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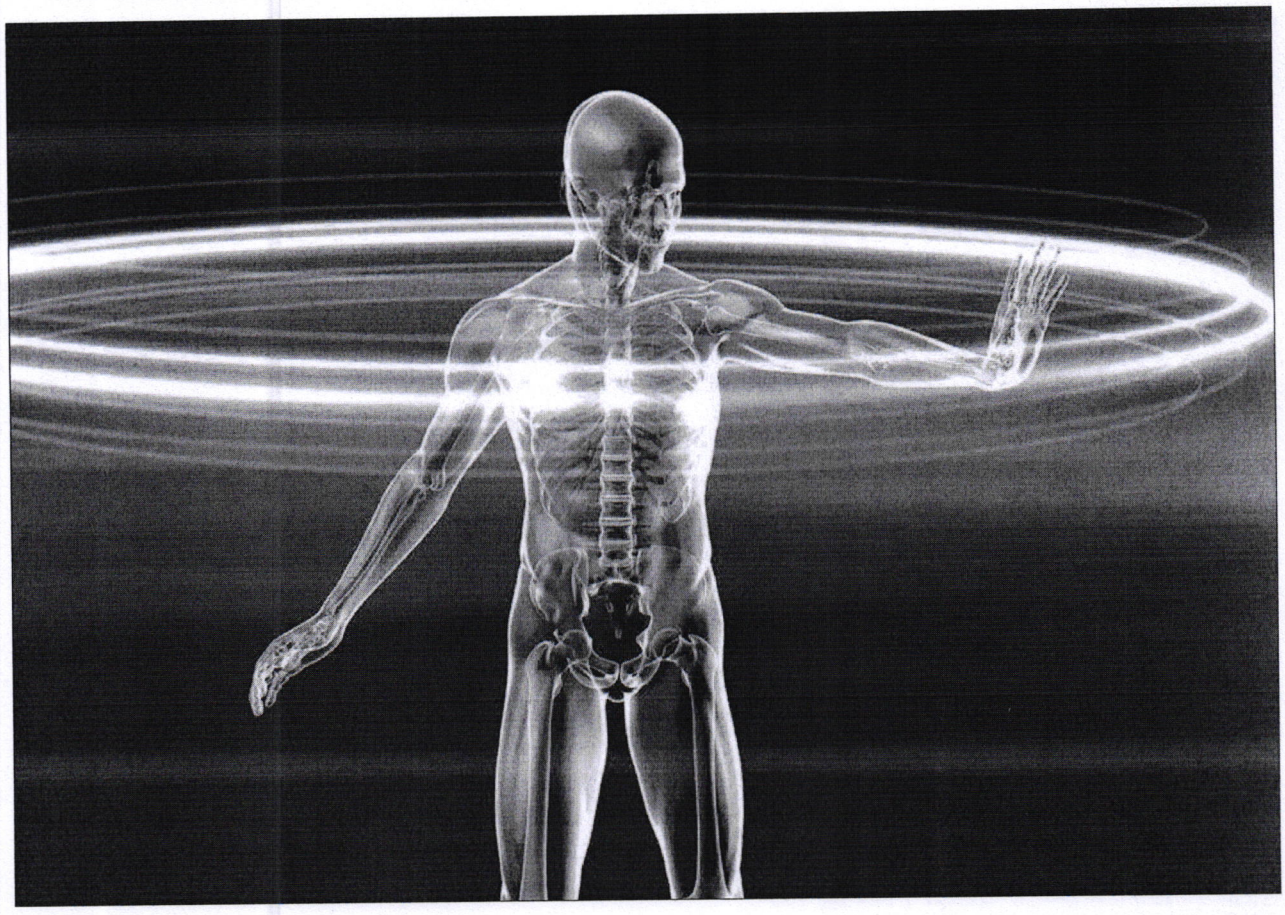

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Research Article
Immunomodulatory Effect of Orally Red Fruit (*Pandanus conoideus*) Extract on the Expression of CC Chemokine Receptor 5 mRNA in HIV Patients with Antiretroviral Therapy

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Abstract

Background and Objective: The C-C chemokine receptor 5 (CCR5) is a coreceptor of human immunodeficiency virus (HIV) and is related to immune cells. Therefore, it was investigated immunostimulant effect of red fruit (*Pandanus conoideus*) oil extract on the level of CCR5 mRNA in HIV infected patients with taking antiretroviral therapy. **Materials and Methods:** Seventy of HIV infected patients (age of 17-45 years) were into the antiretroviral (ARV) control (n = 35) and the antiretroviral+red fruit capsule (ARV+RFC)-treated (n = 35) groups. In ARV+RFC group, they were given oral RFC (1 g daily for two months). Monitoring evaluations of the laboratory were performed at baseline (0 months) and two months during the study. The quantification of CCR5 messenger ribonucleic acid (mRNA) in human blood immune cells was determined using real-time reverse transcriptase polymerase chain reaction (RT-PCR) assay. **Results:** In this study, it was found that ARV+RFC exhibited a significantly increased level of CCR5 mRNA of HIV-infected patients compared with ARV alone ($p<0.001$). **Conclusion:** From this, it was concluded that the red fruit oil extract may have an excellent immunostimulant effect and has potential as an adjuvant in the management of HIV-infected patients.

Key words: Antiretroviral therapy, CCR5, HIV/AIDS, immune response, *Pandanus conoideus*

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Human immunodeficiency virus (HIV) caused a problem in immune systems and can develop become an infectious disease namely the acquired immune deficiency syndrome (AIDS)[1-3]. In 2015, WHO reported that 36.7 million people were infected with HIV and causing 1.1 million deaths[3], while in Indonesia estimated 690,000 people living with HIV[4]. Papua Province is one of Indonesia province with a higher prevalence of HIV infection and AIDS; Merauke is a regency in Papua Province with a significant prevalence of HIV infection and AIDS[5]. A total of 2,502 cases were reported for HIV infection (1,063 cases), AIDS (902 cases) and AIDS-related death (537 cases) in Merauke Regency from 1992 to January, 2017[5]. Therefore, this study focused on management HIV-infected patients with antiretroviral therapy and combined with red fruit extract in Merauke District of Papua Province, Indonesia.

To date, one successful alternative management in HIV-infected patients was used antiretroviral therapy (ARV)[6,7]. However, there were limited to ARV treatment in HIV-infected patients include drug resistance[8-10], toxicity[11], drug-drug interaction[12], drug-food interaction[13], required lifelong use, failed treatment response, the optimal time to start treatment and switching regimens[14]. Therefore, new strategies are required that can reduce the negative impact and improve the efficacy of ARV therapy for the management of HIV-infected patients. One of the alternatives that can be used is medicinal plants; because it contains metabolite compounds that are responsible for some pharmacological properties[15-21]. Some reasons use the medicinal plant for a treat of people with HIV infection include to enhance their immune function, to treat symptoms, to improve their quality of life and to reduce side effects related to medications[22]. Recent clinical research reported that there was a change in the concentration of antiretroviral drugs in the body and it had increased efficacy when HIV-infected patients were treated with combination medicinal plant extracts from Papua New Guinea with ARV[23]. Another literature showed that combination treatment of Chinese herbal compound and antiretroviral agents increased antiviral benefit compared with antiretrovirals alone[24].

The immune system has a significant damage problem in infection of HIV on human[25]. The C-C chemokine receptor 5 (CCR5), a β-chemokine receptor, expressed on immune cells such as monocytes[26], T cells[27,28], dendritic cells[29] and macrophages[30]. A number of studies have reported that CCR5 is the significant coreceptors of HIV required for successful viral entry to the host cell[31-33]. Another function showed that CCR5 is involved in signaling and coordination of immune responses[34]. Therefore, the improvement level of CCR5 may indicate an increase immune response in HIV-infected patients.

The red fruits or *Pandanus conoideus*, called "BuahMerah" in Indonesia, is family *Pandanaceae* that most known and widely distributed in the Papua Province of Indonesia[35]. This plant has a high value because in traditional of Papua community can be used to treat cancer, rheumatoid arthritis, stroke and HIV/AIDS[36]. Previous works have shown that red fruit has some pharmacological activities such as anticancer, anti-inflammation, antioxidant, antibacterial activities[37-40]. Another research showed that red fruit oil could decrease the level of creatine kinase enzyme at maximum physical activity[41]. Red fruit contains various nutrient including fat, carbohydrate, vitamin C, phosphorus, calcium, carotenoids and tocopherols[35]. Another literature showed that red fruit contains various phytochemicals such as phenolic, flavonoid[40], oleic acid, linoleic acid[42], triolein, palmito-diolein, linoleo-diolein and palmito-linoleo-olein[35].

This study aimed to the evaluation of the level of CCR5 mRNA effect of red fruit (*Pandanus conoideus*) oil extract on HIV-infected patients with taking antiretroviral therapy.

MATERIALS AND METHODS

Ethical considerations: The Medicine Faculty Research Ethics Committee of the Hasanuddin University, Indonesia, approved the study protocol (532/H4.8.4.5.31/PP36-KOMETIK/2017). The study was conducted in randomized controlled groups. Patients qualified for inclusion in the study were ambulatory, with the base CD4 line was between 200-349 cells μL^{-1}, the body weight of 45-70 kg and treated with ARV. Excluded were pregnant women and kidney failure, body weight under than 45 kg and no treated ARV in three months.

Study location and design: Recruitment and drug administration took place in Merauke Hospital, Merauke Regency of Papua Province, Indonesia. Laboratory tests were performed at a Molecular Biology and Immunology Laboratory for Infectious Diseases, Faculty of Medicine, Hasanuddin University, Makassar, Indonesia.

Seventy HIV-infected patients of either gender aged between 17 and 45 years were selected in this study. The patients were divided into the ARV (antiretroviral) control (n = 35) and the antiretroviral+red fruit capsule (ARV+RFC)-treated (n = 35) groups. RFC gelatin (1000 mg red fruit extract per capsule) was administered to the patients. The dosage was 1000 mg (one capsule) daily for two months. Monitoring evaluations of the laboratory were performed at baseline (0 months) and two months during the study.

Determination level of CCR5 mRNA: The determination of CCR5 mRNA used human blood immune cells and it is determined using RT-PCR assay[43]. The CCR5 gene was amplified by RT-PCR using forward primer 5'-GCTGTGTTTGCGTCTCTCCCAGGA-3' and reverse primer 5'-CTCACAGCCCTGTGCCTCTTCTTC-3'[43]. The level of CCR5 copies of samples was determined based on the standard curve of known CCR5 gene copies of a plasmid used as the RNA standard for glyceraldehyde-3-phosphate dehydrogenase (GAPDH) real-time RT-PCR. Thus, the CCR5 mRNA levels are expressed as the mean copy number of CCR5 mRNA per milliliter of total RNA.

Statistical analysis: One-way analysis of variance (ANOVA) was employed to assess significant differences in CCR5 mRNA expressions at $p<0.001$. Statistical analysis was performed using software of SPSS 16.00 for Windows (SPSS Inc., Chicago Il, USA).

RESULTS AND DISCUSSION

Figure 1 showed the level of CCR5 mRNA of ARV and ARV+RFC-treated groups at baseline (0 months), two months and mean change. The result shows that the level of CCR5 mRNA in the ARV+RFC-treated group was a gradual increase in the mean CCR5 mRNA from 7.25±1.86 copies mL^{-1} at baseline (0 months) to 9.25±1.87 copies mL^{-1} after two months treatment of ARV+RFC-treated (Fig. 1). While in ARV group showed that a lower increase in the mean level of CCR5 mRNA from 7.84±1.55 copies mL^{-1} at baseline (0 months) to 8.12±2.13 copies mL^{-1} after two months therapy. One-way ANOVA with LSD test showed that ARV+RFC-treated group has a significant difference of the CCR5 mRNA copies with ARV group with $p<0.001$; mean change level of CCR5 mRNA in the ARV+RFC-treated group was 2.27±1.93 copies mL^{-1} higher than ARV group with value mean change of 0.29±1.56 copies mL^{-1}. The percentage of CCR5 mRNA was increased by 13.54% in the ARV+RFC-treated group while only 1.82% in ARV group. The CCR5 was known as a protein on the surface of white blood cells and its involvement in the immune system with a function as a receptor for chemokines[44]. Therefore, these results indicated that the application of ARV+RFC could be an enhancement of the immune status of the patients compared with ARV only; red fruit oil extract has potential as an adjuvant in the management of HIV patients.

Effect of red fruit oil extract on the expression of CCR5 was probably derived from its metabolite compounds, one of

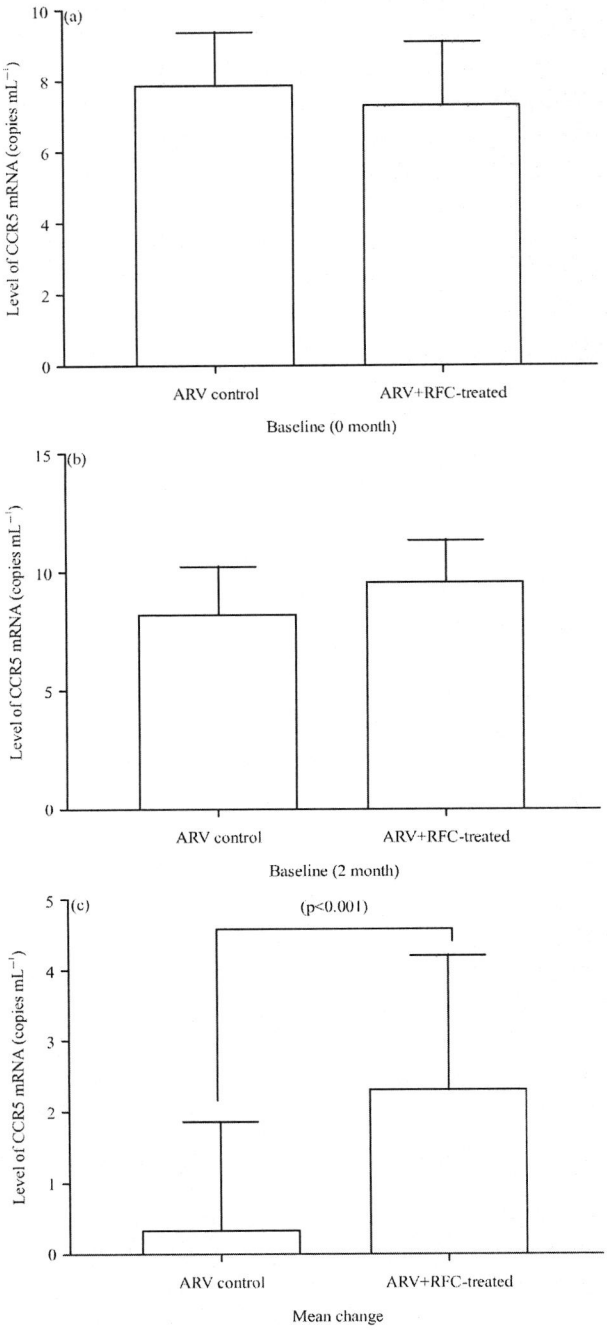

Fig. 1(a-c): Level of C-C chemokine receptor 5 (CCR5) mRNA of ARV (antiretroviral) control and ARV+RFC (red fruit capsule)- treated in the, (a) Baseline, (b) Two months and (c) Mean change

which is carotenoid[35]. Carotenoid has been widely reported and has been shown to possess antioxidant[45,46], anticancer[47] and immunomodulatory capacity[48]. As an immunomodulator,

carotenoid has been shown to enhance lymphocyte blastogenesis, increase the population of specific lymphocyte subsets, increase lymphocyte cytotoxic activity and stimulate the production of various cytokines[49]. Another mechanism reported that the carotenoid has immunomodulatory effects by increasing INF-γ and IL-2 production without inducing cytotoxicity[50]. In HIV-infected patients, the role of carotenoid was as antioxidant appears to be related to both direct immune modulation and inhibition of cytokine and NF-κB activation and inhibiting HIV replication[51].

In the context of an immune system in HIV-infected patients, the CCR5 changes after the administration of red fruit oil extract have a definite meaning and benefit. The natural target of HIV infection was $CD4^+$ T lymphocytes[52]. Some studies have reported that CCR5 to be associated with disease progression and level of CD4 in HIV-infected patients[53-55]. Regulatory CCR5 expression affects many factors, including genetic mutation[56], activation, signaling and trafficking and environmental[57]. Increasing effect of CCR5 mRNA levels is expected to improve the effectiveness of the immune response in HIV-infected patients.

Results showed that level of CCR5 mRNA in ARV+RCV treatment was significantly increased in HIV-infected patients as compared to ARV alone (Fig. 1). Results indicated that red fruits extract oils functional as immunostimulants; because the CCR5 as a coreceptor of the $CD4^+$ cell and $CD4^+$ cell counts reflect the immunologic status of HIV-infected patients[58-60]. Thus it is possible that the functional interaction of red fruit extract oils with antiretroviral therapy as an immunostimulant in HIV-infected patients occur at the level of metabolism through enzyme induction or inhibition[23]. Another possible mechanism that metabolite constituents of red fruits extract oils remedies may affect ARV metabolism as a result of their efflux drug transporter systems[61,62].

This work shows the first report of immunostimulants effect on HIV-infected patients with ARV therapy that intervened with RFC. Thus, the combination of RFC and ARV can be alternative in the management of HIV-infected patients. The small of a sample size of current research is limited, so further research needs to be done by using a large number of samples.

CONCLUSION

In conclusion, this study shows that the increased level of CCR5 mRNA expression by the ARV+RFC-treated group provided positive benefits in HIV/AIDS therapy that its combination can increase the mechanism of the immune system.

SIGNIFICANCE STATEMENT

This study discovered the immuno stimulant effect of red fruit (*Pandanus conoideus*) oil extract in HIV infected patients with taking antiretroviral (ARV) therapy. This study will help the researcher to uncover the critical areas of immunological abilities from red fruit oil extract in combination with ARV therapy on the HIV-infected patients that many researchers were not able to explore. Thus, the red fruit oil extract could be a combination with ARV therapy that has potential as an adjuvant in the management of HIV-infected patients.

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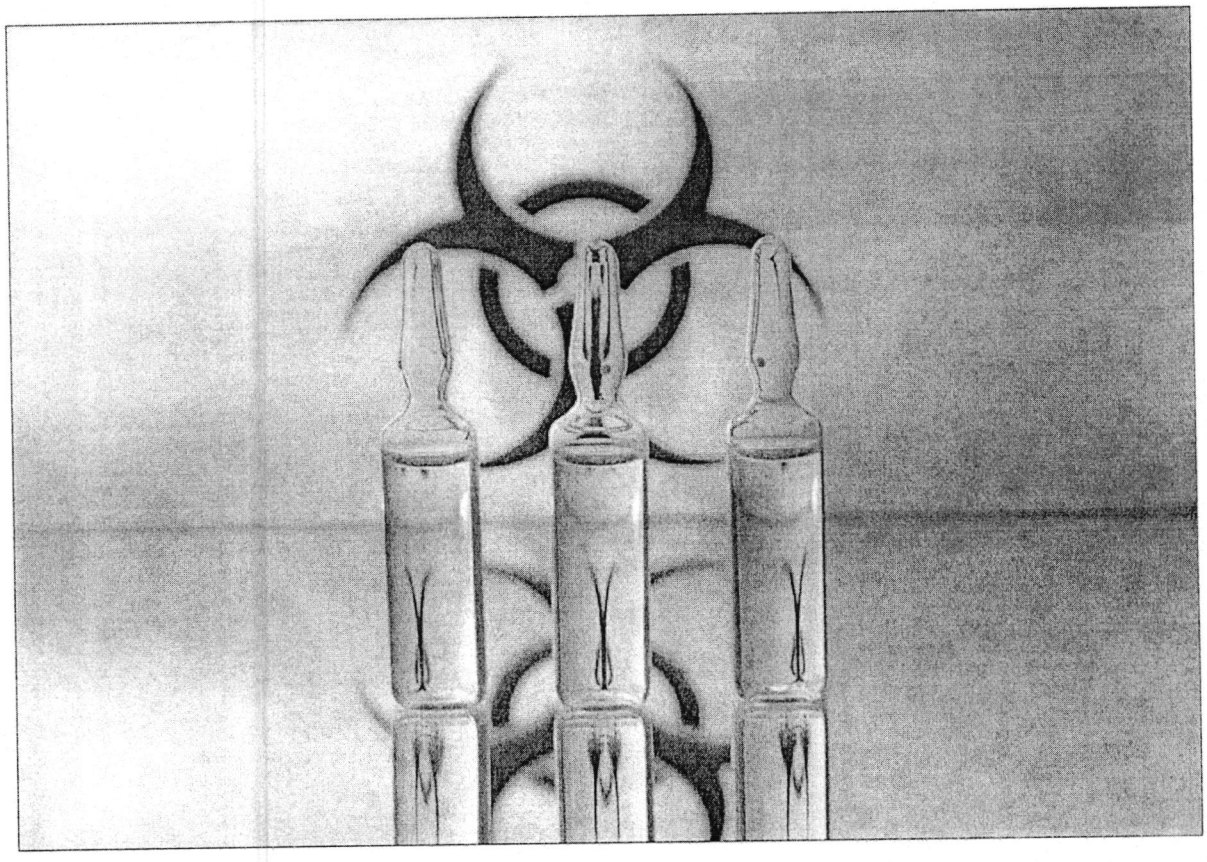

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Research Article

Trends in HIV/AIDS Epidemics in Merauke-Papua, Indonesia, from 1992-2017

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Abstract

Background and Objective: The pattern and severity of HIV/AIDS cases in Indonesia and Merauke Regency of Papua Province are on the increase. There is a limited study on the epidemiologic analysis of HIV/AIDS cases in Merauke Regency. This study aimed to identify trends in HIV/AIDS epidemics in Merauke Regency. **Materials and Methods:** Data were obtained from Info AIDS from 1992-January, 2017 under Disease Control and Environmental Health of Merauke Regency. The univariate, correlation and polynomial regression models and SPSS 19 were used as statistical tools for analyzing data. **Results:** During the study, 1,063 people tested positive for HIV in Merauke Regency, 902 people had AIDS and 537 died due to AIDS-related causes. The association between reported HIV infection cases and AIDS-related deaths yielded a Pearson correlation of 0.8053 ($p<0.0001$), however, there was no correlation between reported cases (HIV infection cases and AIDS cases and between AIDS cases and AIDS-related deaths). The values of a variation curve of the 5th-degree polynomials were 40.86, 60.17 and 58.90% for reported HIV infection cases, AIDS cases and AIDS-related deaths, respectively. **Conclusion:** It was concluded that data obtained in this study can be used as a basis for making policies and programs to reduce the spread of HIV and AIDS.

Key words: Fifth-degree polynomial, HIV/AIDS epidemic, Merauke, Pearson correlation, prevalence

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

According to the 1st report of 1987, HIV/AIDS has devastated public health in Indonesia[1]. The number of people living with HIV infection in Indonesia by the end of 2015 was 690,000[2]. Furthermore, the number of new HIV infection cases in Indonesia was 73,000 by the end of December, 2015[2]. The prevalence of HIV infection and AIDS varies according to the province among Voluntary Counselling and Testing (VCT) clients, cumulative AIDS cases and some VCT sites. The Indonesian regions with the highest numbers of cumulative AIDS cases in 2010 were Jakarta (3,995), West Java (3,728), East Java (3,771) and Papua (3,665)[3]. Recently, 407 districts or cities reported HIV infection and AIDS cases in Indonesia[4]. The report of Directorate General of Communicable Disease Control and Environmental Health from Ministry of the Health Republic of Indonesia showed that the cumulative number of HIV infection and AIDS cases in Papua in 2014 were 16,051 and 10,184, respectively[5]. These data, compared with 2010, revealed that incidence of HIV infection and AIDS is increasing and the number of cumulative HIV infection and AIDS cases in Papua was higher than West Java in 2014[5].

Merauke is a regency in Papua Province, Indonesia, with a significant prevalence of HIV infection and AIDS. In March, 2016, a Papua Health Office report showed that Merauke regency has the highest number of cumulative HIV infection and AIDS cases (1,807) after Jayapura Regency (1,813), Jayapura City (3,762), Nabire Regency (4,162), Mimika Regency (4,162) and Jaya Wijaya Regency (5,293)[6]. Epidemiologic analysis in Merauke Regency is still limited. This study aimed to identify the trends in HIV infection and AIDS epidemic in Merauke Regency. The findings will be useful to develop effective policies and programs with tailored public health goals and planning that can positively affect treatment and prevention services for people living with HIV or AIDS.

MATERIALS AND METHODS

This study used the reported data for HIV infection, AIDS and AIDS-related death cases from the Info AIDS from 1992-January, 2017 under Disease Control and Environmental Health of Merauke Regency (Table 1)[7]. The distribution of reported HIV infection and AIDS cases and AIDS-related death cases has not been examined in Merauke Regency over the years. The data were assessed using univariate analysis to accomplish the description of the variables and their attributes, Pearson's correlation to discover whether there were any relationships among the variables and polynomial regression analysis to model the trend of HIV infection, AIDS and AID-related deaths reported from the 1992-January, 2017.

Table 1: Distribution of HIV, AIDS and AIDS-death Cases in Merauke Regency from 1992-January, 2017

	Reported cases		
Year	HIV infection	AIDS	AIDS-related death
1992-1999	114	71	80
2000	57	71	17
2001	31	56	13
2002	69	64	18
2003	20	54	11
2004	36	57	26
2005	57	46	32
2006	57	28	27
2007	68	13	18
2008	32	27	20
2009	67	29	18
2010	67	66	40
2011	54	80	35
2012	60	85	25
2013	65	48	45
2014	56	46	30
2015	70	29	40
2016	83	32	40
2017	0	0	2
Total	1063	902	537

Disease Control and Environmental Health of Merauke Regency, Merauke Health Office (MHO) 2017[7]

Statistical analysis: Statistical analysis was performed using SPSS 19 (IBM SPSS Inc., Chicago, IL)[8]. The independent variable was time (t) in years. Dependent variables were X1 = reported HIV infection cases, X2 = reported AIDS cases and X3 = reported AID-related death cases. Polynomial regression analysis was established using Microsoft Excel 2016 and it was used to determine the yearly trend in the HIV infection, AIDS and AIDS-related death cases ($p<0.05$).

RESULTS

The numbers of HIV infection, AIDS and AIDS-related death cases reported in Merauke Regency from 1992-January, 2017 are shown in Table 1. A total of 2,502 cases were reported for HIV infection, AIDS and AIDS-related death. The magnitude of the increase in reporting rates was 42.52 cases of HIV infection, 36.08 cases of AIDS and 21.48 cases of AIDS-related death per year for the 1992-2017 period.

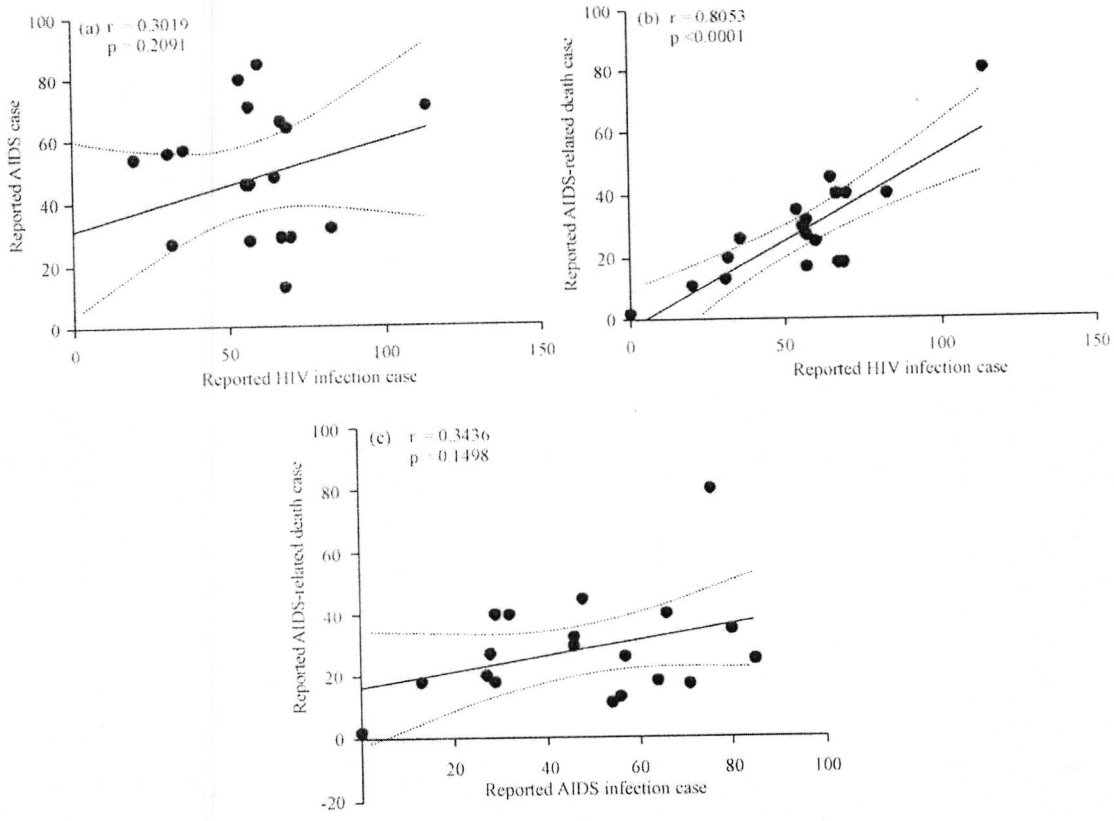

Fig. 1(a-c): Correlation between
(a) Reported HIV infection vs AIDS cases, (b) HIV infection vs AIDS-related death cases and (c) AIDS vs AIDS-related death cases

Table 2: Descriptive statistics of HIV, AIDS and AIDS-death reported

Descriptive statistics	Reported HIV cases	Reported AIDS cases	Reported AIDS-related death cases
Mean	55.95	47.47	28.26
Std. Deviation	24.70	23.05	16.97
Range	(0.00-114.00)	(0.00-85.00)	(2.00-80.00)
Variance	610.05	531.26	287.87

Descriptive statistics of predictor and response dependent variables of HIV infection, AIDS and AIDS-death cases reported in Merauke Regency from 1992-2017 are shown in Table 2. In this Table, the data demonstrated the descriptive statistic values for all the cases under study as well as their means, standard deviations, ranges and variants to explore the main features of data of Merauke Regency.

The relationship among the reported HIV infection, AIDS and AIDS-related death cases in Merauke Regency are demonstrated in Fig. 1. The direction, strength and significance of associations between the variables of HIV infection, AIDS and AIDS-related death cases were completed using the Pearson's correlation coefficients (r). The variable of reported HIV infection cases are significantly correlated with reported AIDS-related death cases ($p<0.0001$). There was no significant association between reported HIV infection and AIDS cases and reported AIDS and AIDS-related death case.

The prevalence of HIV infection, AIDS and AIDS-related death in Merauke by age, sex, ethnic and main occupation groups from 1992-2017 are presented in Fig. 2. The highest prevalence of HIV infection and AIDS was found of 25-49 years (59.54%) for age groups, women (51.15%) for sex groups, Papua (49.41%) for ethnic groups and labor/farmer/fisherman (21.22%) for main occupation groups.

The polynomial regression analysis of reported HIV infection, AIDS and AIDS-related death cases from 1992-January, 2017 in Merauke Regency is presented in Fig. 3. Polynomial regression analysis showed that the polynomials of degree 5 gave the well-fitted models for each population, resulting in 40.86% ($R^2 = 0.4086$) for reported HIV infection cases, 60.17% ($R^2 = 0.6017$) for reported AIDS cases and 58.90% ($R^2 = 0.5890$) for reported AIDS-related death cases. It

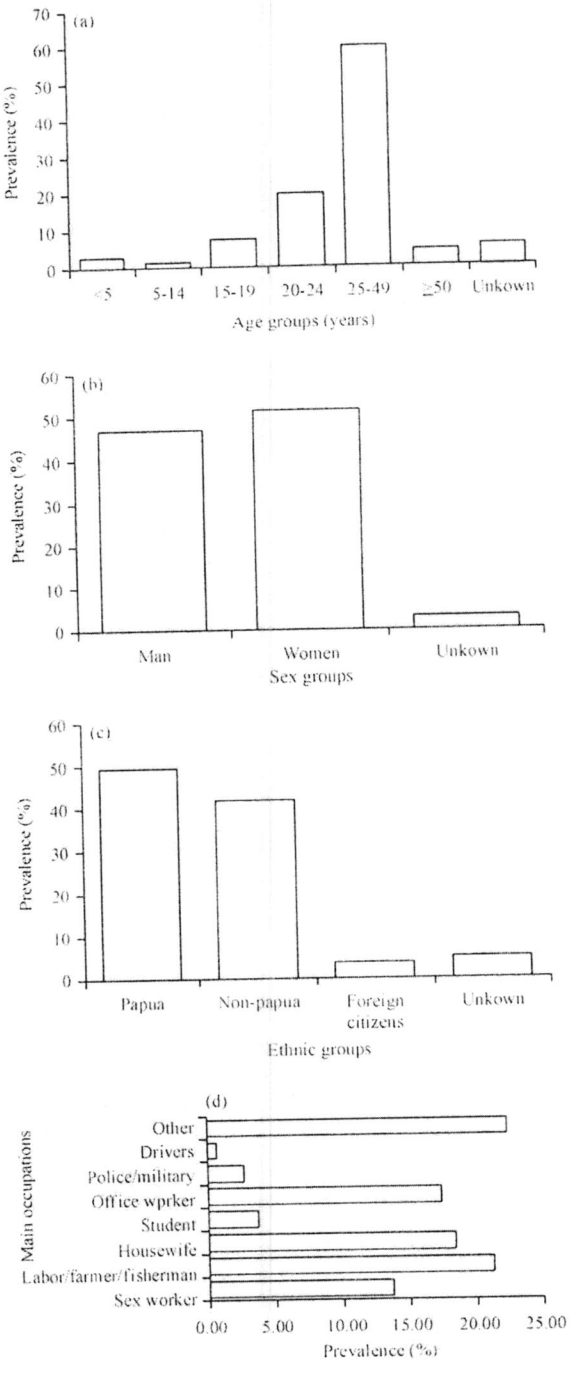

Fig. 2(a-d): (a) Trends of HIV/AIDS prevalence by age groups, (b) Sex groups, (c) Ethnic groups and (d) Main occupations in Merauke from 1992-2017

could explain the yearly variation when the 5th-degree polynomial model was applied as shown in Fig. 3. All the parameters of the fitted models were statistically significant ($p<0.05$).

DISCUSSION

The results of this study, identified some significant findings. Firstly, the number of HIV infection, AIDS and AIDS-related death cases reported in Merauke Regency from 1992-January, 2017 were 1,063, 902 and 537, respectively. Secondly, the gaps were steadily increasing in HIV infection and AIDS-related death case reported, while steadily reducing for AIDS case reported. The 1st HIV/AIDS case made its debut since in 1992 and the HIV/AIDS epidemic has become one of the most serious health and development challenge in Merauke Regency.

This is the 1st report, using local surveillance data to describe the epidemic of HIV infection and AIDS in Merauke Regency. The number of HIV infection, AIDS and AIDS-related death cases reported in Merauke Regency from 1992-January, 2017 are demonstrated in Table 1. HIV infection and AIDS remain global health and socioeconomic problems for individuals, families, communities and governments[9,10]. Merauke Regency in Papua Province has the highest prevalence of HIV infection and AIDS. An epidemiologic analysis is needed to understand how HIV infection and AIDS cases are currently handled and enable formulation of effective policies and programs to identify and eliminate risk factors that aid the spread of HIV and AIDS in Merauke Regency.

The data explained the significantly similar relationships between the reported HIV infection and AIDS-related death cases, however, there was no significant association between reported HIV infection and AIDS cases and reported AIDS and AIDS-related death cases (Fig. 2). In Malaysia, different report results indicated that the reported HIV infection, AIDS and AIDS-related death cases significantly ($p<0.05$) correlated with each other[11]. These findings need a resolution because HIV and AIDS can affect individuals in their productive years, their services significantly affect the development and growth of a country[12]. There are several global efforts to eliminate the effects of HIV infection and AIDS on population health including antiretroviral therapy[13,14], prevention of mother-to-child transmission[15], needle and syringe exchange programs[8], etc. However, in Merauke, appropriate use of information strategies to reduce the spread of HIV and AIDS infection is still limited.

WHO categorizes HIV/AIDS epidemic as low-level, concentrated and generalized, depending on HIV prevalence and the diffusion of HIV transmission in different sub-populations[16]. The results show that the epidemic remains concentrated (approximately 50% of reported cases) in individuals 25-49 years of age (59.54%), women (51.15%) and

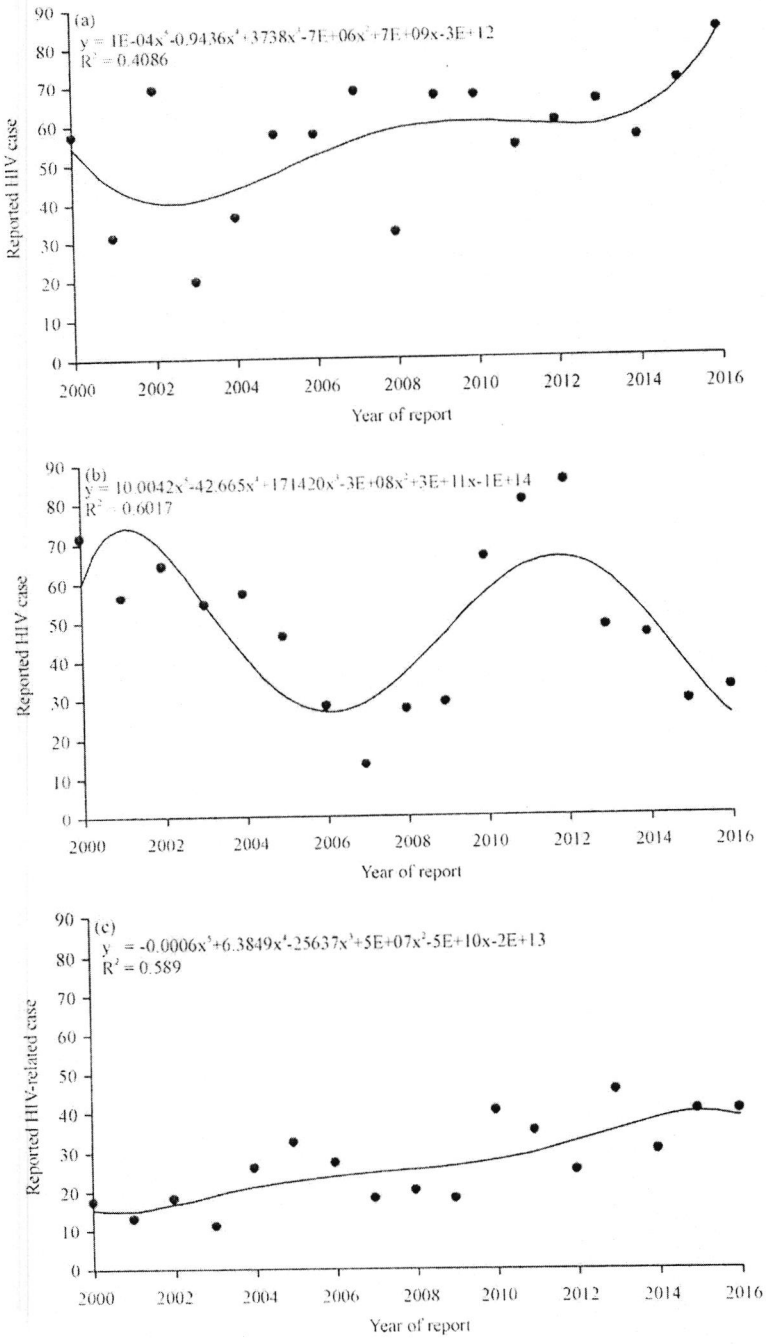

Fig. 3: Polynomial regression analysis of reported, (a) HIV infection, (b) AIDS and (c) AIDS-related death cases from 1992-January, 2017 in Merauke Regency

those of Papua ethnicity (49.41%). The HIV epidemic in some areas of Indonesia has already reached the "Concentrated" stage[17]. These data are limited information of critical populations. Several significant populations of nation in 2011 showed 41% HIV prevalence among people who inject drugs, 10% among direct female sex workers and 8% among men who have sex with men[18]. Thus, further epidemiologic analysis is needed to understand the population of individuals with HIV infection from Merauke Regency.

In data from 2000-2016, the highest reported HIV infection cases (83) occurred in 2016, reported AIDS cases (85) in 2012 and reported AIDS-related death cases (45) in 2013. The studies reviewed in the present work are limited because the models of the HIV/AIDS epidemic for demographic

parameters are mostly based on mathematical models. This study focused on descriptive statistics, correlation analysis and a polynomial regression model, it did not identify trends by age, sex and ethnic groups for relationships among annually reported cases of HIV infection, AIDS and AIDS-related deaths. Thus, future epidemiologic analysis should evaluate local context and changes in behaviors to develop targeted strategies to eliminate HIV infection and AIDS in Merauke Regency. Similarly, Hardon *et al.*[19] stated that achieving a global goal of reducing the incidence of HIV infection in children by 50%, requires the adjustment for globally designed public health programs for gender-based HIV transmission pathways, as well as, local opportunities for continued care and social support. Another study found a lack of comprehensive knowledge of HIV was associated with an increased risk of being diagnosed with HIV infection[20]. Stahlman *et al.*[21] concluded that there was a link between social stigma and testing positive for HIV. The absence of support for access to healthcare services plays a significant role in the prevention of HIV testing including the lack of transportation, lack of a phone, cost of the test, concerns about parental consent (for patients under 18 years old), the wait time for results and unfriendly test environments[22]. In a study in Nevada, Pharr *et al.*[22] found social barriers to HIV testing including behavioral risks such as lack of HIV infection awareness are important because they might result in a disproportionate number of new HIV infection cases. Wejnert *et al.*[23] reported that lack of knowledge has been recognized as a public health challenge that still needs to be addressed. Thus, in future, epidemiologic analysis in Merauke Regency, studies need to address additional factors associated with HIV infection including social norms, structural support and behavioral choices. In Papua Province, many coordinated programs and approaches have contributed to reduction in new HIV infection, including mass media campaigns, sexual health promotion and improvements and increased access to HIV and STI testing and treatment[24]. These programs can be alternatives to help prevent the spread of HIV infection in Merauke Regency.

CONCLUSIONS AND FUTURE RECOMMENDATIONS

We identified 1,063 HIV infection, 902 AIDS and 537 AIDS-related death cases in Merauke Regency from 1992-January, 2017. The Pearson correlation coefficient for the association between reported HIV infection and AIDS-related death cases was 0.8053 ($p<0.0001$). There were no correlations between reported HIV infection and AIDS cases and AIDS and AIDS-related death cases. The values of a variation curve of the 5th-degree polynomials were 40.86, 60.17 and 58.90% for reported HIV infection, AIDS and AIDS-related death cases, respectively.

Finally, further studies are needed in an epidemiologic analysis to address factors that could be associated with HIV infection in Merauke Regency including social norms, structural support and behavioral choices. The results could be useful for developing effective policies and program targets that address major risk factors and help to reduce the spread of HIV and AIDS.

SIGNIFICANCE STATEMENTS

This study discovered the trend spread and correlation of Human Immunodeficiency Virus (HIV) infection and Acquired Immune Deficiency Syndrome (AIDS) in Merauke Regency of Papua Province, Indonesia, from 1992-2017. This study will help the researcher to uncover the critical areas of HIV/AIDS epidemic in Merauke Regency that many researchers were not able to explore. Thus, a new theory on epidemiology analysis provides useful information for improving case prevention and management of HIV infection and AIDS in Merauke Regency of Papua Province, Indonesia.

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