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Trend of Malaria Cases in Maluku Province 2012-2016

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Abstract

Malaria is a worldwide problem, including in Indonesia. Malaria is a vector-borne disease, and the vector is *Anopheles* mosquito. In Indonesia, the most endemic are located in the eastern regions of Indonesia. Maluku Province had the fourth highest rate of Annual Parasite Incidence (API) in 2015 at 5.81%. This research was quantitative with a descriptive analysis of malaria positive cases in Maluku. The study used secondary data from January 2012 to December 2016 that were obtained by the Health Office of Maluku. The result of this research shows that the trend of malaria, according to the current rate of positive cases found, tends to decrease every year with R square value from the linear line of 0.5534. The lowest number of cases was recorded in February. Based on gender, malaria on both genders tends to decrease every year. Maluku Barat Daya Regency had the highest rate of Annual Parasite Incidence (API) among other regencies in Maluku. As a suggestion, the government should be more concerned about the prevention program of malaria in Maluku Province. Some of the preventive ways are to disseminate knowledge to the community that if they want to do activities outside at night, they have to wear long clothes that can cover the whole body.

Keywords: *Malaria cases; API; Maluku.*

Introduction

Malaria is a disease caused by five different Plasmodium parasites that are transmitted to humans through the bite of an infected female *Anopheles* mosquito. Malaria can infect all ages and genders. A person who is infected will feel fever, shiver, sweat, have headache, have nausea, and vomit. A person with clinical symptoms has to get a laboratory test to confirm the positive status of malaria [(1)]. Malaria is considered as a threat to the gains in health and development and the attainment of the 2030 Agenda for Sustainable Development because of the high number of people at risk of the infection. More specifically, the third goal of the Sustainable Development Goals (SDGs) is "Good Health and Well-Being", so malaria as a communicable disease and the epidemic which it brings have to be eliminated and ended by 2030[(2)]. All heads of the states in the Asia Pacific region, including Indonesia, have committed to the complete elimination of malaria in their respective countries by this time as well [(3)].

In Indonesia, the most endemic areas are found in the eastern regions of Indonesia. Maluku is also located in the eastern region of Indonesia. Malaria is the main problem in some areas, including Maluku. Maluku Province had the fourth highest rate of Annual Parasite Incidence (API) in 2015 at 5.81%. Maluku is also categorized as HCI (High Cumulative Incidence) area in Indonesia [(1)].

Malaria was one of the ten most common diseases in Maluku. Based on a report from the 2014 Maluku Health Profile, the Annual Parasite Incidence (API) from 2008 to 2014 fluctuated, while in 2008 the API was 12.3/1000 citizens. That number decreased in 2009 to 7.0/1000 citizens and increased in 2010 to 10.4/1000 citizens. In 2011, the API decreased again to 9.1/1000 citizens and increased again in 2012 to 11.1/1000 citizens.

Based on the data, API in Maluku did not show a stable decreasing trend. Therefore, the province needs a comprehensive scheme of malaria prevention which

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includes effective promotional, preventive, and curative efforts. It aims to reduce morbidity and mortality and to prevent outbreaks. To achieve optimal results, the preventive and curative efforts should be carried out professionally and integrated with other programs.

Maluku Province is a malaria endemic area, and currently a program referral system that refers to the cluster system is being developed. Enforcement of clinical malaria diagnosis (without laboratory confirmation) will provide an overview of the clinical malaria rate occurring in the target community [4]. After reviewing the available data, the researcher took interest in performing a research project to investigate the trend of malaria cases in Maluku from 2012 to 2016.

Method

Maluku was chosen as a location for this study because Maluku is one of the endemic areas of malaria. This research was quantitative with a descriptive analysis of malaria positive cases in Maluku. Descriptive analysis is conducted to know the existence of independent variables, either only one or more variables (stand-alone variables), without making comparisons and searching the relationship between that variable and another variable [5].

The study used secondary data from January 2012 to December 2016 that were obtained by the Health Office of Maluku. Data were analyzed by numerical processing software. The study also obtained a body of data concerning malaria positive cases based on gender, minimum and maximum monthly cases, Annual Parasite Incidence (API) from every city/regency in Maluku from 2012 to 2016, and the type of Plasmodium. The trend of malaria is presented in several figures as the results of this study.

Findings: The results of this research show that the trend of malaria, according to the rate of positive cases found, tends to decrease every year with R square value from linear line of 0.5534. It means that the model fits to 55.34%. The maximum number of malaria cases was recorded in a different month in different year. In 2012, the highest number of cases was recorded in March with 1947 positive cases. In 2013, the highest number of cases was recorded in May with 1980 cases. Moreover, in 2014, the highest number of malaria cases was recorded in April with 1913 cases. In 2015, the highest number of cases was recorded in February with 1080 cases, while in 2016, the highest number of cases was recorded in December with 1484 cases (Figure 1).

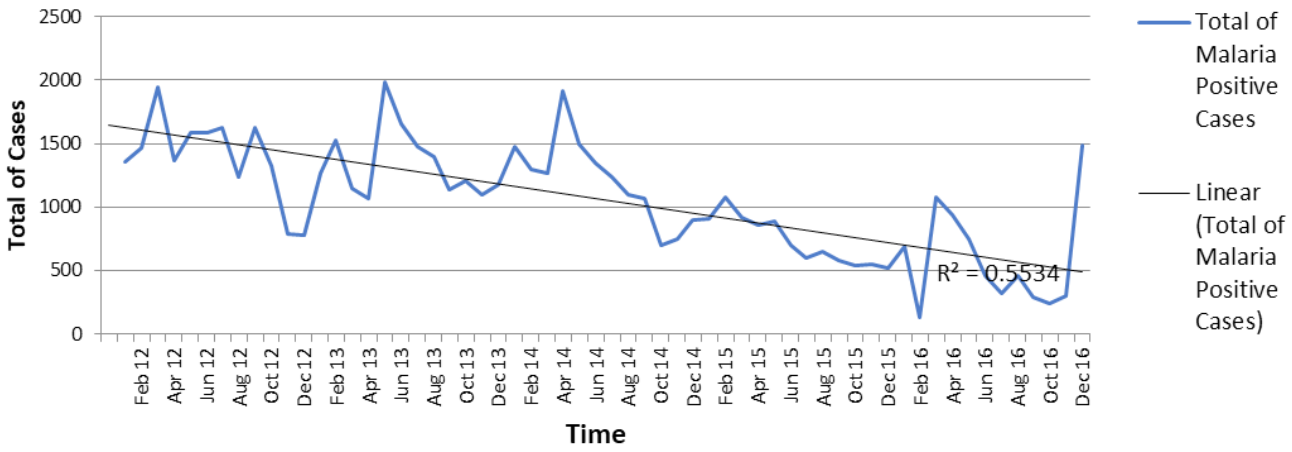


Figure 1: Malaria Positive Cases in Maluku

In contrast to the seemingly irregular occurrence of maximum number of malaria cases in each year, the monthly data about the minimum and maximum of malaria cases from 2012 to 2016 (Figure 2) show that the lowest number of cases was recorded in February. It means that rainfalls during the rainy season can also decrease malaria cases because rainfalls helped to eliminate the breeding sites of *Anopheles* [6].

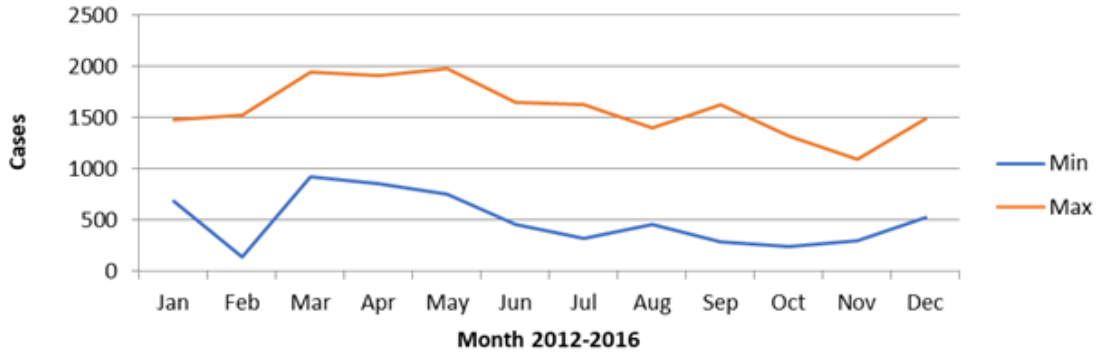


Figure 2: Minimum and Maximum Monthly Malaria Cases in 2012-2016

The trend of malaria which largely decreased from 2012 to 2016 might show the success of the governmental program to eliminate malaria, especially in Maluku Province. A study by Oktafandi *et al* (2014). found that the number of malaria cases declined every year from 2011 to 2013[7]. Although the trend showed a decrease, Maluku province is still an endemic area of malaria. Based on gender, malaria cases tend to decrease every year in both men and women. Malaria cases in men had R square value from linear line of 0.5247. It means that the model fits to 52.47% (Figure 3). Meanwhile, in women, the value was 0.5708, and it means that the model fits to 57.08% (Figure 4). However, men suffered a higher number of malaria cases than women.

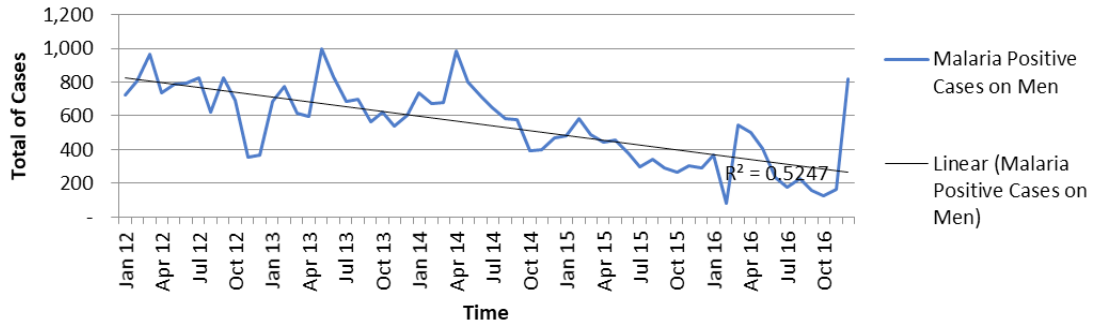


Figure 3. Malaria Positive Cases on Men in Maluku

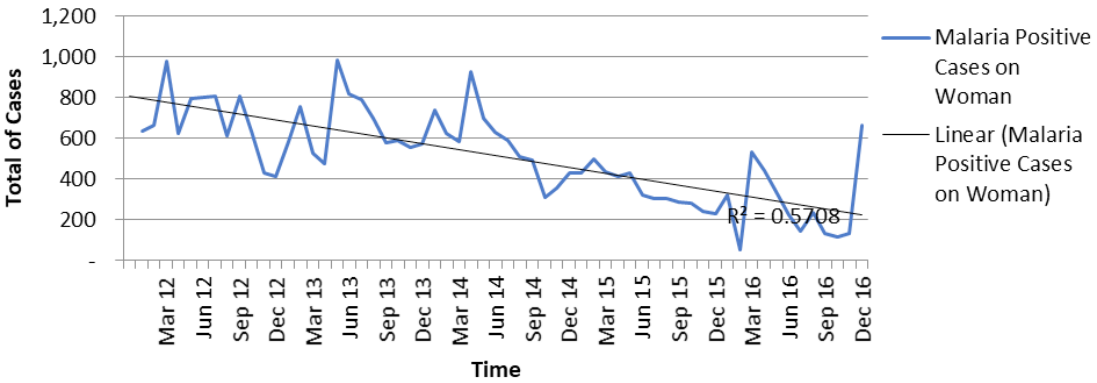
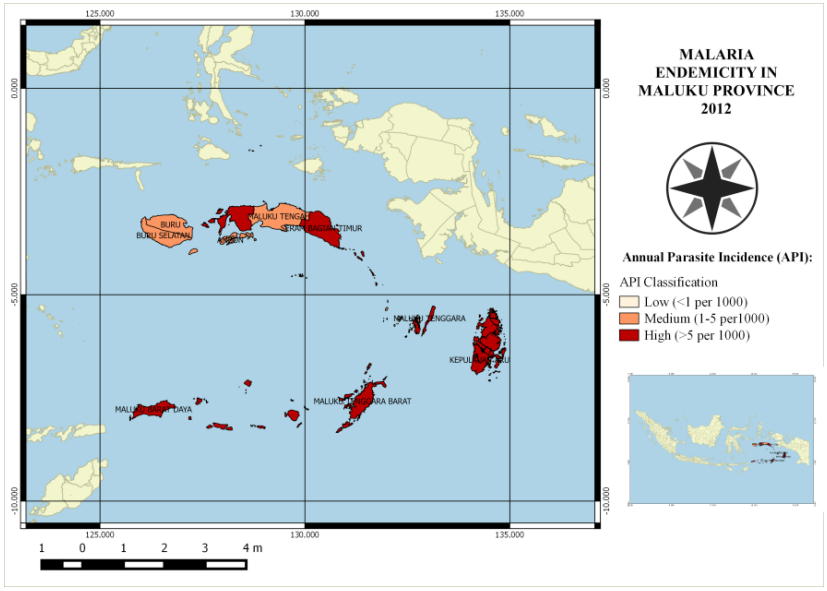
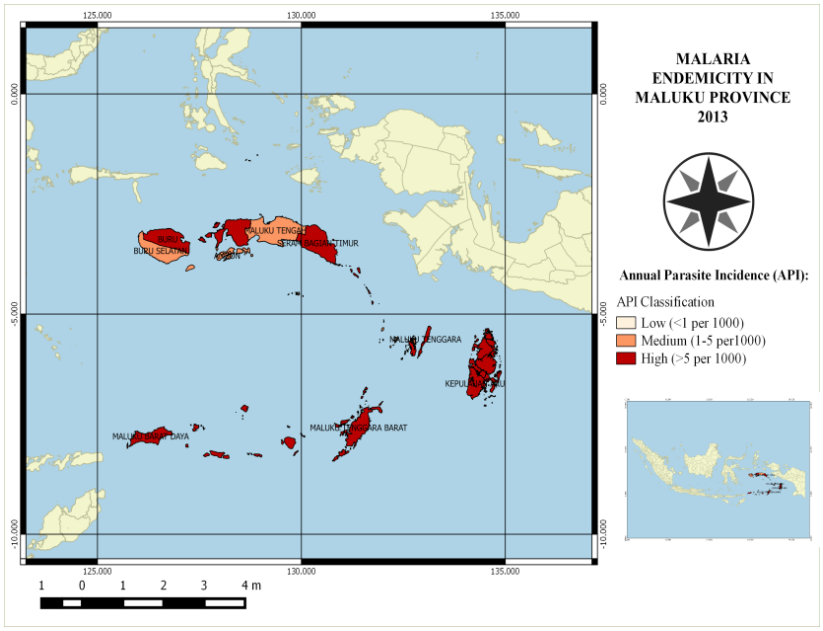


Figure 4. Malaria Positive Cases on Women in Maluku

The number of malaria cases in Maluku Province decreased from 8.31 per 1000 citizens in 2014 to 4.3 per 1000 citizens in 2016. The highest number of malaria cases was found in Maluku Barat Daya (MBD) Regency which was 25.9 per 1000 citizens, and the lowest number was found in Tual City and Buru Regency at 0.6 and 0.9 per 1000 citizens, respectively. According to the result of a study by a health research and healing team, Wetar and Moa Sub-districts were malaria endemic areas with the highest rate of incidence in MBD Regency[8]. In addition to that, the API in eleven cities/regencies in Maluku varied every year between 2012 and 2016 (Figure 5).


MALARIA ENDEMICITY IN MALUKU PROVINCE 2012
Annual Parasite Incidence (API):
API Classification
Low (<1 per 1000)
Medium (1-5 per1000)
High (>5 per 1000)
BURU
BURU SELATAN
MALUKU TENGAH
SERAM BAGIAN TIMUR
MALUKU TENGGARA
KEPULAUAN ARU
MALUKU BARAT DAYA
MALUKU TENGGARA BARAT
125.000
130.000
135.000
0.000
-5.000
-10.000
1 0 1 2 3 4 m


MALARIA ENDEMICITY IN MALUKU PROVINCE 2013
Annual Parasite Incidence (API):
API Classification
Low (<1 per 1000)
Medium (1-5 per1000)
High (>5 per 1000)
BURU
BURU SELATAN
MALUKU TENGAH
SERAM BAGIAN TIMUR
MALUKU TENGGARA
KEPULAUAN ARU
MALUKU BARAT DAYA
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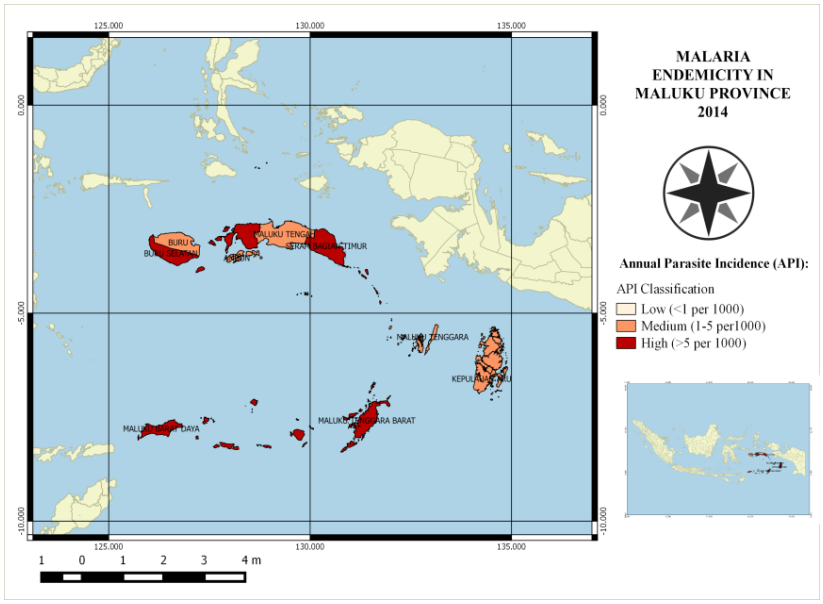
MALARIA ENDEMICITY IN MALUKU PROVINCE 2014
Annual Parasite Incidence (API):
API Classification
Low (<1 per 1000)
Medium (1-5 per1000)
High (>5 per 1000)
BURU
BURU SELATAN
MALUKU TENGAH
SERAM BAGIAN TIMUR
MALUKU TENGGARA
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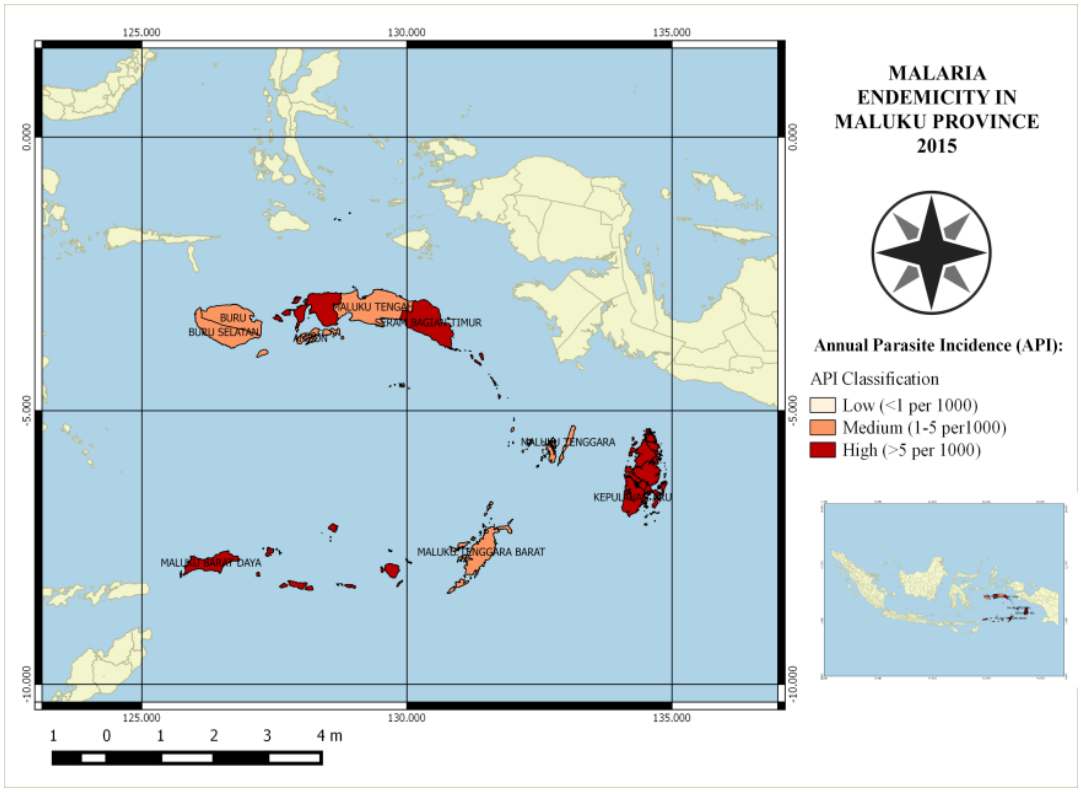

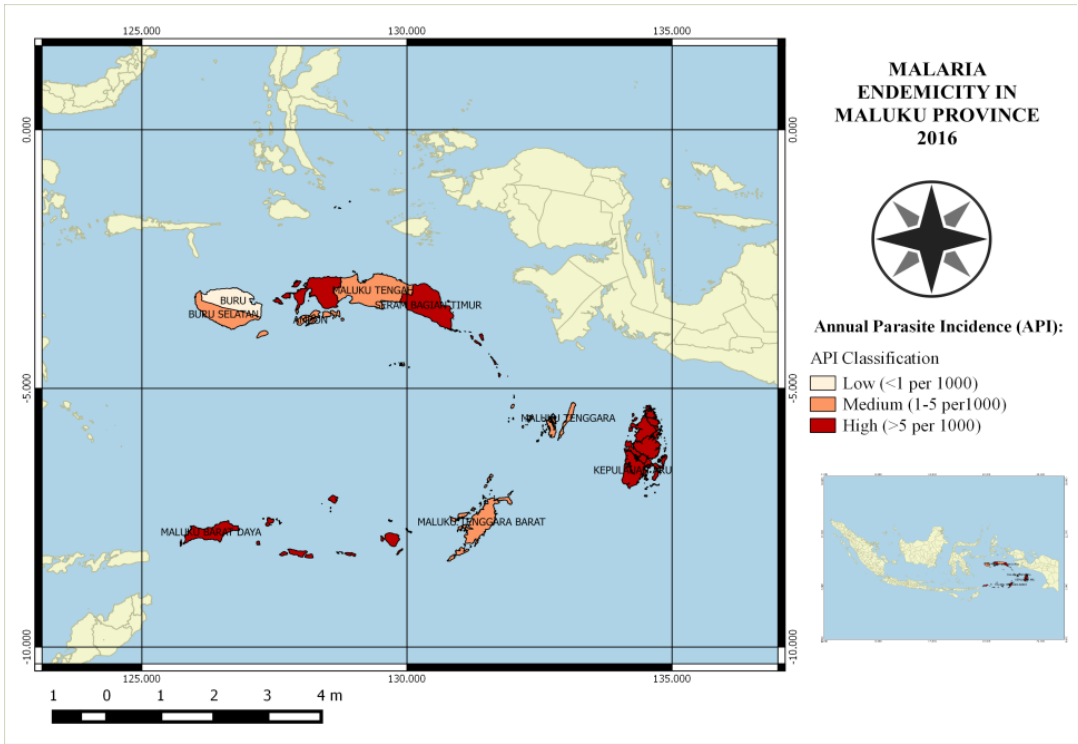

Figure 5: Annual Parasite Incidence (API) in Maluku 2012-2016

Based on current studies, there were four types of *Plasmodium* found in Maluku, while the highest number of malaria incident every year was attributed to *Plasmodium vivax* and the lowest was attributed to *Plasmodium ovale*. The risk of *Plasmodium vivax* malaria occurs almost everywhere, with several exceptional zones or pockets free of malaria risks in Java, Bali, and Sumatra, as well as fewer pockets in Sulawesi and Papua (Figure 6).

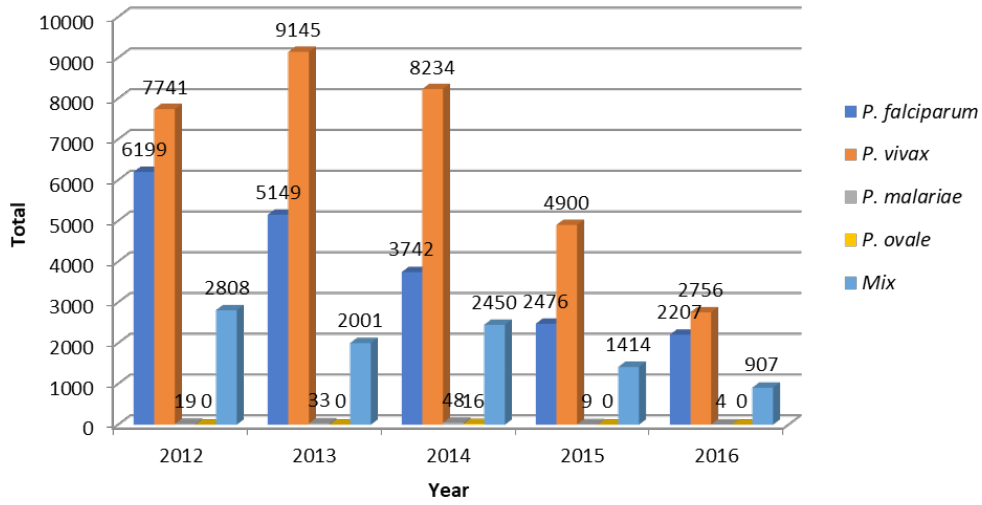

Figure 6. Total Number of Malaria Cases due to Different *Plasmodium* Types in Maluku 2012-2016

Discussion

Malaria is an entirely preventable and treatable disease. It is caused by a protozoan parasite belonging to the genus *Plasmodium*. It is spread from a person to another by *Anopheles* mosquito bites. All efforts to prevent malaria are considered as part of collective contribution to the country's sustainable development. The objectives of reducing and eliminating malaria are intrinsically linked to most Sustainable Development Goals (SDGs) as they comprise nearly all of the Millenium Development Goals (MDGs). Malaria is a result, as well as a cause, of such inhibition of development [(9)].

Maluku is an archipelagic region, which encourages the transmission of *Anopheles* as a vector of malaria. *Anopheles* cannot live in a high area at an altitude of above 2000 meters[(10)]. Maluku is one of the provinces in Indonesia with a high number of malaria cases. Maluku is located in the eastern region of Indonesia and has two main cities consisting of Ambon and Tuai. It also consists of nine regencies consisting of Buru, Buru Selatan (South Buru), Kepulauan Aru (Aru Islands), Maluku Barat Daya (Southwest Maluku), Maluku Tengah (Central Maluku), Maluku Tenggara (Southeast Maluku), Maluku Tenggara Barat (West Southeast Maluku), Seram Bagian Barat (Western Seram), and Seram Bagian Timur (Easterm Seram).

Even though the maximum number of positive malaria cases was always recorded in a different month every year, they always occurred in the same climate zone in terms of season. According to Mulyana [(11)], June, July, and August are generally considered as the dry season in Indonesia; September, October, and November are the transition period from the dry to rainy season; December, January, and February are considered as the rainy season; while March, April, and May are the transition period from the rainy to dry season. Based on the data, the highest numbers of malaria cases were recorded during the transition from the rainy to dry season in three different years, while the highest numbers of malaria cases were recorded during the rainy season in two different years.

Malaria is a protozoan infection that is transmitted by mosquitoes, which require moisture for breeding. Malaria, along with other vector-borne infections, is strongly affected by weather variables. In arid areas, the increase of rainfall can be associated with the expansion of the breeding sites of *Anopheles*, the most common malaria vector. Meanwhile, in humid areas, drought can improve breeding conditions for mosquitoes, leading to outbreaks. Natural predators of vectors also determine the vectors' abundance. If the reproductive cycle of predators is longer than that of mosquitoes, the mosquito population could increase before the predators have a chance to control it. Air temperature, rainfall, and vegetation also affect the abundance of food and the behavior of predators [(12)].

Rainfall could increase the transmission of *Anopheles* by promoting the vectors' breeding site or, conversely, it could also eliminate it by flooding the vectors' breeding site [(6)]. This phenomenon is shown by the fact that the maximum numbers of cases from 2015 to 2016 were recorded during the rainy season (December to February). It means that rainfall during the

rainy season could encourage malaria by promoting the breeding site of *Anopheles*.

Besides, ambient temperatures are required for parasite growth within the *Anopheles* mosquito. Optimum temperatures are between 25ºC and 30ºC, hence their abundance in the tropical zones, including Indonesia. Temperature affects the extrinsic or sporogonic stages of the parasite within the mosquito, which means that temperature can affect the transmission rates of malaria [13].

Besides that, in 2012, 2013, and 2014, the maximum numbers of cases were recorded in March, April, and May, respectively, while those months are classified as part of the transition period from the rainy to dry season. This could happen because the breeding site was formed at the end of the rainy season, which is in the end of February, but the transmission and cases would be detected later between March and May.

According to Oktafandi *et al.*(2014), there was a significant difference of the proportion of malaria between males and females in 2011–2013[7]. The study that was conducted by Letelay and Delima (2012) also showed that men had a higher rate of malaria infection at 53.06% than women had at 46.94% [14].

It may be due to the fact that men do more activities outside their home, including at night, so it is reasonable that malaria transmission is more common in men than in women. Based on a study by Bagaray, Umboh, and Kawatu [15], there was a significant relationship between outdoor night activities and malaria infection (OR=3.375: CI 95%: 1.303–8.744). It means that people who have activities outside at night have a 3.375 times higher risk of getting malaria infection than people who do not.

There are more than 400 different species of *Anopheles* mosquitoes, but only 30 are considered as important malaria vectors. Five species of *Plasmodium* can infect human beings, and two of them are *Plasmodium falciparum* and *Plasmodium vivax* which pose the greatest threat [16].

Most major cities in Indonesia are also free of malaria risk, even in otherwise high-risk areas. However, the highest risk is found in eastern Indonesia, especially in the provinces of East Nusa Tenggara, Maluku, and Papua [17]. Although *Plasmodium vivax* causes the highest number of malaria cases in Maluku and can cause severe illness and deaths, *Plasmodium falciparum* is the most dangerous malaria parasite. Furthermore, *Plasmodium falciparum* causes the second highest number of malaria cases after *Plasmodium vivax* in Maluku [16].

The limitation of this study included the time range of malaria cases being investigated. Expansion of the time range can show a more comprehensive and valid trend of malaria in Maluku Province. Other limitations include relatively small number of cases and lack of climate data. Besides those, the climate factor should also be included in order to generate a more thorough picture of the trend in malaria cases in Maluku.

Conclusion

In conclusion, the number of malaria cases in Maluku Province tends to decrease over the past several years. The highest numbers of cases were found during the rainy season (December to February) and the transition period from the rainy to dry season (March to May). The lowest number of cases was found in February. Men had a higher number of malaria infection than women. The highest API of monthly malaria has been found in Maluku Barat Daya Province. The government should be more concerned about the malaria prevention program in Maluku Province. The trend of malaria cases has decreased, but Maluku Province still has the High Level of Incidence (HLI) of malaria in Indonesia. The highest number of malaria cases in Maluku was caused by *Plasmodium vivax*, while the lowest was caused by *Plasmodium ovale.* Some preventive measures to deal with malaria must be introduced to the local communities, so their knowledge about the transmission and elimination of malaria can increase. Health officers can also help disseminate the knowledge by providing information that anyone who wants to do activities outside at night must wear full-length clothes that can protect their body from mosquito bites. Besides that, the local people should also use mosquito repellent lotion to prevent mosquito bites. Thus, the transmission of malaria through mosquitoes can be reduced.

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Ethical Clearance: No ethical approval for this research because it is used secondary data.

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