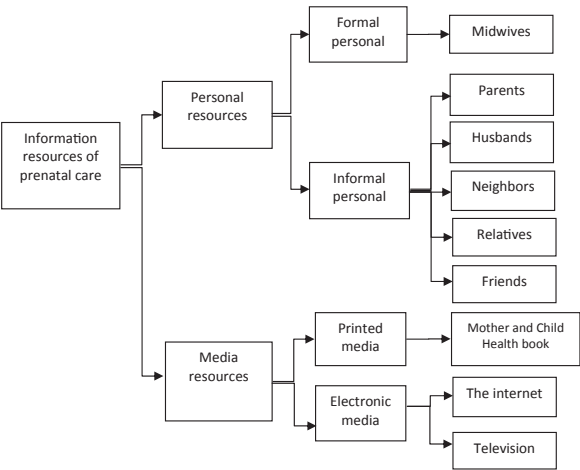


Figure 1. Resources of Pregnancy Care Information

nant women, leads to reduce access to health services thus inhibiting pregnant women in prenatal care.

Domination of parents about the myths surrounding food taboos expressed by key informants,

“Not eating [the food]. Yes, because [I am] not allowed to eat, so I do not eat that [food]...” (JD)

It was also supported by the midwife’s statement, *“Those who still believe in the myth [are influenced] by their parents, so what we provided is not implemented because they prefer to believe in their parents.”* (NM, midwife)

Moreover, it was due to the low level of family support during prenatal care visit.

“Seldom, they only come if we call them to come.” (SI, midwife)

Factors supporting the prenatal care of pregnant women came from the role of midwives and family. The attitude of health personnel (midwives) played an important role to improve the use of health services, so as to support pregnancy care including the urge for pregnant women to attend classes and to provide necessary health information for them.

It is supported by the following key informant’s statement,

“Indeed, pregnant women were asked to participate, so while checking up yesterday, they were told to come again and there was also the invitation for them.” (NH)

According to midwives, information of pregnancy care was already provided during classes and examinations of pregnant women prenatal care.

“During maternal class, then sure we also provide counseling during the prenatal care.” (WD, midwife)

Based on results of in-depth interviews, all informants need promotion media about prenatal care in the forms of books, the internet, video, leaflets, or posters. Books with a vivid explanation should be illustrated and colored to attract.

“Yes, [media] I like the most are those with pictures, colored. If I see the pictures are interesting, I will read them then.” (RS)

“Pictures are necessary, but an explanation of prenatal care is also important.” (SW)

Video made the information clearly submitted to pregnant women by using many effects on audio and vi-

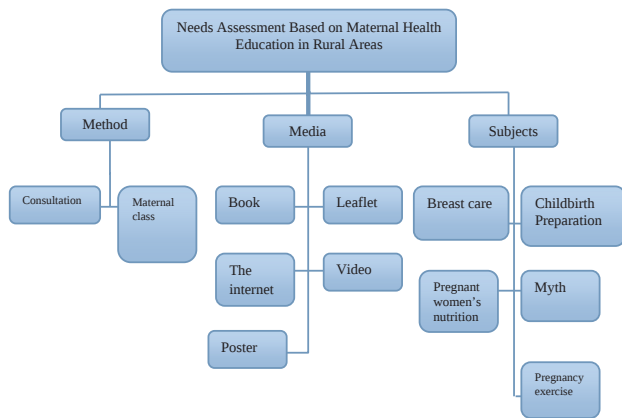


Figure 2. Needs Assessment Based on Maternal Health Education in Rural Areas

sual. It was expressed in the following quote,

"Yes, I prefer VCD as it could have clearer pictures, so it is clear about this and that. You know there is not picture only, but there is also an explanation by voice, the picture is also not that passive... I mean it is moving." (NA)

According to the midwife, media that could be applied in Kembaran Region II and Banyumas was a book by economic considerations and existing facilities.

"Printed media are, for example, books. If it is electronic media, not all of them are affordable. Just like those whose economy is low. The tape is no longer used nowadays, also not everybody has CD, so it could be book instead." (Midwives PI)

Counseling methods needed were consultation because any personal matter could be asked and quickly accepted, and information campaigns. According to the midwife, consultation was suitable, but some women were shy to ask when consulting, so the maternal class was considered more appropriate.

"They are usually [passive] during consultation, but during maternal class they become more active because they have many friends." (Midwife PI)

Based on the results of in-depth interviews, pregnancy care materials required were about the prevention and management of danger signs of pregnancy, prenatal care standards and a balanced intake of nutritious food. Those materials needed by informants had not been discussed in details in the maternal and child health book.

Based on results of in-depth interviews, additional materials of prenatal care needed by pregnant women, which had not been discussed in the maternal and children health book, were information about breast care, childbirth, and the food intake of pregnant women who explained about the nutritional needs of pregnant women and the food that should be avoided for pregnant women including the described myths about food, infor-

mation about fetal development in the womb each month, explanation of the causes and consequences of leg swelling as well as information about pregnancy exercise.

Discussion

Knowledge can be constituted by exposure of information.⁷ This is in line with the results of study that ignorance of prenatal care was because it had not been exposed to the information. Knowledge can also be based on the local culture, this is in line with the results of study confirming that knowing or unknowing about prenatal care was a result of the habit of observing the environment.⁸ Knowledge can be influenced by experience, it is in line with findings that danger signs of pregnancy mother experienced increased knowledge of pregnancy danger signs.⁹

Myths developed in the community also become an obstacle to prenatal care because of the myth as opposed to prenatal care that should be done. For example, pregnant women are prohibited to eat food, such as shrimp and catfish, while according to health the food actually have high nutritional content. Then pregnant women may not take a nap within the last trimester as needed to maintain the health and strength of the pregnancy, so they do not get fatigue due to whole day activities as it can endanger pregnancy (fetal/maternal).¹⁰ In addition, behavioral treatments were also based on the family support and the role of midwives as educators.^{11,12} Results showed that prenatal care had not been performed because of lack of family support for prenatal care. Tradition also mentioned dietary restrictions although the diets contained nutrients to pregnant women, such as shrimp and catfish.¹³

Another tradition is to avoid the supernatural because pregnant women have distinctive aroma, so they should use sharp objects, such as pins or scissors.¹⁴ In addition, there is also four and seven monthly tradition as thanksgiving for the fetus when it was given the soul at the age of four months and given fetal forms perfectly at the age of seven months. *Ngupati* and *mitoni* ceremonies are to wishing for the fetus to grow healthy.¹⁵

Sources of information can be divided into two sources, namely recorded sources and personal sources.¹⁶ Personal sources consist of informal (parents, husbands, siblings, neighbors, and friends) and formal (midwife) personal sources. Recorded sources were obtained from the printed (maternal and child health book) and electronic (the internet and television) media, but there were no neighbors as a source of informal personal information.¹⁶

A matter that can inhibit prenatal care is the affordability of health care. It affects the prenatal care visit.⁶ Weather is also an obstacle, for example, a mother cannot come to prenatal classes because of the rain.

However, the role of family in prenatal care is very important. The family as the closest people to pregnant women should motivate the pregnant women to have prenatal care visit, but in fact, some of them do not perform their important task or even prohibit prenatal care because of the myths in society hindering the pregnant women to have prenatal care. Family support services will increase the use of prenatal care by the pregnant women.¹⁷ Prenatal care is a very important determinant in providing information on prenatal care, maintaining the health of the fetus and mother, also encouraging pregnant women to give birth in health care to reduce maternal mortality. The family as a decision maker should perform pregnancy care.¹⁸

Books, leaflets and posters are favored because they can be read over and over again, the internet is accessible and easy to find all the information about prenatal care, then video (CD) is favored because it can be played repeatedly. After digging deeper, the informant said the media needed by them were interesting and packaged in forms of books and videos. Selection of media was then considered by looking at the characteristics of the Kembaran Region II and Banyumas.

Video packaged in a CD cannot be applied in the Kembaran Region II or Banyumas because of inadequate facilities. In order for the media to be well function, it is needed to have supported facilities, so the implementation of management functions run well.¹⁹

Book media is in accordance with the preparation of media considerations. Book media can be accepted by the public because it is kind of media favored and required by most key informants. In literacy criteria, according to the health profile of Kembaran Region II and Banyumas Health Center, fertile women in the region had a minimum education level of primary school, so on average, people could read. The third criterion is convenience that does not require complex equipment and electricity for visual media like book.²⁰ The fourth criterion is the feasibility as book is very likely to be implemented because the media prior to the handle of pregnant women is a maternal and child health book, and knowledge of pregnant women can be increased by the book. Therefore, book is such a media that can be implemented in Kembaran Region II and Banyumas.²¹

There was an improvement in term of knowledge of pregnant women after maternal class.²² There was also a close relationship between the class of pregnant women and the ability to detect danger signs of pregnancy.²³

The material needed to be added in the book was related to knowledge of informants who did not know some pregnancy care due to exposure of information that would increase someone's knowledge, so additional material as mentioned above was needed to be discussed in the media of pregnancy treatment.²⁴

Conclusion

There are several key informants who do not know the benefits of some treatments, breast care, sexually transmitted disease screening tests and the danger signs of pregnancy. The attitude of pregnant women to prenatal care is supportive, but there remain pregnant women who do not support the prenatal care like taking a nap in the late pregnancy. There are still pregnant women who have prenatal care, such as tetanus toxoid immunization, breast care, Fe tablets consumption, maternal class and sexually transmitted disease tests.

Inhibiting factors of pregnant women in prenatal care is distance to health services, weather, myths and family support. Supporting factors for pregnant women to take prenatal care are the family support and midwife's role.

According to needs analysis of rural-based intervention for pregnant women, media needed by pregnant women is an interesting book with pictorial design, colors and complete explanation. Health promotion method that could be implemented well according to the needs of pregnant women in prenatal care is counseling, such as lecture and discussion during maternal class. The materials needed by pregnant women and have not been discussed completely in the maternal and child health book is a matter of prevention and response to danger signs of pregnancy, standard prenatal care, dietary advice and restrictions during pregnancy, breast care and pregnancy exercise, fetal development and myths of prenatal care.

Recommendation

Banyumas District Health Agency should create a media campaign that is pictorial and colored book with complete explanation of prenatal care, also regularly hold classes for pregnant women. Health Ministry should add materials concerning pregnancy care in the maternal and child health book.

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Role of Hearth Program with Undernutrition Incidence among Toddlers in Tangerang City

Peranan Program Pos Gizi dengan Kejadian Gizi Kurang pada Anak Bawah Lima Tahun di Kota Tangerang

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Abstract

Toddler is a group at risk of undernutrition in which World Health Organization stated that toddler mortality because of undernutrition was 54% in 2002. In Indonesia, its prevalence increased from 17.9% in 2010 to 19.6% in 2013. In Tangerang City, there was 1.43% of toddlers suffering from undernutrition in 2013. This study aimed to prove in valid the relation between Hearth Program, which covered behaviors of food providing, toddler's hygiene, health care seeking and toddler parenting, with undernutrition incidence among toddlers. This study was quantitative, cross-sectional, using primary data, analyzed in univariate, bivariate and multivariate within September 2015. Samples were taken by total sampling as many as 60 toddlers suffering from undernutrition in Tangerang City. Results showed that 12 (20%) of 60 toddlers suffered from very underweight nutrition and the remaining 48 toddlers (80%) suffered from underweight nutrition. There was a relation between food-providing behavior and health-care seeking behavior with undernutrition among toddlers. Variable food-providing behavior was the dominant factor influencing undernutrition among toddlers with OR = 4.655 (CI = 1.052 – 20.6) after controlled by the variable health care-seeking behavior.

Keywords: Hearth program, toddlers, undernutrition

Abstrak

Kelompok yang rentan terhadap gizi kurang adalah anak bawah lima tahun (balita). World Health Organization menyatakan kematian balita akibat gizi kurang sebesar 54% pada tahun 2002. Di Indonesia, prevalensinya mengalami peningkatan dari 17,9% tahun 2010 menjadi 19,6% tahun 2013. Di Kota Tangerang, terdapat 1,43% balita yang mengalami gizi buruk tahun 2013. Penelitian ini bertujuan untuk membuktikan secara valid hubungan Program Pos Gizi yang meliputi perilaku pemberian makan, kebersihan balita, pencarian pelayanan kesehatan dan pengasuhan balita dengan kejadian gizi kurang pada balita. Penelitian ini merupakan penelitian kuantitatif, potong lintang, menggunakan data primer serta dianalisis secara univariat, bivariat, dan multivariat selama bulan September 2015. Sampel diambil secara total sampling sebanyak 60 balita yang mengalami gizi kurang di Kota Tangerang. Hasil menunjukkan bahwa dari 60 balita yang mengalami gizi kurang, sebanyak 12 balita (20%) mengalami gizi sangat kurus dan sisanya sejumlah 48 balita (80%) mengalami gizi kurus. Terdapat hubungan perilaku pemberian makan dan pencarian pelayanan kesehatan dengan gizi kurang pada balita. Variabel perilaku pemberian makan merupakan faktor dominan yang memengaruhi gizi kurang pada balita dengan OR = 4,655 (CI = 1,052 – 20,6) setelah dikontrol oleh variabel perilaku mencari pelayanan kesehatan.

Kata kunci: Program pos gizi, anak bawah lima tahun, gizi kurang

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Introduction

Almost all countries have “nutrition problems” and perform many actions to conquer nutrition problems in the world including Indonesia. However, the actions are not yet completely succeed. Now people are facing multiple nutrition problems, namely undernutrition and overnutrition.¹

One of groups at risk of nutrition problem is toddler group because toddler period is a transition period in term of food consumption from infant's food to adult's food. Therefore, this is very influenced by family role because food received by toddlers depend on their family's affordability. Families that have good knowledge and awareness related to family nutrition will be able to prepare nutritious food for their toddlers. Determination of nutritional status can be conducted by weighing body weight and measuring body height of toddlers compared to age toward World Health Organization/National Center for Health Statistic (WHO/NCHS) (< -3 SD WHO-NCHS).¹

In Fatma's study, there were three indicators of family aware of nutrition which was well performed by mothers of toddlers, except exclusive breastfeeding and consumption of various food. Meanwhile, exclusive breastfeeding and consumption of various food are necessary to meet toddler's need of balanced nutrition.¹ Thus, undernutrition and malnutrition problems among toddlers remain the main nutrition problems that need to be concerned on. According to WHO, infant and toddler mortality because of undernutrition and malnutrition was 54% in 2002.²

Negative impacts of nutrition problems among toddlers include brain and intelligence development disorder, physical growth and body metabolism disorders as well as the decrease of cognitive ability and learning achievements. Study conducted by Hartanto with Kodim,³ found relation between condition of toddlers' nutritional status and their learning achievements in which the low numerical learning achievements could occur among children with undernutrition at the time of infant age, meanwhile verbal learning achievement was influenced by nutritional status along their lifetime. Moreover, another effect of nutrition problem is the decrease of body immune, so children easily get ill and have a high risk of suffering from degenerative diseases at old ages, which apparently will decrease Indonesian human resources, productivity and competitiveness.

According to WHO in 2010, public health problem is considered serious if the prevalence of malnutrition less than between 20 – 29%, while the prevalence is considered very high if $\geq 30\%$. Basic Health Research data in 2007 showed the prevalence of malnutrition in Indonesia was 18.4% and 17.9% in 2010, then increased in 2012 that was 19.6% consisting of 5.7% malnutrition and

13.9% undernutrition. Thus, malnutrition and undernutrition in Indonesia remain the public health problems closer to the high prevalence.⁴

In Tangerang City, there were malnutrition records in 2008 by 1.54%, 1.89% in 2009, 1.91% in 2010, 1.75% in 2011 and 1.43% in 2013. Based on the data, there was an increase from 2008 to 2010. For undernutrition data, there was a decrease by 0.3%. In 2012, toddlers with malnutrition were mostly found in Benda Subdistrict by 3.27%.⁵

Undernutrition among toddlers is influenced by many factors. Based on a study, there were several factors influencing to undernutrition incidence among toddlers including maternal education level, child's birth weight, birth intervals and chronic infections.⁶ In another study, the factors which also influence to toddler's nutritional status is baby weighing and conscious family nutrition status.⁷ Furthermore, baby parenting is also the factor that has significant influence to undernutrition incidence among toddlers both in urban and rural areas.⁸

Considering the cause of undernutrition incidence among toddlers is complex, therefore, handling actions need integrated approach from many aspects of children's life. This means that it is not enough by improving food aspect only, but also children's living environment, such as parenting patterns, education and environmental health, quality of health services, etc. The government planned seven major activities in order to prevent and handle malnutrition within 2005 - 2009. Those seven major activities included revitalization of integrated health care, revitalization of primary health care, health and nutrition intervention, promotion of conscious family nutrition, family empowerment, advocacy and assistance as well as revitalization of food and nutrition vigilance system. One of nutrition recovery activities among people, especially toddlers with people empowerment approach, is Hearth Program.⁹

Hearth Program is family-based nutrition program. The principle of such program is that poverty is not the main cause of undernutrition because there are some poor families whose children are healthy (good nutrition) found due to implementation of good parenting patterns. Undernutrition is commonly caused by food-providing practice or improper parenting patterns. By Hearth Program, hopefully undernutrition can be conquered with behavioral change. During Hearth Program activities, parents learn positive behavior together and implement it at home. Tangerang City Government has performed actions to handle undernutrition among toddlers that cover balanced nutrition promotion including nutrition counseling at integrated health care, provision of additional food including Complementary Feeding and Nutrition Clinic. However, as a matter of fact, there were still many families that had unhealthy nutritional beha-

rior.

Therefore, this study aimed to prove in valid any relation between Hearth Program consisting of food-providing, toddler's hygiene, health care seeking and toddler parenting behaviors with undernutrition incidence among toddlers in Tangerang City.

Method

This study was quantitative study with observational design and cross-sectional approach of time. Variable that would be observed consisted of dependent variables including undernutrition with categories of toddlers with underweight nutrition and very underweight nutrition. Category toddlers with very underweight nutrition was nutritional condition of toddlers measured anthropometrically based on body weight index in accordance with body height with Z score < -3 . Meanwhile, the category underweight if Z score SD -3 SD to < -2 SD. Then independent variable was Positive Deviance/Hearth Program consisting of variables food-providing, toddler's hygiene, health care seeking and toddler-parenting behaviors. This study used primary data as taken on September 2015 at six places for Hearth Program in Tangerang City (Tanah Tinggi Subdistrict, Larangan Indah Subdistrict, Karang Mulya Subdistrict, North Poris Plawad Subdistrict, Karang Anyar Subdistrict and Sukajadi Subdistrict). Toddlers participated at Hearth Program activities for one month. Samples of study as taken by total sampling were 60 toddlers. Data were obtained from each primary health care with inclusion criteria including mothers who had toddlers with underweight and very underweight nutrition aged of 12 – 59 months that were at six places for Hearth Program and following Hearth Program activities regularly within 15 days.

Hearth Program was executed for one month as conducted by Tangerang City Health Agency and six primary health care as Hearth Program targets with the details were 15 days in Hearth class and the next 15 days practicing at home, then followed by home visits on the 18th and 30th day. Hearth Program activities performed by mothers of toddlers were food-providing, parenting, tod-

dlers' hygiene behaviors and such activities were directly practiced in Hearth Program places and implemented at home.

By using the strength of test 90% and 95% confidence interval (CI), data was analyzed in univariate, bivariate and multivariate. Bivariate analysis used chi square test and multivariate analysis used multiple logistic regression with prediction model.

Results

Table 1 showed that based on results of bivariate analysis using chi square test with alpha 5% and 95% CI, there was a significant relation between behavior of food provision and undernutrition among toddlers (p value = 0.022; odds ratio (OR) = 6.0; 95%CI = 1.42 – 25.27), likewise a significant relation was found between health care-seeking behavior and undernutrition among toddlers (p value = 0.038; OR = 4.9; 95%CI = 1.26 – 18.77).

Then results of analysis on relation between behavior of toddler's hygiene and undernutrition among toddlers showed no significant relation found (p value = 1.000; OR = 1.0; 95%CI = 0.28 – 3.60), also no significant relation found between parenting behavior and undernutrition among toddlers (p value = 0.746; OR = 0.7; 95%CI = 0.18-2.65).

Multivariate analysis was started by selection of candidate variables that was conducting bivariate analysis using simple logistic regression between dependent variable and independent variable. If there was p value < 0.25 , thus such variable could include into multivariable model. According to the candidate selection using simple logistic regression, variables included into multivariate analysis were food-providing behavior (p value = 0.022) and health care-seeking behavior (p value = 0.038). Meanwhile, variable toddler's hygiene behavior and toddler parenting behavior had p value > 0.25 (1.000 and 0.746), so both did not include into multivariate analysis.

Table 2 showed the final model of multivariate analysis in which the most dominant variable that had influence to undernutrition incidence among toddlers was variable food-providing behavior with OR = 4.655,

Table 1. Bivariate Analysis

Variable	Category	Underweight among Toddler						OR (95% CI)	p Value
		Very Underweight		Underweight		Total			
		N	%	N	%	N	%		
Food-providing behavior	Bad	9	36	16	64.0	25	100	6.0 (1.42-25.27)	0.022
	Good	3	8.6	32	91.4	35	100		
Toddler's hygiene behavior	Bad	5	20	20	80.0	25	100	1,0 (0.27-3.60)	1.000
	Good	7	20	28	80.0	35	100		
Health care-seeking behavior	Bad	8	36.4	14	63.6	22	100	4.9 (1.26-18.77)	0.038
	Good	4	10.5	34	89.5	38	100		
Toddler-parenting behavior	Bad	4	16.7	20	83.3	24	100	0.7 (0.18-2.65)	0.746
	Good	8	22.2	28	77.8	36	100		

Table 2. Final Model of Multivariable Analysis

Variable	OR	SE	p Value	95% CI for EXP (B)	
				Lower	Upper
Food-providing behavior	4.655	0.759	0.043	1.052	20.609
Health care-seeking behavior	3.605	0.724	0.077	0.872	14.907

which means that group of toddlers raised by mothers having bad behavior in providing food had 4.655 times higher risk of suffering from very underweight nutrition than toddlers raised by mothers who had good behavior after controlled by variable health care-seeking behavior.

Discussion

Every parent definitely wanted their children to grow healthy and smart. To embody it, every child must get attention, control and treatment thoroughly, especially in terms of their growth and development. Even though development of children occurred naturally, but such a process really depended on parents, especially mothers as the parent in providing parenting pattern to toddlers. Moreover, period of five years old (toddler period) is the important period within child development and the period determining their physical, psychic and intelligence development.¹⁰

WHO stated that the major problem in the field of health is malnutrition, specifically in developing countries, and Indonesia is one of the countries as Basic Health Research data in 2013 showed malnutrition prevalence reached 19.6% that consisted of malnutrition (5.7%) and undernutrition (13.9%). Study conducted by Kartono, *et al*,¹¹ concerning condition of toddler nutrition in three regions during economic crisis including Bogor, Tangerang and Bekasi in 1996 and 1999 showed that amount of toddlers with undernutrition and malnutrition was almost half of the amount of toddlers with good nutrition. Likewise the results of this study showed two of ten toddlers suffering from undernutrition were toddlers with very underweight nutrition.

There were many actions performed by the government to decrease undernutrition incidence, one of those actions was through Hearth Program consisting of food-providing behavior, toddler's hygiene behavior, health care-seeking behavior and toddler-parenting behavior. Based on results of this study, there were still many bad practices of food-providing, toddler's hygiene maintenance, health care-seeking and toddler-parenting in six subdistricts as Hearth Program targets. This case could be one of causes why toddlers with undernutrition incidence was still found in six subdistricts around Tangerang City. Therefore, eating habit in household was important to be concerned on because the eating habit influenced the selection and the use of food, then influ-

enced high or low household's food quality.

Execution of Hearth Program activities was only one month and as the target, such program activities were only conducted in six subdistricts around Tangerang City with each of the program place only took 10 samples based on criteria, so there was a possibility of not significant variable finding in results of this study.

Results of study also showed relation between food-providing behavior with undernutrition among toddlers whereby toddlers who got bad food providing behavior had six times higher risk of suffering from very underweight nutrition than toddlers who got the good behavior. Then the risk became 4.6 times after controlled by variable health care-seeking behavior. Likewise study conducted by Lubis,¹² that also showed any relation between food-providing behavior with toddler's nutritional status. Results of another study showed relation between parenting patterns toward nutritional status after following Hearth Program in any countries, such as in Guatemala dan Costa Rica, some mothers had good technique regarding food-providing, treatment for children while sick and recovery period.¹³

Bad behavior in providing parenting patterns to toddlers was related to knowledge, attitude or behavior of mothers, socio-cultural background that became factors in selecting improper food. Because of food ingredient selection, the availability of adequate amount of food and food diversity were influenced by level of maternal knowledge about food and its nutrition. Ignorance of mothers could cause mistake in food selection, especially for toddlers. One of which was the needs of food/nutrition necessary to be prepared since prenatal period as mothers needed to manage their diet during pregnancy, then exclusive breastfeeding at period of 0 to 6 months as a study stating that exclusive breastfeeding was the controller to undernutrition incidence.¹⁴ The postponed breastfeeding initiative, not providing colostrum and improper weaning were the risk factors significant for undernutrition among toddlers. Moreover, the optimum food-providing practice could improve children's nutritional status.¹⁵

Theoretically, self-hygiene was the important factor because of environment related to agents causing diseases, such as diarrhea, dengue hemorrhagic fever and infectious diseases in correlation with children's nutritional status. Child parenting from individual hygiene as-

pect, environmental health and child safety regarding mothers' ability to maintain their children stay healthy and hygienic, children got healthy environment and avoided from injuries or accidents. However, this was not in line with results of this study that showed no any significant relation between toddler's hygiene behavior and undernutrition incidence.

There was a relation between health care-seeking behavior and undernutrition among toddlers whereby toddlers raised by families who had bad health care-seeking behavior had 4.9 times higher risk of suffering from very underweight nutrition than toddlers raised by families who had the good behavior. It was because toddler period is a period easily infected by diseases. Therefore, it took family's commitment, specifically mothers to carry their children to health care facilities if the children suffered from infectious diseases. Beside providing complete immunization to children before the age of one year, medical treatment of diseases during child period and getting professional's assistance on the right time played a role in maintaining children's health. Moreover, providing nutritional counseling for parents and good communication with mothers of toddlers would make nutritional status of toddlers better.¹⁶

Study conducted by Hidayat and Jahari,¹⁷ showed a significant difference that behavior of mothers who used health care facilities got more toddlers with good nutrition compared to mothers who did not use health care facilities.

Theoretically, parenting pattern to children is the important matter because it will influence their growth and development process. Child-parenting pattern is the ability of family and society to make time, give attention and supports in order to make children able to grow and develop as well as possible both physical, mental and social in form of attitude and behavior of mother or other sitters in terms of their closeness with children, providing food, maintaining hygiene and showing affection. Therefore, parenting is the factor closely related to growth and development of toddlers. Likewise the study conducted by Huriah, *et al*,⁸ that also found a relation between child parenting and nutritional status. However, this was not in line with results of this study showing no significant relation between toddler-parenting behavior with undernutrition incidence among toddlers.

Conclusion

Two of ten toddlers suffering from undernutrition are toddlers with very underweight nutrition. Mothers participate at Hearth Program within 15 days in Hearth Program places and 15 days at home following home visits. There is a significant relation between food-providing behavior and health care-seeking behavior and undernutrition among toddlers. There is no relation bet-

ween toddler's hygiene behavior and toddler-parenting behavior with undernutrition among toddlers. Food-providing behavior is the dominant factor influencing undernutrition incidence among toddlers with variable health care seeking behavior as confounder.

Recommendation

It is necessary for every family to have good behaviors in terms of food-providing and health care seeking for their toddlers. It is hoped that Hearth Program as an action to improve food-providing and health care-seeking can be continuously performed, so able to fix and decrease undernutrition incidence among toddlers.

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Good Corporate Governance Implementation and Performance of Civil Servant

Penerapan Good Corporate Governance dan Kinerja Pegawai Negeri Sipil

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Abstract

In order to achieve the vision and mission, every hospital must implement Good Corporate Governance (GCG). Its implementation aims to optimally improve performance of employees that will finally improve organizational performance. This study aimed to analyze the relation between principles of GCG and performance of civil servants of the Natuna Field Hospital in Anambas Islands District. This analytical descriptive study using cross sectional design involved 56 civil servants as samples. Data was collected in 2012 using a structured questionnaire. This study used chi square and logistic regression tests. Multivariate model was simplified by eliminating the confounding variables using backward stepwise method. This study found two variables significantly related to performance of civil servants, namely implementation of fairness and transparency principles. Both were the most related variables to the performance of civil servants.

Keywords: Civil servants, fairness, good corporate governance, performance, transparency

Abstrak

Dalam rangka mencapai visi dan misi, setiap rumah sakit harus menjalankan tata kelola perusahaan yang baik (Good Corporate Governance/GCG). Penerapan GCG sendiri bertujuan untuk meningkatkan kinerja pegawai secara optimal, yang akhirnya akan meningkatkan kinerja organisasi. Penelitian ini bertujuan untuk menganalisis hubungan penerapan prinsip-prinsip GCG terhadap kinerja pegawai negeri sipil (PNS) Rumah Sakit Umum Lapangan Natuna Kabupaten Kepulauan Anambas. Jenis penelitian ini adalah deskriptif analitik dengan desain potong lintang pada 56 PNS. Pengumpulan data dilakukan pada tahun 2012 dengan kuesioner terstruktur. Digunakan analisis dengan uji kai kuadrat dan regresi logistik, dan untuk penyederhanaan model dilakukan eliminasi terhadap faktor perancu dengan menggunakan metode backward stepwise. Penelitian ini menemukan dua variabel yang signifikan berhubungan dengan kinerja PNS, yaitu penerapan prinsip fairness dan penerapan prinsip transparency. Keduanya merupakan variabel yang paling berhubungan dengan kinerja pegawai negeri sipil.

Kata kunci: Kinerja, keadilan, good corporate governance, transparansi

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Introduction

To achieve national goals, all Indonesian people particularly the state apparatus such as civil servants that is a key element of a nation's human resources participate in the development. Civil servants are expected to have complete competency and good performance to achieve those goals.¹

Individual performance is affected by many factors which are then classified into three groups, namely individual, management support and organizational support. One of organization support is the organization governance.²

Hospital Act (Act No. 44/2009) Article 33 Paragraph 1 states that every hospital must have an effective, efficient and accountable organization. Explanation of the article is that in order to achieve hospital vision and mission, a hospital must be organized by running a *Good Corporate Governance* (GCG) and good clinical governance. The article 36 of this law also states that every hospital shall render the hospital's GCG and clinical governance.³

GCG is a system to regulate and control enterprises in order to create added value to all stakeholders. GCG emphasizes the importance of shareholders' rights to obtain information correctly and timely, and the company's obligation to make disclosure in an accurate, timely, about enterprise performance, ownership and stakeholders. There are four main components needed in the concept of GCG, namely fairness, transparency, accountability, and responsibility. Those four components are essential for the implementation of GCG principles consistently and proven able to improve the quality of financial reports as well as to inhibit engineered performance activity.^{4,5}

The implementation of GCG principles aims to achieve optimal performance of employees that will improve organizational performance. The interests of management and employee must be in accordance with their respective capacities that should be equally and properly treated.⁶ Similarly stated by Effendi,⁷ that human resource as human capital needs to be managed professionally by implementing GCG principles in order to maintain professional, competent and reliable human resources in order to improve hospital's performance.

From the initial data, the Natuna Field Hospital is known from the management that this hospital has implemented the principles of GCG since its establishment. In contrast, the management claimed that they have not obtained civil servants' performance as expected. It is seen from frequent complaints from the management, civil servants themselves and the public. Some civil servants assumed that GCG principles in the Natuna Field Hospital has not been completely implemented, although they have done their job as well as possible during the

work.

This study aimed to investigate the implementation of GCG principles and its relation to the performance of civil servants in the Natuna Field Hospital in 2012, based on the principle of fairness (reasonableness), transparency, accountability, and responsibility.

Method

This was a non-experimental survey study design in which data were collected cross-sectionally. This study was conducted in the Natuna Field Hospital, Anambas Island, Riau Islands Province, Indonesia and carried out in 2012. The study population were 56 civil servants working in the Natuna Field Hospital who were totally taken as sample.

Data were collected by using a structured questionnaire, measuring implementation of GCG principle as the independent variable, and civil servants' performance as the dependent variable. Questionnaire for the independent variables composed of 34 positive and negative questions/statements about principles of fairness, transparency, accountability and responsibility. Questionnaire for the dependent variable direct supervisor evaluation towards the performance consisted of 24 positive and negative questions/statements about the fidelity, performance, responsibility, obedience, honesty, cooperation, initiative and leadership. A sort of Likert scale was applied, where 4 to 1 scale was used for positive question/statement and a 1 to 4 scale for negative question/statement.

Score of performance variable measurement were then concluded, the total score were then categorized into 'good enough' if the score were less or equal than median value and 'good' performance if the scores were higher than median.

Questionnaire validity and reliability test was conducted by distributing the questionnaires to 30 respondents in Lapangan Lingga Hospital, Lingga District. Validity was determined by comparing the *r* calculated value with *r* table value. In this study, the *r* table value used for those 30 responders was 0.361 within significance level of 5%. The calculated *r* value could be seen in the column *corrected item - total correlation*. If the calculated *r* in the column is higher than 0.361, then the question is valid.

Data collected from the questionnaire, were then processed for further analysis. Univariate analysis provided the frequency distribution, mean, median, standard deviation, and inter quartile range, minimum and maximum. Bivariate analysis was carried out by applying chi-square test, using confidence level of 95% at $\alpha = 0.05$, then multivariate analysis used was multiple logistic regression prediction model. Logistic regression is one approach to mathematical models to analyze one or more

independent variables with some dependent variable categories that have two dichotomized values.^{8,9} Variables included in the model are variables with p value less than 0.25.

Results

This study found that slightly more than a half of the respondents (51.8%) had good enough performance (Table 1). While in the fairness, transparency, accountability and responsibility principles rating the 'good enough' value is higher than 'good'. When viewed from proportions of 'good enough' and 'good' values, the difference was found not more than 20% or there was no

difference in performance, fairness, transparency and responsibility variables. The difference was only found in the accountability variable.

Furthermore, the relationship between implementation of the GCG principles on the respondents' performance showed p value = 0.034 (Table 2). It means that within the 5% alpha, significant relation existed between the principle of fairness and transparency and civil servants' performance. It is known that the employees who were mostly 'good' in their principle of fairness, would likely to have a good performance (65.4%). Likewise, if they were 'good' in principle of transparency, then the majority would also be likely to have a good performance (65.4%).

OR value was 3.778, means that civil servants who gave 'good' in evaluation of application of fairness or transparency principles were 3.778 times more likely to have good performance than those who gave 'good enough' evaluation to the implementation of fairness or transparency principles.

At the following stage, the only variable that had p value less than 0.25 were included in the multivariate modeling. At the end of the analysis model (Table 3), the dominant variables related to the performance of civil servants were fairness and transparency principles' variables. Previously the model was processed by issuing responsibility principle's variable (p value = 0.147).

Table 1. Distribution of Respondents' Performance Evaluation by Good Corporate Governance Principles

Principles	Category	Respondents	
		n = 56	%
Performance	Good enough	29	51.8
	Good	27	48.1
Fairness	Good enough	30	53.6
	Good	26	46.4
Transparency	Good enough	30	53.6
	Good	26	46.4
Accountability	Good enough	34	60.7
	Good	22	39.3
Responsibility	Good enough	30	53.6
	Good	26	46.4

Table 2. Relation between Respondents' Performance and Evaluation towards Implementation of Good Corporate Governance Principles

Principles of Good Corporate Governance	Category	Performance						OR (95 % CI)	p Value
		Good Enough		Good		Total			
		n	%	n	%	n	%		
Fairness	Good enough	20	66.7	10	33.3	30	100	3.778 (1.247-11.447)	0.034*
	Good	9	34.6	17	65.4	26	100		
Transparency	Good enough	20	66.7	10	33.3	30	100	3.778 (1.247-11.44)	0.034*
	Good	9	34.6	17	65.4	26	100		
Accountability	Good enough	17	50	17	50	34	100	0.833 (0.284-2.442)	0.953
	Good	12	54.5	10	45.5	22	100		
Responsibility	Good enough	12	40	18	60	30	100	0.353 (0.119-1.049)	0.104
	Good	17	65.4	9	34.6	26	100		

Note: *associated

Table 3. The Dominant Good Corporate Governance Principles Related to the Civil Servants' Performance

	Variable	B	Wald	Sig	OR (95 % CI)
Model I	Principle of fairness	1.367	4.941	0.026	3.922 (1.175 – 13.087)
	Principle of transparency	1.055	2.913	0.088	2.872 (0.855 – 9.649)
	Principle of responsibility	-0.907	2.098	0.147	0.404 (0.118 – 1.377)
	Constanta	-2.287			
Model II	Principle of fairness	1.274	4.626	0.031	3.576 (1.120 – 11.423)
	Principle of transparency	1.274	4.626	0.031	3.576 (1.120 – 11.423)
	Constanta	-3.812			

p value = 0.005 r² = 23.1%

The OR 3.576 (Table 3) showed that the implementation of fairness and transparency principles would improve performance of civil servants by 3.576 times. The r^2 value of 0.231 (23.1%), means that fairness and transparency principle variables were able to explain 23.1% variation of civil servants performance in the Natuna Field Hospital.

Discussion

The results of this study showed that civil servants' performance in the Natuna Field Hospital, 2012 were in the 'good enough' category. This finding was contrary to the facts in the field, where the performance of 56 civil servants were 'good' category using The List of Work Implementation Assessment (*Daftar Penilaian Pelaksanaan Pekerjaan/DP3*). The DP3 instruments measure performance based on the following indicators, namely performance, responsibility, obedience, honesty, cooperation, initiative and leadership.

This difference may be caused by performance appraisal of civil servants with DP3 instrument is still a formality to meet the requirements for the promotion. Performance appraisal process using confidential DP3 instruments, has fairly good educational value when applied, because of the direct superior civil servants as assessors will merely provide an assessment and does not perform follow-up of the assessment. Fears towards supervisor management for the adverse result will impact on civil servants' career.

This study found that the variables significantly related to the civil servants' performance are fairness and transparency principle variables. This is in line with several studies on the relationship between implementation of GCG principles and civil servants' performance. Study in Banda Aceh,⁶ showed there was a significant relation between implementation of GCG principles and performance of the administrative staff.

Study in Pangkep Department of Health,¹⁰ showed GCG principles that influence the civil servants' performance were accountability, professionalism, efficiency and effectiveness, while the transparency variable had no effect. Another study in Luwu Timur District Health Agency,¹¹ showed that the GCG principles such as transparency, fairness, accountability and participation were related to the civil servants' performance.

Other factors affecting the implementation of good governance among others are the political will of the central government and regional government heads, the ability of the government, the minimum budget, infrastructure and cultural factors, organizational culture, internal controls, leadership styles and organizational commitment.¹²⁻¹⁴ These factors can be considered as a proxy for the implementation of the GCG principles in an organization.

The results of the bivariate analysis showed no significant relation between employee assessment towards the application of the principle of accountability (p value = 0.953) and the principle of responsibility (p value = 0.104) with the civil servants' performance. This is in line with Nurwahida's,¹⁵ study that found the responsibility, fairness and accountability variables were not related to the performance of Wajo District Health Office employees.

There was no significant relation statistically between implementation of the principle of accountability and civil servants performance due to the possibility of the most respondents are civil servants who have main duties and functions have been arranged in accordance with the responsibilities of their position. For example, collaboration between doctors and nurses as both knew their duties and functions or authority without an assignment letter. Doctors discuss with the nurses about care plans, nursing performance nursing care according to their professional authority on doctors' orders. Doctors to supervise the work of nurses. Meanwhile, nurses report their duties performance to the doctors and doctors give feedback on the work of nurses.

Similar to the implementation of the responsibility principle which was not significant, it was probably because most of them were health workers (87.5%). Health workers are bound by the professional rules and professional ethics, which serve as guide in carrying out everyday tasks, so that the hospital existing regulation whether or not made with involvement of employees will not affect their performance.

Based on the results of this study, GCG principle variables that ominantly related to the performance of civil servants were fairness and transparency principle variables. The analysis result was found through the backward stepwise method until the second step. These results were in line with Ningsih' study,¹¹ that fairness variable was the most dominant variable affecting the performance of employees. Similarly studied by Marniati,⁶ that found transparency variable as the most dominant variable affecting employees' performance.

There are other factors that have significant effect on the employees' performance within the healthcare organization that include organizational development, leadership, career development, and job satisfaction (p value < 0.05).¹⁶ If there are other variables that are not strongly affect the employees' performance, then the hospital management requires intervention to other factors beyond the present observed variables.¹⁷

By definition, good administration looks easy to implement but is not always the same in reality.¹⁸ In the government agencies, it is known that the competence of personnel and supervision officers professionally influence the implementation of good governance positive-

ly.¹⁹

Good governance is an important factor for sustainable development at all levels and sectors.²⁰ Being a strategic framework for a long-term commitment to the strategic objectives, policy integration mechanisms within vertical and horizontal coordination, and transparent public participation and consultations process.²¹ According to an independent research institute, implementation of GCG in Indonesia is still very low. This is mainly because of no corporate culture as the core of a corporate owned by the organizations.⁴

The GCG rules are often overlooked in Indonesia. Barriers that frequently arise in the GCG implementation are among others because of their conflict of interest with other parties and ineffective law enforcement against violation.²²

In the medical field, good governance refers to the formulation and implementation of appropriate policies and procedures to ensure pharmaceutical systems effectiveness and efficiency, especially in the transparent treatment regulation and procurement system that are transparent, accountable and in accordance with regulation.^{20,23} Similar to corporate governance, that can simply be defined as a system built to direct and control an organization so as to create a good relationship management, fair and transparent among the various interrelated parties.²⁴

By having GCG implemented benefits to all stakeholders, such as public in general, customers, suppliers, employees, investors, shareholders and the management. Similar results with others, this study concluded that GCG implementation affect satisfaction towards the excellent services provided to the patients in the government hospitals.²⁵

Conclusion

The performance of civil servants in the Natuna Field Hospital can be categorized as good enough (51.8%). The implementation of GCG principles from the civil servants' side brought about the fairness is still good enough (53.6%), transparency is good enough (53.6%), accountability is also good enough (60.7%), and responsibility is still good enough (53.6%). The dominant variables related to the civil servants' performance in this hospital are transparency and fairness variables, that likely can improve the performance of the civil servants to 3.576 times.

Recommendation

Management of Natuna Field Hospital should improve the fairness and transparency principles in the management of civil servants' performance through the communication of information as well as transparency in appraising the subordinates' performance. It is recom-

mended that the supervisory management has the courage to assess *DP3* fairly and transparently.

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Well Water Consumed and Urolithiasis in Gedangsari Subdistrict, Yogyakarta

Konsumsi Air Sumur dengan Urolitiasis di Kecamatan Gedangsari, Yogyakarta

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Abstract

The land in Gedangsari Subdistrict area composes of limestone. Many local people consume drinking water from wells that contain high levels of calcium. Many people suffer from urolithiasis. This study aimed to describe calcium or Ca(OH)_2 distribution in the well water and explain its relation with urolithiasis incidence. This study was conducted in Gedangsari Subdistrict, Gunung Kidul District from July to November 2013. The study was cross sectional confirmed with titration test in laboratory. Samples were 94 wells of 3,849 well population as selected randomly. Criteria of sample selection included wells used for drinking by the population aged older than 30 years already, with less than 15 meter of depth. Laboratory test of Ca(OH)_2 level was conducted by titration. Suspect urolithiasis was clinically diagnosed by doctor and data analysis used chi-square test. Results showed relation between water hardness and urolithiasis ($RP = 2.27$), although statistically not significant. In conclusion, there was no relation between mineral water consumption, age, and length of stay with urolithiasis incidence in Gedangsari Subdistrict, Gunungkidul District.

Keywords: Urolithiasis, water hardness, well water

Abstrak

Tanah di wilayah Kecamatan Gedangsari mengandung batuan kapur. Masyarakat di daerah ini banyak yang mengkonsumsi air minum dari sumur gali yang mengandung kadar kalsium tinggi, dan banyak yang menderita urolitiasis. Penelitian ini bertujuan untuk mendapatkan gambaran distribusi kalsium atau Ca(OH)_2 pada air sumur dan menjelaskan hubungannya dengan kejadian urolitiasis. Penelitian dilakukan di Kecamatan Gedangsari, Kabupaten Gunungkidul selama Juli sampai November 2013. Penelitian dilakukan secara potong lintang dengan konfirmasi uji titrasi di laboratorium. Sejumlah 94 sampel sumur dipilih secara acak dari populasi 3.849 sumur. Kriteria pemilihan sampel adalah sumur gali yang telah digunakan untuk minum oleh penduduk berusia lebih dari 30 tahun, dengan kedalaman kurang dari 15 meter. Pemeriksaan laboratorium kadar kalsium dilakukan dengan titrasi. Dugaan urolitiasis didiagnosis melalui pemeriksaan klinis oleh dokter. Data dianalisis dengan uji kai kuadrat. Hasil analisis menunjukkan hubungan antara kesadahan air dengan urolitiasis ($RP = 2.27$) namun tidak bermakna secara statistik. Konsumsi air putih, usia, dan lama tinggal tidak berhubungan dengan kejadian urolitiasis di Kecamatan Gedangsari Kabupaten Gunungkidul.

Kata kunci: Urolitiasis, kesadahan air, air sumur

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Introduction

Water is a vital part of human life, and in all facets of life including for preparing food, hygiene and sanitation.¹ Water hygiene use will determine the human health who consume. Several studies suggest that drinking at least 2 liters of water per day is effective to reduce the risk of urolithiasis because it will smooth the urine flow and prevent deposit forming in the kidneys.^{2,3} Water hardness is the term used for water containing cations that cause hardness.⁴ In general, the hardness is caused by the presence of metals or monovalent cations such as Iron (Fe), Strontium (Sr), Manganese (Mn), Calcium (Ca), and Magnesium (Mg), although the main cause of hardness are calcium (Ca^{2+}) and magnesium (Mg^{2+}).^{1,2} Hardness is often found in the water from the ground or in the area where the land contains salt and chalk deposits.⁵

Whitewash is said as hard water because it contains $\text{Ca}(\text{HCO})$ and $\text{Mg}(\text{HCO})_2$ elements and flows through calcareous soils. Maximum hardness allowed is 500 mg/l, consuming water that exceed the threshold may cause health problems. The impact of hard water to health includes the formation of urinary stones (urolithiasis).⁶

Gedangsari Subdistrict in Gunung Kidul District is a subdistrict where majority of its territory composed of limestone structure. The people living in this region, in the long term may be affected by diseases associated with urolithiasis. Based on the information from Gedangsari Primary Health Care medical record officer, 38 patients were suspected to having kidney stones in 2013. Based on those facts, this study was to analyze relation between the lime content wells water consumption and the incidence of urolithiasis in Gedangsari Subdistrict, Gunungkidul District.

Method

This study was qualitative and quantitative observational study in which data were collected cross sectional. To collect data, in-depth interviews were performed using an interview guide containing questions about the risk factors of kidney stone disease and daily activities of the informants aged 30 years and older, and consuming water from wells in this area. To extract informant interviews, content analysis was used supported by triangulation.

This study was conducted in Gedangsari Subdistrict, Gunungkidul District, from July to September 2013. The study population was 3,849 wells in Gedangsari Subdistrict. Most of dig wells were located in Ngalang Village (1,430 wells) and the least was in Mertelu Village (68 wells). Sample size was 94 wells calculated by using proportional random sampling formula from Lemeshow. Samples from Ngalang Village were 35 wells, followed by Hargomulyo (25 wells), Serur (10 wells), Sampang (9 wells), and respectively Watugajah, Tegalrejo and

Mertelu (7, 6 and 2 wells).

This technique ensured the balance between the number of samples of each village with the population. Criteria for sample selection were that wells were used for drinking and having the depth at least 15 meters. Measurements of water hardness was performed by titration test in the Yogyakarta Health Laboratory, and based on National Standards Institute (NSI) procedure. Tools used were 25 ml pipette, 100 ml Erlenmeyer flask, turtles spoons and sample bottle. The materials used included 25 ml distilled water, 25 ml sample water, NaOH, EBT indicator, standard EDTA 0.01 M solution. As quoted from BSN instructions, the working principle of this titration test was that the disodium salt of ethylene diamine tetra acetic (EDTA) will react with certain metal cations to form soluble chelate complex compounds. At the pH of 10.0 ± 0.1 , ions of calcium and magnesium in the sample will react with the Eriochrome Black T (EBT) indicator, and form a solution of purplish red. If N_2EDTA is added as a titrant, the ions of calcium and magnesium will form complex compounds, molecular indicators of detaching, and to endpoint solution will change color from red to purple became blue.⁷

If the CaCO_3 levels showing more than 300 mg/L, then the water was categorized as high hardness water and low hardness if less than 300 mg/L. Human population and sample were all citizens who consumed the wells water. Samples were 159 people who met the criteria, including those aged 30 years and older and consumed water from 94 well water samples. To know the informants' characteristics and disease history, in-depth interviews were performed using a questionnaire.

Interview results were written in manuscript form, then processed, summarized, analyzed and concluded. The residents selected as samples were examined by the medical doctors to determine suspect urolithiasis with history-taking and physical examination. The statistics used for analysis was chi square test, to determine relation between levels of well water hardness and several other variables with incidence of suspect urolithiasis. Suspect urolithiasis is a condition in which a person is diagnosed by medical personnels (doctors) to have suffered from urolithiasis by clinical signs, so that requires supporting medical examinations, such as laboratory, x-rays or ultrasound examinations. However, this study did not conduct such examinations.

Results

The study results (Table 1) showed that 94 selected wells were consumed by 159 people as dominated by women. Around 99% of the respondents were residents who have lived more than 30 years in this area, and 10% of these respondents were positively suspect urolithiasis. As many as 53% of the respondents consumed water less

than 8 glasses per day and 15 of them positive suspect urolithiasis. As grouped into aged 30 - 60 years and older than 60 years, 4 of 54 respondents aged more than 60 years were positive urolithiasis. Wells water hardness level was measured by titration methods to get the lime content in the wells water to obtain hardness level. Hardness level was categorized into low, medium, high and very high.

Table 2 showed the chi square analysis result between water hardness, water consumption, length of stay, sex and age with the incidence of urolithiasis. Water hardness were related to urolithiasis with $RP = 2.27$, showing that high hardness of the water was a risk factor of urolithiasis. Those who consumed high hardness water were 2.27 times more likely to get suspect urolithiasis higher than those who consumed low hardness, although not statistically significant (p value = 0.26).

Analysis of water consumption with the incidence of

Table 1. Description of Respondents

Variables	Category	Frequency (n=159)	%
Sex	Male	76	47.79
	Female	83	52.21
Length of stay	> 50 years	95	59.75
	≤ 50 years	64	40.25
Age	> 60 years	46	28.93
	30 - ≤ 60 years	113	71.07
Drinking water habit	> 8 glasses	69	43.40
	≤ 8 glasses	90	56.60
Water hardness level consumed wells	high (≥300)	120	75.47
	low (<300)	39	24.53

urolithiasis, showed no relation ($RP = 0.98$; p value 1.00). Similarly, no relation was found between length of stay and urolithiasis incidence ($RP = 0.87$; p value = 0.76). This study also showed no relation between age and incidence of suspect urolithiasis. Sex was found related to urolithiasis. Despite not statistically significant, male was found to have risk 1.40 times higher than women to get urolithiasis ($RP = 0.65$; p value = 0.43).

Multivariate analysis of all variables altogether as shown in Table 3 showed that the variables which had higher risk of urolithiasis incidence were hardness level and sex (Exp B = 2.63 and 1.29 respectively), although statistically not significant.

In-depth interviews with respondents showed that people have the local wisdom in managing drinking water, like precipitating and filtering the water before it was cooked.

The respondents' statements were illustrated below: *"The water here is calcareous, However, I usually precipitate the water in the barrel for two days before cooking, drinking and is deposited again to avoid drinking the chalk."* (Respondent 1)

"We use well water here for drinking. Since it contains lime, before cooking usually I precipitate and filter the water to separate the chalk from the water..." (Respondent 2)

Another finding was that the local community did not have the habit of consuming water, as enhanced by one respondent's statement:

"I was not too fond of drinking water, drinking tea is

Table 2. Relation between Urolithiasis and Hardness Level of Well Water, Water Consumption, Length of Stay, Sex, and Age Group in Gedangsari Subdistrict

Urolithiasis									
Variable	Category	Suspect		Healthy		Total	Ratio Prevalence (RP)	p Value	95% CI
		N	(%)	N	(%)				
Water hardness level	High	14	(11.6)	106	(88.4)	120	2.27	0.26	0.5 - 9.57
	Medium	2	(5.1)	37	(94.9)	39			
Water consumption	≤ 8 glasses	9	(10.00)	81	(90.00)	90	0.98	1.00	0.39 - 2.51
	> 8 glasses	7	(10.14)	62	(89.86)	69			
Length of stay	>50 years	9	(9.47)	86	(90.53)	95	0.87	0.76	0.34 - 2.21
	≤ 50 years	7	(10.94)	57	(89.06)	64			
Sex	Male	9	(11.84)	67	(88.16)	76	1.40	0.48	0.55 - 3.59
	Female	7	(8.43)	76	(91.57)	83			
Age group	≥ 60 years	4	(7.41)	50	(92.59)	54	0.65	0.43	0.22 - 1.91
	30-60 years	12	(11.43)	93	(88.57)	105			

Table 3. Multivariate Analysis of Urolithiasis Incidence

Variable	B	Exp B	p Value	95%CI
Hardness level	0.97	2.63	0.22	0.56 - 12.38
Length of stay	-0.34	0.71	0.69	0.14 - 3.72
Age	-0.67	0.51	0.35	0.12 - 2.12
Water consumption	-0.59	0.56	0.53	0.09 - 3.43
Sex	0.25	1.29	0.64	0.43 - 3.87
Constanta	3.13	22.98	0.34	

more frequent. I only drink water once or twice a day." (Respondent 1)

"I drink water whenever I want, but I could drink tea 6–7 cups a day." (Respondent 2)

Discussion

Well water is the main water source of the people in Gedangsari Subdistrict. Based on the laboratory examination, the lime or $\text{Ca}(\text{OH})_2$ content in the water of this area varied. Moderate level was 24%, high was 42% and very high level was 34%. The limestone structure that made up the region was allegedly the reason for the high lime content of wells water, and it was in line with the statement that main source of hardness was limestone and dolomite. The ground water will be hard easier than superficial water.¹ This statement also confirmed that there was a negative correlation and positive hardness by stone formation.⁸ In line with this is a statement saying that thick top soil layer and limestone presented in the area will have high water hardness.⁹ In the contrary, if the area is located in the place with thin soil layer and lime stones, then will probably give low hardness.

Hardness can be seen in an area where limestone and rock are found in a big amount.¹⁰ The length of contact between groundwater with the rocks would affect the size of the dissolved minerals. The longer the groundwater in contact with the rock, the higher the elements dissolved in the water.¹¹ Similar to the water from the wells in the limestone area, the longer the calcareous rocks in contact with the ground water calcareous rocks, the higher the lime content in the water.

Based on the findings, it seemed that the hardness spread evenly throughout the study area. Although wells water hardness level in Gedangsari Subdistrict is still below the standards set by Health Ministry of the Republic of Indonesia (Decree No. 907/Menkes/SK /VII/2002, that is ≤ 500 mg/L). However, this is feared to trigger health problems to people who long term consume the water, such as kidney stones or urinary tract stones.¹² This is in line with study findings stating that composition of calcium in the urine was one reason of urinary tract stone formation.¹³

From the observations and interviews to the respondents, 79% of the cooking place had precipitated chalk (limestone sediment). The limestone sediment indicated that the water contained lime or hard water. Hard water is harmless, but it can cause quite serious problems in a long term. In addition, the turbidity of the water can reduce the physical quality of drinking water as in accordance with the Decree of Health Minister of the Republic of Indonesia that water consumed must meet the established standards to prevent health problems.¹²

Multivariate analysis showed relation between well water hardness and suspect urolithiasis (Exp B = 2.63; p

value = 0.22), which means that the high water hardness level would have 2.63 times higher risk than the moderate level, although statistically not significant. Water hardness level in Gedangsari Subdistrict was high, but not many residents experienced suspect urolithiasis. This might be because most people had already managed by precipitating, filtering the water in advance before consuming.

Such a local wisdom practiced by the local people is suspected to bring about some variables did not significantly influence urolithiasis. This showed that although the theoretically some variables had risk the occurrence of suspect urolithiasis, but the local people treatment to the water had lowered the risk of urolithiasis. Water hardness can be lowered by heating. Water containing $\text{Ca}(\text{HCO}_3)_2$ and $\text{Mg}(\text{HCO}_3)_2$, when heated will precipitate the CaCO_3 and MgCO_3 compound.^{4,13}

Based on the interview, most respondents practiced a local wisdom (treatment), among others, by precipitating and filtering the water prior to consumption, aiming to lower the lime content. Although statistically not significant, it was suspected as the cause of the relation between water hardness and urolithiasis. Aside from the local wisdom, water hardness value was still below the recommended maximum limit according to the World Health Organization (WHO), that is less than 500 mg/l. It also affected the incidence of urolithiasis because it could slow the formation of kidney stones in the body.

Filtering water before consuming is good practice in lowering the water hardness. One of the materials that can be used to lower the hardness is zeolite stone, that could lower water hardness based on screening study.¹⁴ The most effective medium for lowering hardness level of the well water is a 70 cm thickness combination of of zeolite and activated charcoal.¹⁵ The respondents carried out filtering in several ways, such as by installing fabric at the end of the faucet, using filter tools purchased in the market, and there were people using charcoal and zeolite stone. Although the well water lime content of the respondents' wells were still below the recommended level, but this was still necessary to be worried because it remained a risk factor for the occurrence of kidney stones. If the composition of calcium in the body is constantly increasing, then stone may be formed in the urinary tract, despite in a relatively long time. This is because of the hardness of water is less than 500 mg/l, compared to the people who consume water hardness 500 mg/l and over. These results indicated that there were two respondents (5.1%) who used to consume water with medium hardness and suspect urolithiasis.

The respondents with high water hardness had 22.96 times higher risk to get the kidney stone disease than those with water that met the requirements. In the statistical test, risk estimate calculation was found for OR =

22.97 (OR > 1), within 95% confidence level (CI) (4.796 to 110.002).¹⁶ A study conducted by Sulistiyani,¹⁷ found that OR was 5.916, meaning that the respondents whose water hardness level did not meet the requirement would be 5.916 times at risk of kidney stone disease compared to whose water hardness levels met the requirement.

In this study, the risk factors studied were hardness level of well water, water consumption, age, length of stay (residing) and sex. However, there were other risk factors that were not studied, among others, records of hypertension and diabetes mellitus. This is in line with studies that stated that untreated hypertension could cause other organ failure such as kidney.¹⁸ Of all the above discussed factors, the hardness level of well water, water consumption, age, length of stay and sex were not significantly related. But when referred to the prevalent ratio (PR), water hardness RP was 2.27 and sex was 1.40.

It shows both variables were risk factors of urolithiasis. In theory, gender is one of risk factors of kidney stone. Men are more susceptible to kidney stones for several reasons, such as men have narrower ureter tract than women, men have higher intensity activity that risk dehydration and lastly women have kidney stone growth inhibiting hormone.¹⁹ Urolithiasis incidence among women in this study was not much different than among men, causing relation between sex with urolithiasis incidence was not statistically significant. Water consumption was suspected to be one of the risk factors that affected suspect urolithiasis among people in Gedangsari Subdistrict. Of 16 suspect cases, 9 of them claimed they consumed water less than 8 glasses per day. Less water intake causes an increase in plasma osmolality and decrease in effective arterial volume, resulting decrease in urine volume and natrium excretion.²⁰ Decreasing urine volume may uplift solute concentration in the urine and increases the formation of stones. This finding is supported by Izhar,⁷ study (OR = 4.3), who found that respondents having a habit of drinking less than 1.5 liters/day or 8 glasses per day had a risk of calcium oxalate sediment 4.3 times compared to those who drank more. It is encouraged to consume water more than 2 liters per day or equivalent with 8 glasses per day.²¹

Stone formation can be prevented by drinking plenty of water (8-10 cups/day), as well as reducing consumption of food and beverage that are rich of oxalates, such as spinach and tea that can lead to calcium stone formation.¹⁶ This is in line with the theory, that oxalate comes from the body (endogenous), food eaten and from the vitamin C metabolism, will generally form crystals that cause kidney stone disease.¹⁶ When the urine becomes oversaturated with materials that are not dissolved like calcium, uric acid, oxalate and cystine, and because of the excessive level of excretion, or because of extreme water

savings, the minerals in urine sediment that causes crystallization, may be then developed and united to form the stone.²²

From analysis of relation between length of stay and urolithiasis, this study found that there was no relation between the length of stay and the incidence of urolithiasis (RP = 0.87; p value = 0.76). Most of the respondents in this study had lived in this area for a long time. Only 2 (1.26%) respondents have stayed less than 10 years. Statistically, there was no relation between length of stay and the occurrence urolithiasis suspect.

No relation was found between age and the incidence of urolithiasis (RP = 0.65; p value: 0.43 or Exp-B = 0.51 Sig = 0.35). In general, the age factor may influence the occurrence of urolithiasis, because the function of the organ at the age of 50 years and over began to decline. In this study, the incidence of suspect urolithiasis was measured by age from 30 years to older than 60 years. Urolithiasis was more expected to happen among people older than 65 years. The results showed a significant difference between urolithiasis among those aged 65 years and older than those younger.²³ However, this study showed different results. The highest percentage of suspect urolithiasis was at the age of 30 - 60 years, despite the difference in incidence with the age older than 60 years was not significant.

Another risk factors that may associate with the incidence urolithiasis was hypertension, but this risk factor was not investigated in this study. This variable may influence the incidence of urolithiasis, in line with study findings that stated untreated hypertension could cause organ failure including kidney.¹⁸ Diabetes mellitus and hypertension are diseases common among patients with urolithiasis. There were significant differences between both diseases and incidence of urolithiasis among patients aged 65 years and older compared to the younger.

Conclusion

There is relation between water hardness and sex with incidence of urolithiasis, but not statistically significant. However, there is no relation between water consumption, length of stay and age with incidence of urolithiasis in Gedangsari Subdistrict, Gunungkidul District, Yogyakarta. This is probably because of people's habits in treating drinking water through precipitation or filtration before cooking.

Recommendation

The local health authority should follow up the diagnosis of suspect urolithiasis, and socialize lime content water treatment and processing by precipitating and filtering the water before consuming, aside from advising people to accustom drinking proper water daily.

Further studies should measure the levels of water

hardness by measuring water hardness after sedimentation or filtration stages, instead of measuring the water directly from the wells. Also suggested in the further to involve other confounding variables, such as hypertension, diabetes, and others.

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Identification of Pathogenic *Leptospira* in Rat and Shrew Populations Using *rpoB* Gene and Its Spatial Distribution in Boyolali District

Identifikasi *Leptospira* Patogen pada Populasi Tikus dan Celurut Menggunakan Gen *rpoB* dan Distribusi Spasialnya di Kabupaten Boyolali

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Abstract

Leptospirosis becomes health problem in Indonesia. Until April 2014, leptospirosis cases transmitted by rats were reported in Boyolali with case fatality rate (CFR) by 83.3%. *Leptospira* genus consists of various serovars and genetic types living in different environment. *Leptospira* species classification based on *rpoB* gene could be used as this gene has high polymorphism level. This study aimed to identify *Leptospira* serovars in rat population using kinship analysis based on *rpoB* gene polymorphism, and describe spatial distribution of rats with *Leptospira* positive in Boyolali District. A cross-sectional study was conducted on April 2014 at Sindon Village in Ngemplak Subdistrict and Jeron Village in Nogosari Subdistrict, Boyolali District. Polymerase Chain Reaction test was performed on 104 rat kidney samples from two locations of study. Spatial analysis was conducted to map distribution of rats with *Leptospira* positive. There were six positive *rpoB* gene samples in *Rattus tanezumi*, *Rattus argentiventer* and *Suncus murinus*. Five of six positive samples showed the closest genetic kinship to *Leptospira borgpetersenii* serovar Sejroe based on *rpoB* gene. One isolate did not have a close genetic kinship to any serovar included in the cluster. Spatial analysis based on home range buffer zone showed rats with *Leptospira* positive were found in 30 meter and 150 meter from leptospirosis patients. Keywords: *Leptospira*, *rpoB*, spatial

Abstrak

Leptospirosis merupakan masalah kesehatan di Indonesia. Hingga April 2014, dilaporkan kasus leptospirosis yang ditularkan oleh tikus di Kabupaten Boyolali dengan angka kematian 83,3%. Genus *Leptospira* terdiri dari ratusan serovar dan tipe genetik yang hidup di pelbagai jenis habitat. Pengelompokan spesies *Leptospira* berdasarkan gen *rpoB* dapat digunakan karena tingkat polimorfisme gen tinggi. Penelitian ini bertujuan untuk mengidentifikasi serovar bakteri *Leptospira* pada populasi tikus di Kabupaten Boyolali menggunakan analisis hubungan kekerabatan didasarkan pada polimorfisme gen *rpoB* dan menggambarkan distribusi spasial tikus positif *Leptospira* di Kabupaten Boyolali. Penelitian potong lintang dilaksanakan pada April 2014 di Desa Sindon Kecamatan Ngemplak dan Desa Jeron Kecamatan Nogosari, Kabupaten Boyolali. Pemeriksaan Polymerase Chain Reaction dilakukan pada 104 sampel ginjal tikus dari dua lokasi penelitian. Analisis spasial sederhana dilakukan untuk memetakan sebaran tikus yang positif *Leptospira*. Terdapat enam sampel positif gen *rpoB* *Leptospira* pada *Rattus tanezumi*, *Rattus argentiventer* dan *Suncus murinus*. Lima dari keenam sampel menunjukkan hubungan kekerabatan yang paling dekat dengan *Leptospira borgpetersenii* serovar Sejroe berdasarkan gen *rpoB*. Satu isolat tidak memiliki hubungan kekerabatan yang dekat dengan serovar manapun yang masuk dalam cluster. Analisis spasial berdasarkan jarak aktivitas harian tikus menunjukkan tikus positif *Leptospira* ditemukan berada dalam kisaran 30 meter dan 150 meter dari penderita leptospirosis.

Kata kunci: *Leptospira*, *rpoB*, spasial

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Introduction

Leptospirosis in the recent decades appeared as outbreak or extraordinary incidence in several countries in Asia, South and Central America, and the United States. This condition has made the disease is included in new or emerging infectious diseases.¹ This disease as caused by the bacterium *Leptospira* is still a public health problem in some areas in Indonesia.

Leptospirosis outbreak in Indonesia occurred in Jakarta in 2002, Sleman in 2008 and 2009, and the districts of Bantul in 2010. Cases of leptospirosis in Boyolali have been reported since 2012 involving two cases, and in 2013 increased to four cases.² From April 3 to March 2014, six cases of leptospirosis were reported and five of them died. In 2012 and 2013, no cases of leptospirosis deaths in Boyolali was found, but in 2014 there were deaths due to leptospirosis reached 83.3%.³ It is necessary to increase the management of leptospirosis cases, especially for early detection, so that appropriate measures and prompt treatment can be performed to reduce leptospirosis fatality and death.

Leptospirosis is spread through direct contact or indirectly by pathogenic *Leptospira* bacteria. Rats are a common source of infection throughout the world.⁴ Countries in Asia Pacific report that rats are detected carry *Leptospira* in their body.⁵ Rats are animals that have adapted to human life and living close to humans. *Leptospira* excreted in the urine of rat in the long term and can survive in the environment that would allow them to act as transmitting *Leptospira* to humans and the environment.⁶ Thus, checking up *Leptospira* in rats is necessary. In addition, shrew is also known to transmit the *Leptospira* bacteria into the environment through its urine.⁶

The genus *Leptospira* is a group of organisms that have tremendous diversity, consisting of hundreds of serovar and genetic types that live in various types of environments or habitats. In this genus, there are pathogenic serovar that highly select the host, and harmless serovar that live freely in the aquatic water environment. At first, this genus is only divided into two species, namely: pathogenic (*L. interrogans*) and saprophytic (*L. biflexa*). The second type is a normal biota that is often found in the surface water.⁷

Leptospira is now grouped into 17 groups genomospecies based on genetic similarity with various molecular methods.⁸ Based on this categorization, pathogenic *Leptospira* species is divided into eight, namely *L. interrogans sensu stricto*, *L. weillii*, *L. borgpetersenii*, *L. noguchii*, *L. santarosai*, *L. alexanderi*, *L. kirschneri* (formerly known as *L. alstoni*) and *L. genospecies*.¹ The division of this species was based on phylogenetic analysis of *rrs* gene (ribosomal RNA gene) that encodes the 16S rRNA gene. However, the ability to distinguish one

species and another species for gene *rrs* is relatively weak, due to the absence of a high degree of polymorphism in the gene, even at the level of complete gene grouping.⁵ *Leptospira* classification by genetic variation will add information to conduct epidemiological analysis.

Since the presence of multiple species in an environment is associated with a particular reservoir, *RpoB* gene is known to be useful for classifying species of bacteria, including group *Spirochaeta*. *Leptospira* is a genus belonging to groups *Spirochaeta*.⁶ The use of *rpoB* gene to differentiate *Leptospira* species has also been developed by La Scola.⁷

The use of Geographic Information System (GIS) is presented in spatial to display and compare the distribution object layout relationship, to describe position or location of disease spread and other health condition.⁹ GIS method is very good for epidemiologic visualization and GIS analysis can be used to describe the disease pattern and the source of infection that is important in controlling and terminating the transmission chain correctly.^{10,11} This study aimed to identify serovar *Leptospira* that exist in the rat population in Boyolali by analyzing the kinship based on gene polymorphism *rpoB* and describing the spatial distribution of rats with *Leptospira* positive in Boyolali.

Method

The survey locations were chosen based on the latest cases of leptospirosis found, that were distributed in Ngemplak Subdistrict and Nogosari Subdistricts. Rat trapping was conducted at the Sindon Village in Ngemplak Subdistrict and Jeron Village in Nogosari Subdistrict, Boyolali District in April 2014. A total of 385 single live trap purposively were installed in residential areas around the home of patients with leptospirosis in both villages. During January-March 2014, leptospirosis cases were found two adjacent subdistricts of Boyolali District, namely Ngemplak Subdistrict and Nogosari Subdistrict. Leptospirosis case data was secondary data obtained from the local health office.

The single live traps were layed for two days inside and outside the house. The caught mice and shrew were identified by the Center for Research and Development (*Balai Litbang P2B2*) in Banjarnegara by using identification key.¹² Then, mice and shrew's kidney organ were taken and further inserted into a tissue lysis buffer that had been placed in a 1.5 ml microcentrifuge tubes. Kidney samples were stored at a temperature of 4°C until the examination process done. DNA isolation process was done by using a Tissue Genomic DNA Mini Kit reagent (Geneaid). The examination stages were conducted in the working manner recommended by the kit.

The Polymerase Chain Reaction (PCR) process performed on DNA samples obtained using the following

primer: rpoB-F-CCTCATGGGTTCCAACATGCA and rpoB-R-CGCATCCTCRAAGTTGTAWCCTT using Go Taq Green Master Mix (Promega).⁷ The PCR stages are as follows: predenaturation 94°C for 2 minutes, followed with 40 cycles of amplification consisting of denaturation at 94°C for 30 seconds, annealing at 55°C for 1 minute, extension at 72°C for 1 min followed by a final extension for 20 min at 72°C. Analysis of the PCR result was performed by electrophoresis using a 1.5% agarose at 100 volts for 15 minutes. Specific DNA visualization was performed using UV transilluminator. Sample was tested positive when the electrophoresis results showed that the DNA bands was in the position of 600 bp.

The PCR rpoB gene products were purified using the Gel/PCR DNA Fragments Extraction Kit (Geneaid) according to the protocol recommended by the kit, sequencing reaction using a primer used in the PCR process. PCR product subsequently were sent to the sequencing service provider (first base) in Jakarta to determine the nucleotide sequences.

The phylogenetic tree is based on the partial rpoB gene DNA sequences with the reference sequences based on the neighbor-joining using MEGA6.¹³ Bootstrapping program to measure the level of confidence conducted using 1000 data sets. The data point location coordinates of patients with leptospirosis and rats with *Leptospira* positive were analyzed spatially using ArcView 3.3 software to map the spread of leptospirosis patients and *Leptospira* positive. Mapping the location of the rats *Leptospira* positive were analyzed based daily rats cru-

ing buffer (home range). Rats home range buffer were grouped at a distance of 30 meter, 60 meter, 90 meter, 120 meter and 150 meter.^{14,15}

Results

Rat trapping results in Jeron Village and Sindon Village showed their pretty solid population. It is based on the success trap numbers that were high in both villages by percentage 16.49% for Jeron Village and 10.75% for Sindon Village. The composition of rats and shrew species found in both villages was shown in Figure 1.

Figure 1 showed that there were two species of rats found in Sindon Village, namely *Rattus tanezumi* (*R. tanezumi*) and *Rattus norvegicus* (*R. norvegicus*) and one species of insectivore that was *Suncus murinus*. Three species of rats that were *R. tanezumi*, *R. norvegicus* and *R. argentiventer* and one species of insectivore that *Suncus murinus* were found in Jeron Village. Rat species in these two villages was dominated by *R. tanezumi*. A total of 91 samples of rat kidneys consisting of 39 from Sindon Village and 52 from Jeron Village were tested by PCR to detect *Leptospira* DNA. Six of them showed positive results for the rpoB gene (Figure 2).

Six kidney samples that gave positive results of the rpoB gene were obtained from three tanezumi rats (*R. Tanezumi*), two ricefield rats (*R. Argentiventer*) and one shrew (*S. murinus*). This showed that the rodents and insectivores carried *Leptospira* in their bodies. More results were presented in Table 1.

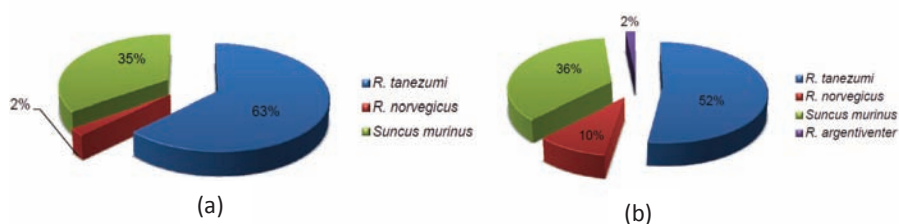


Figure 1. Rat and Shrew Species Caught in Sindon Village (a) and Jeron Village (b), Boyolali District

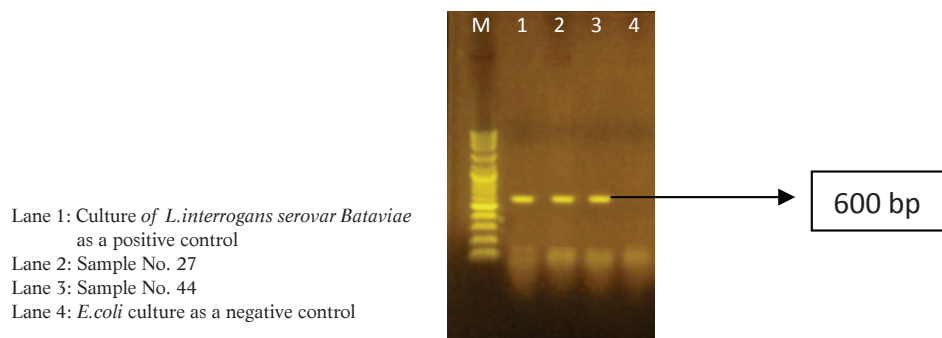
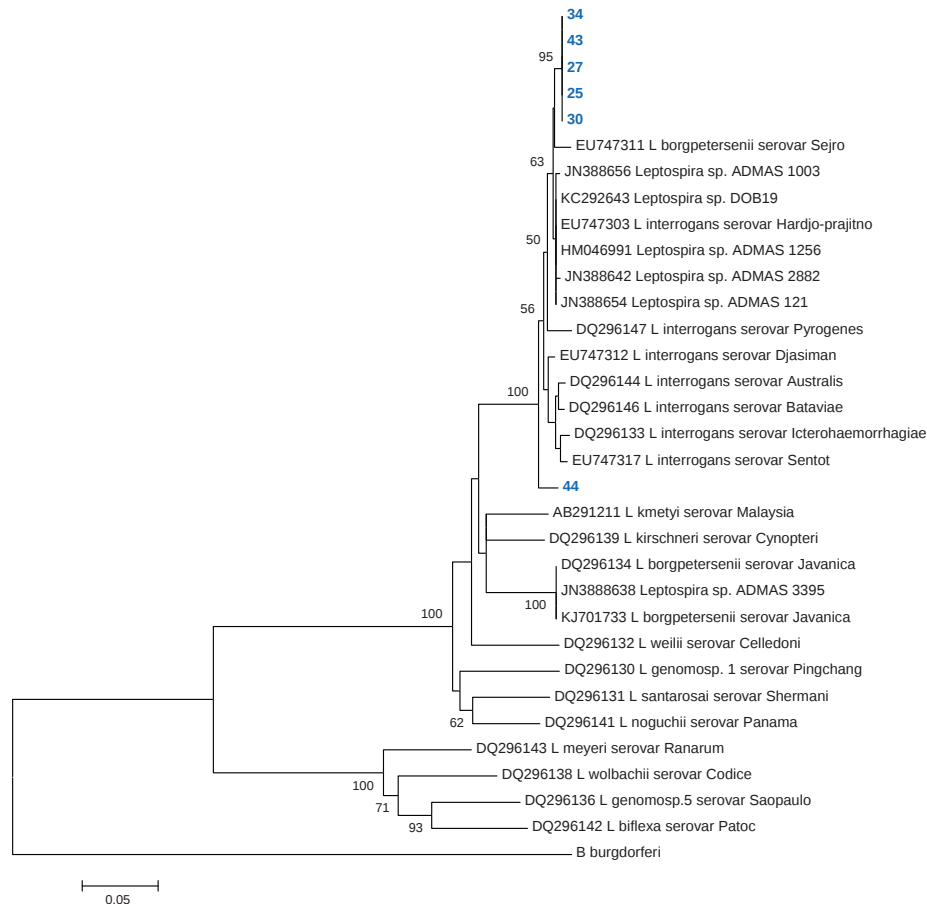


Figure 2. Amplification Product of the PCR Process with rpoB Gene

Table 1. Details of Rat Trapping Results and *Leptospira* Detection Based on the Detection of *Leptospira rpoB* Gene

Origin	Species	Number of Samples	Number of Positive Samples	Positive Mice (%)
Jeron village	<i>R. tanezumi</i>	31	2	3.8
	<i>R. norvegicus</i>	6	0	0
	<i>R. argentiventer</i>	1	1	1.9
	<i>S. murinus</i>	14	2	3.8
Sindon village	<i>R. tanezumi</i>	11	1	2.6
	<i>R. norvegicus</i>	1	0	0
	<i>S. murinus</i>	5	0	0

Figure 3. *Leptospira* Phylogenetic Tree - Phylogenetic Analysis Conducted by Neighbor-Joining Method Using MEGA6 to 1000 Repetitions (Boostraping), Boyolali Origin *Leptospira* was Marked with Blue

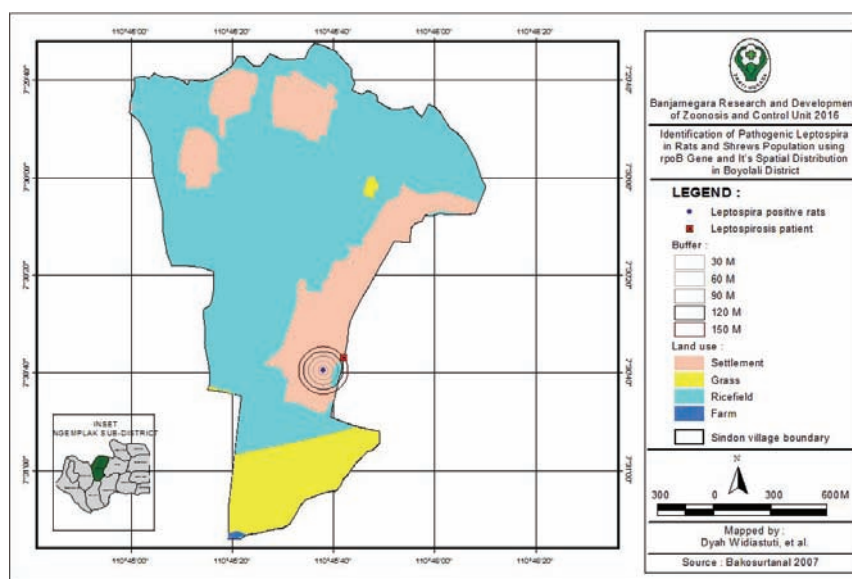
Phylogenetic tree based on partial nucleotide *rpoB* gene sequence showed a breakdown constructed by bootstrap test using neighbor-joining method in the MEGA6 program (Figure 3). Phylogenetic analysis showed that 5 strains of *Leptospira* found in the rat population in Boyolali clustered with *Leptospira borgpetersenii* serovar Sejroe. One sample showed was not clustered with the sequence reference.

Buffer analysis results indicated that coordinates of leptospirosis cases and rats with *Leptospira* positive in Sindon Village located in a distance of 150 meter. In

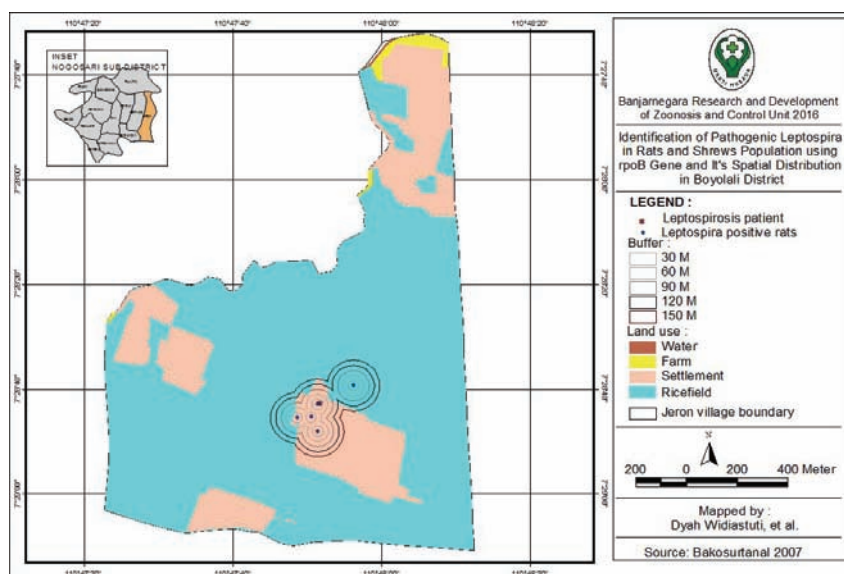
Jeron Village, there were coordinates point of mice with *Leptospira* positive, within a distance of less than 30, 90 dan 150 meters from the location of leptospirosis cases. Location of rats with *Leptospira* positive in Jeron Village and Sindon Village gathered in a residential area. There was only one detected rat with *Leptospira* positive in the rice field found in Jeron Village.

Discussion

Rats trapping showed trap success index by 10.75% in Sindon Village, and by 16.49% in Jeron Village. Rat



(a)



(b)

Figure 4. Buffer Home Range Mapping of Rats with *Leptospira* Positive with Leptospirosis Patients in Sindon Village (a) and Jeron Village (b)

species in both villages was dominated by *Rattus tanezumi*, reaching 63% in Sindon Village and 52% in Jeron Village.

Detecting *rpoB* gene based on PCR showed that of six *Leptospira* positive rats and shrew, three of them were *R. tanezumi* species. This indicated that *R. tanezumi* is the most abundant species giving positive results containing pathogenic *Leptospira*. *Leptospira* infection in rats can be influenced by species.^{16,17} Previous studies showed

the most abundant species found infected by *Leptospira* were *R. tanezumi* and *R. norvegicus*.¹⁸⁻²² This showed that *R. tanezumi* could serve as a source of *Leptospira* infection and spread to humans and the environment. Possibility of human exposed to *Leptospira* from *R. tanezumi* is even higher because of close living habitat of rats to human life. Applin *et al.*²³ explained that was commonly found in urban and rural areas.

L. borgpetersenii serovar Sejroe infection was report-

ed detected in seven clinical blood serum specimens derived from humans in New Caledonia.²⁴ Sakamoto,²⁵ reported that a Japanese tourist was serovar infected after a vacation in Bali. Desvars *et al*,²⁶ stated that serovar Sejroe was a major serovar causing abortion in cattle in the Reunion Island. Chronic infection of *Leptospira* in cattle can cause reproductive problems, such as abortion and low fertility.²⁷ In the study area, there were quite a lot of farm animals, such as goats, sheep and cows. Based on data from the Central Statistics Agency, there were 562 cows, 278 goats and 95 head of sheeps at Jeron Village in 2014. Meanwhile, cattles in Sindon village consisted of 159 cows, 175 goats and 194 sheeps.²⁸⁻²⁹ Cattles can be a source of infection for humans and the environment.

Isolate number 44 was shown mostly different from the other five isolates. Isolate number 44 also did not have close kinship with any serovar. This indicated that probably the isolate number 44 is a pathogenic *Leptospira* serovar derived from different ancestors with five other isolates. The point of location where the positive *Leptospira* rats found were mapped to determine areas with possible transmission. Spatial analysis was done by using the buffer analysis of rats daily cruising. Spatial distribution indicated that the position of positive *Leptospira* rats either in Sindon or in Jeron were around the latest leptospirosis cases in both villages.

In Jeron village, there is a positive shrew found in a distance of less than 30 meter from leptospirosis cases. Meanwhile, in Sindon Village, positive rat was found at a distance of 150 meter from leptospirosis case. The location of leptospirosis cases in these two villages were within the range of daily activity area of positive rats, enabling acquiring leptospirosis from *Leptospira*-infected rats. Priyambodo,¹⁴ mentioned that the average distance of rats daily activity at a time when food abundant was 30 meter, and not more than 200 meter. Villafane *et al*,¹⁵ reported that the average longest distance taken by *Rattus norvegicus* was 33.7 meter.

Rat trapping in this study were performed three and four weeks after the death cases of leptospirosis. Although it cannot be concluded that the source of infection leptospirosis cases who died were from the positive rats found in this study, the discovery of the positive rats remains a concern because it can serve as a source of transmission. *Leptospira* in environmental viability depends on pH, temperature and the presence of pollutants. *Leptospira* is sensitive to acids and can live in fresh water for approximately one month. In the sea water, sewage and undiluted urine, the bacteria will quickly die. *Leptospira* can live for three weeks in the flooded land.³⁰ It also suggests that *Leptospira* was still in the neighborhood and can be a source of infection given the *Leptospira* to be excreted into urine of mice for a long

time, and *Leptospira* is able to live in a suitable environment for months.

The PCR method can be performed at various locations bacteria genome *Leptospira*, so making this method becomes a reliable method. Delay in leptospirosis diagnosis can cause severity that likely to result in death. Conventional methods, such as culture or Microscopic Agglutination Test (MAT), require live cultures of bacteria *Leptospira* with high bio-hazard level. Another advantage of the PCR method is its ability to detect *Leptospira* bacteria from samples. Joshi *et al*,³¹ explained that the PCR method has high accuracy, because of DNA amplification is done specifically, so that the samples containing only small amounts of DNA can still be detected. Besides, the PCR requires a relatively short time.

Rapid diagnosis of leptospirosis is very important in the handling this disease. Delay in diagnosis can lead to various complications, such as inflammation of the pancreas, brain hemorrhage, pulmonary hemorrhage, and others that require intensive therapy.

Conclusion

From rats and shrew samples examined, six samples were *rpoB* gene positive from *R. tanezumi*, *R. argentiventer* and *S. murinus* species. Five of the six positive samples showed the closest kinship to *L. borgpetersenii* serovar Sejroe. One isolate does not have a close kinship to any serovar included in the cluster. Rats with *Leptospira* positive are found within the home range (30 meter and 150 meter). Location of rats with positive *Leptospira* was accumulated around the leptospirosis patients.

Recommendation

People in location of study should increase awareness towards transmission of leptospirosis disease because in their environment, rats with pathogenic *Leptospira* positive are already found. For further studies, detection of *Leptospira* in environment (water and land) or other reservoir in Boyolali District can be performed.

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Environmental, Behavioral Factors and Filariasis Incidence in Bintan District, Riau Islands Province

Faktor Lingkungan, Perilaku, dan Kejadian Filariasis di Kabupaten Bintan, Kepulauan Riau

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Abstract

Microfilaria rate of filariasis in Bintan District remains high, especially in Teluk Bintan, Teluk Sebong, and Sri Kuala Lobam Subdistricts. This study aimed to determine relation between environmental risk factors (physical, biological, chemical, socio-cultural, economic) and behavioral factors with filariasis incidence. The study was an analytic observational study conducted on May – September 2015 using case control design, which consisted of a total of case as many as 33 filariasis sufferers and a total of control as many as 65 non filariasis sufferers as taken by cluster sampling technique. Population of study was people in Bintan District. Data obtained were then analyzed by using chi square and logistic regression test. Results showed correlation of knowledge (p value= 0.045; OR = 1.365), wire-net use (p value = 0.048; OR = 1.381), stockyard (p value= 0.018; OR = 3.5), swamp (p value = 0.038; OR = 1.358), plantation/forest (p = 0.035; OR = 0.373) and mosquito-net use (p value = 0.036; OR = 1.417) as risk factor of filariasis incidence. In conclusion, variables most related to filariasis incidence in Bintan District are knowledge (OR = 6.154), mosquito-net use (OR = 3.861) and distance to swamp (OR = 3.668).

Keywords: Behavior, environment, filariasis, risk factors

Abstrak

Tingkat mikrofilaria filariasis di Kabupaten Bintan masih tinggi, khususnya di Kecamatan Teluk Bintan, Teluk Sebong, dan Sri Kuala Lobam. Penelitian ini bertujuan untuk mengetahui hubungan faktor risiko lingkungan (faktor fisik, biologi, kimia, sosial budaya, ekonomi) dan faktor perilaku dengan kejadian filariasis. Jenis penelitian observasional analitik yang dilakukan pada Mei – September 2015 dengan desain kasus kontrol, yang terdiri dari jumlah kasus 33 orang penderita filariasis dan kontrol 65 orang bukan penderita filariasis dengan teknik cluster sampling. Populasi penelitian adalah masyarakat di Kabupaten Bintan. Data yang diperoleh dianalisis menggunakan uji kai kuadrat dan regresi logistik. Hasil menunjukkan adanya hubungan pengetahuan (nilai p = 0.045; OR = 1.365), kawat kasa (nilai p = 0.048; OR = 1.381), kandang ternak (nilai p = 0.018; OR = 3,5), rawa-rawa (nilai p = 0.038; OR = 1.358), perkebunan/hutan (nilai p = 0.035; OR = 0.373), dan penggunaan kelambu (nilai p = 0.036; OR = 1.417) sebagai faktor risiko kejadian filariasis. Sebagai kesimpulan, variabel yang paling berhubungan dengan kejadian filariasis di Kabupaten Bintan adalah pengetahuan (OR = 6.154), penggunaan kelambu (OR = 3.861) dan jarak dengan rawa-rawa (OR = 3.668).

Kata kunci: Perilaku, lingkungan, filariasis, faktor risiko

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Introduction

Filariasis known as elephantiasis, up to now still becomes one of public health problems in the world, especially in Indonesia. In 2004, filariasis infected 120 million people in 83 countries, mainly in tropical and sub-tropical regions. It is estimated that one fifth of world's inhabitants or about 1.1 billion people are at risk of getting filariasis infection.¹ The rapid survey of filariasis in 2000 reported that this disease has spreaded to all provinces in Indonesia consisting of 231 regencies, 674 community health centers, and 1,533 villages, with the number of chronic clinical cases (elephantiasis) around 6,500 people. Meanwhile, in 2004, the number of clinical cases both in the form of acute and chronic filariasis increased to 11,969.²

The case of clinical filariasis is that sufferers of Filaria worm infection show the clinical symptoms that attack lymph duct and lymph gland, damage lymphatic system, and the manifestation of swollen hands, legs, glandula mammae and scrotum. Differ from Malaria and hemorrhagic fever, filariasis can be infected by 23 mosquito species from the genus of *Anopheles*, *Culex*, *Mansonia*, *Aedes*, and *Armigeres*. Therefore, this disease can circulate very rapidly.³ The results of a study conducted by Ramadhani,⁴ showed a high of microfilaria number and morbidity rate of acute filaria (0.4 %), as well as the high density of microfilaria parasite of *Wuchereria bancrofti* as one of filariasis agents. This disease may lead to permanent physical defect, social stigma, and psychosocial barrier as well as the decrease of work productivities of individual, family and the community, so that leads to huge economic lost.⁵

Filariasis is triggered by the condition of physical environment encompassing climate, geographical situation, geological structure, etc. Physical environment factors highly relate with breeding and resting places of the mosquito vectors. The environment of breeding places (swamp) with water plants and the existence of reservoir host animals (such as monkey, langur and cat) intensely affect the spread of filariasis by *Brugia malayi* of both sub-periodic nocturna and non-nocturna types.⁵ A publication of Srividya, *et al*,⁶ titled "A Geostatistical Analysis of the Geographic Distribution of Lymphatic Filariasis Prevalence in Southern India" yielded a prevalence disparity between filariasis cases among people living in mountain and coastal areas.

Bintan District, Batam City and Lingga District are filariasis-endemic areas in Riau Islands Province.⁷ A finger blood survey was held in Tembeling Village and Bintan Buyu Village in 2012 in which the blood samples were examined in the laboratory of Environmental Health Technique (*Balai Teknik Kesehatan Lingkungan/BTKL*) of Batam. The examination found 53 microfilaria positive blood samples, for instance, 28 out of 318 samples in

Tembeling Village (8.8%) and 25 out of 343 samples in Bintan Buyu Village (7.3%). Microfilaria rate in Bintan District by 8% meant that the district is categorized as filariasis-endemic area that should follow the eliminating program. Mass medication is conducted once a year for a period of five years. It aims to reduce the prevalence of microfilaria to less than 1%, and to improve the management of clinical cases, so the disease no longer becomes public health problem. In 2014, the number of cases increased to 66 in Teluk Bintan, Teluk Sebong and Sri Kuala Lobam Subdistricts, and were comprised of 45 males and 21 females.⁷

The geographical condition of Bintan District constitutes of highlands, forest, plantation and swamp areas. Major occupations of the local people are farmer, plantation worker, fisherman and trader. There is a habit among the people to come and sit together in food stalls, especially during the night.⁷ The high of fillariasis cases and the still unknown factors related to those cases were the main reasons for this study that aimed to find out relation between environmental and behavioral risk factors with filariasis incidence in Bintan District in 2015.

Method

This study was an analytic observational using case-control design. Location of study was in Bintan District as conducted from May to September 2015. Study population was 66 filariasis cases taken from the data of Bintan District Health Agency in 2014. Samples were all those population, and some inclusion criteria applied were receiving health services from the government and still living in Bintan District at the time of study. However, persons who refused to be interviewed were excluded from the sample list. Based on those criteria, 33 samples of filariasis cases were selected by following cluster random sampling technique. To fulfill the case control design, a number of non-filariasis sufferers were also involved in. By using a ratio of 1:2 between the case and the control, 65 people were selected as the control group. The condition in study location made the number of control hard to reach its optimal size, for instance, there was one case that only had one neighbor.

The distance from respondents' houses to sub-variables of stockyard, swamp, bushe, seashore, plantation/forest (supportive and not supportive) were measured by using measuring-tape and stated in meter unit. The sub-variables of salinity (normal and high) and pH (high and low) were measured by using salinity-meter and universal indicator respectively. The sub-variables of wire-net, ceiling, and ditch/sewerage (meet and unmeet the requirements), mosquito-net (in-use and not in-use), and reservoir animals (present and not present) were observed by using check list. The sub-variables of income (high and low), gender (male and female), age (produc-

tive and non-productive), education (high and low), occupation (employed and unemployed), knowledge (good and bad), attitude (good and bad), mosquito repellent (in-use and not in-use), clothes hanging (yes and no), night going-out (yes and no) were measured by using questionnaire.

Filariasis cases as the dependent variable were obtained from documents of Bintan District Health Agency. Meanwhile, as the controls were neighbors whose houses nearest to the cases' houses and who were not suffered from filariasis. The data were then analyzed by using chi square test and logistic regression test at confidence level

of 95%.

Results

Results of statistical analysis concluded that independent variables which had relation with filariasis incidence were knowledge (p value = 0.045; OR: 1.365), ventilation installed with wire-net (p value = 0.048; OR: 1.381), and distance between house and stockyard (p value = 0.018; OR: 3.500), swamp (p value = 0.038; OR: 1.358), and plantation/forest (p value = 0.035; OR: 0.373) as well as the use of mosquito-net (p value = 0.036; OR: 1.417). Meanwhile, sex, age, education, oc-

Table 1. Characteristics of Individuals, Environments and Filariasis Incidence

		Filariasis Incidence						
Variables	Category	Yes		No		p Value	OR	95% CI
		N	%	N	%			
Characteristics of Individuals								
Sex	Male	14	38.9	22	61.1	0.405	1.440	0.609-3.405
	Female	19	30.6	43	69.4			
Age	Productive	18	30.5	41	69.5	0.415	0.702	0.300-1.644
	Non productive	15	38.5	24	61.5			
Education	High	4	22.2	14	77.8	0.225	0.502	0.151-1.670
	Low	29	36.3	51	63.8			
Occupation	Employed	13	39.4	20	60.6	0.393	1.463	0.610-3.507
	Unemployed	20	30.8	45	69.2			
Knowledge	Good	16	26.4	45	73.8	0.045*	1.365	0.979-1.903
	Poor	17	45.9	20	54.1			
Attitude	Good	23	29.1	56	70.9	0.051	1.496	0.913-2.454
	Bad	10	52.6	9	47.4			
Environments								
Wire-net	Present	3	15.0	17	85.0	0.048*	1.381	1.071-1.781
	Absent	30	38.5	48	61.5			
Ceiling	Present	7	43.8	9	56.3	0.351	1.675	0.562
	Absent	26	31.7	56	68.3			
Ditch/sewerage	Present	16	34.8	30	65.2	0.827	1.098	0.475
	Absent	17	32.7	35	67.3			
Stockyard	Present	5	16.7	25	83.3	0.018*	3.500	1.195-10.253
	Absent	28	41.2	40	58.7			
Swamp	Not supportive	13	24.5	40	75.5	0.038*	1.358	1.003-1.839
	Supportive	20	44.4	25	55.6			
Bush	Not supportive	8	47.1	9	52.9	0.199	1.991	0.688-5.762
	Supportive	25	30.9	56	69.1			
Seashore	Not Supportive	28	33.3	56	66.7	0.861	0.900	0.276-2.940
	Supportive	5	35.7	9	64.3			
Plantation/forest	Not supportive	8	21.1	30	78.9	0.035*	0.373	0.147-0.950
	Supportive	25	41.7	35	58.3			
Salinity	Normal	30	33.3	60	66.7	0.811	0.833	0.187-3.723
	High	3	37.5	5	62.5			
Water pH	Low	30	33.7	59	66.3	0.982	1.017	0.238-4.352
	High	3	33.3	6	66.7			
Income	High	13	38.2	21	61.8	0.486	1.362	0.570-3.252
	Low	20	31.3	44	68.8			
Mosquito-net	Yes	18	26.9	49	73.1	0.036*	1.417	0.978-2.052
	No	15	48.4	16	51.6			
Mosquito repellent	Yes	29	36.7	50	63.3	0.195	2.175	0.659-7.178
	No	4	21.1	15	78.9			
Night going-out	Yes	16	44.4	20	55.6	0.086	0.472	0.199-1.118
	No	17	27.4	45	72.6			
Clothes hanging	Yes	15	33.3	30	66.7	0.948	1.029	0.444-2.385
	No	18	34.0	35	66.0			
Reservoir animals	Yes	2	16.7	10	83.3	0.158	0.335	0.073-1.724
	No	31	36.0	55	64.0			

Table 2. Relation between Characteristics of Individuals, Environments and Filariasis Incidence (Multivariate Logistic)

Variable	Category	B	p Value ^a	Exp (B)	95% CI Exp (B)	
					Lower	Upper
Characteristics of Individuals	Education	1.245	0.091	3.471	0.818	14.729
	Knowledge	1.817	0.002	6.154	1.898	19.952
Environments	Wire-net	1.345	0.079	3.837	0.858	17.166
	Swamp	1.300	0.017	3.668	1.263	10.650
	Plantation/forest	1.108	0.061	3.027	0.948	9.663
	Mosquito-net	1.351	0.016	3.861	1.291	11.549
	Night going-out	1.098	0.037	2.998	1.068	8.416
Constant		-3.375	0.000	0.034		

cupation, the presence of ceiling and ditch/sewerage, the distance to bush and seashore, water pH, income, mosquito repellent use, the habit of night going-out and outfit hanging as well as presence of reservoir animals had no significant relation with filariasis incidence (all p value > 0.05). The complete results could be seen in Table 1.

Table 2 presented multiple logistic regression to variables with chi square test results that were eligible (p value < 0.25). Based on the results, the most influential variables to the incidence of filariasis in Bintan District were knowledge (p value = 0.002; OR = 6.154); netting (p value = 0.016; OR = 3.861); and swamp (p value = 0.017; OR = 3.668). The equation is $y = -3.375 + 1.245 (\text{education}) + 1.817 (\text{knowledge}) + 1.345 (\text{gauze}) + 1.300 (\text{marshes}) + 1.108 (\text{gardens / forest}) + 1.351 (\text{bed nets}) + 1.098 (\text{night going-out})$. The equation was applied to predict the probability of suffering from filariasis disease incidence.

Discussion

In general, number of respondents with good knowledge was 61 persons (62.2%). Based on the statistical test, there was a relation between knowledge and the incidence of filariasis in Bintan District (p value = 0.045), and respondents with low knowledge were 1.365 times more likely to contact with filariasis. Based on results of the interviews, on average the respondents could answer the questions about filariasis. This was because the health officers often provided information to people living in high risk areas. The presence of some people who had low knowledge was because they lived in remote areas and had low education, so this condition was potential to influence their knowledge and understanding. Therefore, information sharing has to be raised continuously, but accompaniment by optimizing roles of health cadres among the community has to be implemented as well.

Results of this study was in line with Agustiantiningsih's,⁸ study which stated that a relation was found between knowledge and preventive measures

of filariasis (p value < 0.001). Preventive efforts could be applied by doing applicative yet simple elucidation activities which comprise of advices for avoiding contact with filariasis mosquito vectors by means of using mosquito-net, closing house ventilation with wire-net, and applying mosquito repellent.⁹ A study conducted by Ulohi,¹⁰ in Boneraya Subdistrict of Bone Bolango District obtained result that education and filariasis incidence was related (p value = 0.042; OR = 2.004). However, different result was found in study of Ambar, *et al.*,¹¹ in Pangku Tolole Village that knowledge of filariasis (p value = 0.431) and the prevention of filariasis (p value = 0.159) had no relation.

Theoretically, variation of specific elucidation method for filariasis sufferers and people living around and near to them is needed to be implemented. It can be done, for example, through video screening in coffee shops, before and after community activities, and information propagation through radio stations that is designed specifically to be inserted in favorite programs for general people, such as musical or news ones. This motivating effort hopefully can reach communities in the remote areas about the information of filariasis impact that is not immediately treated, and therefore either the surroundings people or neighbors or family members with filariasis clinical symptoms cases can be directly active bringing them to the nearest community health center.¹²

Good knowledge is hopefully to build good attitude, so that individuals or the community are able to solve health problems they face. People who still maintain bad attitude to filariasis may be caused by the lack of knowledge and education level they attain. It may be caused as well through less appropriate socialization activities about the disease and its corresponding preventive measures which is performed by health officers.^{13,14} This is because the foundation of attitude consolidation is positive behaviors of which the trust and believe about the gained advantages grow from.¹⁵

The proportion of those whose houses were far from swamps (not supportive) was 54.1% or 53 persons. The

statistical test showed that swamp was significantly related to filariasis incidence (p value = 0.038), and the risk of getting filariasis was 1.358 times higher. A study by Uloli,¹⁰ stated that living near swamp environment was correlated with filariasis incidence (p value = 0.017; OR: 3.563). Study conducted by Jontari,¹⁶ also concluded that there was a relation between human settlement and swamp in the surrounding (< 500 meter) and the filariasis incidence (p value = 0.008). These conditions depicted that transmission of filariasis was so influenced by interaction between human behavior and the surrounding environment which had possibility to support filariasis infection.¹⁷ Wire-net installed at house ventilation aims to reduce the frequency of mosquito bite, therefore will prevent the potential risk of contracting filariasis.¹⁸ Ministry of Health states that habit of using wire-net for mosquito protection is highly needed, especially for people living in endemic areas or near swamps, plantations and rice fields where mosquito bite is very intense.¹⁹

A study conducted by Sipayung, *et al*,²⁰ concluded that existence of biological environment around houses is related to lymphatic filariasis incidence in the endemic areas of Sarmi District (p value = 0.005). Upadhyayula's,²¹ study in India found relation between presence of mosquito's breeding places and filariasis incidence (p value = 0.002). Meanwhile, Ike's,²² study found that in Pekalongan District, relation between biological environment and filariasis incidence was identified. Lasbudi's,²³ study stated that mosquito density was found more in place that has suitable temperature, humidity and illumination for mosquito's growth and development, so potential for filariasis incidence.

The existence of water puddle will increase the risk of being infected by filariasis because this condition can increase mosquito population. The Ministry of Health says that endemic location for *Brugia malayi* is areas with forest and swamps along river flow, or water body that full with water plants.² A study conducted by Ashari,²⁴ found relation between presence of water plants and filariasis incidence. The study also found that people living in houses with mosquito habitat were eight times more likely to get filariasis. In addition, a study of Mulyono, *et al*,²⁵ concluded that water puddle was the risk factor of filariasis 4.14 times higher.

Therefore, swamp is highly related to bionomics of mosquito vectors since this type of environment is used as both breeding and resting places for the insects. Water plants are breeding places for *Mansonia* mosquitoes as the larva's and the pupas of this species breathing by means of the plants' roots beneath the water surface, and through the floating stalks and leaves.²⁶

The need of high humidity level affects mosquitoes to seek damp and wet places outside people's houses as their resting place during day time. *Anopheles farauti*,

one of filariasis vectors, enters houses just for blood sucking and afterward go out of the houses to perch for maturing their eggs. One of the preferred outdoor places is shady spots with trees.²⁷

Management of the environment is very important for controlling the vector mosquitoes of diseases. Immediate intervention is needed to lessen the swamps, to treat the unoccupied yards, and to install mosquito traps, so that can force the vector control to run more optimal.² The government hopefully can do communication with plantation companies about reinvestment and Corporate Social Responsibility (CSR), such as development of healthy houses, the control and size reduction of swamps, and the management of unoccupied yards as breeding places for mosquitoes in order to diminish the biting intensity of filariasis-causing mosquitoes.

Based on the interviews and observations which has been carried out, the proportion of those using mosquito-net was 68.4% or 67 people. Test of relation showed that habit of not using mosquito-net had significant relation to filariasis incidence (p value = 0.036), and risk of contracting filariasis was 1.417 times higher.

Results of Jontari's study concluded that sleeping without using mosquito-net (p value = 0.029; OR = 1.170) was the risk factor of filariasis.¹⁶ A study conducted by Ambar,¹¹ identified relation between prevention and self-protection methods by using mosquito-net or repellent, and filariasis incidence (p value = 0.038). It was identified as well that 61.25% of respondents owned mosquito-net and used it. Results of study conducted by Juriastuti,²⁸ is different that found no relation between the use of mosquito-net and filariasis incidence. The main effort of filariasis prevention is keep away from the biting of mosquito vectors, such as by using mosquito-net when sleeping, covering house ventilation with wire-net, and rubbing skins with mosquito repellent.³

Based on the results of multiple logistic regression test, four variables showed significant relation to filariasis incidence, such as knowledge, mosquito-net use, swamp, and night going-out. Similar results were also obtained by Febrianto's,¹⁸ study which concluded that the dominant factors for filariasis incidence were mosquito-net and ceiling construction. Meanwhile, a study of Nasrin,¹² found that the most dominant risk factors of filariasis incidence in West Bangka were occupation, income, swamp presence, and respondents' knowledge level.

Main focus for Filariasis handling in Bintan District starts from knowledge increasing efforts by means of health promotion activities equipped with elucidation and information dissemination through pictorial banners, as well as by socialization about the importance of mosquito-net use as preventive measure from mosquito bites, and the distribution of the nets to people, especially those

living in case areas. Prevention action for filariasis can be carried out by cleaning breeding places of the mosquitoes, burying used stuffs potential for becoming water containers, draining water containers, mass insecticide spraying, wearing self-protective devices when working at plantation, such as long sleeve apparel, applying mosquito repellent on skin, using mosquito-net when sleeping, not going-out home at night, and covering ventilation with wire-net.^{29,30} These actions should be integrated held through coordination with all stakeholders among the community, private sectors and the government (cross program and cross sector). Community empowerment is also needed for up-leveling the behaviors of clean and healthy living.^{31,32} At the end, all those activities can contribute to the success of filariasis eliminating program that has been declared by the local government of Bintan District.

Conclusion

There is no relation found between sex, age, occupation, education, attitude, ceiling, ditch/sewerage, salinity, water pH, bush, seashore, income, mosquito repellent, night going-out, clothes hanging and reservoir animals, and the incidence of filariasis in Bintan District. On the other hand, knowledge, wire-net use, stockyard, swamp, plantation/forest, and mosquito-net are related to the incidence of the disease. Factors most related to filariasis incidence in Bintan District are knowledge, mosquito-net use and swamp.

Recommendation

The community health centers should keep strengthening the surveillance system, especially for the subsidiary health centers throughout and in remote areas of Bintan District. Then people should use mosquito-net or repellent when sleeping or going out at night. Vectors and environment (swamp and plantation/forest) control should be implemented in an integrated manner by strengthening cross-sectoral coordination including the mining companies and plantations around filariasis-endemic areas.

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Measles Immunization and Vitamin A for Prevention of Pneumonia in Indonesia

Imunisasi Campak dan Vitamin A untuk Pencegahan Pneumonia di Indonesia

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Abstract

Pneumonia is the major cause of child death in Indonesia after diarrhea. Increasing coverage of measles, pertusis, *Streptococcus pneumoniae* (Spn) and *Haemophilus influenzae b* (Hib) immunization substantially can control pneumonia. Spn and Hib vaccines have not been included in category of mandatory immunization in Indonesia. Measles vaccine has more direct effect on prevention of pneumonia than pertusis vaccine. Providing immunization followed by providing vitamin A will increase the specific antibody titer among children. This study aimed to determine effects of measles vaccine and vitamin A to pneumonia incidence among toddlers. Method of study was cross sectional using 13,062 data of children drawn from 2012 Indonesia Demographic and Health Survey. Data were analyzed using poisson regression test. Analysis results showed that prevalence of pneumonia among Indonesian children was 5.4%, measles immunization coverage was 82.57%, and vitamin A supplementation coverage was 74.9%. Furthermore, providing measles immunization and vitamin A could prevent pneumonia incidence among toddlers (12 – 59 months old) up to 26.5%. Providing measles immunization then followed by providing vitamin A can be used as a preventive action in attempt to decrease pneumonia incidence.

Keywords: Toddlers, measles, pneumonia, prevention, vitamin A

Abstrak

Pneumonia merupakan penyebab kematian tertinggi pada anak di Indonesia setelah diare. Pengendalian pneumonia dapat dilakukan dengan peningkatan cakupan imunisasi campak, pertusis, *Streptococcus pneumoniae* (Spn), dan *Haemophilus influenzae b* (Hib). Vaksin Spn dan Hib belum masuk ke dalam kategori imunisasi wajib di Indonesia. Vaksin campak lebih memiliki pengaruh langsung terhadap pneumonia dibandingkan dengan vaksin pertusis. Pemberian imunisasi yang disertai pemberian vitamin A akan meningkatkan titer antibodi pada anak. Penelitian ini bertujuan untuk mengetahui pengaruh pemberian imunisasi campak dan vitamin A terhadap kejadian pneumonia. Metode penelitian adalah potong lintang dengan menggunakan 13.062 data anak yang terdapat pada data Survei Demografi dan Kesehatan Indonesia tahun 2012. Data dianalisis dengan menggunakan uji regresi poisson. Hasil analisis menunjukkan prevalensi pneumonia pada anak di Indonesia adalah 5.4%, cakupan imunisasi campak sebesar 82.6%, dan cakupan pemberian vitamin A sebesar 74.9%. Pemberian imunisasi campak disertai dengan pemberian vitamin A dapat mencegah terjadinya kejadian pneumonia pada anak usia 12 – 59 bulan sebesar 26,5%. Pemberian imunisasi campak yang disertai dengan pemberian vitamin A dapat digunakan sebagai tindakan pencegahan dalam upaya penurunan kejadian pneumonia.

Kata kunci: Anak bawah lima tahun, campak, pneumonia, pencegahan, vitamin A

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Introduction

One of efforts many countries in the world in the fight against poverty and health problems is the Millennium Development Goals (MDGs) program. There are eight goals to be achieved as one of the MDG-4 goals is to decrease two-third of child mortality. This goal can be achieved if the two major problems of infant mortality, such as pneumonia and diarrhea, can be addressed effectively.^{1,2}

In 2011, there was approximately one-third of toddler death because of pneumonia worldwide.^{3,4} In 2007, toddler mortality in Indonesia was 44 per 1,000 live births.⁵ The figure is still relatively high compared to other countries in Southeast Asia. Mortality rate of toddler aged 1 – 4 years in Indonesia was 9 per 1,000 children in 2007. As much as 15.5% of deaths are due to pneumonia. This data ranks Indonesia at the sixth place in term of pneumonia incidence in the world and the highest in Southeast Asia.⁵ There are approximately six million new cases each year with incidence of pneumonia 0.28 episode per each child.⁶

Indonesia Demographic and Health Survey (IDHS) in 2007 showed that pneumonia was the cause of 11.2% of morbidity among toddlers.⁷ In 2007 and 2008, pneumonia cases showed that proportions of pneumonia among toddlers were 49.35% and 49.23% respectively. These figures showed that half of pneumonia incidence occurred among toddlers.⁵

Pneumonia is a case often associated with the incidence of measles, in which 56 – 86% of pneumonia mortality was associated with measles. Cases of severe pneumonia mortality associated with measles are two times higher than the mortality of severe pneumonia without measles. The increase of mortality is because of immunosuppressive and systemic effects of measles with bacterial super infection.^{4,7} Widodo, in his study suggested that complete immunization (*pertusis* and measles) on young children could reduce the morbidity caused by pneumonia.⁸

Vaccination programs recommended by Global Action Plan for Pneumonia conducted by the United Nations Children's Emergency Fund (UNICEF) have interventions for the prevention of morbidity and mortality due to pneumonia that include measles, *pertusis*, Spn and Hib. Hib vaccine can significantly reduce the incidence of severe pneumonia by 6% (RR = 0.94, 95%CI 0.89 - 0.99), reduced by 18% (0.82, 0.67-1.02) pneumonia with radiological confirmation.^{3,9} Based on several studies of vaccines (vaccine probe), it is estimated that pneumococcal conjugate vaccine can prevent morbidity and mortality by 20 – 35% of pneumococcal pneumonia cases.¹⁰

Pneumonia is a serious complication of measles, and the most common cause of mortality associated with

measles worldwide. Thus, reducing risk factor and management of measles incidence among children through vaccination will help control occurrence of pneumonia associated with measles.¹¹ In this study, the control is defined on preventive measures on the incidence of pneumonia among toddler. The study results will be a benchmark in estimating the effectiveness of measles immunization in reducing the risk of pneumonia incidence as a preventative measure in Indonesia. Therefore, this can significantly contribute in improving the understanding of decision makers to prevent the occurrence of pneumonia. The aim of data analysis was to determine effects of measles immunization and vitamin A that decreased prevalence of pneumonia among toddlers in Indonesia in 2012.

Method

This study used secondary data as drawn from 2012 IDHS, conducted by Indonesia's Central Statistics Agency (BPS) in collaboration with the National Population and Family Planning Board (BKKBN); Ministry of Health and ICF International. The survey was designed to collect data of fertility, family planning as well as maternal and child health. IDHS was commissioned by Indonesian government. The ICF International provided technical assistance through MEASUREDHS project, a program funded by the United States Agency for International Development (USAID). Data drawn from IDHS used in the study were prevalence of pneumonia, measles immunization and vitamin A.¹²

Prior to the start of the fieldwork of IDHS, the questionnaires were pretested in Riau Province and East Nusa Tenggara Province to make sure that the questions were clear and could be understood by the respondents. Different sample coverage of women from ever-married women aged 15 – 49 years to all women aged 15 – 49 years was importantly provided in the pretest. In addition, there were new questions and changes in question format from those in the standards of IDHS questionnaires. Persons who participated at the main survey were trained for interviewers. The training took place for 12 days in May 2012 at nine training centers. All of participants were trained using the household and individual questionnaires. Fieldwork took place from May 7 to July 31, 2012.¹²

2012 IDHS is designed with sample calculations that can be used to estimate data for the national, rural and urban, and provincial level. IDHS interviewed as many as 47,533 women aged 15 – 49 years, but only as many as 45,607 women had completed the interviews with results of the response rate or the achievement of number of interviews to 96%. Results of interviews of women aged 15 – 49 years identified number of 18,021 toddlers aged 0 – 5 years.¹² The missing data and "do not know" were ex-

cluded from analysis. The data sample used in this analysis was 13,062 toddlers aged 12 – 59 months.

Cross-sectional studies with dichotomous outcomes often use logistic regression. Result of logistic regression data was as a score of odds ratio (OR). If in the very rare cases, OR score would be closed to the value of risk ratio (RR)/prevalent ratio (PR). In the study with not rare case, the OR would move away from PR.¹³ This study used PR to describe the results. The regression poisson test was suitable for this analysis. The use of poisson regression robust at sufficient sample would show better results for estimating PR than the log-binomial method.¹⁴ Analysis of the cross-sectional and Mathel Haenszel was deemed unsuitable in the analysis of a complex sample.

Results

Overview of measles immunization could be obtained through the answers from maternal and child health record book availability of the measles immunization status acquired by the child. Generally, measles vaccine to children is provided at the age of 9 months or thereafter. Pneumonia is characterized by cough with difficult or rapid breathing and chest in-drawing at the last two weeks.

Table 1 showed that prevalence of pneumonia among Indonesian children was 5.4%. The highest prevalence of pneumonia was in Central Sulawesi (12.4%), meanwhile the lowest was Papua Province. The achievement of measles immunization on toddlers in Indonesia in 2012 was amounted to 82.6%. The highest achievement of measles immunization was in the Special Region of Yogyakarta, while the province with the lowest immunization coverage was in Papua Province. Result of Vitamin A proportion in Indonesia showed 74.9%, meanwhile the highest achievement was in the Special

Table 1 . Distribution of Proportion of Pneumonia, Measles Vaccine and Vitamin A

Variable	Category	Proportion (%)	95% CI
Pneumonia	No	94.6	94.0-95.2
	Yes	5.4	4.8-5.9
Measles vaccine	No	17.4	16.2-18.7
	Yes	82.6	81.3-83.8
Vitamin A	No	25.1	23.7 - 26.5
	Yes	74.9	73.5 - 76.3

Region of Yogyakarta (89.8%) and the lowest achievement was in Papua Province (45.9%).

Based on results of Table 2, PR was under 1 ($PR < 1$), which means that children who got measles vaccine were protected from pneumonia. This result also showed PR of measles vaccine among toddlers who did not get vitamin A and measles vaccine among toddlers who got vitamin A. It found that toddlers who got measles vaccine and vitamin A were more protected then toddlers who did not get vitamin A.

Potential impact measurement can be done by calculating in Population Attributable Fraction (AFP) and Prevented Fraction in Population (PFP). When the exposure is a protective factor or $OR < 1$ then used PFP. PFP is used to calculate the prevalence of potential that can already be prevented as a result of their exposure/intervention in the population.

According to results of Table 3, PFP of measles immunization was 24.8%. This means that there was 24.8% incidence of pneumonia in the population that had been prevented by the presence of measles immunization. PFP value can be increased if toddlers get measles vaccine and vitamin A. PFP value under these conditions was 26.5%.

Discussion

Based on analysis, the prevalence of pneumonia among toddlers in Indonesia amounted to 5.4%. This prevalence was still within the range of values reported by 2012 IDHS, in which the prevalence among children was 5.1%. Prevalence of pneumonia in Indonesia in 2012 was lower than the prevalence in 2007 that reached 11.2%.⁵ This study showed the prevalence of pneumonia among children who did not get measles immunization was 7.4%, meanwhile there were 4.9% children with pneumonia who got measles immunization. Prevalence of pneumonia among children who got measles immunization was lower than prevalence of children who did not.

Measles immunization can prevent morbidity and mortality of pneumonia because measles is a major complication of pneumonia that causes almost a quarter of deaths due to pneumonia. Measles infection can suppress the immune system in toddlers and often causes them lose weight, shrinking production of vitamin A in the

Table 2. Effects of Measles Vaccine among Toddlers

Variables	Category	PR	95% CI	p Value
Measles vaccine	No	1		
	Yes	0.7	0.57-1.96	0.022*
Measles vaccine * Vitamin A	Measles vaccine among toddlers not getting vitamin A	0.8	0.4-1.2	
	Measles vaccine among toddlers getting vitamin A	0.6	0.3-0.8	0.07**

* p value regression poisson test

**p value for Homogeneity of prevalent ratio

Table 3. Calculation of Prevented Fraction in Population of Measles Immunization against Pneumonia

Variables	PR	Pe (%)	PFe (%)	PFP%
Measles vaccine	0.7	82.6	30	24.8
Measles vaccine by not getting vitamin A	0.8	16.4	20	3.3
Measles vaccine by getting vitamin A	0.6	66.2	40	26.5

body as well as toddlers will be more susceptible to pneumonia.¹⁵

The prevalence of pneumonia was higher among toddlers who received vitamin A (5.6%) than who did not (4.7%). Giving vitamin A is in aim to enhance immunity against infectious diseases. However, in this study, it turned out to be different as pneumonia incidence was higher in the group of toddlers who received vitamin A than who did not. Similar result was found by Riza,¹⁶ stating that infants who did not receive vitamin A had 1.164 times risk higher than the infants who received vitamin A.

Toddlers in countryside have lower immunization coverage and lower access to health care than toddlers in urban areas. Economic and educational characteristics are also found lower in rural areas. From the air pollution sources inside homes, in village, fuel that produces residual pollution is generally used for cooking.¹⁷ This is cause of pneumonia among children in rural areas. Anwar,¹⁸ in his study concluded that social factors, demographic, economic and physical environmental conditions of the home jointly contribute to the incidence of pneumonia among toddlers in Indonesia.

The effect of measles immunization against pneumonia based on economic status can be seen that children who got measles immunization and belong to middle income family were more protected from pneumonia than children who got measles immunization and belong to lower income families. According to another study, Machmud,¹⁹ found the relation between poverty in families with pneumonia among children.

PR of pneumonia among toddlers who got measles immunization against pneumonia was 0.7 times lower than who did not. Toddlers who had been immunized were more resistant to pneumonia. The effect of measles immunization on children who received vitamin A was proven to have a better effect to prevent from pneumonia, which means that children who got measles immunization and vitamin A were more protected from pneumonia than children who got measles immunization without vitamin A. Providing vitamin A to children who never had pneumonia, in a certain period of time, the children would not suffer from severe pneumonia and it can prevent mortality. Otherwise, when suffering from pneumonia, vitamin A no longer reduces morbidity due to

pneumonia.²⁰

In general, the highest of PFP was found among toddlers who got measles immunization and vitamin A with the number of PFP was 26.5%. This means that toddlers who got measles immunization and vitamin A were protected from pneumonia by 26.5%. Therefore, providing measles immunization and vitamin A periodically for toddlers in a mass scale can increase endurance and protection for Indonesian children, so they can grow up and develop in good condition.²¹

Conclusion

The achievement of measles immunization in Indonesia in 2012 was 82.6%. This coverage is still lower than the target set by the Global Action Plan for the Prevention and Control of Pneumonia (GAPP). One of the targets set by the GAPP is coverage by 90% for any relevant immunization (with coverage by 80% in each region). Toddlers who get measles immunization plus vitamin A will be more effective in preventing pneumonia. PFP on toddlers who get measles immunization and vitamin A is 26.5%, which shows a significant value in prevention of pneumonia among children. It states that measles immunization and vitamin A are as effective as Spn and Hib.

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