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Sarcopenia: The Prevalence and Associated Factors in Community-Dwelling Elderly

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ABSTRACT

Sarcopenia is a syndrome characterized by a decrease in skeletal muscle mass and function due to aging. This study aims to assess the prevalence and associated factors of sarcopenia among the elderly in the Pekanbaru. 275 samples were selected using cluster sampling technique. The independent variables were socio-demographic characteristics, metabolic syndrome, independence level, physical activity, quality of life, depression, and nutritional status. Meanwhile, the dependent variable was sarcopenia. Data analysis was carried out through SPSS using statistical tests including descriptive statistics, chi-square, and multivariate logistic regression. The results show that 45.5% of the participants experienced sarcopenia. The mean age of participants was 63.3 years old; most were female; 90.2% were married; and 39.3% had moderate quality of life. The education level was mostly high school; 69.1% were not working; 72% did not experience metabolic syndrome; and 78.5% had normal nutritional status. Gender, education, metabolic syndrome, independence level, physical activity, quality of life, nutrition, marital, depression, and occupational status are associated with sarcopenia. The most significant variables for sarcopenia in the elderly were nutritional status (p=0.031) and physical activity (p= 0.016). Nutritional status and physical activity were predictors of sarcopenia. *Posyandu*, or integrated service post, for the elderly in the public health center, needs to be optimized which requires continuous collaboration among the doctors, nurses, nutritionists, social workers, physiotherapists, psychologists, families, religious institutions, and community shops. Furthermore, a treatment program needs to be developed, both in the community and in the health services area.

INTRODUCTION

Sarcopenia can be defined as an universal decreased ability and skeletal muscle mass.[1] It is a recognized geriatric syndrome which is an important threat to the independence of the elderly and it is caused by a decrease in muscle mass.[2,3] Sarcopenia has emerged as a significant aging-related health problem affecting many facets of public health and represents a major cause of falls and functional deterioration in older persons and increase morbidity.[4,5] Sarcopenia had increased risks of all-cause mortality.[6] This problem also needs attention because of the increased prevalence and negative impact.[7] Sarcopenia was estimated to influence 10 %-16 % of the elderly worldwide.[8] Sarcopenia was increased age, Namely was 60-70 years reported 5-13%, >80 years was 11-50%.[9]

Several previous studies about the prevalence of sarcopenia was spread in various cities in Indonesia and it can be seen to experience a fluctuating increase. The studies have been carried out about sarcopenia was 91,3%.[5] Prevalence sarcopenia of elderly in the urban area in the Surabaya was 41.8%.[10] Furthermore, the research results have been carried out in Indonesia with national scale, it was 50.25% .[11] In addition to urban areas, sarcopenia was also found in the elderly in sub-districts in Pangkalan Pinang, such as a decrease in muscle strength with 29.5% and walking speed with 71.2%.[12]

The cause of sarcopenia is generally considered multifactorial, with environmental causes such as declines in physical activity and nutritional intake. It is also an age-related disease.[11] It is strictly related to poor quality of life, and have risk factors including age and gender.[13] Sarcopenia was independently associated with depression.[14] Metabolic syndrome is a component of Sarcopenia which is associated with greater lean mass and forearm muscle size but poorer muscle quality.[15] The other risk factors for sarcopenia including age, gender, lifestyle, nutritional status, physical activity, disability, and decreased independence.[12]

Screening and early identification of sarcopenia is important to prevent adverse outcomes in elderly.[16] The studies of sarcopenia among elderly in the community undertaken in the Indonesia are not only just a few but also narrow. Therefore, investigation of the prevalence of sarcopenia and associated factors is urgently needed. Currently, no prevalence data has been found in Pekanbaru, Indonesia. The aim of this research was to identify the community's older adult population's sarcopenia risk factors.

MATERIAL AND METHOD

A study with cross-sectional design was carried out in Tenayan Raya Sub-district which covers thirteen villages in Pekanbaru, From August to October 2020. According to the Pekanbaru statistics center, the number of elderlies in Tenayan Raya is high.[17] The samples were selected by cluster sampling. The sample's amount has been established using the following formula $(n=N/1+Ne^2)$ with an error value of 5%.[18] There are 275 samples obtained from the elderly living in thirteen villages in the Tenayan Raya sub-district. The Eligibility criteria were elderly with age of 60 years old and above who were Tenayan Raya citizens and stay in the selected information collection process. They were invited to participate in the study. Those who have mental health disorders, severe communication problems hearing, vision disorders, and people who had received therapy or drugs which impacted exercise ability and developed a health problem causing muscle mass loss had been eliminated from the study. The Asian Working Group for Sarcopenia (AWGS) has taken the same approach as the European Working Group on Sarcopenia in Older People (EWGSOP) and it also recommend a cut-off value for sarcopenia diagnosis parameters different from that of the Europe.[19] This consisted of muscle mass <7.0 kg for men and <5.7 kg for women, muscle strength <26/28(men) and <18 kg (women), and walking speed <0.8/0.1 m/s.[19]

The Prevalence of metabolic syndrome was assessed by the presence of central obesity, type 2 diabetes mellitus, or hypertension and triglyceride therapies. The assessment is based on triglyceride levels ≥150 mg/dl, HDL <40 mg/dL (men) and 50 mg/dL (women), blood pressure ≥ 130/85 mmHg and glycemia ≥100 mg/dl .[20] Blood pressure (systolic and diastolic) was measured by using a sphygmomanometer and stethoscope.[21] central obesity was defined according to the WHO, WC ≥ 94 cm for men and ≥ 80 cm.[22] The Mini Nutritional Assessment (MNA) has been used to determine nutritional

status. MNA, as defined by Bauer JM, Kaiser MJ, Anthony P et al (2008), is an incredibly reliable measure of sensitivity and specificity. This is an appropriate tool to analyze elderly people with normal nutritional status as well as people at risk of malnutrition.[23] The MNA displays excellent reliability levels for the overall score, the classified score, and the majority of its elements.[24] The nutritional status tool received scores on three categories: mild malnutrition (0-7 points), malnutrition risk (8-11 points), and normal (12-14 points).

According Tas Ü, Verhagen AP, Bierma-Zeinstra SM, Odding E, Koes BW forward that the respondents were also assessed based on ADL which is defined as a person's independence in carrying out activities and daily life functions routinely and universally. This was performed through the modification of the Barthel Index.[25] Thus, according to (Mahoney, Barthel, 1965), functional status was assessed by the Barthel index Activities of Daily Living (ADLs), which measures the ability to perform daily living activities eating, dressing, personal hygiene, bathing, bowel, and urine continence, toileting, walking up stairs and along a plane, and transfer from bed to chair. Evaluation of the results of the questionnaire are interpreted according to points gained, whereby 0–40 points were considered high dependency, 45–60 points are considered a moderate dependency, 65 to 95 points is considered a mild dependency, and 100 points independence.[26] WHO (2001) stated that the formula for assessing physical activity is Physical activity Level (PAL) = Physical Activity Ratio (PAR) X time allocation (W) / 24 hours.[27] Depression level was measured through the Geriatric Depression Scale (GDS). This covers 15 closed-question items with a sensitivity of 92% and specificity of 89% when evaluated against the diagnostic criteria by D'ATH et al. 1994.

The Geriatric Depression Scale (GDS) was developed by Brink et al in the United States, and Sheikh, J.I.; Yesavage, J.A (1986), which is the original questionnaire with internal consistency Cronbach's α coefficient was 0.72. It is widely used for psychological evaluation to screen the depression level of elderly in long-term care institutions, without racial or regional bias, and has high reliability and validity in research around the world. The questionnaire has 15 dichotomous "yes" (1 point) and "no" (0 points)

items related to emotional, cognitive, and behavioural symptoms to evaluate life over the past week. The total scores are 0–15, with higher scores indicating a higher depression level. The scores are also categorized into Normal (0-4 points), Mild (5-8 points), Moderate (9-11 points), Severe (12-15 points).[28]

The quality of life was assessed from the World Health Organization Quality of Life (WHOQOL) and a score range of 0–100.[29] To determine quality of life, the WHOQOL-BREF questionnaires (Czech version, Dragomirecká, Prajsová, 2009) had been applied. The WHOQOL-BREF questionnaire includes twenty-six questions, 24 of which have been divided into four main domains: physical health, mental health, social interactions, and environment. The questionnaire has 24 items classified into 6 domains: sensory capacities, autonomy, past, present, and future activities, social engagement, death and dying, and intimacy. After conversion, the standardized ratings in these domains range from 0 to 100 (WHO 2006), where 0 representing the poorest quality of life and 100 indicating the best quality of life.[30]

Muscle mass measurement was used to assess sarcopenia in the participants through Bio-Impedance Analysis (BIA) by asking them to stand barefooted on the analysis board and then hold the detector with both hands. Its data were obtained from the muscle mass index by calculating the appendicular skeletal muscle mass (ASM). This was obtained from the total muscle mass of both lower and upper limbs in kg divided by the square of height in meters (ASM/TB2). Muscle strength was measured in kg using a dynamometer, which was taken 3 times on the dominant hand and then the highest score in a standing position. Physical performance was measured by the walking speed in m/s through the calculation of distance travelled within 6 minutes according to the American Thoracic Society (ATS). All Data were analysed using SPSS. Univariate analysis was used to determine frequency of each variable and bivariate test using chi-square test were used. A regression test was used for multivariate analysis and using multiple logistic regression models. Inferences were drawn at a significant level of <0.05. A multiple regression test was conducted to analyse the associated factors correlated with the sarcopenia, with a *p*-value

less than 0.05 was considered statistically significant. Furthermore, logistic regression analysis consisted of 3 steps. The model consists of bivariate analysis was performed by including all sarcopenia-associated variables ($p<0.05$) with logistic regression, multivariate analysis was conducted by re-entering the sarcopenia-associated variables ($p<0.025$) with logistic regression, interaction testing was carried out by re-entering variables that interacted substantially or had a relationship ($p<0.05$) by the means of logistic regression. All the participants were informed in advance about the study procedure and they also signed the consent form in Indonesian. Data collection was carried out after obtaining approval from the ethics committee of the Medicine Faculty, University of Riau, Indonesia with No.B/13/UN.19.5.1.1.8/UEPKK/2020.

RESULTS

A total of 275 participants were involved in the study. The mean age of the participants was 63.39 (SD±37) years. More than half of the (63.60%) participants were females. More than half (90.20%) were married. The majority, 112 (40.70%) of the participants were graduated from senior high school and 190 (69.10%) were not working (Table 1). Most respondents were not found to have metabolic syndrome at 198 (72%), and the majority of nutritional status is normal. Furthermore, Independence Level and depression status were normal (with 260 independents participants (94.50%). 198 (72%) did not experience metabolic syndrome and 216 (78.50%) had normal nutritional status. Most of the independence level and depression status were normal, the physical activity was mostly mild.

Based on Table 2, elderly male (55%) with sarcopenia are rather common. Compared to old adults with no companion, married elders (48%) had a higher rate of sarcopenia. Sarcopenia was most common in the elderly who had completed elementary school (63.60%). Elderly who does not work experience sarcopenia at 50.50%. Elderly who have metabolic syndrome was at 50%. 69.20% of the elderly at risk of malnutrition developed sarcopenia. Sarcopenia relates to the elderly with moderate independence is at a risk of 66.70%. In 46.90% of the elderly with depression, sarcopenia was

displayed. Sarcopenia affected the elderly who involve to physical activity at 54.10% and 59.40% of the elderly having poor quality of life experienced sarcopenia.

Table 3 shows the dominant factors related to the prevalence sarcopenia of the participants. The value used to identify the predictor factors that related to sarcopenia among elderly in the community was the p-value and standardized coefficient beta (β) and odds ratio (95%CI). The result of analysis shows nutrition status with a value of $p=0.031$; (β)=1.134; CI 95%=1,272-7.588 and physical activity with a value of $p=0.016$; (β)= 0.681; CI 95% = 0,271-0,944).

Table 1. Characteristics of Respondent

Characteristics	n = 275	%
Age (Mean ± SD) Years	63,39 (± 37)	
Gender		
Male	100	36.40
Female	175	63.60
Marital Status		
Married	248	90.20
Widower/Widow	27	9.80
Education Status		
No Education	1	0.40
Elementary School	44	16
Junior High School	44	16
Senior High School	112	40.70
Diploma/Bachelor/ Master	74	26.90
Occupational Status		
Working	85	30.90
Not Working	190	69.10
Sarcopenia		
Positive	125	45.50
Negative	150	54.50
Metabolic Syndrome		
Positive	77	28
Negative	198	72
Nutritional Status		
Malnutrition	33	12
Risk of Malnutrition	26	9.50
Normal	216	78.50
Independence Level		
Heavy	2	0.70
Moderate	3	1.10
Light	10	3.60
Normal	260	94.50
Depression Status		
Severe	0	0
Moderate	9	3.30
Mild	49	17.80
Normal	217	78.90
Physical Activity		
High	63	22
Moderate	64	23.30
Light	148	53.80
Quality of Life		
Very Bad	3	1.10

Bad	32	11.60
Moderate	108	39.30
Good	46	16.70
Very Good	86	31.30

Source: Primary Data, 2020

Table 2. Socio-Demographic and The Factors Associated with Sarcopenia

Variables	Sarcopenia				p-value
	Positive		Negative		
	n	%	n	%	
Gender					
Male	55	55	45	45	0.023
Female	70	40	105	60	
Marital Status					
Married	119	48	129	52	0.019
Widower/Widow	6	22.20	21	77.80	
Education Status					
No Education	1	100	0	0	
Elementary School	28	63.60	16	36.40	0.033
Junior High school	21	47.70	23	52.30	
Senior High School	69	61.61	43	38.39	
Diploma/Bachelor/Master	26	35.10	48	64.90	
Occupational Status					
Working	29	34.10	56	65.90	0.017
Not Working	96	50.50	94	49.50	
Metabolic Syndrome					
Positive	26	33.80	51	66.20	0.022
Negative	99	50	99	50	
Nutritional Status					
Malnutrition	18	54.50	15	45.50	
Risk of Malnutrition	18	69.20	8	30.80	0.014
Normal	89	41.20	127	58.80	
Independence Level					
Heavy Dependence	1	50	1	50	
Moderate Dependence	2	66.70	1	33.30	0.881
Light	5	50	5	50	
Normal	167	64.23	93	35.77	
Depression Status					
Severe	0	0	0	0	
Moderate	0	0	9	100	0.021
Mild	23	46.90	26	53.10	
Normal	102	47	115	53	
Physical Activity					
High	22	34.90	41	65.10	0.008
Moderate	23	35.90	41	64.10	
Light	80	54.10	68	45.90	
Quality of Life					
Very bad	3	100	0	0	
Bad	19	59.40	13	40.60	0.022
Moderate	53	49.10	55	50.90	
Very Good	29	33.70	57	66.30	

Source: Primary Data, 2020

Table 3. Final Model of Analysis Results Multivariate

	Variables	Coefficients Beta (β)	p-value	OR (95% CI)
Steps 1	Gender	-0.108	0.666	0.898 (0.551-1.461)
	Marital status	-0.62	0.831	0.939 (0.529-1.668)
	Education	-21.693	0.132	0.65 (0.108-2.341)
	Occupation status	-0.227	0.455	0.797 (0.439-1.446)
	Metabolic Syndrome	-0.179	0.058	0.836 (0.459-1.523)
	Nutritional status	1.166	0.013	3.211 (1.337-7.708)
	Depression Status	-21.083	0.004	5.109 (0.356-5.910)
	Physical Activity	-0.785	0.008	0.456 (0.248-0.840)
	Quality of Life	1.571	0.013	4.812 (1.135-8.650)
Steps II	Nutritional status	0.954	0.049	2.597 (0.945-7.140)
	Depression Status	-20.898	0.999	0.65(0.006-3.235)
	Physical Activity	-0.673	0.046	0.510 (0.264-0,988)
	Quality of Life	20.907	0.999	1.12 (0.17-7.25)
Steps III	Nutritional status	1.134	0.031	5.089 (1.272-7.588)
	Physical Activity	-0.681	0.016	1.591 (0.271-0.944)

Source: Primary Data, 2020

DISCUSSION

According to our analysis, the overall prevalence of sarcopenia was 45.50%. In Indonesia, sarcopenia has been the subject of several research in the past. This is in line with the finding of sarcopenia in the city of Surabaya, as much as 41.8.[10] Furthermore, the data of Indonesia Longitudinal Aging Study (INALAS) from community-dwelling outpatients in eight center found that the prevalence of sarcopenia was 17,6%.[31] The difference in the prevalence of sarcopenia in regions in Indonesia was influenced by sample. It can be seen that there were fewer studies in Bandung, so the findings are different. However, the findings in the city of Surabaya were higher because of there were more samples. In addition, the difference in gender produced a difference in sarcopenia. The results of previous studies have been found that sarcopenia among the elderly in Malaysia was 28.5%.[3] In the Singapore was 16%.[32] In the di Thailand was 10%.[33] It can be seen that there is a significant difference among these countries. The low number of sarcopenia cases in the above countries is due to several factors. Geriatric nursing has received by high attention and high comprehension. In addition, taken care by families can cause low number of sarcopenia percentages.

Moreover, variables related to sarcopenia in the elderly in the community include gender, marital status, level of education, occupation, metabolic syndrome, nutritional status, depression status, physical activity, and quality of life. The findings of this study were similar to those of earlier ones. One of them is European interconnection which the majority of older women are vulnerable to disproportional Sarcopenia.[34] Disadvantaged socioeconomic position was an independent determinant of probable sarcopenia in community-dwelling older adults.[35] Those with social disadvantages are disproportionately more likely to develop sarcopenia.[36]

The major element of insulin-induced glucose metabolism is the muscle. Furthermore, metabolic syndrome and glucose intolerance were intimately related to muscle loss.[37] The results also showed that the elderly with malnutrition tend to get sarcopenia by an OR value of 5.089 compared to their counterpart. It was stated that internal factors cause this condition and sarcopenia has a relationship with physical performance, muscle strength, and mass. Energy is required to fulfill these three conditions, of which strength is obtainable from the daily nutritional intake. This is supported by the previous study that protein supplementation combined with exercise provides additional benefit on lower-extremity strength in healthy older adults with sarcopenia in Asian countries.[38] One important organ for insulin-induced glucose metabolism is the skeletal muscle.

Moreover, Sarcopenia has been associated to a higher probability of a variety of adverse health consequences, namely metabolic disorders.[39] Previous studies have shown that there was a link between sarcopenia and depression in the elderly.[40] Physical activity issues in the elderly have an impact on health concerns, particularly when it comes to muscular illnesses like sarcopenia.[41] The quality of life, rather than the quantity of time left to exist, is what greatly importantwhile people get older. The elderly's ability to establish enjoyable, meaningful life is an indicator of their quality of life. Sarcopenia in the elderly is linked to a variety of negative clinical outcomes, including physical debilitation, mobility restrictions, a decrease in quality of life, a greater chance of falling, hospitalization and mortality.

On the other hand, the study indicated that reduced physical activity causes a higher risk of sarcopenia development.[42] Elderly should be engaged in physical activity to avoid diseases and enhance their quality of life.[41] Previous multivariate studies found that sarcopenia was unrelated to the degree of independence of the elderly in the community.[43] Elderly might prevent muscle tension, weakness, and poor physical performance while being independent in their daily activities.

Based on the results of multivariate analysis, in this study, elderly with nutrition disorders were 5.089 times more likely to develop sarcopenia compared to elderly with normal nutrition status (OR: 5.089, 95% CI: 1.272-7.588).[44] The elderly who had physical activity disorders were 1.591 times more likely to develop sarcopenia compared to those not having problems with physical activity. Physical activity was associated with sarcopenia by an OR of 1.591 and a p-value of 0.032, which aligns with the previous studies. It showed that Physical activity was mostly in the light category (53.8%). Furthermore, the study indicated that reduced physical activity causes a higher risk of sarcopenia development.[42]

The findings of the current investigation have implications for health care in the community (*PERKESMAS*) and nursing care for the elderly policies in setting of reducing morbidity, such as muscle disorders in the elderly. In addition, enhancing health services with various disciplines is necessary to comprehend the causes of sarcopenia. There are definitely some limitations in this research, for instance, during data collection on factors related to sarcopenia, it is still reported that some elderly were assisted by researchers and their family to answer questionnaires, which could results in inaccurate and biased data that ultimately affects the research findings.

CONCLUSION AND RECOMMENDATION

According to this study, sarcopenia affects 45.50% of elderly in Pekanbaru City, Indonesia. In addition, the most dominant influencing factors were nutritional status (p=0.031; (β)= 1.134; CI 95%=1,272-7.588) and physical activity (p=0.016; (β)=0.681; CI 95%=0,271-0,944). Furthermore, a program for sarcopenia treatment needs to be developed, both in the community and health services area. Posyandu, or an integrated service unit for elderly people, has to be enhanced at Tenayan Raya Primary Health Centre (PHC). Nurses and doctors need to collaborate together continuously to solve problems, social workers, physiotherapists, psychologists, families, and religious and community shops. Exercise is also an effective strategy to avoid sarcopenia.

AUTHOR CONTRIBUTIONS

S, ME, and AR, wrote the manuscript. The research article has been thoroughly reviewed and authorised by all contributors. S = Sumandar; ME = Mersi Ekaputri; AR = Arya Ramadia.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Coletta G, Phillips SM. An Elusive Consensus Definition of Sarcopenia Impedes Research and Clinical Treatment: A Narrative Review. *Ageing Research Reviews*. 2023;86. https://doi.org/10.1016/j.arr.2023.101883

2. Setiorini A. Sarcopenia dan Risiko Jatuh pada Pasien Geriatri. *Muhammadiyah Journal of Geriatric*. 2021;2(1):10. https://doi.org/10.24853/mujg.2.1.10-16

3. Sazlina SG, Lee PY, Chan YM, Hamid MSA, Tan NC. The Prevalence and Factors Associated with Sarcopenia among Community Living Elderly with Type 2 Diabetes Mellitus in Primary Care Clinics in Malaysia. *PLoS One*. 2020;15(5):2–4. https://doi.org/10.1371%2Fjournal.pone.0233299

4. Santos JL dos, Trennepohl C, Rosa CB, Garces SBB, Myskiw J de C, Costa DH. Impact of Sarcopenia, Sedentarism and Risk of Falls in Older People's Health Self-Perception. *Fisioterapia em Movimento*. 2019;32:1–10. https://doi.org/10.1590/1980-5918.032.AO17

5. Pratiwi YS, Lesmana R, Setiawan S, Purba A. Tinjauan Pustaka: Autophagy dan Sarkopenia. *Syifa' MEDIKA: Jurnal Kedokteran dan Kesehatan*. 2019;10(1):31. https://doi.org/10.32502/sm.v10i1.1781

6. Kitamura A, Seino S, Abe T, Nofuji Y, Yokoyama Y, Amano H, et al. Sarcopenia: Prevalence, Associated Factors, and the Risk of Mortality and Disability in Japanese Older Adults. *Journal of Cachexia, Sarcopenia Muscle*. 2021;12(1):30–38. https://doi.org/10.1002/jcsm.12651

7. Diar Meitha Wardhana, Novira Widajanti JI. Association of Comprehensive Geriatric Assessment's Component and Sarcopenia in Elderly. *Jurnal Penyakit dalam Indonesia*. 2019;6(4):188–295. https://doi.org/10.7454/jpdi.v6i4.370

8. Yuan S, Larsson SC. Epidemiology of Sarcopenia: Prevalence, Risk Factors, and Consequences. *Metabolism*. 2023; 3:155533. https://doi.org/10.1016/j.metabol.2023.155533

9. De P, Tonial C, Colussi L, Sant' AL, Alves A, Stürmer J, et al. Prevalence of Sarcopenia in Elderly Users of the Primary Health Care System. *Nutricon Hospitalaria.* https://doi.org/10.20960/nh.02790

10. Widajanti N, Ichwani J, Dharmanta RS, Firdausi H, Haryono Y, Yulianti E, et al. Sarcopenia and Frailty Profile in the Elderly Community of Surabaya: A Descriptive Study. *Acta Medica Indonesia*. 2020;52(1):5–13. https://www.actamedindones.org/index.php/ijim/article/view/1206/pdf

11. Ridwan ES, Wiratama BS, Lin MY, Hou WH, Liu MF, Chen CM, et al. Peak Expiratory Flow Rate and Sarcopenia Risk in Older Indonesian People: A Nationwide Survey. *PLoS One*. 2021;16(2):1–13. https://doi.org/10.1371/journal.pone.0246179

12. Ratmawati, Fatimah-Muis S, Sofro MAU, Margawati A, Kartasurya MI. Characteristics, Nutritional Status, and Sarcopenia in the Elderly in Pangkalpinang City. *Proceedings of the First International Conference on Health, Social Sciences and Technology*. 2021;521:216–223. https://doi.org/10.2991/assehr.k.210415.046

13. Yeung SSY, Reijnierse EM, Pham VK, Trappenburg MC, Lim WK, Meskers CGM, et al. Sarcopenia and its Association with Falls and Fractures in Older Adults: A Systematic Review and Meta-Analysis. *Journal of Cachexia, Sarcopenia Muscle*. 2019;10(3):485–500. https://doi.org/10.1002/jcsm.12411

14. Kitamura A, Seino S, Abe T, Nofuji Y, Yokoyama Y, Amano H, et al. Sarcopenia: Prevalence, Associated Factors, and the Risk of Mortality and Disability in Japanese Older Adults. *Journal of Cachexia, Sarcopenia Muscle*. 2021 Feb 1;12(1):30–38. https://doi.org/10.1002/jcsm.12651

15. Mesinovic J, McMillan L, Shore-Lorenti C, De Courten B, Ebeling P, Scott D. Metabolic Syndrome and its Associations with Components of Sarcopenia in Overweight

and Obese Older Adults. *Journal of Clinical Medicine*. 2019;8(2):145. https://doi.org/10.3390%2Fjcm8020145

16. Xu J, Wan CS, Ktoris K, Reijnierse EM, Maier AB. Sarcopenia is Associated with Mortality in Adults: A Systematic Review and Meta-Analysis. *Gerontology*. 2021;1–16. https://doi.org/10.1159/000517099

17. BPS Kota Pekanbaru. Data Statistik Sektoral Kota Pekanbaru. Riau: Badan Pusat Statistik Kota Pekanbaru; 2020. https://pekanbarukota.bps.go.id/

18. Ryan TP. Sample Size Determination and Power. Canada: Jhon Wiley & Sons; 2013. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118439241

19. Chen LK, Woo J, Assantachai P, Auyeung TW, Chou MY, Iijima K, et al. Asian Working Group for Sarcopenia: 2019 Consensus Update on Sarcopenia Diagnosis and Treatment. 2020;21(3):300-307. https://doi.org/10.1016/j.jamda.2019.12.012

20. Xiong Y, Zhang Y, Zhang F, Wu C, Qin F, Yuan J. Prevalence and Associated Factors of Metabolic Syndrome in Chinese Middle-Aged and Elderly Population: A National Cross-Sectional Study. *Aging Male*. 2021;24(1):148–159. https://doi.org/10.1080/13685538.2021.1998432

21. Rehman S, Hashmi MF, Nelson VL, Saad Rehman A. Blood Pressure Measurement. 2022. https://pubmed.ncbi.nlm.nih.gov/29489154/

22. World Health Organization (WHO). Waist Circumference and Waist-Hip Ratio of A WHO Expert Consultation, Geneva. 2011. https://www.who.int/publications-detail-redirect/9789241501491

23. Isautier Ennifer MJ, Bosnić M, Yeung SSY, Trappenburg MC, Meskers CGM, Whittaker AC, et al. Validity of Nutritional Screening Tools for Community-Dwelling Older Adults: A Systematic Review and Meta-Analysis. *JAMDA: The Journal of Post Acute and Long Term Medicine*. 2019;20(10):13-25. https://doi.org/10.1016/j.jamda.2019.06.024

24. Woldekidan MA, Haile D, Shikur B, Gebreyesus SH. Validity of Mini Nutritional Assessment Tool Among an Elderly Population in Yeka Sub-City, Addis Ababa, Ethiopia. *South African Journal of Clinical Nutrition*. 2021;34(3):103–109. https://doi.org/10.1080/16070658.2020.1741903

25. Chauhan S, Kumar S, Bharti R, Patel R. Prevalence and Determinants of Activity of Daily Living and Instrumental Activity of Daily Living among Elderly in India. *BMC Geriatrics*. 2022;22(1). https://bmcgeriatr.biomedcentral.com/articles/10.1186/s12877-021-02659-z

26. Nursiswati N, Halfens RJG, Lohrmann C. Psychometric Properties of the Care Dependency Scale in Stroke Survivors in Indonesian Hospitals. *International Journal of Nursing Science*. 2020;7(3):330–336. https://doi.org/10.1016/j.ijnss.2020.06.011

27. Wijaya, N. K., Ulfiana, E., & Wahyuni, S. D. The Correlation between Individual Characteristics, Physical Activity, and Lifestyle with The Level of Physical Vitality among Elderly. *Indonesian Journal of Community Health Nursing*. 2019; 4(2): 46–52. https://doi.org/10.20473/ijchn.v4i2.12365

28. Liu CC, Lin YT, Cheng KC, Pan HH, Chiou CP. Predictors of Depression Level among Community-Dwelling Elderly Persons. *International Journal of Environmental Research and Public Health*. 2022;19(15). https://doi.org/10.3390/ijerph19159414

29. Crocker TF, Brown L, Clegg A, Farley K, Franklin M, Simpkins S, et al. Quality of Life is Substantially Worse For Community-Dwelling Older People Living With Frailty: Systematic Review and Meta-Analysis. *Quality of Life Research*. 2019;28(8):2041–2056. https://doi.org/10.1007/s11136-019-02149-1

30. Lim SC, Chan YM, Gan WY. Social and Health

Determinants of Quality of Life of Community-Dwelling Older Adults in Malaysia. *International Journal of Environmental Research and Public Health*. 2023;20(5). https://doi.org/10.3390%2Fijerph2005397 7

31. Harimurti K, Setiati S, Heriawan Soejono C, Suka Aryana I, Sunarti S, Budiningsih F, et al. Sarcopenia in a Multiethnic State: A Cross-Sectional Data Analysis of Multicentre Indonesia Longitudinal Aging Study. *Acta Medica Indonesiana*. 2023;55(1):61-69. https://www.actamedindones.org/index.php/ijim/article/view/2311/pdf

32. Lim JY, Low NA, Merchant RA. Prevalence of Sarcopenia in Pre-Frail Community Dwelling Older Adult and Utility of SARC-F, SARC-Calf and Calf Circumference in Case Finding. *Journal of Frailty, Sarcopenia and Falls*. 2020;05(03):53–56. https://www.jfsf.eu/Article.php?AID=v05i03_053

33. Therakomen V, Petchlorlian A, Lakananurak N. Prevalence and Risk Factors of Primary Sarcopenia in Community-Dwelling Outpatient Elderly: A Cross-Sectional Study. *Scientific Reports*. 2020;10(1):88–99. https://doi.org/10.1038/s41598-020-75250-y

34. Milewska M, Przekop Z, Szostak-Węgierek D, Chrzanowska M, Raciborski F, Traczyk I, et al. Prevalence of Risk of Sarcopenia in Polish Elderly Population-A Population Study. *Nutrients*. 2022;14(17). https://doi.org/10.3390/nu14173466

35. Swan L, Warters A, O'Sullivan M. Socioeconomic Inequality and Risk of Sarcopenia in Community-Dwelling Older Adults. *Clinical Interventions in Aging*. 2021;16:1119–1129. https://doi.org/10.2147%2FCIA.S310774

36. Brennan-Olsen SL, Vogrin S, Balogun S, Wu F, Scott D, Jones G, et al. Education, Occupation and Operational Measures of Sarcopenia: Six Years of Australian Data. *Australasian Journal on Ageing*. 2020;39(4):498–505. https://doi.org/10.1111/ajag.12816

37. Nishikawa H, Asai A, Fukunishi S, Nishiguchi S, Higuchi K. Metabolic Syndrome and Sarcopenia. *Nutrients*. 2021;13(10):3519. https://doi.org/10.3390/nu13103519

38. Li L, He Y, Jin N, Li H, Liu X. Effects of Protein Supplementation and Exercise on Delaying Sarcopenia in Healthy Older Individuals in Asian and Non-Asian Countries: A Systematic Review and Meta-Analysis. *Food Chemistry: X*. 2022; 13:100210. https://doi.org/10.1016/j.fochx.2022.100210

39. Yuan S, Larsson SC. Epidemiology of Sarcopenia: Prevalence, Risk Factors, and Consequences. *Metabolism*. 2023(7); 144:155533. https://doi.org/10.1016/j.metabol.2023.155533

40. Li Z, Tong X, Ma Y, Bao T, Yue J. Prevalence of Depression in Patients with Sarcopenia and Correlation between the Two Diseases: Systematic Review and Meta-Analysis. *Journal of Cachexia, Sarcopenia and Muscle*. 2022;13:128–144. https://doi.org/10.1002/jcsm.12908

41. Kitamura M, Izawa KP, Ishihara K, Matsuda H, Okamura S, Fujioka K. Physical Activity and Sarcopenia in Community-Dwelling Older Adults with Long-Term Care Insurance. *European Journal of Investigation in Health Psychology and Education*. 2021;11(4):1610–1618. https://doi.org/10.3390/ejihpe11040114

42. Ribeiro Santos V, Dias Correa B, De Souza Pereira CG, Alberto Gobbo L. Physical Activity Decreases the Risk of Sarcopenia and Sarcopenic Obesity in Older Adults with the Incidence of Clinical Factors: 24-Month Prospective Study. *Experimental Aging Research*. 2020;46(2):166–177. https://doi.org/10.1080/0361073x.2020.1716156

43. Wearing J, Konings P, De Bie RA, Stokes M, De Bruin ED. Prevalence of Probable Sarcopenia in Community-Dwelling Older Swiss People-A Cross-Sectional Study. *BMC* Geriatr. 2020;20(1). https://bmcgeriatr.biomedcentral.com/articles/10.1186/s12877-020-01718-1

44. Nursilmi, N., Kusharto, C. M., & Dwiriani, C. M. Hubungan Status Gizi dan Kesehatan dengan Kualitas Hidup Lansia di Dua Lokasi Berbeda. *Media Kesehatan Masyarakat Indonesia*. 207;13(4): 369-379. https://doi.org/10.30597/mkmi.v13i4.3159

Sexual Behavior of Adolescents: Risk Factors in Rural Areas

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ABSTRACT

The percentage of adolescents who have actively engaged in sexual behavior before marriage is 4.92%. Adolescents living in rural areas are more likely to be exposed to risky behavior than those who live in urban areas. This study aims to identify the factors that influence risky sexual behavior among adolescents in rural areas. This study used a qualitative method with a phenomenological approach. Data were collected using in-depth interview techniques on 12 participants consisting of 7 adolescents and 5 parents in rural areas. The samples were selected using a purposive sampling technique. The validity of the data was carried out using source triangulation and peer debriefing. The thematic analysis was carried out using Open code 4.03 software. This study showed that perception is a factor that can influence adolescents to engage in risky sexual behavior. It includes perceptions of risky sexual behavior such as dating, the definition of risky sexual behavior, risk factors, sexual relationships, and sexually transmitted diseases. In addition, adolescents' perceptions of risky sexual behavior in health, psychology, education, and the future are also the factors that influence risky sexual behavior. Apart from the perception, other factors include discomfort feeling at home, sexual experience, the influence of social media, the influence of friends, love from partners, and environmental influences. Based on our results, the better the adolescent's perception of risky sexual behavior is, the lower the risk of adolescents engaging in risky behavior will be.

INTRODUCTION

Adolescence is a group of age who are prone to risky behavior. World Health Organization (WHO) reveals that adolescents are in the transition period between childhood and adulthood, ranging from 10 to 19 years old.[1] Adolescents also have specific physical, emotional, cognitive, and psychosocial characteristics.[2] The adolescent population reaches a considerable amount of 1.2 billion or 16% of the world population.[3] In Indonesia, the number of adolescents is 64.19 million (24,01%), consisting of males (50,78%) and females (49,22%) residing in urban areas (57,94%) and rural areas (42,06%). The estimation of the adolescent population in Yogyakarta (DIY) in 2020, ranging from 15-19 years old, reached 274,4 people, consisting of 140,3 males and 134,1 females.[4] A high percentage of those adolescents are at risk for risky sexual behavior.

According to a study, 4,92% of adolescents have already been sexually active. The sexual activities include 56,9% kissing, 30,7% of kissing restricted to the area of the neck and above (necking), 13.8% touching sensitive parts of the body (petting), 7,2% of oral sex, 5,5% of anal sex, and 14,7% of sexual intercourse before marriage.[5] The prevalence of the percentage of risky sexual the behavior of female adolescents is higher, as much as 54%, compared to male adolescents of 46%. They were exposed to premarital sexual activity as they loved each other. Besides, in the past five years, the percentage of female adolescents using condoms has increased to 49% compared to male with 27%.[6]

The Indonesian Family Planning Association states that risky sexual behavior are influenced by both internal and external factors.[7] This includes promiscuity, environmental factor, friends, school, families who are open to risky behavior, and the influence of the mass media.[4] Other factors include geographic conditions such as urban and rural areas.[8]

People in rural areas tend to be influenced by culture, limitations of health services, education, and the lack of accessible information.[9] Adolescents often lack information regarding health reproduction and have limited access to affordable health reproduction services where confidentiality is guaranteed.[4] According to the Youth Demographic and Reproductive Health Survey in 2017, 57% of young women who live in urban areas can access information about sexual behavior. It is higher compared to young women in rural areas, namely only 47%. Furthermore, adolescents in urban areas have a higher level of education. 52% of female adolescents in urban areas graduated from high school, while only 39% of female adolescents graduated with the same education level in rural areas.[10] It might cause rural adolescents to have risky sexual behavior.[11] It is reported that rural adolescents are more likely engage in sexual activity (24,0%) than those in urban areas (19,7%).[12] Another study states that urban adolescents have less sexual activity without using a condom than those in rural areas. The difference between this study and earlier research is the criteria for respondents with an age range of 15-24 years. It was chosen because it became a consideration in the respondents answering this research question. This study also uses qualitative methods which aim to get more in-depth answers from respondents.

This phenomenon is influenced by poverty and lack of education.[13] Such behavior can harm adolescents and can be influenced by a range of factors. The factors that influence sexual behavior in adolescents consist of internal factors and external factors. The internal factors include a free lifestyle, sexual education, and harmful norms. Meanwhile, the external factors include the risky environment, influence from surrounding peers, and unharmonious family relationships.[14] Another study stated that the factors associated with premarital adolescent sexual behavior are influenced from surrounding peers, alcohol consumption, and adolescent attitudes toward maintaining their virginity.[15] In addition, the lack of attention from school peers and the community also increases the risk of sexual behavior in adolescents because social values, beliefs, and norms are important factors, among others.[16] Based on the introduction above, the researcher is interested in identifying the factors that influence risky sexual behavior in rural areas.

MATERIAL AND METHOD

This study used a qualitative method and phenomenological approach to scrutinize the relevant factors that influence risky sexual behavior in adolescents in rural areas. This research was conducted in Bangunjiwo Village,

one of the rural areas in Bantul Regency, Yogyakarta. The research location was chosen based on the results of earlier studies which showed that many adolescents engaged in risky sexual behavior. The sample in this study include seven adolescents and five parents selected using a purposive sampling method. The inclusion criteria in this study is shown in Table 1.

The instrument of this study was an in-depth interview guide that consists of several open-ended questions. The researcher conducted in-depth interviews with parents and adolescents who had a history of risky sexual behavior. The analysis technique was conducted thematically using open code 4.03 software. The validity of the data was carried out using triangulation sources, member checks, and peer debriefing. This research has received ethical permission from the Faculty of Medicine and Health Sciences ethics committee, Universitas Muhammadiyah Yogyakarta, by the number 020/EC-KEPKFKIK UM/I/2021.

RESULTS

Participants in this study were 12 people consisting of 7 adolescents and 5 parents with the participant characteristics in Table 2.

This study showed that there were many factors affecting risky sexual behavior among adolescents in rural areas (Figure 1). One of the factors was adolescents' perception of risky sexual behavior and perceptions of the impact of risky sexual behavior. Adolescent perceptions of risky sexual behavior consisted of perceptions of the definition, perceptions of the risk factors, perceptions of dating, perceptions of sexual relationships, and perceptions of sexually transmitted diseases. Meanwhile, adolescent perceptions of the impact of risky sexual behavior included health impacts, psychological impacts, educational impacts, and future impacts. Apart from perception, other factors could influence adolescents to engage in risky sexual behavior such as the discomfort feeling at home, sexual experiences, the influence of social mediaor friends, love from partners, environmental influences, youth activities in the village, and the village regulations.
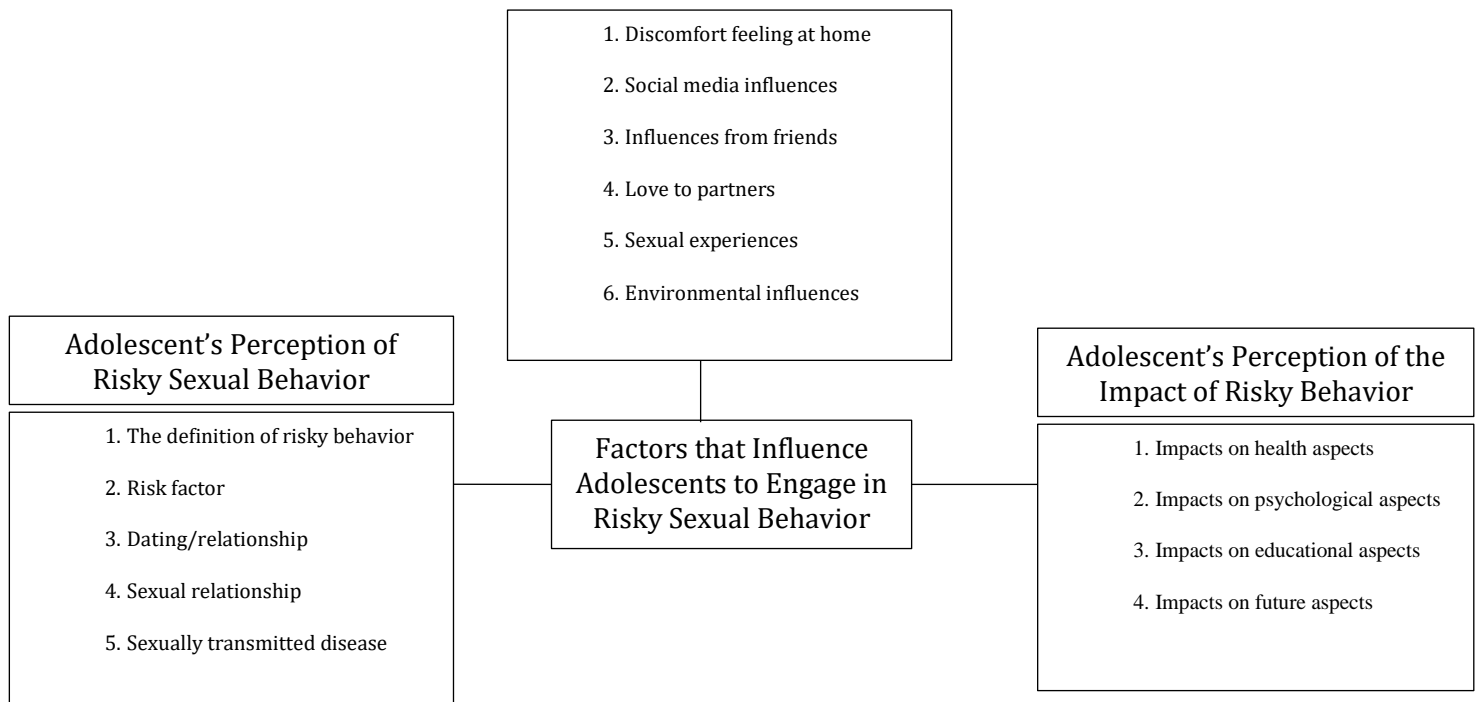
Table 1. Inclusion Criteria of Participants

Adolescent	Parent
1. Willing to be a respondent in data collection	1. Willing to be a respondent in data collection
2. Able to communicate verbally well	2. Able to communicate verbally well
3. Residing in Bangunjiwo	3. Residing in Bangunjiwo
4. Adolescents who have a history of risky behavior aged 12-22 years	4. Parents who have children with a history of risky behavior aged 12-22 years

Source: Primary Data, 2021

Table 2. Participants Characteristics

Participant Code	Gender	Age (Years)	Recent Education	Occupation	Status
Participant 1	Female	22nd	Senior High School	Student	Adolescent
Participant 2	Female	17th	Senior High School	Student	Adolescent
Participant 3	Female	16th	Vocational High School	Student	Adolescent
Participant 4	Male	21st	Senior High School	Student	Adolescent
Participant 5	Male	21st	Senior High School	Student	Adolescent
Participant 6	Male	20th	Vocational High School	Private Employees	Adolescent
Participant 7	Male	16th	Vocational High School	Student	Adolescent
Participant 8	Female	46th	Junior High School	Laborer	Parent
Participant 9	Female	46th	Senior High School	Housewife	Parent
Participant 10	Female	41st	Junior High School	Laborer	Parent
Participant 11	Female	48th	Elementary School	Laborer	Parent
Participant 12	Female	35th	Senior High School	Housewife	Parent

Source: Primary Data, 2021

	1. Discomfort feeling at home
	2. Social media influences
	3. Influences from friends
	4. Love to partners
	5. Sexual experiences
	6. Environmental influences

Adolescent's Perception of Risky Sexual Behavior

1. The definition of risky behavior
2. Risk factor
3. Dating/relationship
4. Sexual relationship
5. Sexually transmitted disease

Factors that Influence Adolescents to Engage in Risky Sexual Behavior

Adolescent's Perception of the Impact of Risky Behavior

1. Impacts on health aspects
2. Impacts on psychological aspects
3. Impacts on educational aspects
4. Impacts on future aspects

Source: Primary Data, 2021

Figure 1. Factors Affecting Risky Sexual Behavior among Adolescents in Rural Areas

Adolescent Perceptions of Risky Sexual Behavior

This study indicated that there are several perceptions of adolescents that can influence risky sexual behavior in this age group. It began with adolescents' perceptions of the definition of risky behavior and the risk factors. The result showed that the participant considered risky sexual behavior as a behavior that led to negative aspects and self-harm, such as unsafe sexual relations causing a disease. One adolescent said that when pregnancy out of wedlock happened, the carrier will experience untimely maturity due to circumstances and will suffer a loss for themselves. It was explained by the participant below:

"Risky behavior is a behavior that leads to negative aspects. It can influence the family relationship and can embarrass parents. Something like that can lower the dignity of the family, that is my opinion." (Parent, Female, 46 years old)

"A sexual relationship without a condom can lead to pregnancy. That is all I know." (Adolescent, Female, 16 years old)

"Hmmm let me think. It might be self-harm behavior." (Adolescent, Female, 17 years old)

"Risky sexual behavior is related to a sexual relationship that can cause diseases. Such as kissing,

smoking, drugs. These are fun aspects that later leads to harm." (Adolescent, Male, 21 years old)

The next is the perception of dating, sexual intercourse, and sexually transmitted diseases. Participants stated that the normal activities to do when dating include holding hands, kissing, and hugging. They also argued that having sexual intercourse is abnormal but mutually beneficial. However, it can lead to sexually transmitted diseases. The diseases are caused by frequent sexual activity or sexual intercourse. This sexually transmitted disease is a deadly disease. It is explained by participants as follows:

"That's a bad thing. I remember my teacher told me that if we frequently do it (sexual relationship) with many different people, it will lead to disease (sexually transmitted diseases) and also can lead to death. Am I right?" (Adolescent, Female, 16 years old)

"The sexually transmitted disease happened because of infectious sexual activities." (Adolescent, male, 21 years old)

"It's like a disease that can be transmitted through sexual activity like sexual intercourse or anything like that...." (Adolescent, Female, 22 years old)

"I think it is becoming normal for people nowadays. Whenever a couple are alone in a quiet place, certainly something will happen between them, kissing is still normal. What is not normal is a sexual relationship. It

depends on the individual. When people like to watch porn movies and they have new partners, they are likely to do sexual relationships hahaha. It is unfortunate but they can take the fun from it. A mutual sexual relation is not a problem for me. However, there is no cure for sexually transmitted disease, a disease that can cause harm to reproduction and even leads to death". (Adolescent, male, 20 years old)

Factors Affecting Adolescents to Engage in Risky Sexual Behavior

The results indicated that other factors influenced adolescents in addition to their perceptions of risky sexual behavior. The factors included feeling discomfort at home, which caused them to seek comfort outside the home. The discomfort felt by adolescents can emerge from not having a close relationship with their parents. The closeness of adolescents with their parents makes adolescents feel that their parents are a safe space to tell stories even as friends. Adolescents tend to feel less or not close to their parents because of their parents busy schedule. This caused adolescents to engage in risky sexual behavior because family is a determinant to shape adolescents' behavior. This statement is in line with what was stated by the participant below:

"Parents should provide a comfortable family environment for their children because family becomes the primary factor for children to behave appropriately. Children do bad things because they might not feel comfortable in their family circle." (Parent, Female, 46 years old)

"Hmm.. family environment seems to have a big influence on children. For example, when they do not feel comfortable at home and they are not close to their parents that will influence how they behave." (Adolescent, Female, 17 years old)

In addition, adolescents were likely to engage in risky sexual behavior influenced by social media. For example, they usually used Google to access porn sites, which was considered normal to them. Besides, other factors include influence from peers and love from partners. Adolescents who had feelings of love for their partners stated that they had no regrets when engaging in risky sexual behavior as they thought they enjoyed the sexual activities. Thus, they did not have feelings of regret. It is proven in the participant's statement below:

P: "Did you access porn sites?"

I: "Honestly yes. It is normal, isn't it? Haha"

P: "Is there something else?"

I: 'When I access porn sites, I was curious which one is a good position for sexual intercourse hahaha." (Adolescent, Male, 20 years old)

"I only access Google and read what pops up. The worst one is accessing porn sites haha." (Adolescent, male, 16 years old)

"Surely, when we are friends with people who have no lovers, we are less likely to have lovers, too. But when we are friends with people who do, we tend to have a gut to be dating, too." (Adolescent, Female, 17 years old)

"It was due to influence from friends that I was curious. They told me it (sexual relationship) was fun; I was curious and I began to get addicted to it and do sexual activities several times with my ex-boyfriend." (Adolescent, Male, 20 years old)

"Hehehe (laughing), I think that's normal for new couples to do it (sexual activity)." (Adolescent, Female, 22 years old)

Furthermore, another factor that also affects adolescents' risky sexual behavior is their sexual experiences. This study indicated that adolescents have had sexual experiences in the past. These experiences included sexual harassment, such as when others touched their breast without consent. Furthermore, the experience also included watching porn movies, holding hands, and doing sexual activities with their partners. It is proven in the participant's statement below:

"Yes.. it possibly happened. When I was a child, I didn't know it (laughing) so others touched my breast." (Adolescent, Female, 22 years old)

P: "Have you ever seen people engaged in risky sexual behavior?

I: "Yes" (Adolescent, Female, 16 years old)

"Yes, just holding hands ...." (Adolescent, female, 22 years old)

P: "How about a sexual relationship?"

I: "I have done it with my ex-girlfriend and also my girlfriend" (Adolescent, male, 20 years old)

Another factor that also influenced adolescents to engage in risky sexual behavior was the environmental factor. In addition, due to the busyness and infrequency of the integrated service posts implementation, adolescents became less active in integrated service posts activities; thus, they lack information. Passive socialization in the village and grouping friendships resulted in adolescents looking for a

more comfortable environment outside of socializing and seeking information. It is proven by the participant's statement below:

"It has an effect... people like to compare others and remind them not to do some things because it will lower their family's dignity." (Adolescent, male, 20 years old)

P: "There is Integrated Service Posts for youth here, isn't it?"

I: "Yes.. but it has been closed for a while"

P: "Did you participate?"

I: "I did"

P: "Were you actively participating?"

I: Not really, just knowing that there was a Posyandu Integrated Service Posts. I participated several times, that's all." (Adolescent, Female, 17 years old)

"The friendship here was divided by cliques/groups since not everyone get along with each other when it comes to friendship. Only a few people participated when it comes to a youth event. The others mostly stay home. We held a lamb cooking event once but only a few of them joined. Lack of participation in social events reduced the harmony of our friendship." (Adolescent, male, 20 years old)

"We have our typical friendship hehe.. (laughing). Hmm kinda promiscuity maybe....." (Adolescent, female, 17 years old)

Adolescent Perceptions of the Impact of Risky Sexual Behavior

This study showed that the factor of adolescents engaging in risky sexual behavior is adolescents' perception of the impact of risky sexual behavior, including health impacts, psychological impacts, educational impacts, and future impacts. First, the adolescent perception of the health impact of risky sexual behavior is when a person is aware that sexual activity leads to sexually transmitted diseases, such as HIV and syphilis. Another health impact is infertility, in which the activity can risk reproduction. It is proven by the participant's statement below:

"Furthermore, when they have sexual relation intercourse and pregnancy happens, it will become a mental burden for both the parents and the family. And if they are diagnosed with sexually transmitted disease, it will risk their life." (Adolescent, Female, 22 years old)

"It tends to be free and there are no rules. After all, it's like having sex with many different people. And we never know whether there is a sexually transmitted disease going around. It affects a lot of our future." (Adolescent, Female, 17 years old)

"There are a lot of them (sexually transmitted diseases), one of which is HIV. The HIV is quickly transmitted. In terms of alcohol, it can harm our kidney. My friend collapsed due to syphilis." (Adolescent, male, 21 years old)

"Of course, HIV can harm our health. I do not know anything; I am still innocent hahaha." (Adolescent, male, 16 years old)

"Well, all I know is just that it is horrible. The disease can be anything. Maybe, infertility is the most severe. Haha." (Adolescent, male, 21 years old)

"Well, it's not good for health, especially the reproductive organs...." (Parent, Female, 46 years old)

Furthermore, adolescents' perception of the impact of risky sexual behavior can be seen from psychological aspects. The impact is when adolescents suffered from stress and trauma, especially when they happen to have a child. In addition, adolescents are more likely to suffer from a mental disorder if they engage in risky sexual behavior. It is proven with the participant's statement below:

"Wow, it has much impact. When people went through traumatic experience, they are more likely to hesitate to step forward. Trauma is hard to heal. I have been in that situation." (Parent, Female, 46 years old)

"It is more like... when one of them is harmed, it can be like a mental burden, you know." (Adolescent, Female, 22 years old)

"Usually, they accept that they are pregnant, and it can cause stress." (Adolescent, Male, 21 years old)

Next, adolescents' perception of the impact of risky sexual behavior can be seen from educational aspects such as school dropouts. In addition, if students were impregnated or were pregnant, the school would not accept students who were currently pregnant. It is proven by the participant's statement below:

"The student who got impregnated can get dropped out of school, for example. And when they have children, they could not provide sexual education for them." (Adolescent, male, 21 years old)

"It is clear that schools do not accept pregnant students. It will embarrass their image in society." (Adolescent, male, 21 years old)

Finally, adolescents' perceptions of the impact of risky sexual behavior can be of influence in the future. If an adolescent engages in risky sexual behavior, it will impact all aspects of their life. For example, it will also impact their family and surrounding community if they get a premarital

pregnancy. In addition, they also lose hope for their future if they engage in risky sexual behavior. It is proven by the participant's statement below;

"No matter which family background you came from, whether it is religious leader, the police, or the head of the village, if you get a pre-marriage pregnancy, you will be belittled. Not only you but also your family, even the community." (Adolescent, male, 21 years old)

"We come to know others' behavior in which we come to understand which one is good behavior. If one makes mistakes, it will affect a lot of aspects of their life. Like what I told my child that once a woman behaves badly, it will forever lead to her self-harm." (Parent, Female, 46 years old)

"That's horrible. They lose hope, sister. it costs responsibility when a person impregnates. Moreover, when he is still in the school year, he probably no longer can continue their education. And when they have babies, how can they raise the babies? They surely lost their minds. Moreover, when they are drunk, they go under control and have no clues about that." (Adolescent, male, 16 years old).

DISCUSSION

The research was conducted in rural areas because it was based on previous research which stated that rural adolescents had a history of sexual risk behavior. This is supported by a study that states that rural communities are influenced by a strong culture, limited health services, and lack of information received.[9] Other studies also explain that the knowledge of adolescents in rural areas is influenced by several factors including gender, several sources of information, and the use of parents as source information.[17]

Adolescent Perceptions of Risky Sexual Behavior

The results of this study indicated that adolescent perceptions of risky sexual behavior are a factor that can influence adolescents in engaging in risky behavior. These perceptions included perceptions of the definition and perceptions of risk factors. In addition, the participant stated that sexual behavior leads to negative and self-harm, such as unsafe sexual intercourse, which can cause disease. These results align with research revealing that most adolescents who had negative perceptions of risky sexual behavior, especially premarital sex, are likely to behave in such as way due to the lack of understanding of premarital sex in

adolescents.[18] Moreover, it is supported by other studies stating that there is a relationship between sexual behavior and reproductive health as well as a sexually transmitted disease.[19]

Based on adolescents' perception that sexually transmitted diseases are caused by frequent unsafe sexual intercourse, an unhealthy relationship is also a factor in sexual behavior in adolescents. Another study explained that unhealthy relationships included holding hands, kissing, and hugging. Moreover, adolescents' risk of sexual intercourse began with unhealthy relationships.[20] The results of this study align with research revealing that risky sexual behavior included holding hands (42,7%), kissing the cheeks and forehead (31.4%), hugging (23,7%), kiss on the lips (20,4%), and having sexual intercourse (1,1%).[21]

Another study contended that 28% of adolescents had engaged in premarital sexual behavior such as hugging and kissing. It is caused by various factors, both internal and external factors.[18] In addition, the low awareness of adolescents about the risk of sexually transmitted disease led them to engage in sexual activity without protection or other activities related to risky sexual behavior. When engaging in risky sexual behavior, adolescents are more likely to be afraid of getting pregnant than fear of being infected by a sexually transmitted disease.[22]

Factors Affecting Adolescents to Engage in Risky Sexual Behavior

This study indicated that several factors could influence adolescents in engaging in risky sexual behavior apart from perceptions such as discomfort feeling at home. Furthermore, another study stated that there was no relationship between adolescents' and parents' communication regarding sexual activity carried out by adolescents. This is because the topic of reproductive health and sexual education is still considered taboo by most parents. Moreover, it was also found that there was no relationship between family support and sexual behavior since adolescents who engage in risky sexual behavior are influenced mainly by environmental factors or peer relationships.[23] In addition, another study stated that adolescents

living in a broken home family had a greater risk for some risky behaviors such as smoking, drinking alcohol, having a sexual relationship, and others.[24] Thus, in this case, family is a very influential factor in adolescents.

Research in Korea argued that adolescents who did not live with their families had a high risk of engaging in risky behavior.[25] In addition, support from parents is essential in shaping behavior in adolescents and can prevent risky sexual behavior. Research stated that 55,6% of adolescents obtain low family support since parents do not monitor their children's sexual behavior.[26] Other research also stated that there is a relationship between the role of the family and premarital sexual behavior in adolescents. Thus, when the family provides good advice to adolescents, it can be a strength to avoid promiscuity.[27] In addition, promiscuity that triggers risky sexual behavior in adolescents is also influenced by peer factors.

This study showed that adolescents' risk factors for risky behavior are peer factors and love for their partners. Peer influence is where adolescents tend to imitate what their friends do. Moreover, love for their partners is considered a supporting factor for adolescents engaging in risky sexual behavior. It aligns with research revealing that there is a relationship between peer influence and premarital sexual behavior among adolescents.[15] The research showed that adolescents are likely to engage in risky sexual behavior due to peers' stories about their sexual experiences.[28] Preferences of sexual behavior in adolescents consisted of several aspects such as touching, kissing, and others. It is done as proof of love and affection for their partner.[29]

In addition, this study also showed that social media influences adolescents to engage in risky sexual behavior. It is in line with other studies stating that there is a very close association between adolescents' access to pornographic media and deviant dating behavior.[30] Other research also showed that 44.6% of adolescents are heavily exposed to social media with pornographic content. One will tend to have a distorted perception of sexuality if they are frequently exposed to pornography.[31] Other supporting research revealed that there is an increase in risky sexual behavior due to the use of social media; nearly 90% of adolescents use cell phones. Adolescents' access to cellphone use is the internet, YouTube, and Instagram, which have consistently increased. Meanwhile, Facebook use has decreased from time to time.[32] Besides, factors from environmental influences and experiences of sexuality can also affect adolescents.

This study revealed that the environmental influence that affects adolescent sexual behavior included in active participation in the village and grouping friendship. In addition, 59,3% of respondents agreed that there was a relationship between the environment and risky sexual behavior.[33] This research aligns with other research showing that the social environment is a supporting factor for adolescent behavior. The social environment included family, peers, neighbors, villagers, village activities, and others.[34] Apart from these factors, this study also showed that there was an influence of sexual experiences in childhood on risky sexual behavior. Another study explained that a person's attitude is influenced by various aspects, including personal experiences, culture, important people, and emotional factors oneself.[35] These personal experiences may consist of sexual abuse in childhood or persistent behavioral problems during childhood considered an external problem at the age of 2. It can increase the risk of unexpected sexual relationships at the age of 15 years.[36] In addition, another study stated that the level of knowledge in adolescents can influence adolescents to engage in risky sexual behavior. This is because adolescents have not received maximum information about reproductive health. The ability of adolescents to absorb different information is also a supporting factor.[37]

Adolescent Perceptions of the Impact of Risky Sexual Behavior

The results of this study found that adolescents have a perception of the impact of risky sexual behavior. Therefore, it becomes a factor influencing these adolescents in engaging in risky sexual behavior. The perception of this impact is the impact on health, where adolescents who engage in sexual behavior are at risk of experiencing sexually transmitted diseases. Other studies also stated that adolescents' perceptions of the health impact of

engaging in risky sexual behavior included unexpected pregnancy, venereal disease, or sexually transmitted diseases.[38] Furthermore, another study revealed that risky sexual behavior had a risk of having a health impact, such as sexually transmitted infections and premarital pregnancy. Most of the respondents in other studies also mentioned that the impact of risky sexual behavior included HIV infections and sexually transmitted diseases.[39] Apart from the impact on health, there are also psychological impacts.

This study indicated that adolescents' perception of the psychological impact is that they are mentally affected, have trauma, or have mental pressure. It is in line with other research showing that premarital sex will impact the psychology of those who do it since premarital sex will cause unexpected incidences, leading to depression.[40] Another study stated that the effectiveness of adolescent reproductive services in developing healthy sexual behavior consists of several indicators, namely the courage to engage in assertive behavior, refrain from watching pornography, and no psychological pressure due to romantic relationship pressure. Thus, it indicated that there is psychological pressure due to a feeling of love in adolescents when they engage in sexual behavior.[41] Furthermore, the impact afterward is an impact on their future.

This study indicated that adolescents' perception of the impact on their future is that they can be hopeless when they have engaged in sexual behavior. Other research also stated that there are many harmful impacts on the future when adolescents engage in sexual behavior, such as destroying their future and family. Furthermore, they are in higher risk when adolescents lack knowledge about sexual behavior.[42] In addition, another research supported that the excessive expression of love in partners will have the risk of adolescents engaging in sexual behavior, which will lead to the loss of adolescents' future.[43] In addition, another impact can happen to the educational aspect.

This study indicated that adolescents' perception of the impact on education is that they will experience school dropouts. Other studies also stated that promiscuity in the adolescents will affect their education negatively. When adolescents commit adultery which will lead to early marriage, it will hinder them from receiving education or drop out of school.[44] Moreover, other studies stated that premarital pregnancy in adolescents impacts not only themselves but also the family. One of the impacts is school dropouts. Premarital pregnancy in adolescents is also associated with the knowledge possessed by the adolescent.[45]

CONCLUSION AND RECOMMENDATION

Many factors influenced adolescents in engaging in risky sexual behavior in rural areas, one of which is their perceptions. In addition, internal factors such as personal experiences and feelings of love and external factors such as family relationships, influences from friends, environment, and social media also affected adolescents to engage in risky sexual behavior. Thus, parents need to provide early sexual education to prevent the occurrence of risky sexual behavior.

AUTHOR CONTRIBUTIONS

EM was carrying manuscript's concepts, design, definition of intellectual content, literature research, clinical studies, data acquisition, data analysis, as well as statistical analysis. EM also undertaking manuscript preparation, manuscript editing, and manuscript review. RAD was carrying concepts, design, definition of intellectual content, literature research, clinical studies, data acquisition, data analysis, and statistical analysis, DP was carrying data acquisition, data analysis, statistical analysis, manuscript preparation, manuscript editing, and manuscript review. HIP was carrying data acquisition, data analysis, statistical analysis, manuscript preparation, manuscript editing, and manuscript review. EM = Ema Waliyanti; RAD = Ratna Ajeng Dewantari; DP = Dewi Puspita; HIP = Harumi Iring Primastuti.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. WHO. Adolescent health in the South-East Asia Region. Geneva: World Health Organization. https://www.who.int/southeastasia/health

-topics/adolescent-health

2. Singh JA, Siddiqi M, Parameshwar P, Chandra Mouli V. World Health Organization Guidance on Ethical Considerations in Planning and Reviewing Research Studies on Sexual and Reproductive Health in Adolescents. *Journal of Adolescent Health*. 2019;64(4):427–429. https://doi.org/10.1016/j.jadohealth.2019.01.008

3. UNICEF. Adolescents Statistics: Investing in a Safe, Healthy, and Productive Transition from Childhood to Adulthood is Critical in 2019. United Nations Children's Fund. https://data.unicef.org/topic/adolescents/overview/

4. BPS. Statistik Indonesia 2019. Jakarta: Badan Pusat Statistik; 2019. bps.go.id/publication/2019/07/04/daac1ba18cae1e90706ee58a/statistik-indonesia-2019.html

5. Suwarni L, Fitrian H, Hernawan A. Model IMB (Information, Motivation, Behavioral Skills) Sebagai Prevensi Primer Seks Pranikah Remaja. *Jurnal Endurance*. 2019;4:622-629. https://doi.org/10.22216/jen.v4i3.4383

6. BPS. Statistik Pemuda Indonesia 2019. Jakarta: Badan Pusat Statistik; 2019. https://www.bps.go.id/publication/2019/12/20/8250138f59ccebff3fed326a/statistik-pemuda-indonesia-2019.html

7. PKBI DIY. Pemenuhan Hak Kesehatan Seksual dan Reproduksi (HKSR). DIY: Perkumpulan Keluarga Berencana Indonesia; 2015. https://pkbi-diy.info/

8. Puspikawati SI, Megatsari H. Pengaruh Pendidikan Sebaya Terhadap Pengetahuan Kesehatan Repoduksi Remaja di Karang Taruna Kabupaten Banyuwangi. *JPH Recode*. 2018;1(2):80-88. https://doi.org/10.20473/jphrecode.v1i2.16236

9. Alpiani D, Widianti E, Kosim K. Persepsi Remaja Tentang Seks Pranikah di Sekolah Menengah Atas. *Jurnal Keperawatan Jiwa (JKJ): Persatuan Perawat Nasional Indonesia*. 2021;9(1):161–170.

https://jurnal.unimus.ac.id/index.php/JKJ/article/view/6633

10. BPS. Survei Demografi dan Kesehatan: Kesehatan Reproduksi Remaja. Kabupaten Kolaka: Badan Pusat Statistik; 2017. https://kolakakab.bps.go.id/news/2017/07/04/16/survei-demografi-kesehatan-indonesia--sdki--2017.html

11. Hasanah DN, Utari DM, Chairunnisa C, Purnamawati D. Faktor Internal dan Eksternal yang Mempengaruhi Perilaku Seksual Pranikah Remaja Pria di Indonesia (Analisis Survei Demografi dan Kesehatan Indonesia 2017). *Muhammadiyah Public Health Journal*. 2020;1(1):1-9. https://doi.org/10.24853/mphj.v1i1.7018

12. Thompson EL, Mahony H, Noble C, et.al. Rural and Urban Differences in Sexual Behaviors Among Adolescents in Florida. *Journal of Community Health*. 2018; 43(2):268–272. https://doi.org/10.1007/s10900-017-0416-6

13. Ali MM, Merdad L, Bellizzi S. Socioeconomic Variations in Risky Sexual Behavior among Adolescents in 14 Sub-Saharan African Countries Who Report Ever Having Had Sex. *International Journal for Equity in Health*. 2021;20(1):11 https://doi.org/10.1186/s12939-020-01352-8

14. Triyanto E, Prabandari YS, Yuniarti KW, Werdati S. Faktor-Faktor Multisistem yang Memengaruhi Perilaku Seksual Remaja. *Journals of Ners Community*. 2019;10(2): 197-210. https://doi.org/10.55129/jnerscommunity.v10i2.913

15. Kusuma NI, Bantas K. Faktor-Faktor yang Berhubungan dengan Perilaku Seksual Pranikah Remaja Wanita dan Pria di Indonesia. *Jurnal Health Sains*. 2021;2(4):508–519. https://doi.org/10.46799/jhs.v2i4.155

16. Alimoradi Z, Kariman N, Simbar M, Ahmadi F. Contributing Factors to High-Risk Sexual Behaviors among Iranian Adolescent Girls: A Systematic Review. *International Journal of*

Community Based Nursing and Midwifery. 2017;5(1):2–12. https://pubmed.ncbi.nlm.nih.gov/28097173/

17. Ernawati, Heny. Pengetahuan Kesehatan Reproduksi Remaja di Daerah Pedesaan. *Indonesian Journal for Health Sciences* 2018;2(1):58-64. http://dx.doi.org/10.24269/ijhs.v2i1.820

18. Alpiani D, Widianti E, Kosim K. Persepsi Remaja Tentang Seks Pranikah di Sekolah Menengah Atas. *Jurnal Keperawatan Jiwa (JKJ): Persatuan Perawat Nasional Indonesia*. 2021;9(1):161–170. https://jurnal.unimus.ac.id/index.php/JKJ/article/view/6633

19. Nurhapipa N, Alhidayati A, Ayunda G. Faktor-Faktor yang Berhubungan dengan Perilaku Seksual. *JOMIS (Journal of Midwifery Science)*. 2017;1(2):54–65. http://jurnal.univrab.ac.id/index.php/jomis/article/view/200

20. Ibnu IF, Wahjuni CU, Devy SR. Narrative Stories of High Risk Sexual Behaviors among Adolescents in Makassar City. *Journal of Public Health Research*. 2020;9(2):156-159. https://doi.org/10.4081%2Fjphr.2020.1830

21. Masni M, Hamid SF. Determinan Perilaku Seksual Berisiko Pada Remaja Makassar (Studi Kasus Santri Darul Arqam Gombara Dan SMAN 6). *Media Kesehatan Masyarakat Indonesia*. 2018;14(1):68-77. https://doi.org/10.30597/mkmi.v14i1.3699

22. Sewanyana D, Mwangala PN, Marsh V, et.al. Young People's and Stakeholders' Perspectives of Adolescent Sexual Risk Behavior in Kilifi County, Kenya: A Qualitative Study. *Journal of Health Psychology*. 2018;23(2):188–205. https://doi.org/10.1177/1359105317736783

23. Sari SN. Keluarga, Teman Sebaya dan Perilaku Seksual Remaja. Prophetic: Professional, Empathy and Islamic Counseling Journal. 2019;2(2):177. http://dx.doi.org/10.24235/prophetic.v2i2.5765

24. Delker E, East P, Blanco E, et.al. Associations Among Household Chaos, School Belonging and Risk Behaviors in Adolescents. *The Journal of Primary Prevention*. 2020;41(4): 383–396. https://doi.org/10.1007/s10935-020-00592-2

25. Valencia ML, Tran BT, Lim M, et.al. Association between Socioeconomic Status and Early Initiation of Smoking, Alcohol Drinking, and Sexual Behavior Among Korean Adolescents. *Asia Pacific Journal of Public Health*. 2019;31:443–453. https://doi.org/10.1177/1010539519860732

26. Putri S, Shaluhiyah Z, Prabamurti PN. Faktor-Faktor yang Berhubungan dengan Perilaku Seksual Remaja yang Tinggal di Lingkungan Resosialisasi Argorejo Kota Semarang. *Jurnal Kesehatan Masyarakat*. 2017;5(5):1092–1101. https://doi.org/10.14710/jkm.v5i5.19254

27. Runtuwene DR, Tucunan AAT, Korompis GEC. Hubungan Antara Peran Keluarga dan Teman Sebaya dengan Perilaku Seksual Pranikah pada Siswa di SMA Negeri 3 Manado. *Kesmas: Jurnal Kesehatan Masyarakat Universitas Sam Ratulangi*. 2019;8(6):225-231. https://ejournal.unsrat.ac.id/v3/index.php/kesmas/article/view/25595

28. Suyuti S, Nurgahayu N, Sani A. Hubungan Peran Teman Sebaya dan Ketaatan Beragama dengan Perilaku Seksual Berisiko pada Mahasiswa FKM UMI. *Jurnal Penelitian Kesehatan Suara Forikes*. 2020;12(1):31–35. https://forikes-ejournal.com/index.php/SF/article/view/sf12108/12108

29. Blegur J. Preferensi Perilaku Seksual Remaja. *Proyeksi: Jurnal Psikologi*. 2018;12(2):9–20. http://dx.doi.org/10.30659/jp.12.2.9-20

30. Nababan S. Perilaku Pacaran dan Faktor-Faktor yang Mempengaruhi Seks Pranikah pada Remaja di Sikka Flores: Dating Behavior and Factors Affecting Premarital Sex in Adolescents in Sikka Flores. *Bali Medika Jurnal*. 2020;7(2):224–233. https://doi.org/10.36376/bmj.v7i2.160

31. Cahyaningsih O, Sulistyowati I, Alfiani N. Keterpaparan Media Sosial yang Berkonten Pornografi dengan Gaya Berpacaran. *Jurnal Ilmiah Permas: Jurnal Ilmiah STIKES Kendal*. 2021;11(1):81–88. https://doi.org/10.32583/pskm.v11i1.1115

32. Landry M, Turner M, Vyas A, Wood S. Social Media and Sexual Behavior Among Adolescents: Is there a Link?. *JMIR Public Health and Surveillance*. 2017;3(2):28-37. https://doi.org/10.2196/publichealth.7149

33. Setiawati L, Febriyanto K. Hubungan Lingkungan dengan Perilaku Seksual Berisiko Pada LSL (Lelaki Seks Lelaki) di Wilayah Kerja Puskesmas Temindung. *Borneo Student Research (BSR)*. 2020; 1(2):1177–1182. https://journals.umkt.ac.id/index.php/bsr/article/view/414

34. Purwatiningsih S. Perilaku Seksual Remaja dan Pengaruh Lingkungan Sosial pada Anak-Anak Keluarga Migran dan Nonmigran. Populasi. 2019;27(1):1–16.
https://doi.org/10.22146/jp.49521

35. Sukun H, Kusmiyanti M. Faktor-Faktor yang Berhubungan dengan Perilaku Seksual Remaja Usia 15-17 Tahun di SMA X Bekasi 2018. *Jurnal Antara Kebidanan*. 2019;2(4):25–37. https://ojs.abdinusantara.ac.id/index.php/antarakebidanan/article/view/99/90

36. Bozzini AB, Bauer A, Maruyama J, Simões R, Matijasevich A. Factors Associated with Risk Behaviors in Adolescence: A Systematic Review. *Brazilian Journal of Psychiatry*. 2021;43(2): 210–221. https://doi.org/10.1590/1516-4446-2019-0835

37. Lukmana CI, Yuniarti FA. Gambaran Tingkat Pengetahuan Kesehatan Reproduksi Remaja pada Siswa SMP di Yogyakarta. *IJNP (Indonesian Journal of Nursing Practices)*. 2017;1(3):115–123. https://doi.org/10.18196/ijnp.1369

38. Gayatri S, Shaluhiyah Z, Indraswari R. Faktor-Faktor yang Berhubungan dengan Frekuensi Akses Pornografi dan Dampaknya Terhadap Perilaku Seksual pada Remaja di Kota Bogor (Studi Di SMA 'X' Kota Bogor). *Jurnal Kesehatan Masyarakat*. 2020;8(3): 410–419. https://doi.org/10.14710/jkm.v8i3.26456

39. Supriyanto, Isyanawulan G, Yusuf S. Persepsi Siswa Terhadap Perilaku Seksual Remaja di Kota Palembang. *Jurnal Emprika*. 2018;3(1):39-54. https://doi.org/10.47753/je.v3i1.54

40. Lumentah P, Yauri I. Eksplorasi Persepsi Remaja Tentang Seks Pranikah pada Remaja di Kecamatan Kema Kabupaten Minahasa Utara. *OSF Preprints*. 2021. https://ejurnal.poltekkes-manado.ac.id/index.php/ps2017/article/view/495

41. Santosa H, Yusuf S, Ilfiandra I. KRR Sebagai Program Pengembangan Perilaku Seksual Sehat Remaja pada Revolusi Industri 4.0. *Indonesian Journal of Educational Counseling*. 2019;3(3):233–242. https://doi.org/10.30653/001.201933.104

42. Andorson S, Asmiyati, Hamid. Gambaran Pengetahuan Remaja Tentang Perilaku Seksual Pranikah di Sekolah Menengah Atas. *Jurnal Medika Hutama*. 2021;2(02):439–447. https://www.jurnalmedikahutama.com/index.php/JMH/article/view/109

43. Nadiarenita AA, Hidayah N. Analisis Teori Ekspresi Cinta Remaja Sebagai Pencegahan Perilaku Seksual Berisiko dengan Menggunakan Strategi Penekanan Ekspresif. *Indonesian Journal of Educational Counseling*. 2018;2(2):151–162. https://doi.org/10.30653/001.201822.28

44. Fendri M, Mobonggi A, Kaawoan S. Dampak Pergaulan Bebas Terhadap Peningkatan Angka Putus Sekolah di Desa Kuala Utara Kecamatan Kaidipang Kabupaten Bolaang Mongondow Utara. *Pekerti*. 2020;2(1):1–14. https://journal.iaingorontalo.ac.id/index.php/pekerti/article/view/1261

45. Masturoh, Naharani AR. Analisis Pengetahuan Remaja Tentang Kesehatan Reproduksi Terhadap Perilaku Pencegahan Kehamilan Pra Nikah pada Remaja di Kabupaten Tegal. *Semnaskes*. 2019. https://semnaskes.unipasby.ac.id/prosiding/index.php/semnaskes-2019/article/view/12

Specific vs Unspecific Smoke-Free Regulation: Which One is More Effective?

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ABSTRACT

Tobacco kills up to half of its users, and smoking prevalence and tobacco exposure among Indonesian youth are increasing. A comprehensive ban on Tobacco Advertising, Promotion, and Sponsorship (TAPS) is a recommended tobacco control measure. Thus, this study aimed to analyze and compare political economy factors that contribute to the effectiveness of the TAPS ban implementation in Surabaya and Kulon Progo. In-depth interviews and a focus group discussion were conducted, recorded, transcribed, then analyzed using thematic analysis. We find that the role of local government was pivotal in creating and implementing regulations for tobacco control, while the leaders' will and capability were also essential. However, the COVID-19 pandemic had limited all tobacco control measures in both studied districts. Furthermore, the lack of political will and low support from the political parties are the several factors hindering tobacco control measures at the district level, including TAPS ban enforcement. We also find that there is a need to strengthen the understanding of local government, society, and other related stakeholders toward the urgency of the TAPS ban. Further studies calculating the impact of the total TAPS ban on local revenue and the potential benefit of a total TAPS ban are urgently needed for advocating total TAPS ban implementation in a broader scope of the country.

INTRODUCTION

Direct tobacco use has led to more than seven million annual tobacco-related deaths across the world.[1,2] More than 80% of tobacco users live in low- and middle-income countries.[3] In 2018, there were 75 million smokers in Indonesia and at least 75% of the total Indonesian population were passive smokers. Smoking prevalence among Indonesians aged 10–18 years increased from 7.3% in 2013 to 9.1% in 2018, and the increasing smoking prevalence in this age group will aggravate the social and economic burdens of chronic disease in the future.[4-6]

The release of the Framework Convention on Tobacco Control (FCTC) 2003 declared a global commitment to reduce smoking prevalence and banning Tobacco Advertising, Promotion, and Sponsorship (TAPS). The TAPS refers to all forms of direct and indirect tobacco commercial communications and any contributions to events or activities that may affect tobacco product promotion.[7] There have been many studies in different countries enforcing the TAPS bans.[8] Several studies reported that tobacco marketing regulations and the TAPS ban policies were successful in significantly reducing smokers' awareness of pro-smoking cues in the United States, the United Kingdom, Australia, and Canada. While this finding was similar across different Socio-Economic Statuses (SES), banning arts sponsorships and billboard advertising sharply reduced the awareness among high SES groups as compared to low SES groups. Banning the TAPS for more than 10 years in five of seven Latin American countries prevented 50,000 deaths and 364,000 cases of tobacco-related illness and saved more than US$7 billion.[9] The authors also estimated that 100% compliance with this regulation in the seven countries would have saved approximately US$15 billion.

The TAPS policy implementation varies across Indonesian regions based on culture and political power. This study was conducted in two Indonesian districts or cities to obtain comprehensive evidence of the TAPS policy enforcement by comparing the two locations. Surabaya was chosen meticulously as this city has profited from tobacco advertisement although it has a tobacco control policy. In 2020, 13.35% of the total Surabaya advertisement income was from cigarette commercial tax revenue. Megatsari et al confirmed this figure where at least 300 large and medium-sized billboards were displayed around education and public areas.[10] Therefore, it appears that the implementation of tobacco control policy is powerless to regulate the TAPS in Surabaya.

In contrast, Kulon Progo was chosen to represent a region featuring excellent implementation of the tobacco control policy. In Kulon Progo, the anti-TAPS policy has been expanded to Outdoor Tobacco Advertisements (OTA) and other forms of the TAPS, thus resulting in the Kulon Progo government receiving zero cigarette advertisement tax. Therefore, Kulon Progo was a progressive city in tobacco control policy implementation.[11] Kulon Progo has also demonstrated more progressive TAPS policy implementation than Surabaya, as Kulon Progo features supporting regulations, such as the regulation and instructions of the regent presented in Table 1. By comparing the TAPS policy enforcement in these two cities, this study obtained evidence and identified problems related to the TAPS ban enforcement. This study also presented both structural and agency diagnoses of the supporting and hindering factors and the challenges the local governments faced when implementing the TAPS ban.

Considering the tobacco problem in Indonesia, there is an urgent need to implement an effective smoke-free policy featuring a strict TAPS ban to protect the community, especially young people, from cigarette smoke exposure. Although the policy has been mandated for local Indonesian governments, the TAPS ban enforcement varies across regions. This study was based on three research gaps: 1) Limited studies have analyzed the TAPS prohibition enforcement dynamics; 2) Studies on the slow progress of Indonesian tobacco control policies have not involved multi-sectoral stakeholders as respondents; 3) Few studies have accommodated the local government perspectives related to tobacco control social studies. This study aimed to analyze and compare political economy factors that contribute to the effectiveness of the TAPS ban implementation in Surabaya and Kulon Progo.

MATERIAL AND METHOD

This qualitative study investigated the TAPS ban implementation in Indonesia, specifically at the sub-national level, by conducting 17 in-depth interviews and a Focus Group Discussion

(FGD). This study followed the conceptual framework of Campos and Reich in identifying a more effective means of health policy implementation.[12] Following the framework, this study involved six stakeholders working closely on tobacco control and the TAPS ban enforcement: 1) Interest groups that may resist or promote policy implementation (health professionals and tobacco control experts); 2) Bureaucrats who are decision-makers and implementers within the system (District Health Officers and the Civil Service Police Unit); 3) Financial decision-makers who manage the financial decisions within the system (the Financial and Asset Management Board); 4) Political leaders to ensure their commitment to policy implementation (the Regional House of Representatives and Local Government Representatives); 5) The intended policy beneficiaries (communities and organizations concerned with health and tobacco control issues); (6) External actors who may fund and influence health policy implementation (donors).

Seventeen informants were selected using the Campos and Reich conceptual framework for virtual interviews spanning approximately 60 minutes.[12] Each informant was invited to the interview, which contained an informed consent form and interview guidelines containing a set of initial questions. The other five respondents were invited to an online FGD, which was conducted as a means of triangulation and was led by a moderator following FGD guidelines. Both the interviews and FGD were conducted in Bahasa Indonesia and were recorded to be transcribed as the raw data.

The data were analyzed using a thematic analysis following Braun and Clarke.[13] First, the raw data were processed in data immersion where the transcripts were read for immersion and familiarization with the contents. Second, patterns and themes were identified from the transcripts and the data were classified based on the identified themes. In the third step, the themes were reviewed and defined, including the sub-themes that may have potentially appeared during the data analysis. In the final step, a narrative discussion was drafted based on the identified themes and the existing literature was integrated into the analysis.

RESULTS

The interviews and FGD have been conducted to collect different stakeholders' perspectives as summarized in Table 2. Indonesia has neither ratified the FCTC nor regulated the TAPS ban even at the national level. In Indonesia, the TAPS ban is typically implemented as part of the smoke-free policy. Although the integration has led to the TAPS ban being enforced only in areas regulated by the general smoke-free policy (schools and offices), there is no obligation to expand the TAPS ban scope into the broader public space. Most Indonesian regions have used regulations derived from Government Law No. 109 of 2012 on the Control of Materials Containing Addictive Substances in Tobacco Products in the Interest of Health. This government regulation includes a mandate for local governments to regulate the TAPS and acts as the only legal document used by sub-national governments for enforcing the TAPS ban and is stated below:

"Further provisions regarding the procedures for controlling tobacco product sponsors as referred to in Article 36 and Article 37 shall be regulated by the Sub-national Government."

Table 1. Comparison of the Revenue and Regulations Related to the Tobacco Control Policy in Surabaya and Kulon Progo

Aspects	Surabaya	Kulon Progo
Local Regulation	- First regulation: Local Regulation No. 5 (2008) - Revision: Local Regulation No. 2 (2019)	- First regulation: Local Regulation No. 5 (2014)
Further Local Government Laws	Mayor regulation No. 110 (2021)	- Regent regulation No. 03 (2015) - Regent instructions No. 01 (2015) - Regent regulation No. 15 (Revision 2020)
Revenue from Tobacco Advertisements in 2020	Rp. 14.711.864.000	Rp. 0

Source: Primary Data, 2021

Despite the mandate for local government enforcement of the TAPS ban, only seven districts or cities have implemented a comprehensive TAPS ban in a broader space in addition to the established smoke-free areas: Kulon Progo, one of the two study locations, and Bogor City, Depok City, Padang Panjang, Bangli, Klungkung, and Denpasar City. Few regions have included the TAPS ban in their policy, which indicated the confusion and divergent understanding of the urgency of enforcing the TAPS ban beyond the areas regulated by the general smoke-free policy.

Both the interviews and FGD suggested that Kulon Progo and Surabaya have regulated smoke-free policies. Kulon Progo has implemented Regional Regulation No. 5 of 2014, which states how and where tobacco advertisements may and may not be installed, restrictions on tobacco sponsorship, and area expansion from smoke-free areas to wider outdoor areas, which was described as follows:

"Local governments control tobacco product advertisements on outdoor media."

The Kulon Progo Regional Regulation was also strengthened by the regulation of the regent, which acted as the legal basis for implementing the regional regulation. Kulon Progo has implemented Regent Regulation No. 15 of 2020, which is a revision of Regent Regulation No. 3 of 2015 that imposed a strict TAPS ban instead of a total TAPS ban, which an informant described as follows:

"Local governments control the promotion and/or display of cigarettes and/or other tobacco products, which is done in such a way so that they are not seen directly by consumers."

In Surabaya, the smoke-free policy was regulated in Regional Regulation No. 2 of 2019, which resulted from a revision of Regional Regulation No. 5 of 2008. Despite Surabaya being the first city in Indonesia to implement the smoke-free policy more than 10 years ago, the decree of the mayor detailing the law to support the existing regional regulation of smoke-free areas in Surabaya had not been signed when this study was conducted. The TAPS were easily noticed in Surabaya, even on roads close to schools. The absence of a total TAPS ban in Surabaya has led to many TAPS in public areas that were not included in the smoke-free policy regulation areas. Some Surabaya informants stated that the area with the most frequent smoke-free policy violations was the office, involving both public and private offices, which was described in the quote below. Few violations were recorded for schools, urban parks, public transport, and other public facilities as these places were more open and easier to monitor.

"I see that the most difficult, or the worst implementation of the smoke-free policy, is in the office area. Both public and private offices have not been able to implement the policy as described in the local regulation…"

In addition to existing regulations, three main themes were identified and presented in Table 3: 1) Challenges faced by local government in enforcing the TAPS ban; 2) Stakeholders' perspectives; and 3) Factors that supported and hindered policy implementation.

The three main issues in the TAPS ban enforcement in Surabaya and Kulon Progo were: 1) misunderstanding of the smoke-free policy and the TAPS ban; 2) the wide range of promotion strategies by the tobacco industry; 3) the varied degree of political support for the TAPS ban. Problems related to geographic diversity were recorded only for the TAPS ban enforcement in Kulon Progo due to its wide area with various geographical characteristics featuring both mountainous and coastal areas, which are not easily accessible.

There was a misunderstanding of the smoke-free policy and the TAPS ban. The policy was perceived as forbidding all forms of smoking activities and applying a total TAPS ban instead of regulating areas that allowed smoking activities and restricting the TAPS. This misunderstanding was exacerbated by low awareness of how pivotal tobacco control is for protecting the younger generation, economic improvement, and reducing non-communicable diseases.

"…It becomes an obstacle not only in the city but also across the province where they don't have a good understanding (toward the policy) …"

"…Lack of understanding and socialization toward how pivotal passive smoking protection is…"

Table 2. Perspective due to Implementation of Smoke Policy Based on Characteristics Informan

Informant	Surabaya	Result	Kulon Progo	Result
Bureaucrats	Regional secretary in the law department, District health officer, Development planning agency at sub-nation level, Civil service police unit	Needs for clearer regulation of the TAPS ban, the smoke-free policy was quite difficult to apply due to the absence of a legal basis. The regulation toward TAPS ban in Surabaya needs to be improved	District health officer, the head of law department, Civil service police unit	Important to continuously socialize TAPS ban to the society
Financial Decision	The financial & asset management board	TAPS-related revenue was not significant. TAPS steadily contributed to only less than 4% of local revenue since 2015. If there is a rule, it can be implemented	The financial department	The strict TAPS ban in Kulon Progo has decreased the advertising tax revenue only by 25% or 0.53% from the total local tax revenue
Beneficiaries	CTFK (Campaign for Tobacco-Free Kids)	Tobacco control measures need political support	The kids' forum, healthy Jogja without Tobacco	Both leadership and politics played a significant role in TAPS ban enforcement in this district
Academics	Health professional (Lecturer of Faculty of Public Health Airlangga University)	Total TAPS ban needs to be implemented and required strong commitment from regional leaders	Manager advocacy Muhammadiyah STEPS Muhammadiyah Yogyakarta University, Health expert faculty of medicine Gajah Mada University	The tobacco control issue is strongly influenced by political actors
Political Leader	The Vice of the Regional House of Representative	Conflict interest personal in legislation influents policy		
Donor	The head of tobacco control support center	Intervention from cigarette industry has an impact towards the implementation of total TAPS ban	Technical support the union Indonesia (International NGO)	Tobacco industries are very progressive and strategic to place their advertisement

Source: Primary Data, 2021

Table 3. Themes and Sub-Themes

Themes and Sub-Themes	Key Quotes (Examples)
Challenges Faced by Local Government in Enforcing the TAPS Ban	
Misunderstanding of the smoke-free policy and the TAPS ban	*"Local government and related agencies don't have the same perception about tobacco control."*
The wide range of promotion strategies by the tobacco industry	*"…Another strategy is by giving promotion banners with the store names…"*
The varied degree of political support for the TAPS ban	*"…in Surabaya (there are) certain political parties that are more powerful and against the issue of tobacco control…"*
Problems related to geographic diversity	*"…The main obstacle is controlling (TAPS) in the outback, especially in the north (part of Kulon Progo) …"*
Stakeholders' Perspectives	
Health professionals and tobacco control experts	*"…Actually, we want to apply a total TAPS ban. It will happen if there is a strong commitment from the leader of the region…"*
Beneficiaries	*"…Leadership and political will are the most crucial…"*
District Bureau of Law	*"…Toward tobacco policies, these tobacco actors intervene and coloring policies…"*
Civil Service Police Unit	*"…(We) found there was ignorance, then the team educated the business owner (regarding TAPS ban)…"*
Financial and Asset Management Board	*"…The income from TAPS is not significant but we haven't studied yet what the impact will be…"*
Regional House of Representatives	*"…(The) regional income will not be significantly affected by the policy…"*
Health officers	*"…This policy does not prohibit, only strictly limits…"*
Donors	*"…Total TAPS ban is not (implemented) in all regions because the intervention from industry is huge…"*
Supporting and Hindering Factors in Policy Implementation	
Supporting factors	
Alliances concerning the tobacco control issue	*"…Having an informal alliance…"*
Public support for the smoke-free policy	*"…We surveyed (the) society's support in Kulon Progo, (and) the results (were) up to 85%…"*
Technical assistance from academicians	*"…from academia encourages the strengthening of smoke-free areas…"*
Technical and financial support from International Non-Governmental Organizations (NGO)	*"…NGO give technical and financial support for (the) implementation (of) smoke-free areas…"*
Political will	*"…(The) Success occurs because of the political will of the leader in those regions…"*
Hindering Factors	
Limited human resources in the District Health Office working on tobacco control	*"…Our limitations (is) for (conducting) socialization because we have to do (the) other programs as well…"*
Small budget for policy implementation	*"…Our capacity budget is not much, so we use gradual management…"*
Promotion and replacement within the local government	*"…When the process was still ongoing, the person was moved to another place. Then we had to start from the beginning…"*
The COVID-19 pandemic	*"…A significant factor hindering the process of major regulation toward smoke-free areas was COVID-19 pandemic…"*

Source: Primary Data, 2021

Tobacco industries have used myriad promotion strategies and studied the regulations and subsequently searched for loopholes to place their advertisements. These progressive attempts have been applied carefully, hence leading to the appearance of advertisements in both Surabaya and Kulon Progo, which were described as follows:

"…TAPS (activities) are very progressive and strategic. They are targeting crowded locations…"

Political parties played a significant role in deciding whether the regulation was approved. Nevertheless, conflicts of interest among political parties, particularly those affiliated with the tobacco industry, remained common. In some cases, the TAPS ban approval was potentially hindered by the different perspectives of political opponents, which the informants described as follows:

"…Our struggle becomes more challenging in the legislative…"

In addition to political parties, regional leaders' political will influenced the magnitude of support for banning the TAPS. In Kulon Progo, the strong political commitment of the regent exerted a positive influence, which manifested in the successful implementation of a strict TAPS ban. The will of the former regent to promote health through tobacco control measures aided smooth enforcement of the TAPS ban by the regent and related agencies. On the other hand, the Surabaya technical guide for implementing the TAPS ban had not been signed when this study was conducted. Furthermore, replacements within the Surabaya municipal government and the refocusing activities of the government during the COVID-19 pandemic resulted in the smoke-free policy being excluded from the priority agenda, which was summarized as follows:

"…When the mayor is elected, we have to adapt to what is wanted…"

The health professionals urged the implementation of a total TAPS ban, which was an intention that required strong commitment from the regional leaders. The beneficiaries stated that tobacco control measures required a good understanding of the TAPS ban as a means of gaining stronger commitment from the mayor or regent and the Regional House of Representatives. The perspectives of the Regional House of Representatives on the significance of both public and political support for tobacco control confirmed this.

The Surabaya Civil Service Unit suggested that there was a need for clearer regulation of the TAPS ban. As the implementer of this regulation, the unit discovered that the application of the current smoke-free policy was quite difficult due to the absence of a legal basis. The unit was only able to enforce the TAPS ban in smoke-free areas but was unable to prevent the TAPS in other areas not regulated in the current policy. An informant described the situation as follows:

"…Regarding the Regional Law 05/2019, there is no TAPS ban regulation, (there is) only the policy from the mayor (stating) that TAPS must have distance from smoke-free areas. We follow the rules that are enforced, (but) better-written rules are needed because we are the implementers…"

Both the health officers and external actors suggested that the TAPS ban regulation, for example, the bans on OTA and no advertising and display at points of sale in Surabaya, required improvement. The TAPS ban has been in effect in smoke-free areas only, yet there is no regulation outside those areas, which was described as follows:

"TAPS ban is regulated for smoke-free areas."

The financial decision-makers of the Financial and Asset Management Board reported that the TAPS-related revenue was not significant. To challenge tobacco control in Surabaya, the tobacco industry raised the issue of a TAPS ban affecting the economy, but Financial and Asset Management Board data revealed that the TAPS consistently contributed to less than 4% of local revenue since 2015.

"…Actually, our goal is total TAPS ban, but the regional government has rejected (total TAPS ban) due to (the potential decrease of) local revenue…"

The beneficiaries stated that leadership and political will were important in the TAPS ban enforcement. This opinion was confirmed by the tobacco control experts, the district Bureau of Law representing the Kulon Progo local government, and the external actors. The parties mentioned that both political actors and significant interference from big tobacco companies strongly influenced the tobacco control issue. The Civil Service Police Unit reported that continuous socialization of the TAPS ban was important, as they determined that several local vendors continued to advertise tobacco products at their stalls due to their ignorance of the TAPS ban regulation.

The Kulon Progo district health officers emphasized that the regulation did not entirely ban the TAPS but only strictly limited them. The Financial and Asset Management Board data demonstrated that the strict TAPS ban in Kulon Progo had decreased advertising tax revenue by

only 25% or 0.53% of the total local tax revenue. The strict TAPS ban in Kulon Progo was imposed as a means of prioritizing public health and did not significantly affect revenue. The local revenue trend continued to increase as the government collected revenue from other potential sources.

The established alliance concerning the tobacco control issue was a prominent enabler of smoke-free policy implementation in the study locations. Similar to its smoke-free monitoring team, the informal alliance in Surabaya comprised multidisciplinary experts, health professionals, civil society organizations, and Non-Governmental Organizations (NGOs). This alliance not only focused on supporting policy implementation but also advocated a total TAPS ban to the government as a means of strengthening the existing smoke-free policy. Another enabler in Surabaya was public support for the smoke-free policy, which was successful in encouraging legislators to accept the proposed smoke-free policy starting in 2017. Academic support also played a significant role in providing evidence. Therefore, the approved smoke-free policy in Surabaya was based on reliable evidence despite the current absence of strict TAPS ban enforcement.

Similar to Surabaya, Kulon Progo received technical assistance from academicians who performed public surveys on support for tobacco control, which demonstrated that around 80-85% of society supported the implemented tobacco control measures. The other supporting factor in Kulon Progo was the technical and financial support from an international NGO focusing on preventing tuberculosis and lung diseases. Political will also conferred significant support for initiating a strict TAPS ban. The former regent directly led the movement from preparation to implementation, which led to the cessation of cigarette advertisements in the district. This commitment continued when the new regent was elected in 2019 and was accompanied by regular socialization to re-emphasize public understanding of the regulation and youth involvement to represent the community's role in tobacco control, which an informant remembered as follows:

"...In 2019, we began to involve regeneration in tobacco control, (involving) young people in Kulon Progo with activities started from their surroundings."

The tobacco control alliances and activists in both Surabaya and Kulon Progo expanded their advocacy area by linking the urgency of tobacco control measures with related health issues. For example, they advocated the urgency of a strict TAPS ban to support the aim of the government to address stunting. Moreover, the positive impact of banning the TAPS was promoted to bolster the efforts of the government in creating child-friendly cities or districts.

In both Surabaya and Kulon Progo, the main hindering factor against tobacco control measures was the limited human resources in the District Health Office, particularly during the pandemic. In addition to tobacco control, the District Health Office was required to manage numerous other programs. Another limitation faced by the District Health Office was the small policy implementation budget, which was described as follows:

"...in the District Health Office, one person is not only responsible for a single agenda but also multiple programs..."

Promotion and replacement within the local government was another factor affecting sub-national tobacco control enforcement. The personnel who were transferred out were not replaced by those with the same knowledge, delaying the regulatory advocacy process and implementation.

Currently, only one national regulation has mandated a TAPS ban but has not endorsed a total TAPS ban. This absence of strong national-level regulation might lead to regions being unable to directly regulate a TAPS ban, thus hindering sub-national tobacco control. A description of the issue was as follows:

"Regulations at the national level are not strong, so that regulations at the regional level become chaotic and confusion arises."

The COVID-19 pandemic, which began in March 2020, was identified as an emerging obstacle to all tobacco control measures in general in both Surabaya and Kulon Progo. The pandemic has led to many local government departments switching their focus to addressing

this communicable disease. Furthermore, it did not merely concern workforce refocusing, but also involved the budget and priority agenda, which was summarized as follows:

"...In 2020 we were affected by a pandemic so our activities declined..."

DISCUSSION

This study investigated the issues of Indonesian TAPS ban enforcement from the perspectives of different stakeholders and the supporting and hindering factors for a sub-national ban on the TAPS. The findings indicated that despite the existing smoke-free policy in the studied locations, the TAPS ban implementation varied. Evidently, a lack of political will was the main hindering factor in the TAPS ban enforcement while community participation played a significant role in advocating the TAPS ban policy.[14]

Many Indonesian districts or cities have implemented a smoke-free policy, but less than 10% of districts or cities have banned OTA.[15] Both Surabaya and Kulon Progo have smoke-free policies but the TAPS ban enforcement in these regions was influenced by differing TAPS ban advocacy processes. Kulon Progo has implemented a strict TAPS ban for both outdoor settings and smoke-free areas, but tobacco industry violations have been reported in its remote areas. In Surabaya, complex bureaucracy has delayed the signing of technical regulations for smoke-free policy implementation, while competing interests in OTA prohibition and refocused policies during the pandemic have weakened the TAPS ban enforcement in the city. The findings were in line with other studies reporting that the partial TAPS ban in Indonesia has resulted in potential governmental loopholes in terms of tobacco control measures, including complex bureaucracy and tobacco industry interference.[15–17]

This study determined that the TAPS ban enforcement was more feasible when a region had leaders with strong political will to support a TAPS ban. This was reflected by the success of Kulon Progo in banning the OTA and TAPS in smoke-free areas, which was due to the strong political will and excellent advocacy skills of the former regent. Nonetheless, several barriers influenced political will: in addition to sociocultural factors and the priorities of the leaders, tobacco industry interference was considered one of the strongest barriers against increasing the interest of political leaders in the TAPS ban enforcement. Tobacco industry networks are well-established and have strong governmental links where Indonesia has demonstrated the highest tobacco interference index score in Southeast Asia.[16] Thus, tobacco industry lobbying and opposition have resulted in competing interests within political parties and difficulties in passing control legislation.[9]

Opposing this interference would require stronger collaboration across sectoral agencies as the District Health Office, the leading sub-national tobacco control sector, cannot impose the measures independently. For example, Regional Women Empowerment and Child Protection Agency *(Dinas Pemberdayaan Perempuan dan Perlindungan Anak)* support in implementing the smoke-free policy in Surabaya and Kulon Progo was evident considering that excellent smoke-free policy implementation is required to achieve the child-friendly district or city ideal.

The success of Kulon Progo in continuously implementing a comprehensive TAPS ban suggested the importance of gaining public support, specifically by overcoming indifference towards the TAPS ban enforcement. The potential decrease in household income and local revenue *(Pendapatan Asli Daerah)* was the most common argument used by the tobacco industry, which is in line with the findings of others.[5,15] Despite the low revenue from tobacco advertisements, this argument nevertheless led to competing interests among political actors and a lack of public support for banning the TAPS.[16] In contrast, academicians and community participation contributed significantly to the TAPS ban advocacy and implementation, specifically by providing evidence and technical guidance to the government, educating the community, monitoring and reporting violations, and assisting the smoke-free policy task force in enforcing the TAPS ban.

The significant impact of the strong tobacco control alliance and community participation observed in this study parallels to the study by Septono et al who also urged the implementation of a comprehensive sub-national TAPS ban instead of the current partial TAPS

ban.[19] Furthermore, continuous public education was essential for shaping perceptions of the TAPS ban based on several factors: the ever-changing nature of the TAPS, the existing opinion that the smoke-free policy aims to prohibit smoking activities, and the various means the tobacco industry has used to exploit loopholes in tobacco control measures.[9]

This study highlighted three potential areas for further research. The first gap concerns the local revenue obtained from the TAPS, which was reflected by the data demonstrating that the lack of support for implementing a total TAPS ban was caused by the potential decreased revenue upon such a ban. Some regions have proven that a total TAPS ban did not decrease their revenue significantly as they were still able to obtain revenue from other advertisement types, taxation, and other sources. Nevertheless, other regions might be unaware of this, hence there remains a need for further studies calculating the impact of a total TAPS ban on local revenue.

The second research gap is related to the potential benefit of a total TAPS ban. This concerns not only the increased income but also the potential advantages from other sectors, for example, the positive impact of total TAPS bans on urban planning, environmental, and health sectors. Research focusing on the potential benefit of a total TAPS ban can also be used to advocate for the implementation of a total TAPS ban in other regions as a means of optimizing the benefits of a smoke-free policy.

The third potential research opportunity is Behavioral Change Communication (BCC) interventions for reducing smoking prevalence at the earliest. Despite the importance of BCC interventions to support the success of a total TAPS ban and smoke-free policy, studies investigating the significance of BCC inter-ventions remain limited. A total TAPS ban would be one of the best prompts for regulating smoking behavior and further reducing smoking prevalence. Nonetheless, smoking prevention should also be initiated at the family and community level, for example, by educating children and adolescents on the negative consequences of smoking and selling cigarettes only to those who are older than 18 years. Combining policies that regulate smoking

behavior and BCC interventions that focus on protecting youth from tobacco product exposure would decrease smoking prevalence further.

To the best of the authors' knowledge, this is the first study to compare the TAPS ban implementation dynamics in Indonesian regions as a means of tobacco control. Thus, this study likely provided a comprehensive context of sub-national TAPS ban enforcement. Multi-sectoral stakeholders with different roles and responsibilities in tobacco control and health promotion were also considered with the aim of gaining different perspectives on the TAPS ban. Understanding the situation and factors influencing the TAPS ban enforcement may enable sub-national governments to develop a TAPS ban policy as a recommended tobacco control measure. This study had two limitations: First, quantitative data related to the TAPS ban enforcement in the study locations were not reported due to inadequate data for statistical analysis. Second, the study scope was limited to two locations in Java only, thus leaving a context gap for other islands in terms of the TAPS ban enforcement.

CONCLUSION AND RECOMMENDATION

The TAPS ban policy has demonstrated non-negligible economic and health benefits in many countries that have ratified the World Health Organization (WHO)-FCTC. It has also high-lighted the importance of a comprehensive ban on TAPS in Indonesia as a means of reducing the smoking epidemic in the country. Considering the lack of a comprehensive sub-national TAPS ban, there is a need to strengthen the TAPS ban enforcement mandate by revising Government Regulation No. 109 of 2012 and starting a more comprehensive TAPS ban as part of the smoke-free policy in Indonesia, particularly in the sub-national level. It might be challenging to both initiate and implement a TAPS ban but the potential benefits would be worthwhile.

Smoke-free policies have been implemented in Surabaya and Kulon Progo with different TAPS ban enforcement. Kulon Progo has initiated a stricter TAPS ban for outdoor settings and smoke-free areas, while TAPS ban enforcement in Surabaya was hindered by several factors including the pandemic. Reflecting on Kulon Progo's experience, a strict

TAPS ban requires strong political will and advocacy skills among the local government, followed by continuous public education on the TAPS ban. These measures will also be required to reduce conflicts of interest among political parties and to close loopholes in the existing smoke-free policy. Further collaboration between government, academia, and community organizations will also be needed in improving public perception, which will lead to the smooth implementation of a total sub-national TAPS ban.

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AUTHOR CONTRIBUTIONS

Conceived and designed the study by HRBA, R, and MSR; HRBA, R, MSR, NAF and ODEA performed the study; HRBA, MSR, NAF, and ODEA analyzed the data; All authors contributed analysis and wrote the manuscript. The authors read and approved the final manuscript. HRBA = Hesti Retno Budi Arini; R = Rumayya; MSR = Muhammad Syaikh Rohman; NAF = Nur Annisa Fauziyah; ODEA = Oktavian Denta Eko Antoro.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Flor LS, Reitsma MB, Gupta V, Ng M, Gakidou E. The Effects of Tobacco Control Policies on Global Smoking Prevalence. *Nature Medicine*. 2021;27(2):239–243. http://dx.doi.org/10.1038/s41591-020-01210-8

2. Health Data. Global Burden of Disease 2019. 2019. https://www.healthdata.org/gbd/2019

3. WHO. Tobacco. Geneva: World Health Organization; 2021. https://www.who.int/news-room/fact-sheets/detail/tobacco

4. Indonesian Ministry of Health. Indonesia Basic Health Research. Jakarta: Agency of Health Research and Development Indonesian Ministry of Health; 2018.

5. Freeman B, Watts C, Astuti PAS. Global Tobacco Advertising, Promotion and Sponsorship Regulation: What's Old, What's New and Where to Next? *Tobacco Control*. 2022;31(2):216–221. https://tobaccocontrol.bmj.com/content/tobaccocontrol/31/2/216.full.pdf

6. Amsal A, Ramadhan K, Nurfatimah N, Ramadhan A, Aminuddin A, Hafid F. Counseling Effect on Smoking Cessation Behavior in Junior High School Students. *Media Kesehatan Masyarakat Indonesia*. 2021;17(1):9–16. https://journal.unhas.ac.id/index.php/mkmi/article/view/13018/7295

7. WHO. WHO Report on the Global Tobacco Epidemic, 2021. Addressing New and Emerging Products. Geneva: World Health Organization; 2021. https://www.who.int/teams/health-promotion/tobacco-control/global-tobacco-report-2021

8. Tselengidis A, Dance S, Adams S, Freeman B, Cranwell J. Tobacco Advertising, Promotion, and Sponsorship Ban Adoption: A Pilot Study of the Reporting Challenges Faced by Low- and Middle - Income Countries. *Tobacco*

Induced Disease. 2023;21:1–14. https://doi.org/10.18332/tid/155816

9. Bardach A, Alcaraz A, Roberti J, Ciapponi A, Augustovski F, Pichon-Riviere A. Optimizing Tobacco Advertising Bans in Seven Latin American Countries: Microsimulation Modeling of Health and Financial Impact to Inform Evidence-Based Policy. International Journal of Environmental Research and Public Health. 2021;18(10):1–13. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8151006/pdf/ijerph-18-05078.pdf

10. Megatsari H, Ridlo IA, Amir V, Kusuma D. Visibility and Hotspots of Outdoor Tobacco Advertisement Around Educational Facilities Without an Advertising Ban: Geospatial Analysis in Surabaya City, Indonesia. *Tobacco Prevention and Cessation*. 2019;5(October):1–6. https://doi.org/10.18332/tpc/112462

11. Dewanti M, Purnomo E, Kasiwi A. Upaya Pemerintah Kulon Progo dalam Pengendalian Tembakau. Jurnal Ilmu Pemerintahan. 2020;5(1):45–59. https://ojs.umrah.ac.id/index.php/kemudi/article/view/2243

12. Campos PA, Reich MR. Political Analysis for Health Policy Implementation. *Health Systems & Reform*. 2019;5(3):224–235. https://doi.org/10.1080/23288604.2019.1625251

13. Byrne D. A Worked Example of Braun and Clarke's Approach to Reflexive Thematic Analysis. *Quality & Quantity*. 2022;56(3):1391–1412. https://doi.org/10.1007/s11135-021-01182-y

14. Sebayang SK, Dewi DMSK, Lailiyah S, Ahsan A. Mixed-Methods Evaluation of a Ban on Tobacco Advertising and Promotion in Banyuwangi District, Indonesia. *Tobacco Control*. 2019;28(6):651–656. https://tobaccocontrol.bmj.com/content/28/6/651

15. Astuti PAS, Assunta M, Freeman B. Why is Tobacco Control Progress in Indonesia Stalled? A Qualitative Analysis of Interviews with Tobacco Control Experts. *BMC Public Health*. 2020;20(1):1–12. https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-020-08640-6

16. Stubbs T. Commercial Determinants of Youth Smoking in ASEAN Countries: A Narrative Review of Research Investigating the Influence of Tobacco Advertising, Promotion, and Sponsorship. *Tobacco Induced Diseases*. 2021;19(July):1–13. https://doi.org/10.18332/tid/139124

17. Fauzi R, Handari SRT. Analysis of Factors Related to the Use of Non-Smoking Tobacco Products in Junior High School Students in Indonesia. *Indonesian Journal of Public Health*. 2019;15(2):135–142. https://journal.unhas.ac.id/index.php/mkmi/article/view/5560/pdf

18. Astuti PAS, Freeman B. "It is Merely a Paper Tiger." Battle for Increased Tobacco Advertising Regulation in Indonesia: Content Analysis of News Articles. *BMJ Open*. 2017;7(9):1-9. https://bmjopen.bmj.com/content/7/9/e016975

19. Septiono W, Kuipers MAG, Ng N, Kunst AE. Self-Reported Exposure of Indonesian Adolescents to Online and Offline Tobacco Advertising, Promotion and Sponsorship (TAPS). *Tobacco Control*. 2022;31:98–105. https://tobaccocontrol.bmj.com/content/tobaccocontrol/31/1/98.full.pdf

The Association between COVID-19 Vaccine Types and Side Effects Following Vaccination: Cross-Sectional Study

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ABSTRACT

Many experts agree and believe that the COVID-19 vaccine is the best way to control the COVID-19 pandemic in a sustainable manner. Each type of vaccine has different side effects and effectiveness. Meanwhile, information regarding the relationship between the type of COVID-19 vaccines and side effects in real populations, especially in Indonesia, is still limited. The aim of this study was to investigate the association between COVID-19 post-vaccination side effects and COVID-19 vaccine type. From April to June 2022, a cross-sectional quantitative study will be conducted in Bekasi City, West Java, Indonesia. The population consists of all 1,885,014 residents of Bekasi City who have received the first dose of COVID-19 vaccination. The samples obtained were 428 respondents from online surveys employing a purposive sampling technique. Among 428 participants, there were 50.50% received Inactivated Virus (Sinovac/Sinopharm), 23.80% Viral Vector (AstraZeneca), and 25.70% mRNA (Moderna/Pfizer-BioNTech). The adjusted analysis showed a significant correlation between the type of viral vector vaccine (OR: 26.60; 95% CI: 11.04-64.30) and the type of mRNA vaccine (OR: 1.80; 95% CI: 1.17-3.04) with side effects of COVID-19 vaccination. There was a correlation between the type of vaccines with side effects after controlled variables of sex and history of infection.

INTRODUCTION

The world's media covered the discovery of the first Coronavirus Disease 2019 (COVID-19) case in Wuhan, China, in December 2019.[1] WHO declared that COVID-19 had been classified as a pandemic on March 11, 2020.[2] According to reports, there were 430,257,564 confirmed cases of COVID-19 worldwide as of February 25, 2022, with 5,922,047 deaths. As of February 25, 2022, there has been 147,568 fatalities and 5,457,775 confirmed cases of COVID-19 reported in Indonesia.[3]

A COVID-19 vaccination, in the opinion of many specialists from several nations, is the greatest option to both permanently contain the pandemic and lower COVID-19-related morbidity and mortality.[4] It is hoped that the COVID-19 vaccination will reduce the incidence of COVID-19 in the future.[5] The Indonesian government had set a target for vaccination at the national level to be 208,265,720 people. As of April 7, 2022, the total dose 1 vaccination throughout Indonesia has reached 197,243,959 doses (94.71%) of the vaccination target.[6]

The types of COVID-19 vaccines available in Indonesia include Sinovac, Sinopharm, AstraZeneca, Moderna, Novavax, and Pfizer-BioNTech. The six types of vaccines have different side effects and effectiveness. Other moderate local side effects including pain, redness, and swelling at the injection site are possible side effects that people may have after receiving the COVID-19 vaccine. Fever, muscular pains, fatigue, feeling unwell, nausea, vomiting, headaches, dizziness, chills, sleepiness, and changes in appetite are just a few of the systemic side effects. The COVID-19 vaccine's side effects are common and safe, thus the general public shouldn't be concerned about them. This proves that the body has reacted to the vaccination, particularly the antigen (molecule that initiates an immune response), and is getting ready to defend itself against the virus. Due to worries regarding vaccination safety and potential adverse effects, many people in various industrialized and developing nations are still apprehensive and reluctant to get the COVID-19 vaccine.[7,8]

It is still unknown if there is a connection between the kind of vaccine and the side effects observed by residents of Bekasi City because descriptions of COVID-19 vaccine side effects by types of vaccine used in the general population are still limited, especially in Indonesia. For example, a study conducted by Supangat et al, which only compared the side effects of one type of vaccine based on the first and the third dose in medical clerkship students in Jember, Indonesia.[9] Then the research conducted by Djanas et al, also only explained the side effects of one type of vaccine on national referral hospital staff in Indonesia.[10] Based on the information provided above, a research was done to ascertain how the kind of COVID-19 vaccination and the side effects in the community of Bekasi City in 2022 relate to one another.

MATERIAL AND METHOD

From April to June 2022, a cross-sectional study conducted in Bekasi City. The results of measuring both local (pain at the injection site, redness, and swelling) and systemic (fever, dizziness, headache, feeling unwell, fatigue, nauseous vomit, muscle ache, chills, sleepy, and changes in appetite) side effects of the COVID-19 vaccination were used to determine the dependent variable. The independent variable is the type of COVID-19 vaccine with measurements of inactivated virus (Sinovac/Sinopharm), viral vector (AstraZeneca), and mRNA (Moderna/Pfizer-BioNTech). Then, there are covariate variables, namely age with cut-off point mean, sex, history of COVID-19 infection, and history of comorbidities such as hypertension, kidney, diabetes, cardiovascular, and respiratory disease. All residents of Bekasi City who received the first dose of COVID-19 vaccination are included in the population. The calculation of the minimum number of samples is carried out using a two-sided hypothesis test formula with a 95% confidence level where P1 = 0.22 and P2 = 0.39 so that the minimum total number of samples is 372 respondents.[11,12]

The number of samples that were successfully obtained in the research was 428 respondents with the criteria of individuals living in Bekasi City, aged 18 years and over, have received the first dose of vaccination evidenced by a vaccination card and filling out the questionnaire completely.

The sampling technique used snowball sampling because the researcher collecting data from the first participants and then asking them to recommend more possible participants who

match the research requirements through social media. Data were collected using an electronic questionnaire (Google Form). Data obtained from the online questionnaire will be checked again by the researcher, whether the answers are complete and appropriate or not. Through social media platforms including WhatsApp, Instagram, Line, and Email, questionnaires were circulated. The distribution of the questionnaire link was carried out for 9 days.

The quantitative phase's data analysis employed a logistic regression model to clarify the adverse effects of various COVID-19 vaccine types. To choose a candidate as the independent variable, a bivariate (chi-square) analysis was carried out initially. In the second stage, the adjusted analysis took into account all parameters (kind of COVID-19 vaccine, history of COVID-19 infection, and history of comorbidities) with a p-value of 0.25 in the first phase. However, the variables of age and sex were analyzed with multivariate analysis because the variables are considered important and considered to be related to the side effects of COVID-19 vaccination. In the multivariate analysis, the crude odds ratio and adjusted odds ratio were evaluated at = 0.05 with a 95% confidence interval (95% CI). SPSS software (27th version, International Business Machines Corp., New York) was used for all statistical analysis. This was given acceptance by the National Veteran Development University of Jakarta's Health Research Ethics Commission, with approval number 302/VI/2022/KEPK.

RESULTS

The number of respondents was 428 people who live in the city of Bekasi. Based on COVID-19 vaccine and demographic data, the majority of respondents received vaccination with the Sinovac (46.30%), the majority of respondents were older than 22 years (64.50%), female (57.70%), had no history of COVID-19 infection (87.90%), and had no comorbid history (90%) (Table 1). The definition of comorbid history is a disease experienced by respondents such as hypertension, diabetes, kidney disease,

cardiovascular disease, respiratory disease. The majority of respondents (50.50%), according to the viral type, had the inactivated virus type vaccination (Table 2). According to COVID-19 side effects, the majority of respondents reported local side effects, such as pain at the injection site (78.30%), and systemic side effects, such as muscle pain (67.50%) and not feeling well (52.30%) (Figures 1 and 2).

Table 1. Distribution of Respondents Based on COVID-19 Vaccines, Demographic Data, History of Infection & Comorbid in Bekasi, Indonesia

Variable	n = 428	%
Types of COVID-19 Vaccines		
Sinovac	198	46.30
Sinopharm	18	4.20
AstraZeneca	102	23.80
Moderna	12	2.80
Age (Years)		
< 22	152	35.50
≥ 22	276	64.50
Sex		
Male	181	42.30
Female	247	57.70
History of COVID-19 Infection		
No	376	87.90
Yes	52	12.10
Comorbid history		
No	385	90
Yes	43	10

Source: Primary Data, 2022

Table 2. Distribution of Respondents by COVID-19 Vaccine Virus in Bekasi Indonesia

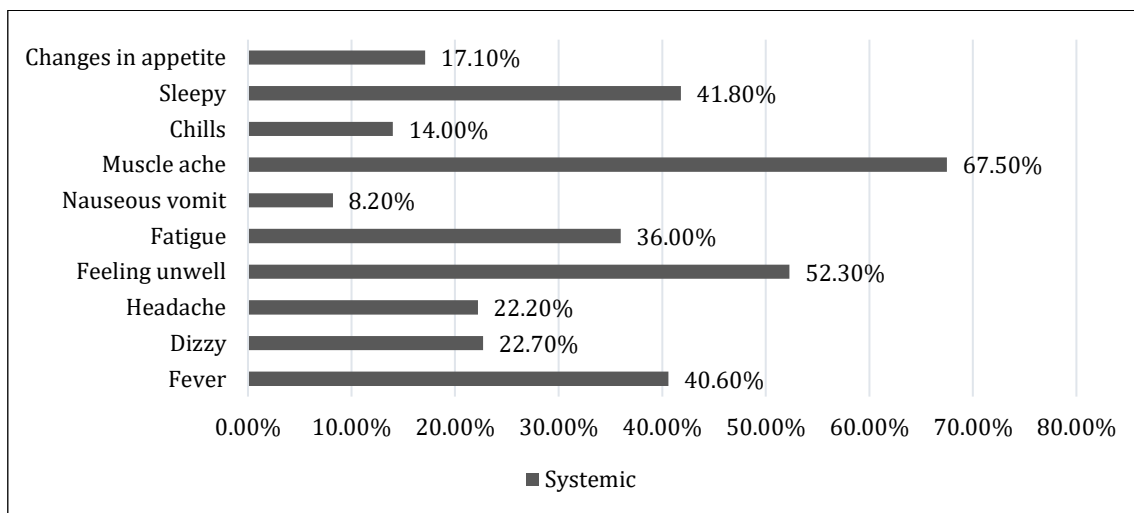| Variable	n = 428	%
Types of Virus Vaccine COVID-19		
Inactivated Virus (Sinovac/Sinopharm)	216	50.50
Viral Vector (AstraZeneca)	102	23.80
mRNA (Moderna/Pfizer-BioNTech)	110	25.70

Source: Primary Data, 2022
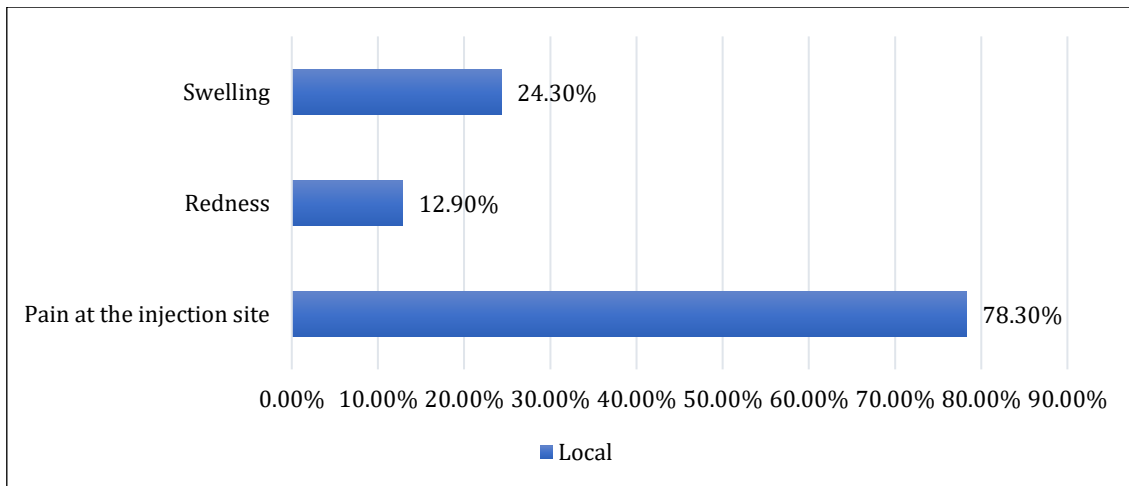
Source: Primary Data, 2022
Figure 1. Distribution of Respondents Based on Local COVID-19 Vaccination Side Effects

Source: Primary Data, 2022
Figure 2. Distribution of Respondents Based on Systemic COVID-19 Vaccination Side Effects

According to the results of multiple logistic regression, those who received the COVID-19 viral vector vaccine (AstraZeneca) had a 26.64 times (95% CI: 11.04-64.30) higher risk of developing systemic side effects than those who received the inactivated virus COVID-19 vaccine (Sinovac/Sinopharm). Additionally, respondents who received the COVID-19 vaccination with mRNA (Moderna/Pfizer BioNTech) had a 1.89 times (95% CI: 1.17-3.04) higher risk of developing systemic side effects than respondents who received the COVID-19 vaccination with inactivated virus (Sinovac/Sinopharm) (Table 3).

DISCUSSION

In this study, the main independent variable was the type of COVID-19 vaccine. This type of vaccine is divided into 3 categories according to the type of virus, namely inactivated virus, viral vector, and mRNA. The samples were 428 respondents. The findings indicated that the inactivated viral vaccine (Sinovac/Sinopharm) was a vaccination that the majority of responders had received. According to Hatmal et al.'s research from 2021, the majority of respondents had the Sinopharm vaccine, which uses an inactivated virus.[13]

Table 3. The Relationship Between Types of COVID-19 Vaccines and Side Effects of COVID-19 Vaccinations in Bekasi Indonesia

Variable	Side Effects of COVID-19 Vaccination		Unadjusted		Adjusted	
	Local	Systemic	OR (95% CI)	*p-value*	OR (95% CI)	*p-value*
	n = 181	n = 247				
Types of COVID-19 Vaccines						
Inactivated Virus	128	88	1		1	
Viral Vector	6	96	25.87 (10.67-62.74)	0.00	26.64 (11.04-64.30)	0.00
mRNA	47	63	1.86 (1.15-3.00)	0.01	1.89 (1.17-3.04)	0.00
Age (Years)						
< 22	65	87	1			
≥ 22	116	160	1.04 (0.65-1.65)	0.86		
Sex						
Male	82	99	1		1	
Female	99	148	1.60 (1.01-2.52)	0.04	1.60 (1.02-2.50)	0.03
History of COVID-19 Infection						
No	166	210	1		1	
Yes	15	37	2.21 (1.12-4.37)	0.02	2.20 (1.11-4.35)	0.02
Comorbid History						
No	156	229	1			
Yes	25	18	0.81 (0.41-1.62)	0.56		

Source: Primary Data, 2022

The findings revealed that most respondents had local side effects, namely pain and swelling (Figure 1). The majority of respondents also experienced systemic side effects, such as muscle pain and not feeling well. Similar to this, from the research study of Supangat et al the most common side effects following the first dose were pain at the injection site and malaise.[9] Experiencing some mild to moderate side effects is common when receiving vaccinations. It is proved that the immune system responds to the vaccine, in particular to antigens (substances that trigger an immune response), and prepares to fight the virus.[14]

The findings indicated that the majority of respondents were older than 22. The majority of responders, according to Riad et al.'s study, are older than 22.[15] The majority of respondents in this study are female. A study by Djanas et al which discusses the side effects of COVID-19 vaccination explained that the majority of respondents from this study were also female.[10]

Based only on data from respondents who filled out the Google form, the majority of respondents did not previously have COVID-19 infection. This result is consistent with a study by Tsai et al which found that the majority of respondents had no prior history of COVID-19 infection.[16] Most of the respondents had no history of comorbid conditions. The majority of respondents in Rosiello et al.'s study did not have a history of hypertension, diabetes, heart disease, or lung disease.[17]

After adjusting for the gender variable and a history of COVID-19 infection, the findings of the multivariate analysis revealed a strong correlation between vaccine type and side adverse effects. In comparison to respondents who received the COVID-19 vaccination with the inactivated virus (Sinovac/Sinopharm), respondents who received the COVID-19 viral vector (AstraZeneca) vaccine were 26.60 times (95% CI: 11.044-64.304) more likely to experience systemic side effects. Additionally, respondents

who received the COVID-19 vaccination with the mRNA type (Moderna/Pfizer BioNTech) were 1.80 times (95% CI: 1.17-3.04) more likely to experience systemic side effects than those who received the COVID-19 vaccination with the inactivated virus type (Sinovac/Sinopharm). According to a research conducted in Malaysia by Elnaem et al compared to the Pfizer-BioNTech and Oxford-AstraZeneca vaccines, the Sinovac vaccine showed much less side effects. Depending on the COVID-19 vaccine adminis-tered, different adverse effects may occur after COVID-19 vaccination.[18] According to the study by Alhazmi et al people who received the AstraZeneca vaccine were more likely to have systemic side effects such fatigue and fever than those who received the Pfizer-BioNTech or Sinovac vaccinations.[19]

The AstraZeneca vaccine is a type of viral vector with genetically modified adenovirus that has been attenuated. Adenovirus is a type of virus that can trigger fever (systemic side effect). Moderna and Pfizer-BioNTech vaccines are types of mRNA with components of genetic material that are chemically synthesized and engineered to resemble certain germs or viruses.[20]

The findings of the multivariate analysis revealed a strong correlation between the history of COVID-19 infection and the side effects of COVID-19 vaccination. In comparison to responders without a history of COVID-19 infection, those with a history of infection are 2.20 times more likely to experience systemic side effects after the COVID-19 vaccinations. This result is consistent with a research by Tissot et al which discovered that people with a history of COVID-19 infection usually reported signs of local and systemic adverse effects. This could be attributed to the increased immunogenicity resulting from the COVID-19 vaccination.[21]

Furthermore, compared to male respondents, female respondents were 1.60 times more likely to be at risk of systemic COVID-19 vaccine side effects. Similar with the research of Riad et al that female is a risk factor for the side effects of the COVID-19 vaccine.[22] Young women usually develop a stronger immune response than adult men, so women are more at risk of experiencing the side effects of the COVID-19 vaccination.[23]

Weaknesses of this study is the possibility of information bias because of the online data collection. However, this was done because of data collection during the COVID-19 pandemic.

CONCLUSION AND RECOMMENDATION

The majority of respondents were female, older than 22 years old, without a history of COVID-19 infection and comorbid, and had received an inactivated virus (Sinovac) vaccination. They also reported having local side effects of pain, systemic side effects of muscle pain, and generalized side effects of feeling unwell. After adjusting for gender-specific factors and COVID-19 infection history, there is an association between vaccine type and side effects of COVID-19 vaccination. The COVID-19 viral vector (AstraZeneca) and mRNA (Moderna/Pfizer BioNTech) vaccine types have more systemic side effects than inactivated viruses (Sinovac/ Sinopharm).

The advice that can be given to the community is not to worry if they experience side effects after vaccination. As long as it is available, they can select an inactivated viral vaccination if they desire a vaccine with little side effects. Other researchers are expected to add a second dose of the COVID-19 vaccine and a booster and add other less common side effects for further investigation.

AUTHOR CONTRIBUTIONS

AMS and CS contributed to the conceptualization of the research; AMS collects and processes data; AMS wrote the script; The manuscript and data analysis were evaluated by CS, LH, and UQK. The manuscript's published version has been approved by all authors, who have also reviewed and approved it. AMS = Alifia Maharani Setyoputri; CS = Chandrayani Simanjorang; LH = Laily Hanifah; UQK = Ulya Qoulan Karima.

CONFLICTS OF INTEREST

The authors state that no competing interest exists.

REFERENCES

1. Putri RN. Indonesia dalam Menghadapi Pandemi Covid-19. *Jurnal Ilmiah Universitas Batanghari Jambi*. 2020;20(2):705-709. http://dx.doi.org/10.33087/jiubj.v20i2.101

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2. Eastin C, Eastin T. Epidemiological Characteristics of 2143 Pediatric Patients with 2019 Coronavirus Disease in China. *Journal of Emergency Medicine*. 2020;58(4):712–713. https://doi.org/10.1016/j.jemermed.2020.04.006

3. WHO. Coronavirus (COVID-19) Dashboard with Vaccination Data. Geneva: World Health Organization; 2021. https://covid19.who.int/

4. Walsh EE, Frenck RW, Falsey AR, Kitchin N, Absalon J, Gurtman A, et al. Safety and Immunogenicity of Two RNA-Based Covid-19 Vaccine Candidates. *New England Journal Med*. 2020;383(25):2439–2450. https://www.nejm.org/doi/10.1056/NEJMoa2027906

5. Voysey M, Clemens SAC, Madhi SA, Weckx LY, Folegatti PM, Aley PK, et al. Safety and Efficacy of the ChAdOx1 nCoV-19 Vaccine (AZD1222) Against SARS-CoV-2: an Interim Analysis of Four Randomised Controlled Trials in Brazil, South Africa, and the UK. *Lancet*. 2021;397(10269):99–111. https://www.sciencedirect.com/science/article/pii/S0140673620326611?via%3Dihub

6. Kemenkes RI. Vaksinasi COVID-19 Berdasarkan Provinsi dan Kabupaten/ Kota. Jakarta: Kementerian Kesehatan RI; 2021. https://vaksin.kemkes.go.id/#/detail_data

7. Machingaidze S, Wiysonge CS. Understanding COVID-19 Vaccine Hesitancy. *Nature Medicine*. 2021;27(8):1338–1339. http://dx.doi.org/10.1038/s41591-021-01459-7

8. Nossier SA. Vaccine Hesitancy: the Greatest Threat to COVID-19 Vaccination Programs. *Journal of Egyptian Public Health Association*. 2021;96:18. https://doi.org/10.1186/s42506-021-00081-2

9. Supangat, Sakinah EN, Nugraha MY, Qodar TS, Mulyono BW, Tohari AI. COVID-19 Vaccines Programs: Adverse Events Following Immunization (AEFI) among Medical Clerkship Student in Jember, Indonesia. *BMC Pharmacology and Toxicology*. 2021;22(1):1–7. https://doi.org/10.1186/s40360-021-00528-4

10. Djanas D, Yusirwan, Martini RD, Rahmadian, Putra H, Zanir A, et al. Survey Data of COVID-19 Vaccine Side Effects among Hospital Staff in A National Referral Hospital in Indonesia. *Data in Brief*. 2021;36(107098):1-7. https://doi.org/10.1016/j.dib.2021.107098

11. Levy PS, Lemeshow S. Sampling of Populations: Methods and Applications [Internet]. 2013 [cited 2022 Jul 7]. https://books.google.co.id/books?hl=id&lr=&id=XU9ZmLe5k1IC&oi=fnd&pg=PT14&dq=lemeshow&ots=ocaXEgPwQn&sig=I5RnaUIsh2NBBiEjGWWhhT0orIk&redir_esc=y#v=onepage&q=lemeshow&f=false

12. Chapin J, Gee J, Myers T. Reactogenicity Following Receipt of mRNA-Based COVID-19 Vaccines. *JAMA*. 2021;325(21):2201–2202. doi:10.1001/jama.2021.5374

13. Hatmal MM, Al-Hatamleh MAI, Olaimat AN, Hatmal M, Alhaj-Qasem DM, Olaimat TM, et al. Side Effects and Perceptions Following COVID-19 Vaccination in Jordan: A Randomized, Cross-Sectional Study Implementing Machine Learning for Predicting Severity of Side Effects. *Vaccines*. 2021;9(6):1–23. https://www.mdpi.com/2076-393X/9/6/556

14. WHO. Side Effects of COVID-19 Vaccines. Geneva: *World Health Organization*; 2021. https://www.who.int/news-room/feature-stories/detail/side-effects-of-covid-19-vaccines

15. Riad A, Hocková B, Kantorová L, Slávik R, Spurná L, Stebel A, et al. Side Effects of mRNA-Based COVID-19 Vaccine: Nationwide Phase IV Study among Healthcare Workers in Slovakia. *Pharmaceuticals*. 2021;14(9):1–24. https://www.mdpi.com/1424-8247/14/9/873

16. Tsai R, Hervey J, Hoffman K, Wood J, Johnson J, Deighton D, et al. COVID-19 Vaccine Hesitancy and Acceptance among

Individuals with Cancer, Autoimmune Diseases, or Other Serious Comorbid Conditions: Cross-sectional, Internet-Based Survey. *JMIR Public Health and Surveillance.* 2022;8(1):1–16. https://publichealth.jmir.org/2022/1/e298 72

17. Rosiello DF, Anwar S, Yufika A, Adam RY, Ismaeil MI, Ismail AY, et al. Acceptance of COVID-19 Vaccination at Different Hypothetical Efficacy and Safety Levels in Ten Countries in Asia, Africa, and South America. *Narra J.* 2021;(May):1–16. https://narraj.org/main/article/view/55

18. Elnaem MH, Mohd Taufek NH, Ab Rahman NS, Mohd Nazar NI, Zin CS, Nuffer W, et al. Covid-19 Vaccination Attitudes, Perceptions, and Side Effect Experiences in Malaysia: Do Age, Gender, and Vaccine Type Matter? *Vaccines.* 2021;9(10):1–15. https://www.mdpi.com/2076-393X/9/10/1156

19. Alhazmi A, Alamer E, Daws D, Hakami M, Darraj M, Abdelwahab S, et al. Evaluation of Side Effects Associated with COVID-19 Vaccines in Saudi Arabia. *Vaccines.* 2021;9(6):1–8. https://www.mdpi.com/2076-393X/9/6/674

20. Salerno L, Craxì L, Amodio E, Lo Coco G.

Factors Affecting Hesitancy to mRNA and Viral Vector COVID-19 Vaccines among College Students in Italy. *Vaccines.* 2021;9(8):1–15. https://www.mdpi.com/2076-393X/9/8/927

21. Tissot N, Brunel AS, Bozon F, Rosolen B, Chirouze C, Bouiller K. Patients with History of Covid-19 Had More Side Effects After the First Dose of Covid-19 Vaccine. *Vaccine.* 2021;39(36):5087–5090. https://doi.org/10.1016/j.vaccine.2021.07. 047

22. Riad A, Pokorná A, Attia S, Klugarová J, Koščík M, Klugar M. Prevalence of COVID-19 Vaccine Side Effects among Healthcare Workers in the Czech Republic. *Journal of Clinical Medicine.* 2021;10(7):1–18. https://www.mdpi.com/2077-0383/10/7/1428

23. Menni C, Klaser K, May A, Polidori L, Capdevila J, Louca P, et al. Vaccine Side-Effects and SARS-CoV-2 Infection After Vaccination in Users of the COVID Symptom Study App in the UK: a Prospective Observational Study. *The Lancet Infectious Diseases.* 2021;21(7):939–949. http://dx.doi.org/10.1016/S1473-3099(21)00224-3

Pesticide Residues Impact on Drinking Water and Farmers Using Environmental Health Risk Assessment Study (EHRA)

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ABSTRACT

Public health problems and decreased environmental health can be caused by pesticides because they are dangerous toxic substances. Pesticides have had a risky impact on farmers in Jonggol village. Assessing the risk of pesticide exposure to drinking water sources in agricultural areas in Jonggol village in 2022 is the aim of this study. The research used the Environmental Health Risk Assessment study. Conducting interviews with questionnaires, measuring pesticides in drinking water sources, and observing are part of the research data collection. The results of research conducted at 3 points only found pesticides at the first point, namely in the well water in Kampung Kujang with a value above the standard of 0.0855 mg/l the location is only 2 m from the agriculture. In the next two points, namely well water in Karni village and river water in Bengkok village, no pesticides were detected and the distance from the agriculture was 20 m. Most of the water from wells in agricultural areas is consumed by farmers for drinking. The calculation result was 0.00246 mg/kg/day for non-carcinogenic intake values (real-time) and 0.001056 mg/kg/day for carcinogenic intake values (real-time). The results showed there was no non-carcinogenic risk with RQ value of ≤ 1 with a value of characteristics of non-carcinogenic risk was 0.246. The conclusion is that both in real-time and in a lifetime, farmers in Jonggol village are already at risk. The risk of health problems for farmers can be reduced by the importance of protecting farmers by carrying out risk management.

INTRODUCTION

Water is vital in supporting living things. Therefore, water supply must be adequate, safe, and easy to access. Increasing access to safe drinking water can be beneficial for health, so every effort needs to be made to get safe drinking water.[1] Drinking water is water that has met health requirements, through the treatment process or not through the treatment process but can be drunk directly by the community.[2] One of the sources of drinking water is groundwater. Groundwater is water in a saturated area underground and moves in the soil contained in the spaces between the grains of soil that form it and in the cracks of rocks.[3] Water is a very important element needed by living things, especially humans.[4] The water needed by humans is clean water suitable for the use that can be used to meet daily needs, especially for drinking water purposes.[4] Drinking water is water that goes through a treatment process or without a treatment process that can meet health requirements and can be drunk immediately.[5]

Pesticides are toxic materials that have the potential to harm the environment and biodiversity, causing resistance, resurgence, the emergence of new pests, as well as disruptions to human health and other living things, so they must be managed with caution.[5] According to Sumardiyono, fungicide is a type of pesticide used to kill or inhibit the development of fungi. Fungicide comes from two words in Latin: *fungus* and *credo*. *Fungus,* plural of fungi, means mushrooms, while *caedo* is killing.[6] In Indonesian, the word becomes fungicidal. According to the European Food Safety Authority acute toxicity of difenoconazole had oral Lethal-Dose 50 in rats of 1453 mg/kg bb, oral Lethal-Dose 50 in mice > 2000 mg/kg bb, Lethal-Dose 50 dermal in rabbits > 2010 mg/kg bb and inhaled LD50 in rats > 3.3 mg/L (4 hours exposure). The maximum limit value of triazole pesticide residues as difenoconazolezole in water is 0.1 ppb or 0.1 µg/l and has a reference dose value of 0.01 mg/kg/day.[7]

Several studies of water contamination by pesticides in Canada, China, and Sri Lanka found that pesticide residues had polluted waters in agricultural settlement areas. In the country of Sri Lanka, of the twenty pesticides tested, ten were detected in the water samples (pretilachlor, oxyfluorfen, thiamethoxam, chlorantraniliprole, fenobucarb, fipronil, diazinon, etofenprox, Tebuconazole, and captan) and concentrations of all detected pesticides exceeded national regulatory threshold limits.[8] In Canada, pesticides were detected consistently throughout all locations in water samples for both sampling years. Overall, concentrations were 3 times higher in 2020 when river discharge was ~2 times higher.[5] In China, multiple pesticide residues found in surface water were consistent with those in topsoil, suggesting a potential risk of water contamination in the rice-vegetable rotation. Water that has been polluted by pesticides in agricultural settlements will increase the risk of residents experiencing poisoning from consuming this drinking water source.[9]

Some researches and cases of pesticides in Bogor are that the proportion of respondents who have heard the term pesticide is the highest in Bogor Regency at 84.6%. Of this proportion, more than 86.6% know how to use pesticides/insecticides and more than 88.4% know how to store them. The proportion of respondents who used Personal Protective Equipment (PPE) in Bogor research was relatively low (no more than 22.6%). Cases of poisoning of drinking water sources have occurred in Bogor; as many as 51 students in Bogor have experienced poisoning and it has been identified that the poisoning comes from groundwater.[10]

Jonggol Village is one of the villages in the Jonggol District, West Java. Jonggol village has the majority of farmers spraying and mixing pesticides. Farmers in Jonggol Village also consume raw water on average in agricultural areas. The duration of activities in agricultural areas with a high level of pollution has the potential to causes disease disorders, both carcinogenic and non-carcinogenic. Several factors, including the duration of exposure, last contact, length of work, dosage, temperature, humidity, wind direction, and speed, pesticide residues in food, age, gender, smoking habits, knowledge, Personal Protective Equipment, and counseling influence pesticide exposure.[10] Environmental Health Risk Analysis (EHRA), or in Indonesia, called *Analisis Risiko Kesehatan Lingkungan (ARKL)*, is the process of estimating the risk of exposure to a toxic agent to human

health, including identifying uncertainty factors and taking into account the characteristics inherent in a toxic agent that is characteristic of a specific target. A total of five steps in the implementation of EHRA are hazard identification, dose-response analysis, exposure analysis, risk characteristics, and risk management.[11]

Jonggol Village was chosen as the research area because most farmers still actively use pesticides to overcome pests (Plant Disturbing Organisms). Based on the results of studies conducted on permanent farmers in Jonggol Village, it is known that 8 out of 10 permanent farmers interviewed have been farming in Jonggol Village for more than 10 years with an average length of farming is 8 hours/day. In addition, some farmers have experienced health problems, at risk of non-carcinogenic or carcinogenic risks. Based on the observations, the location of raw water sources in agricultural areas has poor sanitation.

There are pesticide spraying equipment and bottles of pesticides of fungicidal materials around the raw water source which has polluted the raw water in Jonggol. In the observation activity, farmers do not use personal protective equipment according to procedures. After spraying pesticides, they draw well water (raw water source) without cleaning their bodies first from pesticide exposure.

Many farmers experience carcinogenic health risks, including dizziness, headache, nausea, and vomiting. There is a farmer who is at risk of carcinogenic disease, cancer, and tumors. In observation activities, some farmers carry out burning activities such as burning garbage, smoking, and consuming burnt food which increase the carcinogenic risk. Therefore, based on the results of previous studies and preliminary research in many countries, researchers want to examine the level of environmental health risks due to exposure to pesticide residues of fungicidal substances in the habit of consuming drinking water in agricultural residential areas in Jonggol village, Bogor regency in 2022.

MATERIAL AND METHOD

This descriptive study used the EHRA method. EHRA is a method used to estimate the risk of exposure to a toxic agent to human health. EHRA focuses on the exposure of pesticides to fungicidal ingredients through drinking water sources located in agricultural locations based on the habit of consuming raw water in agriculture, with the subject being farmers. EHRA can also be used to account for characteristics in toxic agents that are targeted specifically. This research was carried out in the Jonggol village farm, lasting 6 months from January 2022 to June 2022. The research finished on 7 June 2022, with a total sample of 91 farmers.

One way to test pesticide residues in water sources is to use gas chromatography techniques. Chromatography is the separation of a mixture of components based on the difference in the degree of interaction with the two phases of the separator material. In the mixture to be separated, the phase of motion is brought, which is then forced to move or filtered through the stationary phase due to the influence of heavy forces or other forces.

The samples were samples of permanent farmers who carried out pesticide mixing and spraying activities. Environmental samples were taken from 3 samples of drinking water sources, those were Point 1 of Kujang Village Well Water, point 2 of Bengkok Village River Water, and point 3 of Karni Village Well Water.

Sampling was done by listing agricultural villages, observations on sanitary hygiene, and interviews with farmers who sprayed and mixed pesticides. Samples of well water and river water collected that day as soon as possible were taken to the Center for Quality and Goods Control laboratory of the Ministry of Trade of the Republic of Indonesia. Ethical Clearance Number of this research was Number: Ket 274/UN2.F10.D11/OOM.00.02/2022.

RESULTS

Based on the results of pesticide concentration measurements at 3 points in the Jonggol village agricultural area, it is found that the highest concentration of pesticide residues is at point 1 or 0.08 mg/L. The lowest concentration of pesticide residues is found at point 2, the Bengkok village river water area and

area 3, the Karni Village well water, which is undetected (Table 1). The quality standard value for difenoconazole pesticides in water is 0.10 ppb.

Based on Table 2, the average age of farmers in Jonggol Village is 55.31 years the average height of the respondents is 162.85 cm and the average weight of the respondents is 60.68 kg. Farmers' exposure duration obtained a mean value of 7.95 hours/day and a median of 8 hours/day. The frequency of farmers' exposure obtained a mean value of 342 days /year and a median value of 346 days/year. The duration of farmers' exposure obtained a mean value of 29.77 years and a median of 28 years.

Based on Table 3, the risk factors for farmers in the habit of wearing gloves are that most of them are not wearing gloves when mixing and spraying pesticides, which is 94.50%; for the habit of wearing boots, most of them does not wear boots when mixing and spraying pesticides, which is 94.50%. For the habit of wearing protective clothing, all farmers wear it when spraying and mixing pesticides, which is 100%. However, for the habit of bathing and changing clothes after spraying pesticides, they mostly does not take a shower and change clothes after spraying at 87.90%. Most of the farmers wash their hands after using pesticides at 97.80%.

Based on Table 4, the calculation results of non-carcinogenic real-time intakes, it is found that the minimum intake value is 0 mg/kg/kg/day, while the maximum intake is 0. mg/kg/kg/day. The results of the calculation of carcinogenic real-time intake, it is found that the minimum intake value is 0 mg/kg/day, while the maximum intake is 10.56 x 10^{-4} mg/kg/day.

Based on Table 5, the possibility of incurring carcinogenic risks can be amplified by finding the Critical Effect of exposure to the pesticide Difenoconazole. Based on research in Jonggol Village, possible risks can be strengthened based on public health profiles in terms of public health. In the variable of health problems or disease complaints for one year, = there were 74.70% of the farmers who experienced respiratory disorders, and the percentage of farmers who experienced indigestion is at 48.40%. Most farmers also have the habit of smoking, which is 72.50%, carrying out burning activities, which is 95.60%, living in areas around agricultural locations, which is 96.70%, and consuming burnt food, which is around 78%.

Table 1. Results of Pesticide Residue Measurement in Agricultural Settlement Areas in Villages Jonggol

Samples	Time Retrieval	Result	Average
Point 1 (Well Water Kujang Village)	09.30	0,0855 mg/L	0,0855 mg/L
Point 2 (Well Water Bengkok Village)	10.15	Not Detected	
Point 3 (Well Water Karni Village)	11.02	Not Detected	

Source: Primary Data, 2022

Table 2. Distribution of Farmers Charasteristic in Jonggol Village

Variabel	n	Mean	Median	SD	Min	Max
Age (Year)	91	55.31	55	10.87	31	79
Body Height (cm)	91	162.85	165	8.73	140	182
Body Weight (kg)	91	60.68	60	9.31	42	82
Duration Of Exposure (Hours/Day)	91	7.95	8	0.27	6	8
Duration Of Time (Years)	91	29.77	28	11.94	10	62
Frequency Of Exposure (Days/Year)	91	342	322	15.57	221	355

Source: Primary Data, 2022

Table 3. Distribution of Risk Factors for Farmers in Jonggol Village

Characteristics	n = 91	%
The Habit of Wearing Gloves		
Yes	5	5.50
No	86	94.50
The Habit of Wearing Boots		
Yes	5	5.50
No	86	94.50
The Habit of Wearing a Mask		
Yes	15	16.50
No	76	83.50
The Habit of Wearing Protective Clothing		
Yes	91	100
No	0	0
The Habit of Bathing and Changing Clothes		
Yes	11	12.10
No	80	87.90
The Habit of Handwashing		
Yes	89	97.80
No	2	2.20

Source: Primary Data, 2022

Table 4. Results of Calculation of Non-Carcinogenic & Carcinogenic Realtime Intake & Risk Quotient for Farmers in Jonggol Village

Non-Carcinogenic Intake	*Intake Realtime Non-Carcinogenic*	
	Minimum	**Maximum**
Realtime (ml/kg/day)	0	0.00246
Non-Carcinogenic Intake	*Carcinogenic Realtime Intake*	
	Minimum	**Maximum**
Realtime (mg/kg/day)	0	0.001056
Risk Quotient (RQ)	**Minimum**	**Maximum**
Realtime	0	0.246

Source: Primary Data, 2022

DISCUSSION

The pesticides in drinking water sources in agricultural and residential areas is the pesticide difenoconazole. When it is compared to the threshold from the European Protection Agency (EPA) and Integrated Risk Information System (IRIS), it is said to be above the upper threshold value of 0.0085 mg/l. However, the threshold value determined by American Conference of Governmental Industrial Hygienists (ACGIH) and Occupational Safety and Health Administration (OSHA) is intended for workers who work for 8 hours per day, while the value determined by ACGIH is for 10 hours per day.

In the results of measuring pesticide concentrations at 3 points in the Jonggol Village Agricultural Area, it is found that the highest concentration of pesticide residues is at point 1 or 0.0855 mg/L. The lowest pesticide residue concentration is found at point 2, the Bengkok Village River Water area, and area 3, the Karni Village well water, which is undetected. The quality standard value for difenoconazole pesticides in water is 0.1 ppb. The concentration value of difenoconazole pesticides in Kujang Village exceeds the quality standard of 0.0855 mg/l for a quality standard of 0.1 ppb or 0.0001 mg/l. Thus, the pesticide difenoconazole has polluted the raw water in the Well Water of Kujang Village. As many as 5 families routinely consume water in the Kujang Village well and the distance between the Kujang Village Well Water and agriculture is about 2 meters. In Bengkok Village, about 7 families use river water and the distance of river water to the farm is about 20 meters. There are about 10 families that use well water sources in Karni Village and the distance of Well Water in Karni Village is about 20 meters from the agricultural location. Related to the distance, not comparing with the location of Well Water and River Water with a radius that is quite far from the agricultural location.

Although both are located in agricultural and residential areas, there are only pesticide residues in the wells in Kujang Village; this can be strengthened because, during field activities and observations, the color of the well water in Kujang Village is different from the Well Water in Jagaita Village and Karni Village. The color of the water is slightly whitish in the Well of Kujang Village. Well Water's location as a drinking water source in Kujang Village also has inadequate sanitation. There are bottles used for spraying pesticides and tools for mixing and spraying pesticides, and farmers do not take a shower immediately after spraying pesticides. The pesticide residue can be decomposed by the air or attached to the farmer's body, hence when taking well water, pesticide residue can stick to the bucket held by the farmer, or pesticide particles can fall into the well.[7] If pesticide residues damage groundwater quality, they can see the contours of water flow in Kujang Village

Agriculture or use an accurate altimeter application.

One of the things that cause the presence of difenoconazole pesticide residues is that during field observation activities, the majority of farmers have poor sanitary personal hygiene to increase the risk of transferring pesticides to farmer bodies or spraying or mixing tools that can pollute well water through the air or pesticide particles that are from farmers when they are about to take water. The distance also affects because the distance of the well water that has difenoconazole pesticide residues is only about 2 meters from the rice fields and rice field environment surrounds the well water. In contrast to the well water in Karni Village and River Water in Jagaita Village, the distance with the rice fields is approximately 10 m and not too close to the rice field location, so the closer the distance to the rice fields, the higher the risk of well water being polluted by difenoconazole pesticide residues. Hence, the radius of the riskiest distance for raw water sources exposed to pesticides is approximately 2 meters from the agricultural location. Research in Sri Lanka also shows that drinking water sources that are closer to agricultural residential areas will have a higher risk of being contaminated with agricultural residues from spraying pesticides on agriculture. This is because the concentration of pesticides will accumulate more in the land closest to agricultural residential areas with the most pesticide spraying activities on site. The accumulation of pesticides will contaminate groundwater which will contaminate drinking water sources in wells in agricultural residential areas which will be consumed as drinking water for farming residents.[8]

In the field research activities, when conducting interviews and observations, it was found that farmers in Jonggol Village most often use pesticides for pesticide mixing and spraying activities with the brand 'E-Score' and after research that the pesticide is a fungicide and contains pesticides in the form of a type of triazole with the specific name of the pesticide, difenoconazole. Farmers also carry out fertilization activities, by using phosphate fertilizer. However, as farming activities progress, the frequency of farmers spraying

difenoconazole pesticides is quite high to eliminate leafhopper pests, which can reduce the quality of agricultural products. In addition, POKTAN or farmer groups are also rarely given counseling and education activities on how to spray and mix pesticides. The majority are only given education about farming activities using fertilizers.

Kujang Village is the population at risk of being affected by health risks. Meanwhile, when conducting the interview, there were as many as 24 farmers whose houses in Kujang Village and lived close to the rice field location, approximately 20-50 m from the agricultural location. So that the population in Kujang Village has the greatest risk in Jonggol Village to cause health risk effects due to pesticide exposure. The majority of farmers also use well water instead of river water. As many as 5 families actively use Well Water in Kujang Village, so the population is most at risk of pesticide exposure from raw water sources. However, not all farmers consume raw water sources in Well Water and River Water that are tested, and some farmers use their own well water in their homes.

Table 5. Distribution of Farmers' Health Risks in Jonggol Village

Characteristics	n = 91	%
Respiratory Health Disorders		
Yes	68	74.70
No	23	25.30
Digestive Health Disorders		
Yes	44	48.40
No	47	51.60
Smoking Habits		
Yes	66	72.50
No	25	27.50
The Habit of Carrying out Burning Activities		
Yes	87	95.60
No	4	4.40
Living in a Farm Location		
Yes	88	96.70
No	3	3.30
Burned Food Consumption Habit		
Yes	71	78
No	20	22

Source: Primary Data, 2022

Pesticide residues in well water in Karni Village and River Water in Jagaita Village were not detected. The possibility is that the area does not have tools for spraying and mixing pesticides and the location of the well is quite high from the agricultural irrigation water area. It has a clear color along the distance between the location of the well and the rice fields, which is approximately 10 meters.

Older farmers in Jonggol Village have more health problems than younger ones. Exposure to difenoconazole pesticides is also related to the impact of health disorders on reproductive organ health.[12] A person with a high level of education generally has a good way of thinking and broader insights, including health-related insights.[13] Body weight below 55 kg affects the risk of higher pesticide absorption, due to the low immune system and disruption of the body's metabolic system. Lack of height can also cause an impact, causing becoming more easily sick due to the body's weak immune system.[9] The duration of exposure will increase the exposure of pesticides.[14] Farmers who do not use PPE will be more at risk of pesticide exposure because pesticide particles can enter the farmers' body through oral, dermal, or ingestion.[15]

Based on the results of calculations that have been carried out, a minimum real-time non-carcinogenic intake value is 0 mg/kg/day, for a maximum intake is 0.00246 mg/kg/day while the average lifetime non-carcinogenic intake value on the five-year projection is 0.0004 mg/kg/day. For the 10-year projection, it is 0.0008 mg/kg/day, for the 15-year projection is 0.0013 mg/kg/day, for the 20-year projection it is 0.0017 mg/kg/day, for the 25-year projection it is 0.0022 mg/kg/day. For the 30-year projection, it is 0.0026 mg/kg/day.

Meanwhile, based on the calculation results that have been carried out for carcinogenic intakes, the minimum real-time value is 0 mg/kg/day, for the maximum intake is 0.001056 mg/kg/day. While the average lifetime non-carcinogenic intake value on the five-year projection is 0.00018 mg/kg/day, for the 10-year Project, it is 0.0003722 mg/kg/day, for the 15-year projection is 0.0005658 mg/kg/day, for the 20-year projection it is 0.0007544 mg/kg/day, for the 25-year projection is 0.0009430 mg/kg/day and for the 30-year projection is 0.0011316 mg/kg/day, in the critical effect or critical effect in this research in relation to pesticides, triazole group fungicides, difenoconazole, which was not found.

Based on the results of the research, it is known that the value of the duration of exposure exceeds 6 hours while the duration of the average farmer's exposure has been more than 6.95 hours and 28 years, because the longer the farmer carries out farming activities in Jonggol Village, the greater the exposure received and the greater the risk that can cause adverse health impacts for farmers. Based on the research results, it is known that the farmer population in Jonggol Village already has a risk of causing non-carcinogenic effects in real time. This is known based on calculations, the RQ value <1 for both minimal and maximum intakes. As for the average non-carcinogenic lifetime exposure, on projections of 5 years, 10 years, 15 years, 20 years, 25 years, and 30 years, it does not have the risk of non-carcinogenic effects, because, based on the calculation results, it has an RQ value of <1, which is 0.246. In the critical effect in this research in relation to pesticides, triazole group fungicides, difenoconazole, was not found.

Non-carcinogenic effects caused by pesticide exposure include neurological symptoms such as drowsiness, dizziness, and headaches and can even cause loss of self-awareness.[16] In addition, it can also cause vomiting, seizures, and even irritation of the skin, eyes and upper respiratory tract in humans.[17] Pesticide exposure can also cause skin redness.[8] Meanwhile, in the carcinogenic effect, real-time exposure has a probability ECR value. The pesticide residue difenoconazole has a possible carcinogenic risk even though it has not been found in the EPA and IRIS.

The possibility of incurring carcinogenic risks can be amplified by finding the Critical Effect of exposure to the pesticide Difenoconazole. Based on research in Jonggol Village, possible risks can be strengthened based on public health profiles in terms of public health. In the variable of health problems or disease complaints for one year, most of farmers experience health problems, at 78%, respiratory disorders, at 74.7%, and indigestion, at 48.4%. Farmers also have a habit of smoking, which is 72.5%, carrying out burning activities, which is 95.6%, and living in areas around agricultural locations, which is 96.7%, consuming burnt food, which is 78%.

Farmers should be able to use Personal Protective Equipment in accordance with the procedures in the Standards of the Pesticide Commission, including wearing masks, gloves, foot protection, and clothing protection.[18] Farmers should also maintain sanitary hygiene, especially with the location around the drinking water source, by not leaving used bottles and pesticide spraying equipment.[19] Farmers should also maintain personal hygiene by cleaning themselves immediately after spraying pesticides so that they are at risk of exposure to pesticide particles.[20] Farmers should also have working hours in accordance with the standard duration of pesticide spraying activities.[21] The distance of the raw water source to the farm's location needs special attention in using the water source.[22]

The drawbacks of this research are that not all drinking water sources in the agricultural settlement area of Jonggol Village are examined for levels of pesticide residues and it does not check all drinking water in residents' housing due to research limitations. The next researcher should be able to periodically check the contamination of pesticide residues in each well in the agricultural settlement area along with the drinking water that residents consume as well as checking the contamination of springs in the area. Future researchers should also be able to examine the soil concentration and sustainable agricultural products from pesticide contaminated water consumed by the surrounding community to carry out an analysis of public health risk assessments along with the content of pesticide residues in the body of the community, especially farmers and farmer families.

CONCLUSION AND RECOMMENDATION

Contamination of the minimum concentration of difenoconazole pesticides is in the agricultural settlement area of Jonggol Village, which is 0 mg/l, and the maximum concentration is in the well water of Kujang Village, which is 0.0085 mg/l. In the observation activity, Kujang Village is a village with well water near the agricultural location. Around the well, water has poor sanitation, and farmers do not use complete PPE. In real-time, the intake of non-carcinogenic exposure pesticides in farmers ranges between 0.00246 mg/kg/day. In comparison, the intake value of carcinogenic exposure pesticides in farmers in real-time ranges from 0.001056 mg/kg/day. Obtained the value of non-carcinogenic risk in farmers in real-time is RQ > 1, which is 0.246, meaning that farmers do not have non-carcinogenic risks. Meanwhile, in terms of lifetime at the 30-year projection, the value of RQ<1, because it increases with the increase of years, and there are some health risks.

The results showed that farmers in Jonggol Village experienced health problems in the form of non-carcinogenic health risk effects and carcinogenic risks. The result of the calculation of the RQ value is that it has not caused a non-carcinogenic risk effectS and the result of the ECR value is that there is a possibility of carcinogenic risk. Farmers should be able to use Personal Protective Equipment in accordance with the procedures in the Standards of the Pesticide Commission, including wearing masks, gloves, foot protection, and clothing protection. Farmers should also maintain sanitary hygiene, especially with the location around the drinking water source. Farmers should also maintain personal hygiene and also have working hours in accordance with the standard duration of pesticide spraying activities. The distance of the raw water source to the farm's location related to the distance closer to the farm needs special attention in using the water source. The need for counseling activities for farmers to use PPE according to procedures and maintain their sanitation and hygiene.

AUTHOR CONTRIBUTIONS

Study conception and design GF and BW; Data collections GF; Data analysis and interpretation GF; Drafting of the article GF; Critical revision of the article GF. GF = Glenzi Fizulmi; BW = Bambang Wispriyono.

CONFLICTS OF INTEREST

There was no conflict of interest in this study.

REFERENCES

1. Kong R, Yang C, Huang K, Han G, Sun Q, Zhang Y, Zhang H, Letcher RJ, Liu C. Application of Agricultural Pesticides in A Peak Period Induces an Abundance Decline of Metazoan Zooplankton in A Lake Ecosystem. *Water Research*. 1;224:119040.

https://doi.org/10.1016/j.watres.2022.119040

2. Slaby, S. et al. Distribution of Pesticides and Some of Their Transformation Products in a Small Lentic Waterbody: Fish, Water, and Sediment Contamination in an Agricultural Watershed. *Environmental Pollution.* 2022; 292:118403. https://doi.org/10.1016/j.envpol.2021.118403

3. Link, M., Schreiner, V. C., Graf, N., Szöcs, E., Bundschuh, M., Battes, K. P., Cîmpean, M., Sures, B., Grabner, D., Buse, J., & Schäfer, R. B. Pesticide Effects on Macroinvertebrates and Leaf Litter Decomposition in Areas with Traditional Agriculture. *The Science of The Total Environment.* 2022;828: 154549. https://doi.org/10.1016/j.scitotenv.2022.154549

4. Mac Loughlin TM, Peluso ML, Marino DJG. Evaluation of Pesticide Pollution in the Gualeguay Basin: An Extensive Agriculture Area in Argentina*. Science Total Environment.* 2022;851:158142. https://doi.org/10.1016/j.scitotenv.2022.158142

5. Dar, A. A., Jan, I., Wani, A. A., Mubashir, S., Sofi, K. A., Sofi, J. A., & Dar, I. H. Risk Assessment, Dissipation Behavior and Persistence of Quinalphos In/On Green Pea by Gas Chromatography with Electron Capture Detector. *Journal of Separation Science.* 2018; 41(11): 2380–2385. https://doi.org/10.1002/jssc.201701543

6. Kuiper, G., Young, B. N., WeMott, S., Erlandson, G., Martinez, N., Mendoza, J., Dooley, G., Quinn, C., Benka-Coker, W., & Magzamen, S. Factors Affecting Urinary Organophosphate Pesticide Metabolite Levels among Californian Agricultural Community Members. *The Science of the Total Environment.* 2023;881: 163362. https://doi.org/10.1016/j.scitotenv.2023.163362.

7. Riedo, J., Wächter, D., Gubler, A., Wettstein, F. E., Meuli, R. G., & Bucheli, T. D. Pesticide Residues in Agricultural Soils in Light of Their On-Farm Application History. *Environmental Pollution (Barking, Essex: 1987).* 2023;331:121892. https://doi.org/10.1016/j.envpol.2023.121892

8. Jayasiri, M. M. J. G. C. N. *et al.* Spatio-Temporal Analysis of Water Quality for Pesticides and Other Agricultural Pollutants in Deduru Oya River Basin of Sri Lanka. *Journal of Cleaner Production.* 2022;330:129897. https://doi.org/10.1016/j.jclepro.2021.129897

9. Tan, H., Li, Q., Zhang, H., Wu, C., Zhao, S., Deng, X., & Li, Y. Pesticide Residues in Agricultural Topsoil from The Hainan Tropical Riverside Basin: Determination, Distribution, and Relationships with Planting Patterns and Surface Water. *The Science of The Total Environment.* 2020;722: 137856. https://doi.org/10.1016/j.scitotenv.2020.137856

10. Dinkes Kota Bogor. Profil Kesehatan Kota Bogor Tahun 2019-2020. Bogor: Dinas Kesehatan; 2020.

11. García, M. G., Sánchez, J. I. L., Bravo, K. A. S., Cabal, M. D. C. & Pérez-Santín, E. Review: Presence, Distribution and Current Pesticides Used in Spanish Agricultural Practices. *Science of the Total Environment.* 2022;845:57291 https://doi.org/10.1016/j.scitotenv.2022.1.

12. Al-Dawood, A. *et al.* Awareness of Pesticides' Residues in Food and Feed Among Students of the Faculty of Agriculture, Mutah University, Jordan. *Journal of the Saudi Society of Agricultural Sciences.* 2023; https://doi.org/10.1016/j.jssas.2023.05.003

13. Tu, L. H., Grieneisen, M. L., Wang, R., Watanabe, H. & Zhang, M. Assessment of Agricultural Pesticide Inert Ingredient Transport Following Modeling Approach: Case Study of Two Formulation Agents in Sacramento River Watershed. *Journal of Environmental Management.* 2023; 330:117123. https://doi.org/10.1016/j.jenvman.2022.117123

14. Rajak, P. *et al.* Agricultural Pesticides – Friends or Foes to Biosphere?. *Journal of Hazardous Materials Advances.* 2023;10; 100264. https://doi.org/10.1016/j.hazadv.2023.100264

15. Monticelli Barizon, R. R., Kummrow, F., Fernandes de Albuquerque, A., Assalin, M. R., Rosa, M. A., Cassoli de Souza Dutra, D. R., & Almeida Pazianotto, R. A. Surface Water Contamination from Pesticide Mixtures and Risks to Aquatic Life in a High-Input Agricultural Region of Brazil. *Chemosphere.* 2022; 308: 136400. https://doi.org/10.1016/j.chemosphere.2022.136400

16. Ramírez-Morales, D., Pérez-Villanueva, M. E., Chin-Pampillo, J. S., Aguilar-Mora, P., Arias-Mora, V., & Masís-Mora, M. Pesticide Occurrence and Water Quality Assessment from an Agriculturally Influenced Latin-American Tropical Region. *Chemosphere.* 2023;262;127851. https://doi.org/10.1016/j.chemosphere.2020.127851

17. Li, W., Wang, B., Yuan, Y., & Wang, S. Spatiotemporal Distribution Patterns and Ecological Risk of Multi-Pesticide Residues in The Surface Water of a Typical Agriculture Area in China. *The Science of the Total Environment.* 2023;870: 161872. https://doi.org/10.1016/j.scitotenv.2023.161872

18. Peluso, J., Chehda, A. M., Olivelli, M. S., Ivanic, F. M., Pérez Coll, C. S., Gonzalez, F., Valenzuela, L., Rojas, D., Cristos, D., Butler, M., Candal, R. J., & Aronzon, C. M. Metals, Pesticides, and Emerging Contaminants on Water Bodies from Agricultural Areas and The Effects on a Native Amphibian. *Environmental Research.* 2023;226:115692. https://doi.org/10.1016/j.envres.2023.115692

19. Gilevska, T., Masbou, J., Baumlin, B., Chaumet, B., Chaumont, C., Payraudeau, S., Tournebize, J., Probst, A., Probst, J. L., & Imfeld, G. Do Pesticides Degrade in Surface Water Receiving Runoff from Agricultural Catchments? Combining Passive Samplers (POCIS) and Compound-Specific Isotope Analysis. *The Science of the Total Environment.* 2022;842:156735. https://doi.org/10.1016/j.scitotenv.2022.156735

20. García-Galán, M. J., Monllor-Alcaraz, L. S., Postigo, C., Uggetti, E., López de Alda, M., Díez-Montero, R., & García, J. Microalgae-Based Bioremediation of Water Contaminated by Pesticides in Peri-Urban Agricultural Areas. *Environmental Pollution (Barking, Essex: 1987).* 2020; 265:114579. https://doi.org/10.1016/j.envpol.2020.114579

21. Rydh Stenström, J., Kreuger, J., & Goedkoop, W. Pesticide Mixture Toxicity to Algae in Agricultural Streams - Field Observations and Laboratory Studies with In Situ Samples and Reconstituted Water. *Ecotoxicology and Environmental Safety.* 2021;215:112153. https://doi.org/10.1016/j.ecoenv.2021.112153

22. Cueff, S., Alletto, L., Bourdat-Deschamps, M., Benoit, P. & Pot, V. Water and Pesticide Transfers in Undisturbed Soil Columns Sampled from a Stagnic Luvisol and a Vermic Umbrisol Both Cultivated Under Conventional and Conservation Agriculture. *Geoderma.* 2020; 377:114590. https://doi.org/10.1016/j.geoderma.2020.114590