EPIDEMIOLOGICAL JOURNAL OF INDONESIA
Volume 2, Number 2, October 2023, pp. 42~49
Online ISSN:2964 -9471
Website:https://journal.paei.or.id
Email:jurnal@paei.or.id

RISK QUOTIENT OF ZINC (Zn) AND CHROMIUM (Cr) LEVEL IN DUG WELL WATER AT THE COMMUNITY LIVING AROUND LANDFILL SITE

Maksuk,[*1,2] Dewi Ulfa Oktarini [2], Tria Effrilia Harahap[2], Maliha Amin[1], Khairil Anwar[2], Kamsul[2], Maya Sopianti[2]
[1] Departement of Epidemiologic Surveillance, Palembang Health Polytechnic, South Sumatera, Indonesia
[2] Departement of Environmental Health, Palembang Health Polytechnic, South Sumatera, Indonesia
Correspondence Author: Maksuk, maksuk@poltekkespalembang.ac.id

ARTICLE INFO

Article History:
Received: 12 August 2023
Revised form: 28 October 2023
Accepted: 30 October 2023
Published online: 31 October 2023

Keywords:
Risk Quotient;
Zinc and Chromium level;
Dug well water;
Landfill site

ABSTRACT

Background: Zinc and chromium are heavy metals that can contaminate community-dug well water that is used by people around landfills, and can cause public health problems. This study aimed to analyze the risk level of zinc (Zn) and chromium (Cr) content in the dug well water of the community around Sukawinatan landfill site. **Methods:** This research was an observational study using a cross-sectional design with an environmental health risk analysis approach, It was conducted in February–May 2021. The sample was water from the dug wells of the community that lives around the Sukawinatan landfill. The examination of zinc and chromium level in dug well water was used the Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES) method. **Results:** Zinc and chromium level in community dug well water was found to range from 0.03 mg/l to 0.09 mg/l for zinc concentration and from 0.0030 mg/l to 0.04 mg/l for chromium concentration, respectively. The results of calculating the potential dose (intake) for the two metals are still below the dose reference value, and for calculating the level of risk, the result is less than 1, which can be interpreted as not being risky. **Conclusion:** Zinc and chromium level in the community's dug-well water around the landfill site was still below the quality standard. The potential dose (intake) and Risk Quotient were safe for the next few years.

Correspondence Author: Maksuk, maksuk@poltekkespalembang.ac.id, Departement of Environmental Health, Poltekkes Kemenkes Palembang

INTRODUCTION

The increase in the amount of waste is in line with the increase in population, and this will cause problems in the environment. The final process of managing waste resulting from human activities is at the Final Waste Disposal Site. In general, there are two waste management systems in Indonesia: sanitary landfills and open dumping. Based on Law No. 18 of 2008, landfills in large and metropolitan cities must be planned according to the sanitary landfill method (Astono et al., 2015). Final waste disposal sites generally use the open dumping method; waste that is stockpiled and left open or not covered daily with soil and non-optimal leachate collection and treatment systems can affect the quality of the surrounding shallow groundwater (Yatim & Mukhlis, 2013). The landfills in Palembang City are located quite far from urban areas, so access to clean water for the people around the landfills still mostly comes from dug wells (Maksuk, 2019b).

Dug wells are a source of water that is still widely used by the people of Indonesia, especially in areas that cannot access clean water through a piped system. Dug wells are one of the means of providing clean water originating from layers of soil that are relatively close to the ground surface, so they need to get attention because they are easily polluted and contaminated through leachate seepage due to piles of garbage at landfills (Sari & Huljana, 2019). The construction of dug wells that do not meet the requirements and leachate seepage due to piles of waste in landfills are factors causing the presence of heavy metals in the well water of people who live around landfills (Maksuk, 2019a; Sari & Huljana, 2019).

Therefore, dug wells are a source of water that is relatively easily polluted, especially through the leach seepage process in areas adjacent to the Garbage Final Disposal Site (TPA) (Hasibuan P, 2016)

Based on the profile of the Palembang City Environment and Sanitation Service in 2020, Palembang City produces around 750 metric tons per day of waste volume, and each person can generate around 0.5 kg per person per day of waste in big cities, including Palembang. Palembang City waste management still relies on the end-of-pipe approach, namely that waste is collected, transported, and disposed of at the Final Disposal Site (Dinas Lingkungan Hidup dan Kebersihan Kota Palembang., 2021). One of the final disposal sites for waste in Palembang City, namely TPA Sukawinatan, which has been in operation since 1994 with a land area of 25 hectares, has been used for 15 hectares, and the remaining 10 hectares of land are expected to accommodate waste until 2028 (Dinas Lingkungan Hidup dan Kebersihan Kota Palembang., 2021).

Garbage accumulation in landfills creates environmental health problems, such as air pollution due to the stench that comes from the waste, and public health problems, especially for those who live less than 1 km away (Axmalia & Mulasari, 2020). Heavy metal contamination can enter dug-well water through leachate, which is a liquid formed from the decomposition of waste due to seepage of rainwater that flows down the mound of garbage. Leachate arising from the decomposition of waste contains both organic and inorganic substances (Pinem et al., 2014). Leachate also has the potential to contain dangerous heavy metals, such as chromium and zinc (Zn). Previous studies found that 93.3% of the dug well construction around the Sukawinatan landfill did not meet the requirements in terms of construction and well water quality (Maksuk & Suzanna, 2018).

Chromium and Zinc are potentially toxic metals that occur in water and groundwater as a result of natural and anthropogenic sources. In accordance with the results of research on the analysis of the heavy metal content of zinc (Zn) in dug well water around the landfill, the result was 0.22 mg/l (Nasution, 2012). The heavy metal content of Zn in the Air Dingin Waste Final Disposal Site (TPA) in Padang City is 0.0 to 0.7254 mg/L (Suyani & Alif, 2015). While the results of examining the Cr VI content in samples of well water around the Malang City Garbage Final Disposal Site were found to be less than 0.012 mg/L, this concentration is still below the water quality standard value (Yuliati, 2018). In addition, the results of research in Surakarta showed that the metal content in the two dug well waters had Cr levels of 0.0001 mg/L and 0.0026 mg/L, respectively (Handes et al., 2021). The average concentrations of Cr and Zn were also found in Calabar metropolis, Nigeria, at 0.02 mg/l and 0.22 mg/l, respectively (Ogarekpe et al., 2023).

The heavy metals zinc and chromium are toxic metals when consumed in excess, and their presence in dug well water exceeds the quality standard values. These two metals in the dug-well water used by the community can have an impact on the health of the people around the final disposal site. Health effects due to consumption of chromium in drinking water exceeding the minimum quality standards can cause respiratory tract disorders, namely irritation of the lungs, kidneys, and liver (Yuliati, 2018). According to a study in Hangu, Pakistan, it was reported that children are more susceptible to health risks than adults if they consume heavy metal content that exceeds the quality standard (Din et al., 2023). Therefore, this study aimed to analyze the risk level of zinc (Zn) and chromium (Cr) content in community-dug well water around the final waste disposal.

METHODS

This research is an observational study with a cross-sectional design using an environmental health risk analysis approach. The research was carried out in February–May 2021. The research samples were five wells dug by residents around the Sukawinatan final waste diposal, which were taken randomly and were a combined sample.

Data was collected by observing and measuring water samples in situ in the field, namely pH and water temperature, and the parameters for zinc and chromium content were examined in the laboratory. Water pH was measured using a digital pH meter, and water temperature was measured using a thermometer. Examination of the content of zinc (Zn) and Chromium (Cr) in well water was carried out at the Institute for Environmental Health Engineering and Disease Control in Palembang with an Atomic Absorption spectroscopy (AAS) measuring instrument.

Furthermore, zinc and chromium examination results are one of the variables used to calculate the potential dose and risk level of the two metals in well water, using environmental health risk analysis methods to predict the risk level of the two metals in the next few years. The calculation of the potential dose of zinc and chromium content uses the formula below (Louvar & Louvar, 1998):

$$\mathbf{I = \frac{C \times R \times fE \times Dt}{Wb \times Tavg}}$$

While calculating the level of risk using the formula below (Louvar & Louvar, 1998):

$$\mathbf{RQ = \frac{I}{R\mathit{f}D}}$$

RESULTS

Table 1. Levels of Zinc (Zn) and Chromium (Cr) Based on Distance, Water Temperature, Water pH in Community Dug Well Water around the Final Waste Disposal Site in Palembang City

Dug well distance (m)	**Temperature (±3^{0}C)**	**pH**	**Zn Level (mg/L)**	**Cr Level(mg/L)**
100	27	5.3	0.09	0.04
200	28	4.9	0.05	0.0030
300	28	5.4	0.04	0.0030
400	26	6.1	0.04	0.0030
500	28	6.4	0.03	0.01

Based on Table 1, zinc and chromium levels were found to be below the minimum quality standards of the Ministry of Health No. 2 in 2023. The water temperature is still normal, while the pH of the water is between 5.3 to 6.4, which is categorized as acidic.

Table 2. Potential Dose (Intake) Calculation Results

Parameter (mg/L)	Dosis Potensial (Intake) (mg/kg/day)	Reference Dose (*IRIS Assessments | IRIS | US EPA*, 2017)
Zinc (Zn) Level		
0.09	0.003	0.3 mg/kg/day
0.05	0.0017	
0.04	0.0013	
0.04	0.0013	
0.03	0.0010	
Chromium (Cr) Level		
0.04	0.001	0.0003 mg/kg/day
0.0030	0.0001	
0.0030	0.0001	
0.0030	0.0001	
0.01	0.0001	

Based on Table 2, the calculation of the potential dose of zinc and chromium through the ingestion route uses several variables, namely the results of checking the concentration of zinc in well water (C) and consumption rate (R): 2 liters; frequency of exposure (fE): 365 days; duration of exposure (Dt): use the EPA default value of 30 years; Asian adult body weight (Wb): 55 kg; time average: 10,950 days. The results of calculating the potential dose of zinc content in dug well water were found to be less than the dose reference value. There is 1 result of calculating the potential dose of chromium in dug well water that exceeds the RfD value.

Table 3. Risk Quotient Calculation Results

Parameter	Potential Dose (Intake) (mg/kg/day)	Risk Quotient (RQ)
Zinc (Zn)		
	0.003	0.01
	0.0017	0.0056
	0.0013	0.0043
	0.0003	0.0043
	0.0010	0.003
Chromium (Cr)		
	0.001	0.003
	0.0001	0.0003
	0.0001	0.0003
	0.0001	0.0003
	0.0003	0.001

The level of zinc and chromium in the water of the community dug wells around the landfill is less than 1. This means that the risk level of zinc and chromium content is still safe or not risky for the people who use the well water.

DISCUSSION

The results of measuring the temperature of the water in the community's dug wells around the landfill from a distance of 100 to 500 meters, namely in the range of 26ºC to 28ºC, are still below the quality standard. While the results of pH measurements ranged from 4.9 to 6.4, based on these results, the pH in dug well water was categorized as acidic. The acidity of water can affect the content of chemical elements or compounds in it, including the heavy metal content. Heavy metal toxicity is also affected by changes in pH; the toxicity of heavy metals will increase if there is a decrease in pH (Triantoro et al., 2018). In accordance with previous studies, the pH in the water of the community dug wells around the landfill in Palembang City was found to range from 3.2–6.7 (Maksuk & Suzanna, 2018).

The results of the analysis of the zinc (Zn) content in the community dug well water around the final waste disposal site were found to be in the range of 0.03 mg/l–0.09 mg/l; this value is still below the minimum quality standard value (Permenkes RI, 2023). According to previous studies, the zinc (Zn) content in dug well water around the Gunung Tugel landfill ranges from 0.0027 mg/l to 0.041 mg/L (Wacano, 2018). While the average zinc content of dug well water around the landfill is 0.22 mg/l with the distance of the well from the landfill between 20 and 75 meters, this means that the closer the distance of the well to the final disposal site, the higher the Zn(Nasution, 2012). In addition, the results of the analysis of zinc levels in dug well water at Pasar VI Padang Bulan were obtained at 0.0647 mg/L(Tarigan, 2017).

The results of the analysis of the content of chromium (Cr) in the community dug well water around the final disposal of waste ranged from 0.0030 mg/l to 0.04mg/l; this figure is still below the minimum quality standard value (Permenkes RI, 2023). According to a study conducted around the Namo Bintang landfill, there is no correlation between the distance of the dug well to the TPA and the concentration of chromium in the dug well water (Ashar et al., 2013). According to a study in the Calabar metropolis, Nigeria, the average Cr and Zn content was 0.02 mg/l and 0.22 mg/l, respectively, this was due to contamination from dissolved solids possibly originating from a geogenic source (Ogarekpe et al., 2023).

The calculation of the potential dose (intake) of zinc via the ingestion route in the adult group is still below the Reference Dose value (0.3 mg/kg/day). This means that the potential dose of zinc content that enters via the ingestion route is still safe. Based on the results of research conducted in Pasuruan Regency, the intake value of zinc (Zn) content in drinking water for workers in Pasuruan Regency has met the requirements for drinking water quality so that it is safe for consumption (Agustina, 2019).

The potential dose (intake) of chromium through the ingestion route in the adult group is still below the Reference Dose value (0.0003 mg/kg/day). This means that the potential dose of chromium levels that enter via the ingestion route is still safe. According to the results of potential dose calculations carried out in Sumber Pakem Village in populations using real-time exposure, it was obtained from 0.00023 mg/kg/day to 0.000461 mg/kg/day, which means that the potential dose of chromium levels entering through the ingestion route is still safe (Utami, 2017).

Based on the calculation of the risk level of non-carcinogenic zinc content in the community dug well water around the Sukawinatan landfill, the result is less than 1, which means that the zinc content through the ingestion route is still safe for the people who live around the Sukawintan landfill. According to the results of the calculation of the risk characteristics of the drinking water parameters carried out in Pasuruan Regency, the RQ value of the entire test sample is <1. This means that ingested zinc (Zn) exposure by workers is still safe (Agustina, 2019). According to Zn Hazard Index (HI) values in Bauchi State, Nigeria, for adults and children were found to be 0.004 and 0.005, respectively. Therefore, the study concluded that there is no significant metal poisoning hazard from the sampled wells due to HI < 1 (Jagaba et al., 2020).

The calculation of the Risk Quotient of non-carcinogenic chromium levels in the community dug well water around the Sukawinatan landfill is less than 1, which means that the chromium content through the ingestion route is still safe for the people living around the Sukawinatan landfill. According to the results of the RQ calculation from previous studies, the RQ value is 1, which means that the risk level is still safe for people who live around landfills. (Yuliati, 2018). According to the results of the calculation of the risk level of chromium in dug well water around the Bintang Timur batik industry, it is still safe with an RQ value still below 1 (Utami, 2017).

In addition, consumption of Cr through household filtered water in the Langat Basin does not pose a health risk because the hazard quotients (HQ) of Cr are significantly within safe limits in 2015 and 2020. Similarly, the LCR value (lifetime cancer risk) of Cr consumption through household filtered water is within safe limits in 2015 and 2020. However, high concentrations of this metal have been found in household tap water, mainly due to contamination of water distribution pipes (Ahmed & Mokhtar, 2020). According to the results of the health risk assessment in Central China, the population in the study area faces a high carcinogenic risk due to Cr^{6+} contamination (He & Li, 2020).

As per the results of a human health risk assessment of chromium contamination in nearby populations of a mining plant located in Balochistan, Pakistan, for carcinogenic and non-carcinogenic contaminants, it was concluded that children and adults in the area are at high risk of several diseases and disorders (Chandio et al., 2021). According to the calculation of the Hazard Quotient (HQ), heavy metals for combined lines of dug well water at Gombe State are below the safety level (HQ < 1) for adults, while HI for children is higher than the safety limit at several stations. The average value of the total carcinogenic risk index (CRI) through exposure to drinking water for children and adults is lower than 1, but overall, the total CRI through exposure to drinking water for children and adults is still safe (Balogun et al., 2023).

In Hangu, Pakistan The hazard index (HI) values obtained from human health risk analysis for adults and children reveal that heavy metals (HM) have a significant contribution to the non-carcinogenic risk (HI > 1) due to groundwater exposure from the area research, children are more at risk than adults, and the lifetime risk of cancer due to Cr is significant for both adults and children. Therefore, water quality issues require immediate attention and action (Din et al., 2023).

Research Limitations (Optional)

The limitations of the research were that the water samples used for the examination were taken only once in a very limited amount, and the test parameters used were only two types of metals. Therefore, it is necessary to have a sufficient number of samples and several samples with some distance between them to be the control for checking the overall water quality.

CONCLUSION

The levels of zinc and chromium in the water from the community's dug wells around the final waste disposal site were found to be below the minimum quality standards for water quality requirements from the Indonesian Ministry of Health. The calculation of the potential dose and risk level is still safe.

However, it is necessary to monitor the water quality for other parameters in full, and the dug well water treatment needs to be carried out so that it is suitable for use by the people who live around the final waste disposal site.

CONFLICT OF INTEREST

We are declare that there are no no conflict of interest regarding this manuscript.

ACKNOWLEDGMENTS

We would like to thank all parties involved in completing this research.

REFERENCES

Agustina, L. (2019). Analisis Risiko Kesehatan Lingkungan (ARKL) Parameter Air Minum untuk Pekerja di Kabupaten Pasuruan Tahun 2017. *Medical Technology and Public Health Journal*, *3*(1), 61–69.

Ahmed, M. F., & Mokhtar, M. Bin. (2020). Assessing cadmium and chromium concentrations in drinking water to predict health risk in Malaysia. *International Journal of Environmental Research and Public Health*, *17*(8), 2966.

Ashar, T., Santi, D. N., & Naria, E. (2013). Kromium, timbal, dan merkuri dalam air sumur masyarakat di sekitar tempat pembuangan akhir sampah. *Kesmas: Jurnal Kesehatan Masyarakat Nasional (National Public Health Journal)*, *7*(9), 408–414.

Astono, W., Purwaningrum, P., & Wahyudyanti, R. (2015). Perencanaan tempat pembuangan akhir sampah dengan menggunakan metode Sanitary Landfill studi kasus: Zona 4 TPA Jatiwaringin, Kabupaten Tangerang. *Indonesian Journal of Urban and Environmental Technology*, *7*(1), 7–16.

Axmalia, A., & Mulasari, S. A. (2020). Dampak tempat pembuangan akhir sampah (TPA) terhadap gangguan kesehatan masyarakat. *Jurnal Kesehatan Komunitas*, *6*(2), 171–176.

Balogun, L. O., Sympa, A. H., Maigari, M. U., Mohammed, A. H., & Abubakar, D. (2023). Carcinogenic and Non-carcinogenic Health Risk Assessment from Exposure of Heavy Metals in Hand Dug Wells in Gombe State. *Journal of Chemistry*, *2*(1), 1–13.

Chandio, T. A., Khan, M. N., Muhammad, M. T., Yalcinkaya, O., Turan, E., & Kayis, A. F. (2021). Health risk assessment of chromium contamination in the nearby population of mining plants, situated at Balochistan, Pakistan. *Environmental Science and Pollution Research*, *28*, 16458–16469.

Din, I. U., Muhammad, S., Faisal, S., Rehman, I. U., & Ali, W. (2023). Heavy metal (loid) s contamination and potential risk assessment via groundwater consumption in the district of Hangu, Pakistan. *Environmental Science and Pollution Research*, *30*(12), 33808–33818.

Dinas Lingkungan Hidup dan Kebersihan Kota Palembang. (2021). *Profil TPA Sukawinatan. 28 Mei 2021*. 9. Dinas Lingkungan Hidup dan Kebersihan Kota Palembang.

IRIS Assessments | IRIS | US EPA, (2017). https://iris.epa.gov/AtoZ/?list_type=alpha

Handes, T., Permatasari, D. A. I., & Mahardika, M. P. (2021). Analisis Logam Cd, Cr, Cu dan Pb Pada Air Sumur di Sekitar Kampus Universitas Duta Bangsa Surakarta Menggunakan Metode Spektrofotometri Serapan Atom (AAS). *Duta Pharma Journal*, *1*(1), 48–56.

Hasibuan P. (2016). *Analisis Kandungan Logam Berat Timbal (Pb), Besi (Fe) dan pH Pada Air Sumur Gali Di Sekitar Tempat Pembuangan Akhir (TPA) Sampah Desa Marelan Pulau Nibung Kota Medan* .

He, X., & Li, P. (2020). Surface water pollution in the middle Chinese Loess Plateau with special focus on hexavalent chromium (Cr6+): occurrence, sources and health risks. *Exposure and Health*, *12*(3), 385–401.

Jagaba, A. H., Kutty, S. R. M., Hayder, G., Baloo, L., Abubakar, S., Ghaleb, A. A. S., Lawal, I. M., Noor, A., Umaru, I., & Almahbashi, N. M. Y. (2020). Water quality hazard assessment for hand dug wells in Rafin Zurfi, Bauchi State, Nigeria. *Ain Shams Engineering Journal*, *11*(4), 983–999.

Louvar, J. F., & Louvar, B. D. (1998). *Health and Environmental Risk Analysis* (Vol. 2). Prentice Hall.

Maksuk, M. (2019). Risk Quotient of Lead Concentration in Dug Wells Water at Community Arround Sukawinatan Dumping Site in Palembang City Maksuk. *Seminar Nasional Hari Air Sedunia*, *2*(1), 10–17. http://www.conference.unsri.ac.id/index.php/semnashas/article/viewFile/1365/790

Maksuk, & Suzanna. (2018). Kajian Kandungan Timbal Dalam Air Sumur Gali di Sekitar Tempat pembuangan Akhir Sampah Sukawinatan Kota Palembang. *Jurnal Ilmu Kesehatan Masyarakat*, *9*(2), 107–114.

Nasution, H. I. (2012). Analisis kandungan logam berat Besi (Fe) dan Seng (Zn) pada air sumur gali disekitar Tempat Pembuangan Akhir Sampah. *Jurnal Penelitian Saintika*, *12*(02), 165–169.

Ogarekpe, N. M., Nnaji, C. C., Oyebode, O. J., Ekpenyong, M. G., Ofem, O. I., Tenebe, I. T., & Asitok, A. D. (2023). Groundwater quality index and potential human health risk assessment of heavy metals in water: A case study of Calabar metropolis, Nigeria. *Environmental Nanotechnology, Monitoring & Management*, *19*, 100780.

Permenkes RI. (2023). *Regulation of the Minister of Health Number 2 of 2023 Implementation Regulations of Government Regulation Number 66 of 2014 concerning Environmental Health*.

Pinem, J. A., Ginting, M. S., & Peratenta, M. (2014). Pengolahan Air Lindi TPA Muara Fajar dengan Ultrafiltrasi. *Jurnal Teknobiologi*, *5*(1), 43–46.

Sari, M., & Huljana, M. (2019). Analisis Bau, Warna, TDS, pH, dan Salinitas Air Sumur Gali di Tempat Pembuangan Akhir. *ALKIMIA: Jurnal Ilmu Kimia Dan Terapan*, *3*(1), 1–5. https://doi.org/https://doi.org/10.19109/alkimia.v3i1.3135

Suyani, H., & Alif, A. (2015). Analisis sebaran logam berat pada aliran air dari tempat pembuangan akhir (TPA) sampah air dingin. *Jurnal Riset Kimia*, *8*(2), 101.

Tarigan, A. R. (2017). *Analisa Kadar Besi (Fe) dan Seng (Zn) pada Sampel Air Sumur Darikampung Susuk Xi dan Pasar VI Padang Bulan dengan Menggunakan Inductively Couple Plasma (ICP)*. Universitas Sumatera Utara.

Triantoro, D. D., Suprapto, D., & Rudiyanti, S. (2018). Kadar logam berat besi (Fe), seng (Zn) pada sedimen dan jaringan lunak kerang hijau (Perna viridis) di perairan Tambak Lorok Semarang. *Management of Aquatic Resources Journal (MAQUARES)*, *6*(3), 173–180.

Utami, S. S. (2017). *Analisis Risiko Kesehatan Lingkungan Krom (Vi) Pada Air Sumur Di Sekitar Industri Batik Ud Bintang Timur (Studi Kasus di Desa Sumberpakem Kecamatan Sumberjambe Kabupaten Jember)*.

Wacano, D. (2018). *Analisis Kandungan Logam Berat Di Dalam Air Tanah Di TPA Gunung Tugel Banyumas*.

Yatim, E. M., & Mukhlis, M. (2013). Pengaruh lindi (leachate) sampah terhadap air sumur penduduk sekitar tempat pembuangan akhir (TPA) air dingin. *Jurnal Kesehatan Masyarakat Andalas*, *7*(2), 54–59.

Yuliati, L. (2018). Tingkat pencemaran Logam Berat Khromium VI (CRVI) Pada Air Sumur (Studi Kasus di Home Industri Poles Dan Chrom’’X’’Kelurahan Bumi Ayu Kota Malang. *Jurnal Ilmiah Kesehatan Media Husada*, *7*(1), 41–46.