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Determinants of Households Tuberculosis Incidence in Arjasa Health Center of The Kangean Islands of Sumenep District

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Abstract

Tuberculosis is a contagious infectious disease with the highest risk of transmission occurring in households or household contacts of sufferers. Arjasa Health Center Sumenep District is located in the Kangean Islands with the highest number of TB cases in a row in the last 3 years since 2021-2023. The purpose of this study was to analyze the determinants of household TB incidence in the Arjasa Health Center work area, Sumenep District. This type of research is observational analytic using case control research design. The population of this study was TB patients who were treated and registered at SITB totaling 134 TB patients while the sample was taken by cluster random sampling with a ratio of 1: 1 in cases and controls. The research sample of 92 patients consisted of a case group of 46 TB patients who came from household contacts of TB patients (cases) and a control group of 46 TB patients who were not from household contacts of TB patients. Research variables consisted of characteristics, perceptions, infection transmission prevention behavior, knowledge, air change per hour (ACH), room occupancy density, floor and wall components of the room. Data analysis using univariate and bivariate by chis square test. The results showed that knowledge (p value = 0.000; OR = 2,165), infection prevention behavior (p value = 0.000; OR= 3.233), perception (p value = 0.001; OR = 0,137), occupancy density (p value = 0.039; OR = 2.521), and air chang per hour (p value = 0.037; OR = 3,790) had a relationship with the incidence of positive household TB at the Arjasa Health Center, Kangean Islands, Sumenep District. Meanwhile, the wall and floor components of the room did not have a relationship with the incidence of positive household TB (p value > 0.05). Arjasa Health Center is expected to increase the strengthening of education to patients and families related to the importance of conducting infection transmission prevention behavior and providing better assistance to TB patients.

Keywords: Arjasa Health Center, Determinants, Households, Tuberculosis

Introduction

TB is an infectious disease caused by infection from Mycobacterium tuberculosis and is life-threatening. Indonesia is one of the countries with the highest dual burden of tuberculosis (TB), both drug-sensitive and drug-resistant, in the world. The Global TB Report (2023) notes that Indonesia has a TB incidence of 385/100,000 population in 2022 with an estimated 1,060,000 cases or ranked the world with the largest TB burden or 1 positive per 30 seconds. Notification of recorded and reported TB cases still amounted to 68.3% or 724,309 cases, while those that had not been found and reported amounted to 335,691 cases (31.7%). By 2022, there will be a decrease in TB deaths from 150,000 to 134,000 cases. The increase in drug-resistant TB cases will further burden TB control efforts, with an estimated 31,000 cases and 7,745 of them treated (World Health Organitation, 2023).

The chance of pulmonary TB transmission in household contacts is influenced by low immunity and contact, especially in families who live in the same house. Families who are home contacts with people with TB have twice the risk of being infectious compared to non-home contacts (World Health Organization, 2019). In addition, people with pulmonary TB who have a positive BTA test have a higher potential for transmission to families who are home contacts (Ariani et al., 2022; Yosua et al., 2022).

Patients with pulmonary TB can transmit Mycobacteriaum Tuberculosis (M.Tb) with droplet nuclei in the free air without realizing it, especially when coughing and discharging sputum incorrectly. Patient behavior and environmental

factors can affect the degree of risk of pulmonary tuberculosis transmission in the household or household family. Youngkong et al that catastrophic costs in households due to drug-sensitive TB were> 20%. The mean total costs per TB episode for all study participants were 903 USD (Youngkong et al., 2024).

Sumenep district has the third highest number of TB cases in East Java. TB is also the second highest infectious disease in Sumenep district. The incidence of TB in Sumenep district continues to rise. In 2023, the number of TB cases in Sumenep district reached 1,802 people. The Sumenep District area is divided into two parts, namely the mainland which has 18 sub-districts and islands with 9 sub-districts (Badan Pusat Statistik Kabupaten Sumenep, 2019).

Based on the incidence of TB cases, Arjasa sub-district has been ranked first in the last three years in all categories. The number of incident TB cases at the Arjasa Health Center from 2020 - 2023 were 114, 98, 134 and 101. However, until December 2023 the treatment coverage achievement of Arjasa Health Center is still at 60%. Moreover, there are currently 3 cases of drug-resistant TB found in the Arjasa Health Center area (people (Dinas Kesehatan Pengendalian Penduduk dan KB Kabupaten Sumenep, 2023). Research needs to be done on these problems to analyze the determinants of household TB incidence in the working area of the Arjasa Health Center, Kangean Islands, Sumenep District.

Methods

This study is a quantitative study using analytic observation method and case-control study design. The population of this study were positive TB patients who were treated and registered in the Tuberculosis Information System (SITB) from January 2023 to February 2024 as many as 134 patients with bacteriological and clinical examinations. The sample in this study amounted to 92 patients. Case and control samples criteria were TB patients aged over 12 years - 65 years who had undergone regular TB treatment. Case and control samples selected by random sampling with a ratio of 1: 1, namely 46 TB patients in the case group and 46 TB patients in the control group. The case sample consisted of positive TB patients who came from household contact with TB patients or called household TB. The control sample was positive TB patients who were not from the same household or household contact of TB patients. The independent variables in this study consisted of individual characteristics (age, gender, education, and income), knowledge, perceptions, infection prevention behaviors (hand washing, cough etiquette, mask use, sputum ethics, opening windows and drying bedding), air change per hour (ACH), occupancy density, wall and floor components of the room. While the dependent variable of this study is the incidence of household positive TB (TB-RT). The inclusion criteria were TB patients aged over 12 years - 65 years who had undergone regular TB treatment. Exclusion criteria were TB patients aged ≤ 12 years and over 65 years who had undergone regular TB treatment.

Data were collected through interviews using a questionnaire to obtain data on individual characteristics (education, gender, age and income), knowledge, perceptions, infection prevention behaviors (hand washing, cough etiquette, mask use, sputum ethics, opening windows and drying bedding) and occupancy density. The data collection questionnaire has passed the validity test with r table < 0.378 and reliability with alpha output of 0.971. Data classification consists of knowledge, perceptions and behavior to prevent infection transmission if good with a score ≥ median, and less if the score < median; Air exchange rate (ACH) measured using a vaneometer is categorized as good if ≥ 6 and less if the score < 6 ACH; Occupancy density is categorized as dense if (> 2 people aged > 5 years / 8 m2) and not dense if (≤ 2 people aged > 5 years / 8 m2). While data on the wall and floor components of the room were obtained using an observation sheet categorized as hard and soft (soil/bamboo).

The data of this study were analyzed by univariate and bivariate. Univariate to explain the frequency distribution of all variables and bivariate analysis with chi-square statistical test (α = 5%) to prove the relationship of the independent

variable with the dependent variable. This research has passed the research ethics test with certificate 2575/UN25.8/KEPK/DL/2024 from the Chairman of the Health Research Ethics Commission (KEPK) Faculty of Dentistry, University of Jember.

Results

A. Characteristics of respondents

Table 1. Frequency Distribution of Cases and Controls Based on Gender, Education, Income and Age Group of Respondents at Arjasa Health Center, Kangean Islands, Sumenep District

Variable	Case		Control		N	%
	n	%	n	%		
Gender						
Women	12	26,09	21	45,65	33	36,67
Man	34	73,91	25	54,35	59	64,13
Education						
Low	32	69,57	22	47,83	54	58,69
High	14	30,43	24	52,17	38	41,31
Income						
< Regional Minimun Wage	34	73,91	25	54,35	59	64,13
≥ Regional Minimun Wage	12	26,09	21	45,65	33	36,67
**Regional Minimun Wage Sumenep Rp. 2.249.113 (Tahun 2024)*						
Age group						
Teens (12-24 th)	10	21,74	5	10,87	15	16,30
Adults (>24 th)	36	78,26	41	89,13	77	83,70

Table 1 above shows that the case and control respondents in this study were mostly male (64.13%) as many as 34 case respondents (73.91%) and 25 control respondents (54.35%). This shows that most of the incidence of positive TB in the Arjasa Health Center work area is male. Most of the case respondents had a low education category, there are 32 respondents (69.57%), while the control respondents mostly had a high level of education (58.69%) as many as 25 respondents (52.17%). This shows that most positive TB patients have a low level of education. Most of the case respondents had an income < Regional Minimun Wage are 34 respondents (73.91%), while in the control respondents most of them had an income level < Regional Minimun Wage as many as 25 respondents (54.35%). This shows that most positive TB patients have an income level < minimum wage (64.13). In terms of age, most of the case respondents belonged to the age > 24 years (83.70%).as many as 36 respondents (78.26%), while in the control group most were adults > 24 years as many as 41 people (89.13%). This shows that most of the incidence of positive TB attacks adults > 24 years of age at the Arjasa Health Center, Kangean Islands, Sumenep District.

Table 2. Frequency Distribution of Household TB Incidence Factors at the Arjasa Health Center, Kangean Islands, Sumenep District

Variable	Case		Control		N	%
	n	%	n	%		
Knowledge						
Less	35	76.09	16	34,78	51	55,43
Good	11	23,91	30	65,22	41	44,57
Infection prevent behavior						
Less	35	76.09	12	26,09	47	51,08
Good	11	23,91	34	73,91	45	48,91
Perception						
Negative	24	52,17	15	32,60	39	42,39
Positive	22	47,83	31	67,40	53	57,61

Variable	Case		Control		N	%
	n	%	n	%		
Air change per Hour (ACH)						
Less	29	63,04	24	52,17	53	57,61
Good	17	36,96	22	47,83	39	42,39
Occupancy Denstiy of room						
Not Density	14	30,43	4	8,70	18	19,57
Density	32	69,57	42	91,30	74	80,43
Floor component						
Soil	10	21,74	10	21,74	20	21,74
Hard (cemet plaster/ceramic)	36	78,26	36	78,26	72	78,26
Wall component						
Soft	3	6,52	10	21,74	20	21,74
Hard	43	93,48	36	78,26	72	78,26

Table 2 above explains that the case respondents in this study mostly had a poor level of knowledge (35 respondents or 76.06%), while the control respondents mostly had a good level of knowledge (30 respondents or 65.22%). This shows that most of the positive TB respondents in the Arjasa Health Center working area have a poor level of knowledge. Most of the case respondents had poor TB infection prevention behavior (35 respondents or 76.09%), while the control respondents had good infection prevention behavior (34 respondents or 73.91%). In the perception factor, it was found that most of the case respondents mostly had negative perceptions (24 respondents or 52.17%) and in the control group most had positive perceptions (31 respondents or 67.40%).

In the factor of room air exchange speed, it is known that most of the case respondents mostly have an ACH level of less (29 respondents or 63.04%) and in the control group also mostly have less ACH (24 respondents or 52.17%). This means that most positive TB patients in the Arjasa Health Center work area have a level of air exchange speed (ACH) that is classified as less. Most of the case respondents had a residential density classified as dense (32 respondents or 69.57%), while the control respondents mostly had a residential density classified as dense (42 respondents or 91.30%). This means that most of the positive TB patients in the Arjasa Health Center work area are categorized as dense. In the factor of wall and floor components, it has the same distribution that most case respondents have room wall and room floor components classified as hard as 36 respondents (78.26%) and 43 respondents (93.48%), respectively, while in the control group most have room wall and room floor components classified as hard as 36 respondents (78.26%).

B. Determinan factor of Household TB Analysis

Table 3. Statistical Test Results of Relationship Between Variables

Variable	*p-value*	OR	CI 95%
Gender	0.016	0,442	0,134 - 1,463*
Education	0,001	0,126	0,034 - 0,469*
Income	0,632	0,088	0,027 - 0,280
Age Group	0,045	0,242	0,134 - 1,483*
Knowledge	0,000	2,165	1,522 - 2,248*
Infection Prevention Behavior	0,000	3,233	3,061 - 3,497*
Perception	0,001	0,137	0,046 - 0,407*
Air change per Hours (ACH)	0,037	3,790	0,119 - 0,754*
Occupancy Density	0,039	2,521	0,173 - 2,594*
Floor Component	0,939	0,256	0,077 - 0,852
Wall Component	0,118	2,750	0,693 - 1.090

The results of the chi square test in table 3 show that the characteristics of respondents who have a relationship with the incidence of positive household TB (p value <0.05) are gender (p value = 0.016), education (p value = 0.016) and age

(p value = 0.045). While respondent characteristics related to income were stated to have no relationship to the incidence of positive household TB at the Arjasa Health Center, Kangean Islands, Sumenep District (p value> 0.05).

The results of the chi square test analysis in Table 3 also show at the Arjasa Health Center, Kangean Islands, Sumenep District that determinant of households TB at the Arjasa Health Center, Kangean Islands, Sumenep District consist knowledge (p value 0.000; OR=2.2), infection transmission prevention behavior (p value 0.000; OR=3.2), perception (p value 0.001; OR = 0.137), Air change per Hour/ACH (p value 0.037 < 0.05; OR = 3,790), occupancy density (p value 0.039 < 0.05; OR = 2.251). While the floor and wall components of the room have no relationship to the incidence of household TB (p value > 0.05)

Discuss

a. The relationship between Respondents' Characteristics and the Incidence of Household Positive TB at the Arjasa Health Center, Kangean Islands, Sumenep

The results of the chi square test in table 3 show that the characteristics of respondents who have a relationship with the incidence of positive household TB (p value <0.05) are gender (p value = 0.016), education (p value = 0.016) and age (p value = 0.045). While respondent characteristics related to income were stated to have no relationship to the incidence of positive household TB at the Arjasa Health Center, Kangean Islands, Sumenep District (p value> 0.05).

The results of this study are in line with the WHO report that 55% of TB was found in men in 2022 (World Health Organitation, 2023). Arif et al., (2022) research also found that most TB patients at the Baubau city health center were male (65.3%), age range 15-35 years (65.3%), primary and secondary education (73.5%). The Community, Rights and Gender (CRG) assessment by the Spiritia Foundation in 2019 showed that both men and women were equally assessed as having poor knowledge. The reason in men is because they tend to delay treatment, seek treatment if they experience more severe symptoms. Whereas in women, the reason is the existence of work and household responsibilities, as well as consulting permission to the husband before treatment (Marguari et al., 2019).

In the aspect of education, research conducted by Ritonga, (2022) also stated that the level of education was associated with the incidence of pulmonary tuberculosis with a p-value of 0.034 and OR 4.750 (95% CI; 1.225-11.481). This study is in line with Nasution et al., (2022) that the education level of respondents in the Pijorkoling Health Center working area is significantly related to the incidence of pulmonary tuberculosis (p-value 0.009). Respondents with a low level of education were more at risk of developing pulmonary tuberculosis and was one of the dominant factors. The cause was found that respondents did not go to health care facilities even though they had symptoms leading to tuberculosis (Kemenkes RI, 2023; Rahim et al., 2020; World Health Organization, 2019). A low level of education will also affect a person's lack of knowledge, such as about tuberculosis and what to do when they are sick.

The percentage of TB cases in children aged <12 years in this study touched 16% and has a relationship with the incidence of TB. The Indonesian Ministry of Health states that the proportion of new and relapsed tuberculosis cases in children less than 15 years of age reported is around 5-15% (Kemenkes RI, 2023). TB cases in children at the Arjasa Health Center are high or exceed the national target of <15%. This indicates that the high risk of household transmission has resulted in many children being infected with M.Tb from household contact with TB patients.

In the aspect of income, in line with Ritonga's, (2022) research that income is not associated with the incidence of pulmonary tuberculosis (p-value 1 > 0.05). In contrast to

research by Youngkong et al that from 1400 patients including 1382 TB (first-line treatment) and 18 drug-resistant TB patients (DR-TB), catastrophic costs in households due to drug-sensitive TB were> 20%. The mean total costs per TB episode for all study participants were 903 USD. The economic burden on TB-affected households consist travel, food/nutritional supplementation, and indirect costs contribute to a high proportion of catastrophic total costs. (Youngkong et al., 2024).

This study found results in line with previous research which found that there was no significant relationship between income level and the incidence of pulmonary tuberculosis (Nisak et al., 2021; Pangaribuan & Khotimah, 2020). According to the economic theory of meeting needs, a person with a low income will find it difficult to meet their needs. Fulfillment of priority needs in health is the fulfillment of nutrition and nutrients that can support the body's immunity in preventing disease. In addition, someone whose socioeconomic level is classified as good, then the level of health is also good. This is because it is driven by knowledge about diseases and access to health services that are also good. However, in this study, the income level of respondents was not a risk factor for household tuberculosis because most patients were farmers, so their role was replaced by other members when they were sick.

b. The relationship between knowledge and the incidence of household positive TB at the Arjasa Health Center, Kangean Islands, Sumenep District

Knowledge is the result of knowing something that occurs through sensing which encourages perception of the objects known, mostly from the eyes and ears as a form of overt behavior. Behavior based on knowledge is persistent (Yenni & Meliyantari, 2024). The results of the chi square test analysis in Table 3 also show that knowledge has a relationship with the incidence of positive TB in households at the Arjasa Health Center, Kangean Islands, Sumenep District (p value 0.000 <0.05) and OR 2.2, meaning that TB patients with poor TB knowledge have a risk of 2.2 times greater than TB patients who have good knowledge in the Arjasa Health Center Area, Kangean Islands, Sumenep District.

The results of the study by Aja et al., (2022) showed that there was a significant relationship (p = 0.021) between knowledge and the incidence of TB in the family/household (95% CI = 1.172 - 1.865; PR = 1.478). Another study in line with this study Nasution et al., (2022) that patient knowledge is related to the incidence of pulmonary TB at the Pijorkoling Health Center. The risk of pulmonary TB incidence was 2.75 times in respondents with poor knowledge compared to those with good knowledge. TB patients with poor knowledge are at risk of pulmonary TB transmission to family members.

This study is in line with Trisno & Hidayat (2024) that results of bivariate analysis of knowledge on 6 sub-variables of perception have a significant relationship. Knowledge was found to increase 16-fold (OR=16.875) the occurrence of behavioral cues. Low knowledge will ultimately increase the risk of contracting TB disease or even transmitting it to others (Trisno & Hidayat, 2024). Andriani et al (2020) also found that the results of the analysis of the relationship between family attitudes and efforts to prevent transmission of tuberculosis disease in the Penana'e Health Center working area show that respondents with a good level of knowledge and a positive attitude have good prevention of tuberculosis disease transmission. This means that knowledge and attitude are supporting healthy behavior (Andriani & Sukardin, 2020).

TB patients' knowledge of their disease will influence their actions to prevent transmission, especially within the household. TB patients with poor knowledge may not prevent transmission. Some important points in literacy about TB knowledge that are lacking and often found are that TB is still considered a hereditary disease (44%) or due to witchcraft (santet) (21%), considers TB not contagious (66%) and incurable (37%). Another important point is that

people do not understand the main signs or symptoms of TB, especially the sign of a long cough for more than 2 weeks (63%). This will certainly continue to strengthen the chain of TB transmission, especially to serum contacts and will ultimately increase the incidence of pulmonary TB disease. Efforts to increase knowledge can be carried out with health promotion activities. Health promotion program interventions are directed at increasing correct and comprehensive knowledge in TB prevention efforts related to transmission and treatment so that changes in attitudes and behavior of TB program targets occur.

c. The relationship between infection prevent behavior and the incidence of household positive TB at the Arjasa Health Center, Kangean Islands, Sumenep District

The main goal of TB treatment, in addition to curative measures, is to interrupt the chain of transmission and prevent relapses. Prevention of TB transmission should be carried out to reduce transmission to people around the patient, especially at the family level (Ramadhan et al., 2021). Family members are high-risk subjects who can be transmitted due to household contact with people with TB. This is due to the easy transmission of TB, especially in dense environments and dwellings.

The results of the chi square test analysis in Table 3 also show that infection transmission prevention behavior has a relationship with the incidence of positive household TB at the Arjasa Health Center, Kangean Islands, Sumenep District (p value 0.000 <0.05) and OR 3.2, meaning that TB patients with poor infection transmission prevention behavior have a 3.2 times greater risk than TB patients who have good infection transmission prevention behavior in the Arjasa Health Center Area, Kangean Islands, Sumenep District.

The results of the analysis of Aja et al., (2022) showed that transmission prevention efforts were significantly associated (p = 0.046) with the incidence of pulmonary TB transmission in the household (PR = 1.440; 95% CI = 1.159 -1.788). Family members who lacked infection prevention measures were at risk of pulmonary TB transmission in the household. Kemenkes RI, (2023) states that unhealthy behavior and supported by an unhealthy environmental situation will have an impact on the high risk of transmission of M. TB to others, especially those who are home contact with patients. Yenni & Meliyantari (2024) explained that most people with TB have poor preventive behavior (79.4%) due to low knowledge, self-efficacy, perceptions and interpersonal relationships in preventing pulmonary TB transmission.

This study found that most TB patients on intensive treatment did not use masks regularly inside or outside the home, especially when gathering with other people (72%). The behavior of discharging sputum in the yard has a large proportion (54%) than discharging sputum in the bathroom (22%). While good and correct cough ethics still have low coverage (26%). Prevention of transmission of TB infection to household contacts and close contacts through the use of masks, such as surgical masks. Respiratory hygiene (including cough etiquette) in people with suspected or confirmed TB is recommended to reduce transmission of M. tuberculosis to health care workers, visitors, including family members, or other high-risk individuals. Respiratory hygiene (or hygiene measures) is the practice of covering the mouth and nose when breathing, coughing, or sneezing (e.g., wearing a surgical or cloth mask, covering the mouth with a cloth, sleeve, bent elbow, or hand followed by hand hygiene) to reduce the spread of airborne respiratory secretions that may contain M. tuberculosis bacilli (Siddalingaiah et al., 2023; World Health Organization, 2019).

The purpose of this mask is to reduce transmission by reducing the number of TB bacilli coughed into the room air. Darmauli et al., (2023) adds several behaviors to prevent the transmission of TB disease, namely TB patients do not spit in any place, cover their mouths when coughing /

sneezing, practice clean and healthy living behavior, take treatment based on drinking rules until declared cured and families who are home contacts are examined and so that they get TB prevention therapy.

Families with household contacts of TB patients are twice as likely to be at risk as non-household contacts. Some people think that they feel healthy, uncomfortable, and claustrophobic when wearing a mask so they seem to underestimate it. According to the World Health Organization (2019), after removing the mask or every time you reuse a used mask, you need to wash your hands first with soap or antiseptic. Masks need to be replaced if they are dirty or wet. If the mask is to be reused, store it first in a clean, sealable plastic bag. Good sputum disposal behavior is not in any place, but is disposed of in a special closed place, for example a plastic container / tin can with a lid that has previously been given soapy water. Because sputum is disposed of in any place when it is dry then carried into the air to be inhaled and infect other people (Balaputra, 2021). Other studies also mention other risk factors that affect the incidence of pulmonary TB disease including coughing behavior without being covered, room air conditions, irregular taking of medicine, behavior of not opening windows, and not wearing masks (Balaputra, 2021; Imaduddin et al., 2019; Luwuk et al., 2023; Ru du et al., 2020; Yosua et al., 2022).

Based on the above, infection prevention behaviors such as coughing etiquette, use of masks during treatment, behavior of opening windows, drying mattresses and pillows regularly, saliva ethics, smoking cessation behavior and hand washing behavior can effectively prevent the transmission of M. TB to others, especially household contacts. Infection prevention behavior can be one of the strategies to break the chain of tuberculosis transmission and achieve good treatment success rates

d. The relationship between perception and the incidence of household positive TB at the Arjasa Health Center, Kangean Islands, Sumenep District

Perception is defined as a process of sensing a stimulus obtained by a person who is organized and interpreted to realize and understand the stimulus (Hakim et al., 2021). In the Health Belief Model theory that perception will determine an individual's healthy behavior (Trisno & Hidayat, 2024). The results of the chi square test analysis in Table 3 also show that perception has a relationship with the incidence of positive household TB at the Arjasa Health Center, Kangean Islands, Sumenep District (p value 0.001 <0.05) and OR = 0.137. This means that TB patients with a negative perception have a 0.137 times greater risk than TB patients who have a positive perception of TB.

This research is in line with Karno & Pattimura, (2022) in the Pabentengan Community Health Center working area, it was found that perceptions and attitudes were strongly related to efforts to prevent transmission of pulmonary TB among household contacts (p=0.026 <0.05). Similar research explains that an individual's attitude can be determined by his perception of certain objects. A person's attitude can even change after receiving additional information about the object due to persuasion or pressure originating from the social environment. Complete knowledge of TPT has a significant relationship in producing positive perceptions (Darmauli et al., 2023; Trisno & Hidayat, 2024).

Researchers assume that the positive perception regarding TB, including treatment and prevention, among the majority of respondents is due to knowing about the dangers of TB, the risk of transmission to at-risk groups and household contacts of TB as well as the benefits of TB treatment. Positive perceptions such as that TB is a disease that is contagious and can be cured, although there is still a perception that TB is obtained from witchcraft/magic. Positive perceptions regarding TB arise from education and literacy of TB sufferers, either independently or from other people, which results in better understanding of TB. This ultimately influences a person's behavior which

originates from his perception. Negative perceptions about TB can be avoided through encouragement to strengthen literacy and family support as Medication Monitors (PMO).

e. The relationship between Air Change Per Hour (ACH) and the Incidence of Household Positive TB at the Arjasa Health Center, Kangean Islands, Sumenep

There are two ways to measure ventilation rates: one uses the volume of a space (i.e. air changes per hour or ACH) while the other takes into account the number of people in the space (i.e. litres/second/person). An air change can remove 63% of what remains, and so on. The exchange air velocity (ACH) recommended by WHO in rooms is 6-12 ACH. Transmission of M.TB infection will increase in rooms with air exchange rates < 6 ACH (World Health Organization, 2009). The results of the chi square test analysis in Table 3 also show that the speed of air exchange/ACH has a relationship with the incidence of positive TB in households at the Arjasa Islands Kangean Islands Health Center, Sumenep District (p value 0.037 < 0.05; OR =3,790). The odds ratio (OR) on room air exchange speed was 3.790, meaning that poor air exchange speed (ACH) had a 3.8 times greater risk of developing household pulmonary tuberculosis than respondents who lived in rooms with good ACH.

The condition of the home environment has a great impact on the transmission of pulmonary tuberculosis. Families in the same household have twice the risk as non-household contacts (World Health Organization, 2019). Some previous studies are in line with the results found in this study that the density of occupancy and the speed of air exchange in the room affect the transmission of TB (Imaduddin et al., 2019; Khairani et al., 2020; Pangaribuan & Khotimah, 2020). Another study was also found by Perdana and Putra (2020) that the results showed that there was a relationship between occupancy density, ventilation, lighting, humidity with the incidence of pulmonary TB at the Panjang Health Center. Meanwhile, the results of research by Jannah, Prayitno and Nawarto, (2024) stated that the ventilation area and occupancy density were not related to the incidence of pulmonary TB.

Ventilation is an effort to provide outdoor air into the building or room, and distribute it throughout the indoor area. Ventilation has a function in air exchange in the room which makes the air fresh. Ventilation area that is not in accordance with health requirements has an impact on low oxygen levels, increased CO_2 gas, stuffy room odor, increased indoor air temperature, and increased indoor air humidity. Increased levels of CO2 gas increase the growth of tuberculosis bacteria as the causative agent of tuberculosis. Ventilation conditions that do not meet health requirements cause no or reduced air exchange in the room which results in bacteria that cause disease, especially tuberculosis bacteria, can multiply. In conditions where there is no proper air exchange, there will be an increase in the number and concentration of bacteria, so the risk of transmission of respiratory diseases is higher. (Anggraeni, 2019; Noerhalimah, 2020).

TB is an airborne disease, so air exchange needs to be measured specifically and accurately, not just using the 10-20% ventilation rate that most previous studies have done. Ventilation area can be an indicator of the health of the residential environment that provides protection at a lower cost. However, for natural ventilation, it is difficult to control the direction of airflow because it depends on the climate and wind direction. This study is in line with Talukdar et al., (2023), that measurement of substantial air exchange velocity using a vaneometer is considered more adequate than using a 20% ventilation area reference. These findings provide practical input for clear guidelines on ventilation assessment using a vaneometer. Ventilation is considered adequate if the surface of the openings is more than 20% of the floor surface. This method is easy to use but has not been validated due to the tightly packed character of the houses (Talukdar et al., 2023).

The WHO infection prevention and control policy implementation document suggests a relatively simple tool, the vaneometer, to assess ventilation (Tuberculosis Coalition for Technical Assistance et al., 2010). Vaneometers were developed for industry to measure air velocity. This air velocity along with the volume of the room and the surface of the opening where air enters the room, provides the input to calculate ACH. The threshold for ventilation requirements may vary depending on the type of ventilation (e.g., recirculated air vs. fresh air). There are two ways to measure ventilation rates: one uses the volume of the room (i.e. air exchange per hour or ACH) and the other takes into account the number of people in the room (i.e. liters/second/person). An air change removes 63% of the remaining air, and so on. One air change is when the volume of air entering or leaving the room is equal to the volume of the room. The air velocity exchange (ACH) recommended by WHO in rooms is 6-12 ACH. Transmission of M.TB infection will increase in rooms with an air velocity exchange rate < 6 ACH (World Health Organization, 2009).

According to WHO, a high-risk environment for M. tuberculosis transmission is a situation in which there are people with undetected or undiagnosed active tuberculosis, or infectious tuberculosis patients, and there is a high risk of M. tuberculosis transmission. Transmission of M.TB infection will increase in rooms with air exchange rates < 6 ACH (World Health Organization, 2009).

Researchers assume that the presence of ventilation cannot be used as a reference in fulfilling a healthy environment, but adequate air exchange (ACH) is more adequate in efforts to control and prevent TB in the household. Natural ventilation, such as opening a window on the opposite side of the room, is more effective than mechanical ventilation. Natural ventilation can provide more protection at a lower cost. However, with natural ventilation it is difficult to control the direction of airflow and there is no easy-to-use tool to measure ACH because natural ventilation is climate dependent.

f. The relationship between occupancy density and the Incidence of Household Positive TB at the Arjasa Health Center, Kangean Islands, Sumenep

The results of the chi square test analysis in Table 3 also show that residential density is related to the incidence of positive TB in households at the Arjasa Islands Kangean Health Center, Sumenep District (p value 0.039 < 0.05; OR = 2.251). The odds ratio (OR) on room occupancy density was 2.521, meaning that a dense room occupancy density has a 2.5 times greater risk of experiencing household pulmonary tuberculosis than respondents who live in rooms with non-compact room occupancy density.

Home environmental conditions play an important role in the transmission of pulmonary TB disease. These include the density of residential ventilation, roof, walls, floors, lighting, availability of windows and speed of room air exchange (Imaduddin et al., 2019; Khairani et al., 2020; Pangaribuan & Khotimah, 2020). Another study conducted by Perdana & Putra, (2020) showed that there was a relationship between residential density and the incidence of pulmonary TB at the Panjang Community Health Center. Wulandari et al., (2023) found that the physical condition of houses that do not meet the indicators of a healthy house has a 3 times greater risk of pulmonary TB incidents. Meanwhile, research results from Jannah et al., (2024) stated that residential density was not related to the incidence of pulmonary TB.

Literature review by Alchamdani and Ningsi (2022) using research from 2014-2020 on physical environmental factors found different results, with ventilation, humidity, temperature, roof, walls, floors and inadequate occupancy density being risks for pulmonary tuberculosis in Indonesia. This difference can certainly be seen from several aspects of the environment, geography, behavior and health services. This study was conducted in one of the areas with the

highest incidence rate for three consecutive years, population density and different community characteristics and behaviors, in the Kangean Islands.

Dense housing densities, especially among those with TB disease, require immediate modification and intervention. Dense housing if supported by a poorly ventilated home environment or poor air exchange rates will further increase the risk of TB transmission to household contacts. The risk of TB transmission in densely populated households can be intervened through setting up natural and artificial air exchange cycles that can maintain humidity and good air quality.

g. The relationship between Room Floor and Wall Components with the Incidence of Household Positive TB at the Arjasa Health Center, Kangean Islands, Sumenep

The results of the chi square test in Table 3 also show that the wall and floor components of rooms were declared to have no relationship to the incidence of positive TB in households at the Arjasa Islands Kangean Health Center, Sumenep District (p value > 0.05). Jannah et al (2024) in their research found variables for wall type and floor type. Meanwhile, other studies state that the type of floor and walls have an influence on the incidence of pulmonary TB (Du et al., 2020; Imaduddin et al., 2019; Khairani et al., 2020).

The researcher assumes that the absence of a relationship between floor and wall components is due to geographic and demographic factors. Arjasa Health Center is located on the islands of Sumenep District with quite high or hot air temperatures. In addition, most of the housing structures for TB sufferers are found in the highlands or mountains. So there are differences in the results of this research compared to previous research conducted in land areas and with quite high population density

Conclusion

Characteristics of respondents that are related to the incidence of positive TB in the household are gender, education and age. Meanwhile, income was stated to have no relationship to the incidence of positive TB in households at the Arjasa Islands Kangean Health Center, Sumenep District. Factors for the incidence of Positive TB in Households found that knowledge, preventive behavior, perception, residential density and speed of air exchange/ACH have a relationship with the incidence of positive TB in households at the Arjasa Islands Kangean Health Center, Sumenep District. Meanwhile, the components of the walls and floors of rooms were stated to have no relationship to the incidence of positive TB in households at the Arjasa Islands Kangean Health Center, Sumenep District. Knowledge, behavior to prevent infection transmission, air exchange rate (ACH) have a dominant influence on the incidence of Positive TB in Households at the Arjasa Islands Kangean Health Center, Sumenep District.

Several suggestions that can be put forward by the Program in controlling TB through health promotion are aimed at increasing knowledge, especially regarding comprehensive understanding of TB, prevention of transmission, complete treatment and healthy behavior, so that there is a change in behavior in program targets such as behavior of expelling phlegm, opening windows, drying equipment. sleep and providing Tuberculosis Prevention Therapy (TPT) to household contacts.

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