

Comparison of Wolbachia Knowledge between High School Students in Suburban and Urban of Yogyakarta

Naufal Abdan Ammar¹, Tri Wulandari Kesetyaningsih^{2*)}

¹Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta

²Department of Parasitology, Faculty of Medicine and Health Sciences, Universitas Muhammadiyah Yogyakarta

Correspondence Email: tri_wulandari@umy.ac.id

ABSTRACT

Dengue hemorrhagic fever is a health problem throughout the world. The problems mainly originate from the control that still need to be improved. The Indonesian government's latest control is the Wolbachia program which was initiated in Yogyakarta Province, especially in Sleman Regency and Yogyakarta City. This research aims to determine the knowledge about Wolbachia program among the students in Sleman Regency (sub-urban) and Yogyakarta City (urban). This is an observational study with a cross-sectional design. Research sampling was carried out using the purposive sampling method. The study involved 181 High School students in Sleman Regency and 200 students in Yogyakarta City. Data collection conducted using questionnaire. The average score for Sleman Regency students is 46.85 and Yogyakarta City students 47.77, means low. Mann-Whitney analysis proved that there is no difference in the knowledge about Wolbachia program between sub-urban and urban students ($p = 0.273$). Male students' scores were lower in urban and female students' scores were lower in sub-urban. Socialization about the Wolbachia program needs to be carried out targeting students.

Keywords: Knowledge, students, Wolbachia, sub-urban, urban

INTRODUCTION

Dengue Hemorrhagic Fever (DHF) is a health problem throughout the world. The World Health Organization (WHO) estimates that between 50 million and 100 million people are infected with the dengue virus every year, including 500,000 people suffering from DHF, and 22,000 of them die. Dengue Hemorrhagic Fever is an endemic disease in various countries, including America, Africa, France, Croatia, the Eastern Mediterranean, Southeast Asia, the Western Pacific, and several European countries. Most dengue infections each year come from Asia. Around 1.3 billion people in Southeast Asia are at risk of dengue fever.¹

From 1968 to 2011, WHO designated Indonesia as the country with the most dengue infections in Southeast Asia.¹ The first case of dengue fever in Indonesia was discovered in the city of Surabaya in 1968, where 24 of the 58 people infected died (mortality rate 41.3%), and since then cases of dengue fever have begun to spread throughout Indonesia.² According to the Ministry of Health RI,³ the amount of 52,313 people have been infected since the start of 2022, and 448 of them have died. Based on

records from the Yogyakarta Provincial Health Service, in Yogyakarta Province the total number of dengue haemorrhagic fever cases in 2020 were 3,623 cases and 13 deaths. Of the 5 districts/cities in Yogyakarta Province, the highest number of cases occurred in Bantul Regency with 1,222 cases and 4 deaths, followed by Gunungkidul Regency with 979 cases and 4 deaths, Sleman Regency with 810 cases and 2 deaths, Kulon Progo Regency with 316 cases and 3 deaths, and Yogyakarta City with 296 cases without deaths.

Dengue hemorrhagic fever is an arthropod-borne virus or a virus spread by insects. This infectious disease is caused by the Dengue virus which is spread through the bites of *Aedes aegypti* and *Aedes albopictus* mosquitoes.⁴

The problem of dengue fever is very complex, especially in countries with tropical climates. The problem of dengue fever covers various aspects, namely social, economic and cultural aspects. These problems mainly originate from control efforts that are still unsatisfactory and do not meet expectations, so dengue fever cases are still relatively high.

The main focus in controlling dengue

fever is controlling the vector, namely the *Aedes sp.* mosquito, this is because until now no vaccine has been found for dengue fever.⁵

Several methods have been used in efforts to control dengue fever, namely PSN/3M plus (covering, draining and burying), fogging/fumigation, using fish that eat mosquito larvae, etc.⁶ However, these efforts have not achieved satisfactory results because the number of dengue infections is still high every year, so a new breakthrough is needed to tackle dengue fever.⁷

One of the government's efforts to control dengue fever is by implementing the Wolbachia program. The research results show that the symbiosis between Wolbachia and *Aedes aegypti* can reduce and prevent transmission of the virus to humans via mosquitoes.⁸

Wolbachia is bacteria that lives as a parasite in arthropod animals and the bacteria is naturally transmitted to many species of insects. Wolbachia bacteria can disrupt the mosquito's reproductive system and inhibit the reproduction of the dengue virus in the mosquito's body. Therefore, *Aedes aegypti* cannot spread the dengue virus if Wolbachia bacteria are present in its body.⁹

In Indonesia, the use of *Aedes* mosquito technology with Wolbachia is still relatively new. This program was initially implemented only in Sleman Regency. This program was formed by the Eliminate Dengue Project (EDP) Global in collaboration with Monash University in Australia. Eliminate dengue Indonesia is a research program led by Faculty of Medicine Universitas Gadjah Mada and funded by the Tahija Foundation.¹⁰ This program started in January 2014, in the form of a program to release *Aedes aegypti* mosquitoes infected with Wolbachia in several locations in Yogyakarta. It is hoped that *Aedes* mosquitoes carrying Wolbachia will mate with local *Aedes* mosquitoes and reduce their ability to transmit the dengue virus. Several countries besides Indonesia that are part of the EDP include Australia, Colombia, Brazil and Vietnam.⁽¹⁰⁾

Research shows that Wolbachia has been proven to reduce the ability of *Aedes aegypti* as a vector for dengue fever by inhibiting the development of the dengue virus in the mosquito's body. Apart from that, there is competition in the mosquito population between those with Wolbachia and those without Wolbachia, if the mosquitoes with Wolbachia are female. Female mosquitoes with Wolbachia will produce fertile eggs from all male *Aedes aegypti* mosquitoes, both with and without Wolbachia. However, female mosquitoes that do not have Wolbachia will produce sterile eggs if they mate with male mosquitoes that have

Wolbachia. This event will cause the number of mosquitoes that do not carry Wolbachia to decrease,¹¹ so that the spread of the dengue virus can be reduced.¹²

The success of the dengue prevention program including Wolbachia program needs to be supported by public awareness. Lack of public awareness is a factor inhibiting intervention or control of dengue fever.¹³ Low awareness is the result of low levels of knowledge. Knowledge about dengue fever is one of the most important aspects in dealing with dengue fever cases. Discussion of knowledge regarding the prevention and control of dengue fever cannot be separated from the stages in which this behavior occurs, because knowledge can influence attitudes and behavior in reacting or assessing a particular object.¹⁴

One component in society is students. Students are individuals who participate in learning activities to gain knowledge. High school students are a group of teenagers who are able to think scientifically, critically and are able to think about the future. Good knowledge about a problem among high school students will have an impact on longer retention of knowledge in society when they grow up, so that awareness of community participation will also increase in the future. Students are a very important asset for a country, because the nation's next generation who are expected to become individuals who can advance religion, nation and state are students, both in cities (urban) and in villages (sub-urban).

Students in urban and rural areas are often viewed differently by society, where urban students are considered to have better average intelligence than students in suburban areas. This is based on the fact that students in cities have better access to facilities and infrastructure that support the learning process, compared to students in villages.¹⁵ Differences in access facilities and infrastructure facilities between urban and suburban students can cause differences in knowledge between urban and suburban students regarding information or knowledge, including information about the Wolbachia program.

This research aims to find out whether there is a difference in knowledge between students from Sleman Regency which represents the sub-urban area and Yogyakarta City which represents the urban area.

METHOD

This research is an observational study with a cross-sectional design. The research was conducted in two places, namely State High School Ngaglik 2 representing suburban students and State High School 11 Yogyakarta

representing urban students. These two public high schools were chosen as samples in the research because all of their students live in areas that can represent suburban and urban areas. State High School Ngaglik 2 is located in Ngaglik Subdistrict in Sleman Regency. Ngaglik is located about 15 km from the city of Yogyakarta and is a suburban area according to the Sleman Regency Regional Government. All subjects of Ngaglik State High School students are confirmed to live in Ngaglik District and its surroundings which are still classified as suburban areas. State High School 11 Yogyakarta is located in Yogyakarta City, and all students live in Yogyakarta City. Thus, the selection of Ngaglik 2 State High School and 11 State High School can represent students from suburban and urban areas. Sleman Regency and Yogyakarta City are the location of the Wolbachia program project. The research was conducted in May-December 2023.

The population of this study were high school students in suburban and urban areas of the Special Region of Yogyakarta Province. Research sampling was carried out using the purposive sampling method. The number of samples is determined by a formula:

$$n = \frac{4pq}{d^2} \dots\dots\dots (1)$$

where n is minimum sample size; p is proportion in population; q is 1 – p, and d is the tolerable error rate (0.5). A total of 177 and 196 subjects, respectively for Sleman Regency and Yogyakarta City are needed in this research according to the formula (1).

The subjects of this research were grade 11 students of State High School 2 (SMAN 2) of Ngaglik, Sleman Regency to represent suburban students and grade 11 students of State High School 11 (SMAN 11) of Yogyakarta City to represent Yogyakarta City students. The inclusion criteria were high school students in Sleman Regency and Yogyakarta City, aged 15-23 years, physically and spiritually healthy, willing to be respondents and able to read and write.

The exclusion criteria are if the respondent does not return the questionnaire or the questionnaire is incomplete. Data was obtained from questionnaires distributed to research subjects. All items in the questionnaire used have been tested and declared valid with the Shapiro-Wilk (r count > r table 0.514) and declared reliable with the Cronbach's Alpha test (α 0.946). The Mann-Whitney difference test was used to analyze differences in knowledge about the Wolbachia program between suburban and urban students, using SPSS

software version 25.0.

RESULT AND DISCUSSION

Study area

This research was located in Ngaglik District, Sleman Regency and Jetis District, Yogyakarta City. Geographically, Sleman Regency is located between 110° 33' 00" and 110° 13' 00" East Longitude, 7° 34' 51" and 7° 47' 30" South Latitude. The area is 57,482 Ha or 574.82 Km² or around 18% of the area of DIY Province. It is recorded that Sleman Regency consists of 17 sub-districts, 86 villages and 1,212 hamlets.¹⁶

Ngaglik is a subdistrict located in Sleman Regency, Yogyakarta Province. Ngaglik consists of 6 villages, 87 hamlets, 222 neighborhood groups (RW), and 657 neighborhood groups (RT), with an area of approximately 3,852 hectares. Ngaglik is located at an altitude of 100-499 meters above sea level. Demographic data obtained from the Sleman Regency Central Statistics Agency shows that the population of Sleman Regency in 2021 is 1,136,474 residents consisting of 564,378 men and 572,096 women. In Ngaglik there are 106,171 residents consisting of 52,751 men and 53,442 women.¹⁶

Yogyakarta City is the capital of the Special Region of Yogyakarta Province and is the city status among 4 other regions which as regency status. The city of Yogyakarta is in the center of Yogyakarta Province whose territorial boundaries are as follows: North; Sleman Regency, East; Bantul and Sleman Regencies, South; Bantul Regency, West; Bantul and Sleman Regencies. The Yogyakarta City area is located between 110° 24' 19" - 110° 28' 53" East Longitude and 7° 15' 24" - 7° 49' 26" South Latitude with an average height of 114 meters above sea level.¹⁷

Yogyakarta City occupies an area of 32.5 km² and is the narrowest area compared to other regions (1.025% of Yogyakarta Province). The city of Yogyakarta is divided into 14 subdistricts, 45 sub-districts, 617 RWs and 2,531 RTs with an average density of 13,117 people/Km².¹⁷ The demographic conditions described below are the general demographic conditions that exist in the research area or location. Demographic data quoted from the Central Statistics Agency (2020) shows that in that year the population of Yogyakarta City was 414,055 residents consisting of 201,538 men and 212,517 women.¹⁷

The number of Dengue Hemorrhagic Fever in Sleman Regency based on data from the Sleman District Health Service in 2022 recorded 330 cases reviewed from each community health center in Sleman Regency.¹⁸

Meanwhile, the dengue fever figures in Yogyakarta City are based on data from the Yogyakarta City Health Service, cases occurring in 2022 are 150 cases.¹⁹

The respondents of this research were students of State High School 2 Ngaglik in Sleman Regency and State High School 11

Yogyakarta in Yogyakarta City. The number of respondents to this research was 381 people, of which 181 respondents were students at State High School 2 Ngaglik, Sleman Regency and 200 respondents were students at State High School 11 Yogyakarta, Yogyakarta City.

Table 1. Distribution of Students in Sleman Regency and Yogyakarta City based on Gender

Gender	Sleman Regency		Yogyakarta City	
	n	%	n	%
Male	70	38.7%	80	40%
Female	111	61.3%	120	60%
Total	181	100%	200	100%

Table 1 shows that the percentage of female students is almost the same between State High School Ngaglik 2 and State High School 11 Yogyakarta City, ranging from 60-61.3%. The number of female students is greater than the number of male students. Table 2 shows the level of knowledge about the Wolbachia program of students at State High School 2 Ngaglik, Sleman Regency and State High School 11 Yogyakarta, Yogyakarta City.

Table 2 shows that the average level of knowledge about the Wolbachia program among Yogyakarta City students is slightly

higher (47.77) than Sleman Regency students (46.85). The distribution pattern of the level of knowledge about the Wolbachia program between students in Sleman Regency and Yogyakarta City is almost the same. Most students have a low level of knowledge (69-74%), and only a few have good knowledge (3.9-4%), with an average score of less than 50 (range 0-100). In general, it appears that the level of student knowledge regarding the Wolbachia program is low in both urban and sub-urban areas.

Table 2. Level of Knowledge regarding the Wolbachia Program of High School Students in Sleman Regency and Yogyakarta City

Category	Sleman Regency		
	n	%	Score Average
Low	134	74%	40.35
Moderate	40	22.1%	63.83
High	7	3.9%	85.71
Total	181	100%	46.85
Category	Yogyakarta City		
	n	%	Score Average
Low	138	69%	38.50
Moderate	52	26%	66.03
High	10	5%	80.67
Total	200	100%	47.77

Tabel 3. Distribution of Knowledge Level about the Wolbachia Program in Sleman Regency and Yogyakarta City by Gender

Sleman Regency			
	Category	n	%
Male	Low	49	70.0%
	Moderate	19	27.1%
	High	2	2.9%
Female	Low	85	76.6%
	Moderate	21	18.9%
	High	5	4.5%
Total		181	100%

Yogyakarta City			
	Category	n	%
Male	Low	62	77.5%
	Moderate	14	17.5%
	High	4	5%
Female	Low	76	63.3%
	Moderate	38	31.7%
	High	6	5%
Total		200	100%

Table 3 shows that in general the majority of male and female students in both research locations have a low level of knowledge (63.3-77.5%) and only a few have good knowledge about the Wolbachia program (2.9-5%). When comparing Sleman Regency students with Yogyakarta City students, female students in Yogyakarta City have better knowledge than female students in Sleman Regency. On the other hand, male students in

Yogyakarta City have lower knowledge about the Wolbachia program than male students in Sleman Regency.

The average overall knowledge score about the Wolbachia program for students in Yogyakarta City (urban) was slightly higher (47.77) than students in Sleman Regency (suburban) (46.85) and was not statistically different ($p=0.273$) (Table 4).

Table 4. Average Score and Test of Different Levels of Knowledge about the Wolbachia Program between Students in Sleman Regency and Yogyakarta City

	n	Average	P* value
Sleman	181	46.85	0.273
Yogyakarta	200	47.77	

*Mann Whitney

Knowledge about Wolbachia among High School Students in Sleman Regency

High school students in Sleman Regency are dominated by female students (61.3%), and only 38.7% are male students. This is in line with research conducted by the Ministry of Education, Culture, Research, and Technology RI²⁰ which stated that in the last five years, Senior High Schools throughout Indonesia had more female students with a figure of 55.05. % compared to men with a figure of 44.95%.

Based on Table 3, as many as 74% of students in Sleman Regency have a low level of knowledge about the Wolbachia program. This is in accordance with research conducted by Suharyo and Musyafira⁷ which shows that the level of student knowledge about the Wolbachia program is still low, this is because students have not received sufficient information about the Wolbachia program. According to Notoatmodjo,²¹ there are several factors that influence the low level of knowledge among students, including class, age, and how much information they have obtained. Students who are younger and sit in lower classes have an influence on receiving information so that it will affect their knowledge.²² This statement is in line with the condition of students in Sleman Regency, namely class X students aged between 15 and 17 years and who have never received information about Wolbachia. Students

aged 15 to 17 years tend to have low knowledge due to lack of learning, curiosity, and not caring about information they don't like.²²

The distribution of knowledge levels based on gender shows that the number of students with low knowledge between men and women is almost the same, namely 70% male and 76.6% female. According to Sulistyowati and Amalia,²² gender does not have an absolute influence on adolescent knowledge because male and female genders have the same level. The same level of knowledge between male and female students also occurs in research on knowledge about sexual behavior and HIV/AIDS prevention. However, in terms of implementation in the meaning attitudes and behavior, adolescent boys have significantly lower scores in various studies related to sexual behavior and HIV/AIDS prevention.²³ There is no data regarding the attitudes and behavior of adolescent boys and girls towards the Wolbachia program.

Knowledge about Wolbachia among High School Students in Yogyakarta City

Almost the same as students in Sleman Regency, there are also more female students in Yogyakarta City (60%) than male students (40%). This may be since some male high school students choose vocational schools

(SMK), but further investigation needs to be carried out to uncover this hypothesis.

Based on Table 2, as many as 69% of students in the city of Yogyakarta have a low level of knowledge. This is in line with the research conducted by Suharyo and Musyafira²⁴ which states that the level of student knowledge regarding the Wolbachia program is low.

According to Yuniati et al.²⁵ recently, the main source of information for students to gain knowledge is educators/teachers and the school. The interaction between students and educators in teaching and learning activities is a process of conveying accurate information. The information conveyed by the teacher will be transformed into knowledge for students, including knowledge about the Wolbachia program. In this case, teachers and the school play a very important role in the level of students' knowledge about the Wolbachia program.

Low levels of student knowledge can also be caused by students' low interest in reading. Based on data submitted by UNESCO, reading interest among students in Indonesia is very low, namely only 0.001%. This means that out of 1,000 students in Indonesia, only 1 person reads diligently. One way that can be done to increase students' interest in reading is to ensure the completeness of school library facilities and infrastructure, such as the availability of reading books and reading rooms. The completeness of library facilities and infrastructure has a significant effect on students' reading interest.²⁶ In today's digital era, information can be provided via online media, such as Instagram, Facebook, Tik Tok, Twitter, and others. In this way, office holders in the secondary education area can improvise to optimize the use of online media for the purposes of disseminating important information, including government programs. Information that is packaged well and is interesting will increase teenagers' interest in reading.

Based on Table 3, the distribution of knowledge levels based on gender shows that 77.5% of male students have a low level of knowledge and 63.3% of female students have a low level of knowledge. According to Sulistyowati and Amalia,²² when they are teenagers, boys tend not to care about information that is considered unimportant, this causes men's curiosity to be weak when compared to women. It is the reason that the level of knowledge of boys as teenagers tends to be lower than that of girls. However, differences based on gender do not have an absolute influence on adolescent knowledge

because men and women have the same level.²²

Comparison of Knowledge about Wolbachia between Sleman Regency and Yogyakarta City Students

The Mann-Whitney difference test shows that there is no difference in the level of knowledge about the Wolbachia program between students in Sleman Regency and students in Yogyakarta City. This lack of difference is probably because students in Sleman Regency and Yogyakarta City have several similarities, namely being in the age range of 15 to 17 years, class X, and have not received information about Wolbachia. Adolescents of the same age likely have the same habits in acquiring knowledge, including about Wolbachia or other health information. Currently, the use of social media among teenagers is high (69%).²⁷ The low knowledge of students in suburban and urban areas is probably because Wolbachia socialization is not through social media that is popular among teenagers, such as TikTok, Instagram, Twitter, Youtube, Whatsapp, Line, etc.

The low knowledge about Wolbachia among high school students can also be caused by the packaging of Wolbachia socialization which is not attractive to teenagers. Further studies are needed to reveal interesting socialization for teenagers, especially high school students.

The low level of knowledge, especially about the Wolbachia program among students from Sleman Regency and Yogyakarta City, is also due to the lack of counseling and outreach provided by local health workers. Research conducted by Suharyo and Musyafira found that socialization or counseling activities showed results in increasing the level of knowledge about the Wolbachia program by 85%.⁷ The low level of student knowledge is due to the lack of information obtained by students and this will affect the dengue vector control program.

Research Limitations. This research only took samples of students from one school in each region, namely State High School 2 Ngaglik, Sleman Regency and State High School 11 Yogyakarta, Yogyakarta City, so it cannot fully describe the real condition about the level of knowledge of students in Sleman Regency and Yogyakarta City.

CONCLUSION

High school students in Sleman Regency and Yogyakarta City have a low level of knowledge about the Wolbachia program, and there is no significant difference between the two. Socializing the Wolbachia program to

school students is important so that new technology in the field of disease eradication, especially dengue fever, can be known to students so that students are more concerned and involved in government programs, as well as learning about new technology in the health sector.

ACKNOWLEDGMENTS

Thank you to the Faculty of Medicine and Health Sciences, Muhammadiyah University of Yogyakarta, for allowing the author to conduct research as a final assignment.

REFERENCES

1. Akbar H, Eko Maulana S. Faktor Risiko Kejadian Demam Berdarah Dengue (DBD) di Kabupaten Indramayu. *Fak Kesehatan Masy Univ Muhammadiyah Palu*. 2019 Sep;2(3):6. <https://doi.org/10.56338/mppki.v2i3.626>.
2. Megawaty DA, Simanjuntak RY. Pemetaan Penyebaran Penyakit Demam Berdarah Dengue Menggunakan Sistem Informasi Geografis pada Dinas Kesehatan Kota Metro. *Explore J Sist Inf dan Telematika* [Internet]. 2017 <http://jurnal.ubl.ac.id/index.php/explore/article/view/954>
3. Ministry of Health. Laporan Tahunan Demam Berdarah Dengue [Internet]. Jakarta: Ministry of Health; 2023. Available from: http://p2p.kemkes.go.id/wp-content/uploads/2023/06/FINAL_6072023_Layout_DBD-1.pdf
4. Fatmawati K, Windarto AP. Data Mining: Penerapan Rapidminer dengan K-Means Cluster pada Daerah Terjangkit Demam Berdarah Dengue (DBD) Berdasarkan Provinsi. *Comput Eng Sci Syst J*. 2018 Aug 1; 3(2): 173. <https://doi.org/10.24114/cess.v3i2.9661>.
5. Sukeesi TY, Supriyati S, Satoto TT. Pemberdayaan Masyarakat dalam Pengendalian Demam Berdarah Dengue (Literature Review). *J Vektor Penyakit*. 2018 17; 12(2): 67–76. <https://doi.org/10.22435/vektor.v12i2.294>.
6. Sukohar A. Buku Ajar Farmakologi Neufarmakologi – Asetilkolin dan Norepinefrin. Metro: Sai Wawai Publishing; 2014.
7. Suharyo Suharyo, Yuniar Martha Musyafira. Pengetahuan Siswa SMA Labschool UPGRIS Kota Semarang Tentang Pencegahan Demam Berdarah Dengan Wolbachia. *J Ris RUMPUN ILMU Kedokt*. 2023;2(1):91–102. <https://doi.org/10.55606/jurrike.v2i1.1027>
8. Irfandi A. Kajian Pemanfaatan Wolbachia terhadap Pengendalian DBD (studi literatur dan Studi Kasus Pemanfaatan Wolbachia di Yogyakarta). *Forum Ilmiah Indonesia*. 2018; 15(2): 276-89. <https://ejournal.esaunggul.ac.id/index.php/Formil/article/view/2364/2045>.
9. WHO. Mosquito (vector) control emergency response and preparedness for Zika virus [Internet]. Geneva: World Health Organization; 2016. Available from: http://www.who.int/neglected_diseases/news/mosquito_vector_control_response/en/
10. EDP. Eliminate Dengue: Our Challenge [Internet]. 2014. Available from: <http://www.eliminatedengue.com/program>
11. Fox T, Sguassero Y, Chaplin M, Rose W, Doum D, Arevalo-Rodriguez I, et al. Wolbachia -carrying Aedes mosquitoes for preventing dengue infection. *Cochrane Database of Systematic Reviews* 2024, Issue 4. Art. No.: CD015636. DOI:10.1002/14651858.CD015636.pub2
12. Firdausi RI, Bestari RS, Dewi LM. Peran Bakteri Wolbachia terhadap Pengendalian Vektor Demam Berdarah Dengue (DBD) Aedes aegypti. *The 13th University Research Colloquium 2021*; 2021;9. available <https://repository.urecol.org/index.php/proceeding/article/view/1440>.
13. Fauzi M, Winarni F. Efektivitas Program Pemberantasan Sarang Nyamuk Melalui Gertak PSN di Desa Banguntapan Kecamatan Banguntapan, Bantul. *J Public Policy Adm Res*. 2018; 3(4): 443–57. <https://doi.org/10.21831/joppar.v3i4.12691>.
14. Rosita E, Hidayat W, Yuliani W. Uji Validitas dan Reliabilitas Kuesioner Perilaku Prosocial. *Fokus*; 2021; 4(4):279-284. DOI 10.22460/fokus.v4i4.7413.
15. Nigella Learning Center. Perbedaan Siswa Kota dan Desa. [Internet]. 2017. Available from: <https://nigellalc.wordpress.com/2017/07/03/siswa-kota-vs-siswa-desa/>
16. Sleman Regency Government. Letak dan Luas Wilayah [Internet]. Sleman: Sleman Regency Government; 2023. Available from: <https://slemankab.go.id/profil-kabupaten-sleman/geografi/letak-dan-luas-wilayah/>
17. Jogja's government. Gambaran Umum [Internet]. Jogja: Jogja's government; 2023. Available from: <https://www.jogjakota.go.id/page/gambaran-umum>
18. Sleman Health Office. Profil Kesehatan Kabupaten Sleman Tahun 2022. Sleman: Sleman Health Office; 2023.
19. Jogja Health Office. Profil Kesehatan Tahun 2022 [Internet]. Jogja: Jogja Health Office; 2023. Available from:

- <https://kesehatan.jogjakota.go.id/berita/id/323>
20. Ministry of Education, Culture, Research, and Technology. Data Pendidikan 2022-2023. Jakarta: Ministry of Education, Culture, Research, and Technology; 2023.
 21. Notoatmodjo S. Metodologi Penelitian Kesehatan. Jakarta: Rineka Cipta; 2012.
 22. Sulistyowati A, Amalia EY. Tingkat Pengetahuan Remaja tentang Kesehatan Reproduksi di SMA PGRI 1 Sidoarjo. *Nurse Health J Keperawatan* 2016 1;5(1): 1–4. <https://doi.org/10.36720/nhjk.v5i1.2>.
 23. Sofni, Lybella M., et al. Perbandingan Pengetahuan dan Sikap antara Remaja Putra dan Remaja Putri Tentang Tindakan Pencegahan Hiv/aids. *Jurnal Online Mahasiswa Program Studi Ilmu Keperawatan Universitas Riau* 2016; 2(2): 1241-9.
 24. Suharyo, Musyafira YM. Pengetahuan Siswa SMA Labschool UPGRIS Kota Semarang Tentang Pencegahan Demam Berdarah Dengan Wolbachia. 2023;2(1).
 25. Yuniyanti T, Purwanta, Nisman WA. Perbedaan Pengetahuan dan Upaya Teman Sebaya dalam Pencegahan Perilaku Merokok pada Remaja SMA di Area Rural dan Urban. *Jurnal Keperawatan Klinis dan Komunitas* 2021; 5(1): 12-22. <https://journal.ugm.ac.id/jkkk/article/download/88655/37546>
 26. Azrin K. Pengaruh Ketersediaan Koleksi Perpustakaan terhadap Minat Baca Siswa. 2017 Desember <http://journal.unair.ac.id/LN@pengaruh-ketersediaan-koleksi-perpustakaan-terhadap-minat-baca-siswa-article-11711-media-136-category-.html>
 27. Anjani MD, Prasetyoaji A. Tingkat intensitas penggunaan media sosial di kalangan remaja. *Prosiding Seminar Nasional Bimbingan dan Konseling Universitas Ahmad Dahlan, 2023* (3): 1144-58. <https://seminar.uad.ac.id/index.php/PSNBK/article/view/13568>