

Health Behaviour Related to Sputum Conversion of Patients Pulmonary Tuberculosis in the Last Phase of Intensive Medication

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ABSTRACT

Introduction: Sputum conversion is one of indicators to quickly determine the result of medication. One target of a tuberculosis (TB) eradication program is the achievement of minimum sputum conversion rate at 80%. The sputum conversion rate at the last phase of intensive medication should be consistently below the predetermined target. This research aims to determine the health behaviour that influence the sputum conversion in the last phase of intensive medication.

Materials and Method: The research design used is quantitative with a cross-sectional approach. The sample in this research is pulmonary TB patients at the last phase of intensive medication in Banyumas area. The sample was taken using consecutive sampling, with the inclusion criteria of living with family and accompanied by caregiver to take the medicine during medication term, and the exclusion criterion was suffering from diseases such as chronic obstructive pulmonary disease, diabetes, HIV/AIDS. A total of 113 pulmonary TB patients were involved in this research. Their conversion status was seen from the reading of Acid-Fast Bacilli (AFB) results in the last phase of intensive medication. The researchers interviewed and observed the patients when they visited their homes regarding their medication, environmental hygiene, exercises, healthy diet, and avoidance of pulmonary TB risk factors.

Results: Most respondents were 15-64 years old, male, and earning below the Regional Minimum Wage (RMW). Most of them had a normal Body Mass Index (BMI). Patients' earning, compliance with medication, maintenance of environmental hygiene, compliance with a healthy diet, performance of physical exercises, and avoidance of risk factors are related to sputum conversion. Adherence to medication has the highest impact on sputum conversion among the pulmonary TB patients [OR: 18.77 (95% CI: 3.924, 89.792)].

Key words: Intensive medication, pulmonary TB, Sputum conversion

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INTRODUCTION

Pulmonary Tuberculosis (Pulmonary TB) has been defined as a global public health emergency by the World Health Organization (WHO) in 1993. Pulmonary TB has become the main cause of death for infectious diseases. 10.4 million people suffer pulmonary TB with death rate of 1.8 million people in 2016. According to the report of the Tuberculosis Global in 2017, Indonesia is at the second highest rate of pulmonary TB incidences in the world after India. 391 cases of pulmonary TB are found out of 100,000

populations [1]. Pulmonary TB disease affects patient's quality of life, particularly in physical and psychosocial domains [2]. The physical domain includes malnutrition, hemoptysis, resistance to medication and death [3]. In psychosocial aspect, the existence of a pulmonary TB patient will cause a negative stigma among the community which may cause depression in the early phase of pulmonary TB diagnosis [4].

The Indonesian Government has since 1995 applied Directly Observed Treatment Short course (DOTS) as the most cost-effective strategy to prevent pulmonary TB (Ministry of Health Indonesia, 2014, Out, 2013) [5,6]. DOTS focus on searching pulmonary TB cases and performing direct medication until patients regain their health. The medication prioritizes pulmonary TB patients

with microscopic sputum examination result showing positive Acid-Fast Bacilli (AFB) [5].

Sputum conversion in the phase of intensive medication has become a therapy success predictor for pulmonary TB patients with positive AFB. Sputum conversion is seen when no acid-fast bacilli are found in patient's sputum during sputum retaking after taking an intensive medication phase for two months [7]. Sputum conversion has become an indicator to monitor and assess how successful a pulmonary TB medication is. The Indonesian Government has targeted a minimum conversion rate of 80% [5]. However, the conversion rate in Central Java remains under the target, which is at 76% [8].

That smear sputum becomes negative indicates that a patient is not infectious [9]. On the contrary, a patient who fails sputum conversion after taking two months of medication shows a bad management [10]. If smear sputum remains positive after two months of medication, the intensive phase will be extended for one more month [11]. Sputum with positive AFB result is also likely to infect other individuals. A patient who fails conversion in the last phase of intensive medication has higher risk of resistance to medication [12].

Various researches have shown that sputum conversion is influenced by age, sex, nutritional status, earning rate, educational level, accompanying diseases, smoking habit, and role of caregiver to take medication [13-15]. The previous researches have not identified TB patients' health behaviour regarding sputum conversion, including compliance with medication, physical exercises, healthy diet, environmental hygiene and avoidance of TB risk factors. Therefore, this research aims at identifying the influence of individual characteristics, compliance with medication, physical exercises, healthy diet, environmental hygiene, and avoidance of sputum conversion risk factors.

MATERIALS AND METHODS

This quantitative research employed the cross-sectional approach and was conducted in the Kembaran Sub-district, Sumbang Sub-district, and Baturaden Sub-district, Banyumas Regency, with the highest pulmonary TB cases. This research obtained approval from the Office of Nation Unity and Politics of Banyumas Regency.

All respondents were informed of their rights, research objectives, procedures, risks, benefit of participation in this research, and duration of participation in the research. The respondents voluntarily participated in this research, and their information is kept confidential.

Sampling

The research employed consecutive sampling with inclusion criteria of age above 15 years old, living with family, and accompanied by caregiver to take the

medicine during the medication term. The exclusion criteria were patients with accompanying diseases such as diabetes, HIV/AIDS, or COPD and patients with physical immobility. A total of 113 respondents met the inclusion and exclusion criteria.

Data collection

The sputum conversion data were obtained from the results of the last phase of intensive sputum examination. The demography and other variable data were obtained from home visits. The researchers interviewed and observed the patients' medication, environmental hygiene, exercise, healthy diet, and avoidance of pulmonary TB risk factors. The Chi Square test was employed to determine factors regarding sputum conversion, followed by a multivariate analysis for factors regarding bivariate analysis.

RESULTS

Data were analysed using SPSS 21 (IBM statistics 21). Descriptive statistics (frequencies) was computed for the frequency of characteristics of respondent including age, sex, educational level, patients' earning, body mass index (BMI), employment, compliance with medication, environmental hygiene, compliance with healthy diet, physical exercises, avoidance of TB risk factors and sputum conversion.

The result indicate that most respondents were 15-64 years old (productive age) and male, with an elementary educational level, earning below the regional minimum wage of Banyumas Regency, normal BMI and more than half 63 respondents (55.8%) successful sputum conversion. The research results also indicate that there is no relation between age ($p=0.487$), sex ($p=0.104$), educational level ($p=0.271$), employment ($p=0.169$), BMI ($p=0.329$), and sputum conversion. Meanwhile, earning rate is related to sputum conversion ($p=0.006$; $OR=3.01$).

Similarly, compliance with medication ($p=0.001$; $OR=9.789$), environmental hygiene ($p=0.001$; $OR=5.76$) compliance with healthy diet ($p=0.001$; $OR=6.83$), physical exercises ($p=0.001$; $OR=8.97$), and avoidance of TB risk factors ($p=0.002$; $OR=3.45$) are related to sputum conversion. The pulmonary TB patients who are compliant with medication will have sputum conversion 9.789 times higher than patients who are not (Table 1).

According to the final multivariate modelling results, the pulmonary TB patients who are obedient to medication will have sputum conversion 18 times higher than the disobedient patients after control with healthy diet, environmental hygiene, exercises, and avoidance of risk factors variables. The OR value of healthy diet variable is lower than that of other variables. Patients who perform healthy diet will have sputum conversion 8 times higher

than patients who do not perform healthy diet after control with other variables in final modelling (Table 2).

Table 1: Relationship of Respondents' characteristics, Compliance with Medication, Healthy Diet, Physical Exercises, Environmental Hygiene, and Avoidance of Conversion Status Risk Factors (n=113).

| Characteristics | Conversion Status | | Total | OR (95% CI) | p value |
|--------------------------------------|-----------------------|--------------------|------------|-------------------|---------|
| | Successful Conversion | Failing Conversion | | | |
| Age | | | | | |
| 15-64 years old | 43 (38.1%) | 31 (27.4%) | 74 (65.5%) | 1.31 | 0.487 |
| ≥ 65 years old | 20 (17.7%) | 19 (16.8%) | 39 (34.5%) | (0.604-2.873) | |
| Sex | | | | | |
| Male | 32 (28.3%) | 33 (29.2%) | 65 (57.5%) | 1.88 | 0.104 |
| Female | 31 (27.4%) | 17 (15.0%) | 48 (42.5%) | (0.87-4.04) | |
| Education | | | | | |
| Elementary School (SD, SMP)* | 43 (38.1%) | 29 (25.7%) | 72 (63.7%) | | 0.272 |
| High School (SMA) | 13 (11.5%) | 17 (15.0%) | 30 (26.5%) | 0.51 (0.21-1.22) | |
| Higher Education (Diploma, Bachelor) | 7 (6.2%) | 4 (3.5%) | 11 (9.7%) | 1.18 (0.31-4.39) | |
| Earning | | | | | |
| <RMW (< Rp.1,589,000) | 29 (25.7%) | 39 (31.9%) | 65 (57.5%) | 3.01 | 0.006 |
| ≥ RMW (≥ Rp.1,589,000) | 34 (30.1%) | 14 (12.4%) | 48 (42.5%) | 1.36-6.65 | |
| BMI | | | | | |
| Thin | 32 (28.3%) | 30 (26.5%) | 62 (54.9%) | 1.45 | 0.329 |
| Normal | 31 (27.4%) | 20 (17.7%) | 51 (45.1%) | 0.68-3.08 | |
| Employment | | | | | |
| Housewife* | 21 (18.6%) | 12 (10.6%) | 33 (29.2%) | | 0.168 |
| Labor | 22 (19.5%) | 12 (10.6%) | 34 (30.1%) | 1.048/0.386-2.845 | |
| Self-Employed | 16 (14.2%) | 19 (16.8%) | 35 (31.0%) | 0.481/0.182-1.272 | |
| Civil Servant | 4 (3.5%) | 7 (6.2%) | 11 (9.7%) | 0.327/0.079-1.349 | |
| Compliance with Medication | | | | | |
| Compliant | 54 (47.8%) | 19 (16.8%) | 73 (64.6%) | 9.789 | 0.001 |
| Non-compliant | 9 (8.0%) | 31 (27.4%) | 40 (35.4%) | 3.94-24.26 | |
| Healthy Diet | | | | | |
| Good | 45 (39.8%) | 15 (13.3%) | 60 (53.1%) | 6.83 | 0.001 |
| Poor | 18 (15.9%) | 35 (31.0%) | 53 (46.9%) | 2.51-13.18 | |
| Physical Exercise | | | | | |
| Regular | 50 (44.2%) | 15 (13.3%) | 65 (57.5%) | 8.97 | 0.001 |
| Irregular | 13 (11.5%) | 35 (31.0%) | 48 (42.5%) | 3.80-21.19 | |
| Environmental Hygiene | | | | | |
| Good | 50 (44.2%) | 20 (17.7%) | 70 (61.9%) | 5.76 | 0.001 |
| Poor | 13 (11.5%) | 30 (26.5%) | 43 (38.1%) | 2.51-13.25 | |
| Avoidance of Risk Factors | | | | | |
| Avoid | 45 (39.8%) | 21 (18.6%) | 66 (58.4%) | 3.45 | 0.002 |

| | | | | |
|-----------|------------|------------|------------|-----------|
| Not avoid | 18 (15.9%) | 29 (25.7%) | 47 (41.6%) | 1.57-7.55 |
|-----------|------------|------------|------------|-----------|

Table 2. Final modelling result of factors related to sputum conversion (n=113).

| Variable | B | Wald | p-Wald | OR | CI 95% |
|----------------------------|-------|--------|--------|--------|--------------|
| Compliance with Medication | 2.932 | 13.484 | 0 | 18.771 | 3.924-89.792 |
| Environmental Hygiene | 2.818 | 12.013 | 0.001 | 16.747 | 3.403-82.428 |
| Healthy Diet | 2.041 | 7.519 | 0.006 | 7.695 | 1.790-33.085 |
| Physical Exercises | 2.616 | 12.863 | 0 | 13.68 | 3.275-57.136 |
| Avoidance of Risk Factors | 2.173 | 8.278 | 0.004 | 8.78 | 1.999-38.570 |
| Earning | 0.65 | 0.77 | 0.38 | 1.915 | 0.449-8.180 |

DISCUSSION

The sputum conversion target for pulmonary TB in early medication at national level is 80% [5]. The research results show that the success rate of pulmonary conversion at intensive phase is still below the national standard. The evaluation of initial medication result is obtained from sputum conversion after intensive phase. Sputum conversion failure is an effort of early detection of medication failure. Patients who fail conversion become a predictor of occurrence of medicine-resistant pulmonary TB.

This research proves that healthy behaviour is related to sputum conversion, including compliance with TB medication, healthy diet, regular exercises, environmental hygiene, and avoidance of TB risk factors. The patients who are obedient to medication have a sputum conversion 18 times higher than disobedient patients after adjusted environmental hygiene, healthy diet, physical exercises, avoidance of risk factors and earning variables. This is supported by previous researches which state that pulmonary TB patients who do not regularly take medicine have 8 times of chance of failing sputum conversion [16]. Medication during the intensive phase consists of 2HRZE containing Isoniazid (H), Rifampicin (R), Pyrazinamide (Z) and Ethambutol (E). Isoniazid is bactericidal class antibiotic that can kill up to 90% of all bacteria in the early days of medication, by disturbing mycolic acid synthesis which serves to build bacteria cell wall. Similarly, Rifampicin and Pyrazinamide have bactericidal effect. Ethambutol is bacteriostatic and inhibits splitting bacteria growth with a mechanism to inhibit their RNA synthesis [17].

Healthy diet and exercise are also related to sputum conversion. Healthy diet is necessary to prevent further infection complication and restore patients' body to the condition before infection. High protein diet which covers overall macro substances must be fulfilled for patients' recovery. Malnutrition will cause body more vulnerable to recurrence and complication. The pulmonary TB patients in early medication will be exhausted, which may lead to disturbance to activity tolerance. Regular and gradual light 30-minute exercises will enhance muscle strength, enhance endurance, enhance pulmonary functions, reduce anxiety, and reduce muscle stiffness

[18]. Therefore, regular exercises will be able to restore patients' health condition to stronger enough to resist bacterial infection.

Maintaining environmental hygiene includes wearing mask and washing hands after cough and sneeze and opening windows for adequate sunlight and good air circulation regarding sputum conversion. Wearing mask and washing hands are intended to protect TB patients from environmental infection. Bacteria in dry sputum will be stuck to dust particles and last up to 8-10 days. When a TB patient accidentally inhales dust, the number of infectious agents will increase, but the sunlight may directly kill the TB bacteria within 5 minutes [19]. However, in a dark, poor ventilated, damp and no-sunlight place, the bacteria will survive for years.

Avoiding TB risk factors has significant relationship to sputum conversion. The TB risk factors here include quit smoking, stress management ability, and avoid contact with person with flu or patients of other infectious disease. Avoiding smoke and contact with other patients will significantly enhance host's body resistance. Smoke may damage pulmonary defines and mucociliary clearance mechanism [20]. For TB patients, the early 2 months of medication will be full of stressors from various sources either from medication process, dominating pulmonary TB symptom, powerlessness in performing physical activities and working, or patient's negative stigma in the community. Poor stressor management will worsen patients' physical condition. Some respondents report that physical powerlessness in the early 2 months of medication causes them cease working. These research results are in line with the research [21] which proposes that pulmonary TB patients' psychological stress and non-working fact negatively influence pulmonary TB medication results.

Based on the research results, most of the 113 respondents are of productive age (15-64 years old). This is in line with the research conducted by [22] that that 75% of pulmonary TB patients are found of most economically productive age. Productive age is an important period to earn living, in which the intensity of socialization with many people may increase pulmonary TB risk [23]. 38.1% out of the 65.5% 15-64-year-old respondents are successful in the conversion. This is

slightly different with ≥ 65 -year-old respondents, with only one respondent difference in the successful conversion. However, age statistic is not related to the conversion status ($p=0.487$), differently with the previous research which proposes that late sputum conversion is closely related to age >50 years old (OR 6.7, $p=0.003$) [24]. This may be caused by no difference in compliance with medication, healthy diet, exercises, and avoidance of TB risk factors by respondents of 15-64 years old with respondents of ≥ 65 years old. However, a difference is found on environmental hygiene between 15-64-year-old respondents with of ≥ 65 -year-old respondents ($p=0.001$).

Most of the respondents are male (57.7%), similarly to the research conducted by [25] which proposes that 66.5% of TB patients are male. Men are at higher risk to pulmonary TB infection since the risk factors performed by them, such as smoking. Cigarette's particle size and other chemicals play role in respiratory tract inflammation. Some studies propose that Tumor Necrosis Factor Alpha (TNF- α), Interleukin-6 (IL-6), cytokine IL-8, Nuclear Factor activation (NF- κ B) and cellular lipid peroxidation serve to be pro-inflammatory and oxidative destructive to lung [26]. Further, the analysis results indicate that there is no significant relationship between age and sex. However, it is found that more female respondents are successful in the conversion. Women have estrogen hormone which may enhance INF- γ secretion and activate macrophage to enhance immune response, thus AFBconversion occurs [27].

Many pulmonary TB cases are found with people with low earnings. The research results show that 57.5% respondents earn below RMW. A significant relationship is found between earnings and conversion status. According to further analysis results, there is significant difference in compliance with medication, healthy diet and environmental hygiene between respondents who earn above RMW with respondents who earn below RMW. An individual with higher earnings will have better ability to maintain his health, to keep environment clean and to make nutritious food available [28]. An individual with low economic status tends to find it difficult to take medication and lacks nutrition [29].

As seen from BMI status, most of respondents are thin (54.9%). TB patients will have their appetite lost, malnutrition and excessive metabolism, thus fat and muscle mass decrease [30]. However, no significant relationship is found between BMI and conversion status. This is not in line with previous research which proposes that TB patients with normal nutritional status are successful in sputum conversion and have more radiology image improvement compared to patients with malnutrition [6]. In this research, BMI is only seen as nutrition status standard without considering patients' macronutrient and micronutrient intakes. In addition, no evaluation is made on patients' weight before suffering TB infection.

Employment is not related to the conversion status ($p=0.169$). This research does not study patients' work

environment. Dusty work environment will cause disturbance to respiratory tract. Chronic exposure to polluted air may enhance morbidity, particularly respiratory disease symptom and generally pulmonary TB [20].

CONCLUSION AND SUGGESTION

It is concluded that the success rate of sputum conversion is still below the national standard. Sputum conversion is a quick indicator to assess the success rate of a medication regarding compliance with medication, healthy diet, regular exercises, environmental hygiene, and avoidance of TB risk factors. All factors related to sputum conversion are ones which are subject to change. Factor with the highest influence is compliance with medication. Therefore, patients and their family need to be educated regarding compliance with medication. The role of caretaker to take medicine needs to be enhanced. In addition, an education of other healthy behaviours such as keep the environment clean, perform healthy diet, perform regular exercise, and avoid risk factors needs serious attention from patients, their family, and the Government.

ETHICAL CONSIDERATION

This research has obtained approval from the Office of Nation Unity and Politics of Banyumas Regency number 070.1/438/IV/2018. All respondents have been informed of their rights, research objectives, procedures, risks, benefit of participation in this research and duration of participation in the research. The respondents voluntarily participate in this research and their secrets are kept confidential.

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