Prevalence and Associated Factor with Hypertriglyceridemia in HIV Infected Patient in Phaya Meng Rai Hospital , Thailand.

Kittisak Taoma[1],Thanakhom Sinprasert[1], Thosapon Jeno[1] ,Praphaporn Chueamuangphan[2], Sririnporn Phupraserd[2], Ratree Watthanathon[2] and Phitsanuruk Kanthawee[1*]

[1]*Department of Public Health,School of health Sciences,Mae Fah Luang University,Chiang Rai, Thailand*

[2]*Department of Phaya Meng Rai Hospital, Phaya Meng Rai,Chiang Rai, Thailand*

*Corresponding Author: Phitsanuruk Kanthawee. e-mail: Phitsanuruk.kan@mfu.ac.th

Abstract

Introduction: According to the WHO (2016), The HIV mortality Rate in 2015 was 36.7 millions people worldwide. Meanwhile, The proportion of new case made up to 2.1 million. In Thailand , the prevalence of HIV patient accounted for 22.4 of the total in 2015. This mainly found in northern of Thailand

Objective: This study aimed to examine the prevalence of hypertriglyceridemia and to determine the risk factor associated with hypertriglyceridemia in HIV infected patients in Phayamengrai hospital,Thailand

Method: This analytical crossectional study was conducted in ARV clinic ,Phayamengrai hospital. The instrument was consisted of completed questionnaires and tested on validity and reliability. The setting was in Phayamengrai hospital. Binary logistic regression was used to find the factor associated with hypertriglyceridemia.

Result: The sample size was 139 after the addition of 20 percent , and this can be classified into 2 group - hypertriglyceridemia (36 persons) and non-hypertriglyceridemia (103 persons).The majority of the participant was farmer aged between 31 and 45 years old (52.5 %).The prevalence of hypertriglyceridemia in HIV infected patient made up 25.9 percent of the total. After analyzing binary logistic regression, Age (OR_{adj} = 1.08 : 95 %CI = 1.02-1.13, p <0.01) , BMI (OR_{adj} = 4.69 : 95 %CI = 1.73-1.27, p <0.01) , and resistance regimens (PI therapy) (OR_{adj} = 5.01: 95 %CI = 1.41-1.77, p <0.01) were the risk factors associated with the hypertriglyceridemia statistically significant.

Conclusion: Developing the hypertriglyceridemia was strongly associated with Age, resistance regimen , and body mass index. Even though the prevalence was not high but the educational program was recommended to reduce the new case.

Keyword: Hypertriglyceridemia, HIV-Infected Patient , Prevalence and associated Factors

Introduction

In 2016,The World Health Organization (2016) reported the HIV mortality with a total of 36.7 million people infected with HIV worldwide. In the meanwhile, the figure of new patients increase of 2.1 million people which was the incidence is highest in patients with AIDS and the figure of HIV mortality was 1.1 million people. The most common cause of death among AIDS patients was from opportunistic infections. Tuberculosis is the most common opportunistic infections. AIDS patients are more vulnerable to TB infection is between 26 to 36 times compared with patients without HIV infection. This is evident from the number of patients which is 1.2 million of TB in patients with HIV (World Health Organization, 2015) However, the patients have an access to antiretroviral

thoroughly. Which can save patients up to 21 million people. Antiviral drugs can reduce new cases up to 18 million people by the year 2039 (World Health Organization, 2016). Moreover, World Health Organization (2015) reported the number of HIV patient in Thailand which is able to access the treatment – this made up to 61 percent of the total, by this, the proportion of adult and young HIV infected patient was around 272,000 people who can access to the primary center. Even though the patient can get an access to the treatment, the HIV infected patient have the opportunity to get the non – communicable disease like hypertriglyceridemia. Jantarapakde (2014) related that the prevalence of hypertriglyceridemia was 22.4 percent of the total. In Chiangrai, 52.5 percent of the total were the patient with hypertriglyceridemia in Phayamengrai hospital. Therefore, this research aimed to examine the prevalence and the associated factor with hypertriglyceridemia in Phayamengrai hospital, Chiangrai, Thailand

Methodology

Study design

The analytic Crossectional study was conducted in ARV clinic in Phayamengrai hospital, Chiangrai, Thailand.

Sample Size Calculation and Sampling Method

139 individuals of the total were the sample in this study which was calculated by the statistical program, and systemic random sampling and telephone calling was applied to this study

Material

A questionnaires was consisted of 5 parts, approved by 3 public health committee at Mae Fah Luang universit, which is General Information, Medical Information, Dietary Information, and Smoking and Drinking information. These were applied from Phayamengrai hospital (ARV clinic), the ministry of public health (Alcohol Use Identification Test, AUDIT), and bureau of nutrition.

Statistical Analysis

Statistical analysis was analyzed by statistical program. Descriptive statistical was used to calculate mean, proportion and standard deviation. Another one was Binary logistic regression were used in search of the associated factor with hypertriglyceridemia.

Ethic

This research was approved by the committees of the school of health school of health science, Mae Fah Luang university, Thailand

Result

Table 1: Demographic and characteristic

Variable	Frequency (N = 139)	Percentage (%)
Gender		
Male	64	46
Female	75	54
Age		
15-30	6	4.3
31-45	73	52.5
46-60	5	40.3
61-75	3	2.2
76-90	1	0.7
Mean 44.58, SD 8.65		
BMI		
Obesity	121	87.1
Normal	18	12.9
Mean 21.8, SD3.1		
Blood Pressure		
High	124	89.2
Normal	15	10.8
Religious		
Buddhist	138	99.3
Christ	1	0.7

Table 2: Demographic and characteristic

Variable	Frequency (N = 139)	Percentage (%)
Marital Status		
Single	45	32.4
Couple	79	56.8
Willow	11	7.9
Divorce	3	2.2
Separate	1	0.7
Educational Level		
Master Degree	1	0.7
Bachelor degree	3	2.2
Vocational Cert.	2	1.4
Senior	15	10.8
Junior	21	15.1
Elementary	87	62.6
Uneducated	10	7.2
Occupation		
Farmer	62	46
Own Business	57	41
Merchant	9	6.5
Employee	1	0.7
Civil	3	2.2
Jobless	5	3.6

Table 3: Demographic Characteristic

Variable	Frequency (N = 139)	Percent (%)
Income		
>10,000	18	12.9
5,001-10,000	53	38.1
<5,000	55	39.6
No Income	13	9.4
Regimens		
Normal Regimen	128	92.7
Resistance Regimen	11	7.9
Duration		
>6 yrs	69	49.6
< 6 yrs	70	50.4
Mean 4.63 SD 2.53		
Chronic Disease		
Yes	34	24.5
No	105	75.5
CD4 Level		
< 200 cell/ml	10	7.2
>200 cell/ml	129	92.8
Exercise		
Yes	41	29.5
No	98	70.5
Triglyceride Level		
Normal (<150 mg/dl)	79	56.8
Moderate (150-199 mg/dl)	24	17.3
High (200-499 mg/dl)	35	25.2
Extremely High (> 500 mg/dl)	1	0.7

Table 4: Demographic Characteristic

Variable	Frequency (N = 139)	Percent (%)
Smoking		
Yes	27	19.4
No	112	80.6
Alcohol Drinking		
Yes	41	29.5
No	98	70.5
Dietary Behavior		
Sweet		
Yes	73	52.5
No	66	47.5
Salt		
Yes	61	43.9
No	78	56.1
Oily		
Yes	80	57.6
No	59	42.4

From the table 1, 2, 3 and 4, the number of male (46 %) and female (54 %) was equal to each other and their age mostly was between 31 and 45 years old. The majority of them were in obesity categories (87.1 %) and their blood pressure mostly categorized as high (> 140/90 mmHg) at 89.2 percent of the total. The educational level was at elementary school (62.6 %) . 46 percent of the total were farmer and some of them were jobless (3.6 %). However, 67.6 percent of the HIV infected patients had hypertension disease, but 75.7 percent of the total had not underlying disease. CD 4 level of participant mainly was below 200 cell/ml (92.8 %). The total proportion of HIV patient who were in high and extremely high category of triglyceride level was 25.9 percent of the total. 19.4 and 29.5 percent of the HIV participant were smoking and drinking alcohol, respectively. When it comes to dietary behavior, the figure of HIV patient who were in favor of having sweet , salty and oily food were 73 , 61 , and 80 , respectively.

Table 5: The associated factors with hypertriglyceridemia by binary logistic regression.

Variable	Group		OR_{Crude} (95%CI)	OR_{Adj} (95%CI)	P-Value
	Hypertiglyceridemia (TG > 200) N = 36	Non-Hypertriglyceridemia (TG<200) N = 103			
Gender					
Female	16 (44.4)	48 (46.6)	1.09	1.28	0.54
Male	20 (53.4)	55 (53.4)	(0.50-2.33)	(0.57-2.88)	
Age					
< 35 year	36 (100)	11(10.7)	1.39	1.08	0.03
>35 year	-	92(89.3)	(1.24-1.55)	(1.02-1.13)	
Mean 44.58, SD 8.65					
BMI					
Obesity (> 23kg/m^2)	28(77.8)	93(90.3)	2.65	4.69	0.02
			(0.95-7.37)	(1.73-12.7)	
Normal (18.5-22.9 kg/m^2)	8(22.2)	10(9.7)			
Mean 2.18, SD 3.1					
Blood Pressure					
High (> 140/90mmHg)	3 (8.3)	12 (11.7)	0.68	0.64	0.47
			(0.18-2.59)	(0.19-2.15)	
Normal (<140/90 mmHg)	33 (91.7)	91 (88.3)			

Table 6: The associated factor with hypertriglyceridemia by binary logistic regression.

variables	Group		OR_{Crude} (95%CI)	OR_{Adj} (95%CI)	P-Value
	Hypertiglyceridemia (TG > 200) N = 36	Non-Hypertriglyceridemia (TG<200) N = 103			
Treatment					
Resistance regimen	5 (13.9)	6 (5.8)	2.60	5.01	0.01
Normal regimen	31(86.1)	97(94.2)	(0.74-9.13)	(1.41-17.7)	
Duration					
>6years	15 (41.7)	54 (52.4)	1.54	0.99	0.28
<6years	21 (58.3)	49 (47.6)	(0.71-3.32	(0.98-1)	
Mean 4.63, SD 2.53					
Chronic Disease					
Yes	9 (25)	25 (24.3)	0.96	0.64	0.47
No	27 (75)	78 (75.7)	(0.39-2.31)	(0.19-2.15)	
CD4 level					
< 200cell/ml	2 (5.6)	8 (7.8)	1.43	0.99	0.99
>200 cell/ml	34 (94.4)	95 (92.2)	(2.90-7.07)	(0.22-4.29)	
Mean 191, SD 191 cell/ml					
Exercise					
yes	23 (63.9)	75 (72.8)	1.5	0.54	0.22
No	13 (36.1)	28 (27.2)	0.67-3.39)	(0.20-1.44)	
Smoking					
Yes	7 (19.4)	20 (19.4)	0.99	0.99	0.95
No	29 (80.6)	83 (80.6)	(0.38-2.60)	(0.38-2.60)	
Alcohol Drinking					
Yes	13 (26.1)	28 (27.2)	0.66	0.54	0.72
No	23 (63.9)	75 (72.8)	(0.29-1.48)	(0.20-1.44)	

Table 7: The associated factors with hypertriglyceridemia by binary logistic regression.

variables	Group		OR_{Crude} (95%CI)	OR_{Adj} (95%CI)	P-Value
	Hypertiglyceridemia (TG > 200) N = 36	Non-Hypertriglyceridemia (TG<200) N = 103			
Sweetly					
yes	17 (47.2)	56 (54.4)	1.33	1.28	0.52
No	19 (52.8)	47 (45.6)	(0.62-2.84)	(0.59-2.78)	
Salty					
yes	13 (36.1)	48 (46.6)	1.54	1.71	0.19
No	23 (63.9)	55 (53.4)	(0.70-3.37)	(0.76-3.86)	
Oily					
yes	22 (61.1)	58 (56.3)	0.82	0.64	0.26
No	14 (38.9)	45 (43.7)	(0.37-1.78	(0.29-1.40)	

From table 5, 6, and 7. If the participant get older for 1 year, they will have an opportunity to have the disease 1.08 time compared to younger age (95% CI = 1.02-1.13, p = 003), and the HIV infected patient who were in obesity category are in risk of developing hypertriglyceridemia 4.69 (95% CI = 1.73-1.27, p = 002) times greater than who were in normal categories. Also, HIV infected patient who took a resistance regimen got higher risk of developing hypertriglyceridemia 5.01 (95% CI = 1.41-17.7, p = 001) times greater who took a normal regimen. However, the HIV infected patients who was smoking , male , in favor of having sweetly and oily are in risk of the hypertriglyceridemia non-statistically significant (P > 0.05) , and the HIV infected patient who exercise and had chronic disease was the protective factor of developing hypertriglyceridemia. This might be from the medicine that reduce the triglyceride in their blood such as diabetes mellitus, gout and hypertension. However, there were the other variables which was non-statistically significant such as duration, blood pressure, and CD4 Level (P> 0.05)

Conclusion

In general, participants were male and female equally whose age mostly was between 31 and 45 years old. The majority of them were in obesity categories and the educational level was at elementary school. The vast majority of them were farmer and some of them were jobless (3.6 %). However, 67.6 percent of the HIV infected patients had hypertension disease, but 75.7 percent of the total had not underlying disease. CD 4 level of participant mainly was below 200 cell/ml (92.8 %). The proportion of HIV patient who were in high and extremely high category of triglyceride level was 25.9 percent of the total.

After analyzing by binary logistic regression, only Age, BMI, and resistance regimen was statistically significant, meaning that, These factors were the risk factor of developing hypertriglyceridemia In HIV infected patient in ARV clinic , Phayamengrai hospital. However, other factors were not statistically significant such as CD4 level, blood pressure, gender, dietary behavior, and smoking and alcohol drinking.

Discussion

The study found that females are more vulnerable to severe levels of hypertriglyceridemia, while males have a risk 1.28 times of developing this condition (95% CI 0.57-2.88) .This result is consistent with research of Thiebaut (2000) and Essen (2013), Moreover, the prevalence of hypertriglyceridemia in male account for 21.5 which is higher than female (15.16) .This is contrast to the study of Dragovic (2000) and Nsagha (2015) who found that women are at the greater risk of developing hypertriglyceridemia (OR = 1.6, 95% CI: 1.1-3.49, p <0.01) .If the participants grow older for one year, they will face the risk of developing hypertriglyceridemia 1.08 times (95% CI = 1.02-1.13, p = 0.03) consistent with the study of Shen (2013) and Health (2001) who found that getting older in each year experience the risk of developing hypertriglyceridemia 1.41 times (OR = 1.41 95% CI: 1.12. -1.77) . In addition, if the body mass index of participant get higher , they are likely to developing hypertriglyceridemia 4.69 times 95% CI = 1.73-12.7, P =. 0.02) . This result is consistent to the study of Lichtenstein (2001) and THIEBAUT (2000) who also found that body mass index associated with increasing of hypertriglyceridemia 1.23 times (OR = 1.23, 95% CI: 1.19-1.36, and. OR = 1.21, 95% CI: 1.07-1.36) .The HIV-Infected patient who take a resistance regimen are likely to become hypertriglyceridemia 5.01 times than the one taking a normal regimens (95% CI = 1.41-17.7, P = 0.01) . This result get along with the study of Hansen (2009) and Heath (2001) which taking a resistance regimen tend to be hypertriglyceridemia than who does not (OR = 1.6, 95% CI: 1.1-3.64; OR = 1.96, 95. % CI: 1.19-3.22; OR = 2.36, 95% CI: 1.1-3.64) , while the study of Jean Hansen (2009) and in Saint-Marc T (2000) found that taking a resistance regimens are the protective factor of being hypertriglyceridemia, meaning that the patients receiving zidovudine are at risk of hypertriglyceridemia (OR = 413 95% CI: 5.2-999 and OR = 3.42 95% CI: 1.73-6.74) ,and Miller (2003) found that NRTIs associate with hyperlipidemia.

However, there are no statistically significant variable found in this research. People who smoke have a risk of hypertriglyceridemia (OR_{adj} = 1.03, 95% CI = 0.31-3.39) which is consistent with the findings of Shen (2013) found that those who never smoke and still smoking can developing hypertriglyceridemia (OR = 1.86 95% CI: 0.9-3.85. and OR = 1.78 95% CI: 4.76-4.17) . Additionally, CD 4 level less than 200 is a protective factor in the occurrence of hypertriglyceridemia getting along with the research of Mauss (2002) and Sharifah (2016) who found that levels CD4 less than 200 are at risk of hypertriglyceridemia (OR = 2.2 95% CI: 1.1-4.6 and OR = 1.95 95% CI: 1-1)

Recommendation

All affiliated staffs in ARV Clinic, Phayamengrai Hospital, can launch the project aimed to enhance HIV patient directly to the impact of hypertriglyceridemia based on this research, for example, They can apply Knowledge Attitude Practice of hypertriglyceridemia project to HIV patient in order to reduce the morbidity rate, and this is likely to make HIV patient realize the adverse impact of hypertriglyceridemia. Also, qualitative research is recommended to implement to identify the further factors such as behavior. Therefore, the morbidity rate of the following comorbidity and the expense of the burden of hypertriglyceridemia in Phayamengrai hospital will be reduced.

Limitation

Shortage of time was the main problem in this research as this was likely to distort the result of this research, and the researcher were unable to collect the data of all HIV patient in ARV clinic. Besides, the questionnaires might not face the validity; the environment of interview room might distract the patient's attention from the questionnaire, and the dietary part should be more easier to understand as they may misunderstand once answering the questions – the result is likely to be affected by all of these aspects.

Acknowledgement

On behalf of researchers, we would like to acknowledge the header in Huai Kang Talad and Huai Kang Nalom Village, and the agriculturist in both villages. Also we are grateful to give a big thank to Dr. Denpong Wongwichit and . Dr.Phisanuruk Kantawee advisor from school of health science at Mae Fah Luang University , and Mrs.Praphaporn Chueamuangphan, Ms.Sririnporn Phupraserd and the officers in, Phayamengrai Hospital, Phayamengrai district ,Chiang Rai Province, Thailand.

References

Alcohol, T., Disorders, U., & Test, I. (2011). Alcohol Use Disorders Identification Test, 110. https://doi.org/10.1037/t01528-000

Carr A, Miller J, Law M, C. D. (2000). A syndrome of lipoatrophy, lactic acidaemia and liver dysfunction associated with HIV nucleoside analogue therapy: contribution to protease inhibitor-related lipodystrophy syndrome. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/10716495

Carr, A., Samaras, K., Burton, S., Law, M., Freund, J., Chisholm, D. J., & Cooper, D. A. (1998). A syndrome of peripheral lipodystrophy, hyperlipidaemia and insulin resistance in patients receiving HIV protease inhibitors. *Aids*, *12*(February 1998), F51–F58. https://doi.org/10.1097/00002030-199807000-00003

DragoviĆ, G., DaniloviĆ, D., DimiĆ, A., & JevtoviĆ, D. (2014). Lipodistrofija indukovana kombinovanom antiretrovirusnom terapijom kod HIV/AIDS bolesnika. *Vojnosanitetski Pregled*, *71*(8), 746–750. https://doi.org/10.2298/VSP121016022D

Hansen, B. R., Petersen, J., Haugaard, S. B., Madsbad, S., Obel, N., Suzuki, Y., & Andersen, O. (2009). The prevalence of metabolic syndrome in Danish patients with HIV infection: the effect of antiretroviral therapy. *HIV Med*, *10*(6), 378–387. https://doi.org/10.1111/j.1468-1293.2009.00697.x

Heath, K. V, Hogg, R. S., Chan, K. J., Harris, M., Montessori, V., O'Shaughnessy, M. V, & Montanera, J. S. (2001). Lipodystrophy-associated morphological, cholesterol and triglyceride abnormalities in a population-based HIV/AIDS treatment database. *AIDS*, *London*, *15*(2), 231–239. https://doi.org/10.1097/00002030-200101260-00013

Innovations, F. O. N., & Africa, I. N. (2015). Boletim HIV Mundo, 2000–2015.

Jantarapakde J, Phanuphak N, Chaturawit C, Pengnonyang S, Mathajittiphan P, Takamtha P, Dungjun N, Pinyakorn S, Pima W, Prasithsirikul W, P. P. (2014). Prevalence of metabolic syndrome among antiretroviral-naive and antiretroviral-experiencedHIV-1 infected Thai adults.

JERIC ´O, C., KNOBEL, H., MONTERO, M., ORDO˜NEZ-LLANOS, J., GUELAR, A., GIMENO, J. L., … PEDRO-BOTET, J. (2005). Metabolic Syndrome Among HIV-Infected. *Diabetes Care*, *28*(1), 132 – 137. https://doi.org/10.2337/diacare.28.1.132

Lichtenstein, K. A., Ward, D. J., Moorman, A. C., Delaney, K. M., Young, B., Palella Jr., F. J., … Investigators, H. I. V. O. S. (2001). Clinical assessment of HIV-associated lipodystrophy in an ambulatory population. *Aids*, *15*(11), 1389–1398. https://doi.org/10.1097/00002030-200107270-00008

Mauss, S., Corzillius, M., Wolf, E., Schwenk, A., Adam, A., Jaeger, H., … Goetzenich, A. (2002). Risk factors for the HIV-associated lipodystrophy syndrome in a closed cohort of patients after 3 years of antiretroviral treatment. *HIV Medicine*, *3*(1), 49–55. https://doi.org/10.1046/j.1464-2662.2001.00100.x

Miller, J., Carr, A., Emery, S., Law, M., Mallal, S., Baker, D., … Cooper, D. A. (2003). HIV lipodystrophy: Prevalence, severity and correlates of risk in Australia. *HIV Medicine*, *4*(3), 293–301. https://doi.org/10.1046/j.1468-1293.2003.00159.x

Nguyen, K. A., Peer, N., Mills, E. J., & Kengne, A. P. (2016). A meta-analysis of the metabolic syndrome prevalence in the global HIV-infected population. *PLoS ONE*, *11*(3), 1–27. https://doi.org/10.1371/journal.pone.0150970

Nsagha, D. S., Assob, J. C. N., Njunda, A. L., Tanue, E. A., Kibu, O. D., Ayima, C. W., & Ngowe, M. N. (2015). Risk Factors of Cardiovascular Diseases in HIV/AIDS Patients on HAART. *The Open AIDS Journal*, *9*(June 2012), 51–59. https://doi.org/10.2174/1874613601509010051

Petit, J. M., Duong, M., Duvillard, L., Piroth, L., Grappin, M., Verges, B., … Portier, H. (2000). HIV-1 protease inhibitors induce an increase of triglyceride level in HIV-infected men without modification of insulin sensitivity: a longitudinal study [In Process Citation].

Reiss, P., Cazanave, C., El-sadr, W., & Phillips, A. (2008). Incidence and risk factors for new-onset diabetes in HIV-infected patients. *Diabetes Care*, *31*(6), 1224–1229. https://doi.org/10.2337/dc07-2013.Incidence

Roth VR, Kravcik S, & Angel JB. (1998). Development of Cervical Fat Pads Following Therapy with Human Immunodeficiency Virus Type 1 Protease Inhibitors. *Clinical Infectious Diseases*, *27*(1), 65–67. https://doi.org/doi:10.1086/514639

Saint-Marc T, Partisani M, Poizot-Martin I, Bruno F, Rouviere O, Lang JM, Gastaut JA, T. J. (1999). A syndrome of peripheral fat wasting (lipodystrophy) in patients receiving long-term nucleoside analogue therapy. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/10509567

Saint-Marc T, Partisani M, Poizot-Martin I, Rouviere O, Bruno F, Avellaneda R, Lang JM, Gastaut JA, T. J. (2000). Fat distribution evaluated by computed tomography and metabolic abnormalities in patients undergoing antiretroviral therapy: preliminary results of the LIPOCO study. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/10714566

Sharifah, C., Omar, F., & Azwa, I. (n.d.). Prevalence , Risk Factors and Management of Hyperlipidemia Among Hiv-Infected Individuals Receiving Treatment.

Shen, Y., Wang, Z., Lu, H., Wang, J., Chen, J., Liu, L., … Zheng, Y. (2013). Prevalence of Anemia among Adults with Newly Diagnosed HIV/AIDS in China. *PLoS ONE*, *8*(9), 1. https://doi.org/10.1371/journal.pone.0073807

Thiébaut, R., Daucourt, V., Mercié, P., Ekouévi, D. K., Malvy, D., Morlat, P., … Dabis, F. (2000). Lipodystrophy, metabolic disorders, and human immunodeficiency virus infection: Aquitaine Cohort, France, 1999. *Clinical Infectious Diseases : An Official Publication of the Infectious Diseases Society of America*, *31*(6), 1482–7. https://doi.org/10.1086/317477

Viraben, R., & Aquilina, C. (1998). Indinavir-associated lipodystrophy, (January), 37–39.

World Health Organization. (2015). Tuberculosis and HIV. Retrieved from http://www.who.int/hiv/topics/tb/en/

World Health Organization. (2016a). Global health sector response to HIV, 2000-2015: focus on innovations in Africa. Retrieved from http://www.who.int/hiv/data/en/

World Health Organization. (2016b). HIV/AIDS. Retrieved from http://www.who.int/mediacentre/factsheets/fs360/en/

กองสุขศึกษาศุนย์เฝ้าระวังพฤติกรรมทางสุขภาพ. (2556). พฤติกรรมการบริโภค หวาน มัน เค็ม. กระทรวงสาธารณสุข.

ปริมากังวาล. (2015). สาธารณสุขเชียงรายเผย พบผู้ติดเชื้อ เอช ไอ วี รายใหม่กว่า 600 ราย เร่งรณรงค์ 1 ธันวาคม วันเอดส์โลกตรวจเร็วรักษาเร็วยุติเอดส์.Retrieved fromhttp://region3.prd.go.th/ct/news/viewnews.php?ID=151127123333.