Relationship between Knowledge, Attitudes, and Motivation and Compliance to Taking Anti-Tuberculosis Medication on the Pulmonary TB Patient

Syaukia Adini [1], Novi Indriani [1], Dewi Aryanti [1,*)]

[1]Poltekkes Kemenkes Tasikmalaya, Cilolohan st. 35 Tasikmalaya

Abstract

Tuberculosis (TB) is a deadly infectious disease worldwide. The annual number of global TB sufferers seeking treatment has increased from around 6 million people in 2015 to 7.1 million people in 2019. Geographically, most TB cases occurred in the Southeast Asian region, one of which is Indonesia. Many factors affect the success and compliance with treatment programs, including knowledge, attitudes, perceptions, and individual motivation. Increased knowledge can lead to changes in one's perceptions, attitudes, or habits. This research contribution analyzes the relationship between knowledge, attitudes, and motivation with compliance to taking anti-tuberculosis medication in pulmonary TB patients at RSUD Dr. Soekardjo, Tasikmalaya City. Furthermore, this research is a descriptive analytical-correlational research with a cross-sectional approach. The sample of this study was 60 respondents (aged 20-80 years) consisting of outpatients at the TB Polyclinic at RSUD Dr. Soekardjo in October-November 2022. The instrument used to measure the variables of knowledge, attitudes, motivation, and medication compliance is a questionnaire. The relationship between the variables was carried out using the Chi-Square statistical test. Based on the research results, it was obtained that 95% (57) of the respondents had good knowledge, 73% (44) of the respondents had good attitude, 72% (43) had good motivation, and 51.7% (31) of the respondents were adherent in taking medication. Furthermore, based on the results of statistical analysis using the Chi-Square test it showed that attitude and motivation variables were not significantly related to medication compliance (p-value >0.05), while the level of knowledge was significantly related to medication compliance (p-value < 0.05). It was further concluded that the level of knowledge of the respondents shows a significant relationship with compliance to taking OAT medication at Dr. Sukarno Hospital.

Keywords: Pulmonary Tuberculosis; Knowledge; Attitude; Motivation; Medication compliance

----

*) Corresponding author: Aryanti
e-mail: dewiaryanti9@gmail.com

1. Introduction

Tuberculosis kills more than one million people every year. In this case, the annual number of global TB sufferers seeking treatment increased from 6 million people in 2015 to 7 million in 2018 and 7.1 million people in 2019. Geographically, 44% of cases of Tuberculosis occurred in Southeast Asia, of which 9.2% of them were in Indonesia (Chakaya et al., 2022; Kementerian Kesehatan Republik Indonesia, 2022).

Tuberculosis (TB) disease has been a health issue in Indonesia to date. With its large population, Indonesia also has a great amount of Tuberculosis (TB) cases, particularly belonging to the five highest worldwide. Furthermore, the estimated death rate of Indonesian people due to tuberculosis is 144,000 or 52 per 100,000 people, while TB-HIV is 6,500 or 2.4 per 100,000 people (Kementerian Kesehatan Republik Indonesia, 2022).

The critical problem of TB in Indonesia is due, among other things, to the discovery of cases, complete treatment, and the spread of the disease. Prior to coming to appropriate healthcare services, many people suffering from such diseases look for treatment other than the healthcare service, including self-treatment. Therefore, education to the public is necessary to be carried out by various layers of public officers (Kementerian Kesehatan Republik Indonesia, 2022).

Tuberculosis is an infectious disease including *M. tuberculosis, M. africanum, M. bovis, M. leprae,* and others. Bacteria that cause tuberculosis have a particular characteristic, which is Acid Fast Bacteria (AFB). Other Mycobacterium groups, except *Mycobacterium*

tuberculosis, which can increase respiratory tract interference, are known as MOTT (*Mycobacterium Other than Tuberculosis*), which sometimes can interfere with the implementation of TB diagnosis and treatment. The main pulmonary tuberculosis symptom in patients is coughing with phlegm for two weeks or more. Such cough can be further followed with other additional symptoms, where the phlegm is mixed with blood, asphyxiation, limp body, decreased appetite, decreased body weight, malaise, sweating at night without physical activity, and repetitive fever within a month (Hunter, 2018).

One of the government programs concerning tuberculosis management is the TB treatment method aiming to allow recovery for TB patients, prevent mortality, prevent recurrence, decide chain transmission, and prevent the occurrence of resistance germs to anti-tuberculosis medication resistance germs (Swarjana & Sukartini, 2019; Kementerian Kesehatan Republik Indonesia, 2022). The success of tuberculosis treatment can be reached if the patient regularly takes the medication. Temporary compliance to taking medication is affected by many factors, including knowledge, communications, healthcare facilities, as well as patients' perception and motivation. In this case, increasing knowledge can change a person's perception, attitude, or behavior (Chang & Cataldo, 2014; Tachfouti et al., 2012).

Several studies that were conducted in Tasikmalaya showed high morbidity and mortality due to tuberculosis. Based on the digital information from the official website of Tasikmalaya City, nearly 3,500 people were suspected of having pulmonary TB disease in 2021, and around 800 of them tested positive for TB after the examination (Dinas Kesehatan Kota Tasikmalaya, 2022). The gap between the number of suspected and tested positive will result in an uncontrolled spread. One study showed that as many as 14% of TB patients in Tasikmalaya were declared to have dropped out of treatment (Nopiayanti et al., 2022). Such a condition will increase the morbidity and mortality rates of TB sufferers. In addition, there are also many people and tuberculosis sufferers themselves who do not understand tuberculosis disease, as well as its prevention and treatment. In this case, many tuberculosis sufferers claimed that they were tired of taking medication and felt uncomfortable with the side effects of the drug. When such case is ignored, and the patient is not compliant or even stopped taking the medication, the emergence of tuberculosis germs that are resistant to drugs (*multi-drug resistance*/MDR and even *extended drug resistance*/XDR) may occur (Chakaya et al., 2022; Ferreira et al., 2018; Hunter, 2018). Furthermore, the control of tuberculosis transmission and medication will be more difficult to hold. The effect is that the number of mortality will keep increasing due to tuberculosis (Hidayani, 2019; Mulyana, 2020; Nopiayanti et al., 2022).

This research contributes to analyzing the relationship between knowledge, attitude, and motivation with compliance to taking anti-tuberculosis medication in pulmonary TB patients at RSUD Dr. Soekardjo of Tasikmalaya City.

2. Method

This study applied descriptive analytical correlational research design using a cross-sectional approach and was conducted at TB Polyclinic of RSUD Dr. Soekardjo from October to November 2022. In this case, the research samples involved were 60 respondents (aged 20-80 years old) of regular patients who received treatment at the TB polyclinic of RSUD Dr. Soekardjo. Among these respondents, the samples were selected through a purposive sampling technique, where respondents who were mentally challenged and illiterate were excluded. Furthermore, the variables studied included the level of knowledge, motivation, attitude, and compliance to taking TB medication. These variables were measured using a completed questionnaire whose validity and reliability have been tested. In addition, univariate analysis was also conducted to describe the level of knowledge, attitude, motivation, and compliance to taking medication through a frequency distribution.

Bivariate analysis was performed as well to see the relationship between the variables of knowledge, attitudes, and motivation with the compliance to taking anti-tuberculosis medication through the Pearson correlation statistical test with a 95% confidence interval (CI) and an error rate (α) of 0.05. Furthermore, to see the determinants of the variable of compliance to taking anti-tuberculosis medication, the data were analyzed using logistic regression analysis. Additionally, the research has been ethically feasible through KEPK Poltekkes Kemenkes Tasikmalaya with the Ethical Clearance number KP-KEPK/0171/2022.

3. Results and Discussion

The characteristics of the respondents involved in this study are shown in Table 1-5. Based on Table 1, it was obtained that most of the respondents were male, although the number was almost equal to that of females.

Table 1. Frequency Distribution of the Respondents Based on Gender Respondents (n = 60)

Gender	N	%
Male	32	53.3
Female	28	46.7
Total	60	100.0

155

According to Table 2, some of the respondents involved were in the advanced adult age group, and only a small proportion were in the elderly group.

Table 2. Frequency Distribution of the Respondents Based on Age (n = 60)

Age (Years)	N	%
20-39	12	20
40-59	25	42
60-79	17	28
>80	6	10
Total	60	100.0

Based on Table 3 above, most of the research respondents involved were Elementary School graduates. Based on Table 4, most of the research respondents involved were employed.

Table 3. Frequency Distribution of the Respondents Based on the Education Level (n = 60)

Level of Education	N	%
Elementary School	26	43.3
Junior high school	21	35.0
Senior High School	9	15.0
Higher Education	4	6.7
Total	60	100.0

Table 4. Frequency Distribution of the Respondents Based on Occupation (n = 60)

Occupation	N	%
Unemployed	18	30.0
Employed	42	70.0
Total	60	100.0

Based on the data on Table 5, a small part of the respondents studied were single. Furthermore, the level of respondents' knowledge concerning tuberculosis treatment is explained in Table 6 below.

Table 5. Frequency Distribution of Respondents Based on Marital Status (n = 60)

Marital Status	N	%
Single	19	31.7
Married	41	68.3
Total	60	100.0

Table 6 states that most of the respondents have a good level of knowledge concerning tuberculosis medication. Meanwhile, the attitude of the respondents concerning their compliance with taking anti-tuberculosis medication is explained in Table 7 below. Based on the data in Table 7 above, most of the respondents had a good level of attitude related to their compliance with taking anti-tuberculosis medication. Meanwhile, an overview of the respondents' motivation in taking anti-tuberculosis medication is shown in Table 8.

Table 6. Frequency Distribution of the Respondents Based on Knowledge (n = 60)

Level of Knowledge	N	%
Good	57	95
Sufficient	3	5
Insufficient	0	0
Total	60	100.0

Table 7. Frequency Distribution of Respondent Based on Attitude of Compliance to Taking Medication (n = 60)

Compliance to Medication	N	%
Good	44	73
Sufficient	16	27
Insufficient	0	0
Total	60	100.0

Based on Table 8, most of the respondents had a good motivation to take anti-tuberculosis medication. Furthermore, the overview of the respondents' compliance with taking Anti-tuberculosis medication is stated in Table 9 below. Table 9 shows that most of the respondents were obedient in taking their medication. However, the number between those who were obedient and those who were disobedient was almost balanced.

Table 8. Frequency Distribution of Respondents Based on Motivation (n = 60)

Motivation	N	%
Good	43	72
Sufficient	17	28
Insufficient	0	0
Total	60	100,0

Table 9. Frequency Distribution of the Respondents Based on their Compliance Drink drug (n = 60)

Compliance with Taking Medication	N	%
Obedient	31	51.7
Disobedient	29	48.3
Total	60	100.0

Furthermore, the relationship between knowledge, attitudes, and motivation of respondents with the compliance to taking anti-tuberculosis medication is shown in Table 10 below.

Based on Table 10 above, it can be seen that the respondents' knowledge concerning the importance of taking anti-tuberculosis medication is significantly related to the compliance to taking anti-tuberculosis medication (p<0.05).

The gender characteristics of the respondents in this study were mostly male. Related

to this matter, a previous study explained that men have more access to health facilities; hence, epidemiologically, data collection showed that many men are recorded as pulmonary tuberculosis sufferers (Andayani, 2020). However, other research projects stated that compliance with taking anti-tuberculosis medication between men and women is not significantly different (Bea et al., 2021; Tola et al., 2017).

Table 10. Relationship of Knowledge, Attitudes, and Motivation with the Compliance to Taking Anti-Tuberculosis Medication
(n = 60)

Knowledge	Compliance with Taking Medication				p
	Obedient		Disobedient		
	N	%	N	%	
Sufficient	0	0	4	6.7	
Good	31	51.7	25	41.6	0.032
Total	31	51.7	29	48.3	
Attitude	Compliance with Taking Medication				p
	Obedient		Disobedient		
	N	%	N	%	
Sufficient	10	16.7	6	10	
Good	21	35	23	38.3	0.311
Total	31	51.7	29	48.3	
Motivation	Compliance with Taking Medication				p
	Obedient		Disobedient		
	N	%	N	%	
Sufficient	8	13.3	9	15	
Good	23	38.4	20	33.3	0.653
Total	31	51.7	29	48.3	

Apart from gender, the age characteristics in this study were mostly in the productive age range, which is in the 40-59 years age group. This result is in line with the research results in a recent study (Mulyana, 2020) that the majority of respondents were in the productive age range, namely the range of 15-54 years old 65 respondents (67%). Nevertheless, several studies have shown that the elderly are the most non-adherent age group in taking pulmonary tuberculosis medication (Emelda & Gunawan, 2021). Such a condition is supported by degenerative conditions that trigger the use of polypharmacy in the elderly group. In this case, the non-compliance behavior in taking medication more often occurs in the elderly group compared to the younger age group (Hassani et al., 2023; Xu et al., 2017). Furthermore, the environment of the workplace can increase the risk of Pulmonary TB disease occurrence in many people cases. The condition of work makes is easier for someone in productive age to be more prone to caught pulmonary TB disease (Gelb et al., 2010; Kearney et al., 2016). In this case, the most potential environment for the occurrence of tuberculosis transmission is the environment outside the house. While the environment of the workplace is a specific environment with a population concentrated at the same time, workers generally live around the companies in dense housing with unhealthy environments. Therefore, the workplace environment is a potential environment for contracting pulmonary TB disease (Kearney et al., 2016). Furthermore, the educational characteristics of the respondents of this study were mostly elementary school graduates, so it is categorized as low level of education. Pulmonary TB can be affected by educational background, particularly good knowledge since it positively affects the treatment or recovery process of pulmonary TB disease (Bea et al., 2021; Nopiayanti et al., 2022; Tola et al., 2017). In this case, the level of education of someone will affect his knowledge of any conditions, such as knowledge concerning the criteria of a healthy home as well as certain diseases, including their prevention and treatment (Tachfouti et al., 2012).

The characteristics of marital status of current research respondents were mostly married. It is possible that people who are married have more obligations in the household, such as working outside the house, which makes them focus more on work so that they may pay less attention to their health. According to one of the previous studies (Tola et al., 2017), marital status did not significantly affect compliance with taking medication for TB sufferers. The presence of a life partner can be a good support system for compliance to taking medication or vice versa, causing additional distress that will reduce motivation and compliance to taking medication.

Furthermore, the results of the chi-square test on the relationship between the level of knowledge of respondents showed that there was a significant relationship between the level of knowledge of the respondents and compliance to taking pulmonary TB medication. This is in line with the previous research (Bea et al., 2021; Mulyana, 2020; Nopiayanti et al., 2022; Tachfouti et al., 2012) that there was a significant relationship between knowledge and compliance with taking pulmonary TB medication. Knowledge is a predisposing factor for achieving compliance with treatment because it can increase confidence in the benefits of treatment, especially offsetting the demands for medical expenses and other obstacles (Tola et al., 2017). Apart from the educational factor, another factor that can affect knowledge is health education, particularly audiovisual and digital information, which is very easy to access by every TB sufferer. In addition, the counseling factor that is carried out by health workers also strengthens one's knowledge and affects compliance with taking medication (Lee et al., 2020; Musiimenta et al., 2019; Nsengiyumva et al., 2018). Based on the results of the study, not all respondents with good knowledge were obedient in carrying out the treatment program and daily medication. This research also found that several respondents who had sufficient knowledge were obedient in taking the medication. This occurs because the patient has a medication supervisor (PMO) who always reminds him to take medication every day.

The chi-square test on the relationship between respondents' attitudes showed that there was no significant relationship between attitudes and compliance to taking pulmonary TB medication. The results of this study indicated that respondents with sufficient levels of attitude were obedient to taking medication. In this case, research respondents had three stages, including compliance, identification, and internalization. At the stage of compliance, the respondents tend to obey the recommendation provided, showing self-awareness and inclination due to being scared of receiving punishment or sanctions. Meanwhile, at the stage of identification, the patients' compliance tends to arise because the individual feels interested or admires a certain figure, so they want to complete their actions in taking medication without understanding the full meaning and benefits of those actions. Furthermore, someone who is at the stage of internalization will obey the recommendation given to them because they are fully aware of the benefits of the recommendation (Chang & Cataldo, 2014). However, there are also several respondents with good attitudes who were not obedient in taking the medication. It is possible because the respondents feel bored in taking medication every day and tired of receiving the side effects of the medication, such as dizziness and nausea, making the respondents not obedient to the medication. Attitude is built from the social interaction and support system around TB patient. Social interaction also includes the relationship patterns and social roles of TB patients. Eventually, knowledge, beliefs, thinking patterns, emotional states, and internal attitudes of the TB patients affect their compliance to taking anti-tuberculosis medication.

The results of this research further showed that there was no significant relationship between motivation and compliance to taking pulmonary tuberculosis medication. In addition, it is not in accordance with the result of previous research projects that discovered that the motivation of TB sufferers is also affected by their faith, willingness, and desire to complete the medication or do something more. In addition, support from the family and healthcare officer in giving encouragement to reach the goal is the driving factor of increased motivation for someone to live longer (Parwati et al., 2021; Tola et al., 2017). The desire to live longer is the main desire of every human. Humans work to get food in order to continue their survival. In this study, most of the respondents had a high desire to live and recover. The results showed that there was not a single respondent who had poor motivation. Based on the results of the research conducted, most of the respondents always receive support from their family and closest ones to achieve recovery. In addition, health workers at the hospital always provide support in the form of counseling and motivation so that patients do not stop taking the medication. Furthermore, support from the PMO in reminding the patients to keep taking the medication regularly for their recovery and the dangers of stopping the treatment program before being declared fully recovered by the doctor is also significant.

4. Conclusions and Suggestions
The results of this study conclude that there is a significant relationship between someone's knowledge concerning pulmonary TB and his compliance with taking medication. However, no significant relationship was found between attitude and motivation. In addition, the role of health workers and PMO has a strong influence in increasing knowledge about tuberculosis medication and increasing the motivation and attitude of pulmonary TB patients so that they are always compliant with taking anti-tuberculosis medication.

6. References
Andayani, S. (2020). Prediksi Kejadian Penyakit Tuberkulosis Paru Berdasarkan Jenis

Kelamin. *Jurnal Keperawatan Muhammadiyah Bengkulu*, 8(2), 135–140. https://doi.org/10.36085/jkmu.v8i2.1063.

Bea, S., Lee, H., Kim, J. H., Jang, S. H., Son, H., Kwon, J. W., & Shin, J. Y. (2021). Adherence and Associated Factors of Treatment Regimen in Drug-Susceptible Tuberculosis Patients. *Frontiers in Pharmacology*, *12*. https://doi.org/10.3389/fphar.2021.625078.

Chakaya, J., Petersen, E., Nantanda, R., Mungai, B. N., Migliori, G. B., Amanullah, F., Lungu, P., Ntoumi, F., Kumarasamy, N., Maeurer, M., & Zumla, A. (2022). The WHO Global Tuberculosis 2021 Report – not so good news and turning the tide back to End TB. *International Journal of Infectious Diseases*, *124*, S26–S29. https://doi.org/10.1016/j.ijid.2022.03.011.

Chang, S. H., & Cataldo, J. K. (2014). A systematic review of global cultural variations in knowledge, attitudes and health responses to tuberculosis stigma. In *International Journal of Tuberculosis and Lung Disease* (Vol. 18, Issue 2, pp. 168–173). https://doi.org/10.5588/ijtld.13.0181.

Dinas Kesehatan Kota Tasikmalaya. (2022, July 7). *Jumlah Kasus Tuberkulosis Tahun 2021*. Open Data Kota Tasikmalaya.

Emelda, R., & Gunawan, S. (2021). *Factors Influencing Adherence to Tuberculosis Treatment Among Patients in UPTD Puskesmas Muaradua and UPTD Puskesmas Buay Pemaca Ogan Komering Ulu Selatan*.

Ferreira, K. R., Orlandi, G. M., da Silva, T. C., Bertolozzi, M. R., França, F. O. D. S., & Bender, A. (2018). Representations on adherence to the treatment of Multidrug-Resistant Tuberculosis*. *Revista Da Escola de Enfermagem*, *52*. https://doi.org/10.1590/S1980-220X2018010303412.

Gelb, S. R., Shapiro, R. J., & Thornton, W. J. L. (2010). Predicting Medication Adherence and Employment Status Following Kidney Transplant: The Relative Utility of Traditional and Everyday Cognitive Approaches. *Neuropsychology*, *24*(4), 514–526. https://doi.org/10.1037/a0018670.

Hassani, S., Mohammadi Shahboulagi, F., Foroughan, M., Nadji, S. A., Tabarsi, P., & Ghaedamini Harouni, G. (2023). Factors Associated with Medication Adherence in Elderly Individuals with Tuberculosis: A Qualitative Study. *Canadian Journal of Infectious Diseases and Medical Microbiology*, *2023*, 1–15. https://doi.org/10.1155/2023/4056548.

Hidayani, W. R. (2019). Screening and factors associated with tuberculosis in Tasikmalaya Regency in 2019. *1stInternational Respati Health Conference (IRHC*, 992–998).

Hunter, R. L. (2018). The pathogenesis of tuberculosis: The early infiltrate of post-primary (adult pulmonary) tuberculosis: A distinct disease entity. In *Frontiers in Immunology* (Vol. 9, Issue SEP). Frontiers Media S.A. https://doi.org/10.3389/fimmu.2018.02108.

Swarjana, K. I., & Sukartini, T. (2019). Level of attitude, medication adherence, and quality of life among patients with tuberculosis. *International Journal of Nursing and Health Services (IJNHS)*, *2*(4). https://doi.org/10.35654/ijnhs.v2i4.141.

Kearney, S. M., Aldridge, A. P., Castle, N. G., Peterson, J., & Pringle, J. L. (2016). The association of job strain with medication adherence is your job affecting your compliance with a prescribed medication regimen? *Journal of Occupational and Environmental Medicine*, *58*(7), 707–711. https://doi.org/10.1097/JOM.0000000000000 733.

Kementerian Kesehatan Republik Indonesia. (2022). *Laporan Program Penanggulangan Tuberkulosis Tahun 2021* (Sulistiyo & A. Y. Kalinda, Eds.). Kementerian Kesehatan RI.

Lee, Y., Raviglione, M. C., & Flahault, A. (2020). Use of Digital Technology to Enhance Tuberculosis Control: Scoping Review. *Journal of Medical Internet Research*, *22*(2). https://doi.org/10.2196/15727.

Mulyana, A. (2020). Faktor-faktor yang mempengaruhi ketidakteraturan minum obat TB paru pada pasien TB paru di wilayah kerja Puskesmas Cipedes Kota Tasikmalaya. *Jurnal Keperawatan & Kebidanan*, *4*(1), 34–49.

Musiimenta, A., Tumuhimbise, W., Mugaba, A. T., Muzoora, C., Armstrong-Hough, M., Bangsberg, D., Davis, J. L., & Haberer, J. E. (2019). Digital monitoring technologies could enhance tuberculosis medication adherence in Uganda: Mixed methods study. *Journal of Clinical Tuberculosis and Other Mycobacterial Diseases*, *17*. https://doi.org/10.1016/j.jctube.2019.100119.

Nopiayanti, G., Falah, M., & Lismayanti, L. (2022). Faktor-faktor yang berhubungan dengan tingkat kepatuhan minum obat pada penderita TB di Kota Tasikmalaya. *Healthcare Nursing Journal*, *4*(1), 243–247. https://doi.org/https://doi.org/10.35568/health care.v4i1.1838.

Nsengiyumva, N. P., Mappin-Kasirer, B., Oxlade, O., Bastos, M., Trajman, A., Falzon, D., &

Schwartzman, K. (2018). Evaluating the potential costs and impact of digital health technologies for tuberculosis treatment support. *European Respiratory Journal*, *52*(5). https://doi.org/10.1183/13993003.01363-2018.

Parwati, N. M., Bakta, I. M., Januraga, P. P., & Wirawan, I. M. A. (2021). A health belief model-based motivational interviewing for medication adherence and treatment success in pulmonary tuberculosis patients. *International Journal of Environmental Research and Public Health*, *18*(24). https://doi.org/10.3390/ijerph182413238.

Tachfouti, N., Slama, K., Berraho, M., & Nejjari, C. (2012). *The impact of knowledge and attitudes on adherence to tuberculosis treatment: a case-control study in a Moroccan region*. 1. www.panafrican-med-journal.com

Tola, H. H., Karimi, M., & Yekaninejad, M. S. (2017). Effects of sociodemographic characteristics and patients' health beliefs on tuberculosis treatment adherence in Ethiopia: A structural equation modelling approach. *Infectious Diseases of Poverty*, *6*(1). https://doi.org/10.1186/s40249-017-0380-5.

Xu, M., Markström, U., Lyu, J., & Xu, L. (2017). Detection of low adherence in rural tuberculosis patients in china: Application of morisky medication adherence scale. *International Journal of Environmental Research and Public Health*, *14*(3). https://doi.org/10.3390/ijerph14030248.