Original Article

Preliminary Study of the Cause of Persistent High Coronary Risk Status and Effect of Applying Family Partnership Intervention Program in Asymptomatic Air Force Officers

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Abstract

OBJECTIVE: Over the past three years, cardiovascular disease (CVD) has become the leading cause of death among Thai military officers. Recent 10-yr cohort study in asymptomatic Air Force (AF) officers suggested that prevention of CVD was feasible by identifying high risk candidates (10-yr risk by the modified Coronary Risk Chart > 20%) for early treatment. At the same time, a failure in risk reduction could lead to catastrophic events. Most of the CVD cases, both acute coronary syndrome (ACS) and stroke, became persistent high risk candidates for three consecutive years. This study intended to explore the cause of risk reduction failure and to reduce the risk by having family member participation through the Family Partnership Intervention Program (FPIP).

MATERAIL AND METHODS: Inclusion criteria were asymptomatic male officers, age ranged from 35-60 years, who had persistent high coronary risk score (> 20% over 10 years) for two consecutive years despite receiving medication, had no CVD and had family members available for the FPIP. Exclusion criteria were officers of age < 35 and > 60 years, had serious illness (such as ACS, stroke, cancer, psychological disease) and had no family members available for participation. A personal interview to assess pre-existing risk factors and life style recommendations was conducted before and after the eight weeks period of FPIP.

RESULTS: Ten AF officers (average age of 55.2 ± 5.3 years) took part voluntarily. Most of them (70%) had a sedentary job and took prescribed medication. The common major coronary risk factors were hypercholesterolemia (80%), hypertension (60%), diabetes mellitus (40%), and impaired fasting glucose (40%). Insufficient knowledge was the major cause of persistent high CVD risk status. It led to several unhealthy habits including having an atherogenic diet (high animal fat, low fiber and sweet) 100%, exercise less than twice a week 90%, cigarette smoking 30%, self-reported mental stress 30% and poor medical compliance 14.2%. After 8-weeks of FPIP, 60% of candidates were able to reduce their high risk status to the intermediate group (predicted ris 10-20%) in five cases and to low risk group (predicted risk 5-10%) in one case. Although, serum triglyceride and HDL cholesterol were not significantly different, total cholesterol reduced from 224 ± 26.1 to 191 ± 30.7 mg/dl, $p = 0.005$, and blood glucose decreased from 118 ± 22.0 to 103 ± 15.4, $p = 0.016$.

CONCLUSION: Ineffective group education and insufficient preventive knowledge led to unhealthy life style decisions and caused persisting high CVD risk status. Individual approach by setting common goals and having family member participation could reduce the predicted CVD risk in 60% of cases. The major limitation of the study was the small number of cases and the short term study of only AF officers. These results may not be applied to general population and may not guarantee the long term outcome beyond eight weeks. However, this study was the first one to identify the cause of persistent high CVD risk status of AF officers and offer a better way of effective risk reduction.

Keywords: modifiable coronary risk factors, modified Coronary Risk Chart, high cardiovascular risk, failure in risk reduction, family partnership intervention program, asymptomatic Air Force officers, cardiovascular diseases (CVD)

Cardiovascular diseases (CVD) i.e. ACS, stroke, remains the number one killer of people worldwide. In 2016, an estimated 17.9 million people died from CVDs, accounting for 31% of the global deaths. Of these deaths, 85% were from heart attack and stroke.[1] In Thailand, a report from the Ministry of Public Health indicated a higher morbidity and mortality due to CVD more than the past. From 2007-2014, our rate of morbidity from ischemic heart disease (CAD) and stroke increased 24% and 41% respectively.[2] The mortality of CAD rose from 21.3 to 28.9:100,000 (2008-2014) and the stroke death rate increased from 20.8 to 31.7:100,00 (2008-2012).[2,3] Since 2015, CVD has become the leading cause of death, in about one-third, of Thai military officers.[4] With no effective prevention, it could compromise future military missions. However, the recently published 10-yr cohort study suggested that prediction and prevention of future CVD events in asymptomatic cases was feasible.[5] By using a screening tool, the modified Coronary Risk Chart (mCRC), available at http://caprecvdrisk.com/CV-DRiskScore/5, allowed for the high (> 20%) predicted CVD risk officers to be identified, treated early and their subsequent CVD events have been reduced.[5] At the same time, failure in risk reduction also led to the worst outcomes. Most ACS (100%) or stroke (72.5%) cases developed clinical events after sustaining their high risk status for three consecutive years.[5] It remained unknown why these high risk officers, who received group education for life style modification and free of charge medication, still failed to improve their CVD risk. Thus, our study intended to explore the etiology of risk reduction failure. By correcting the cause, they might be saved from future catastrophic events. We also believed that their spouses could be the strong facilitators for creating a healthy environment at home so the Family Partnership Intervention Program (FPIP) was created. The result of the FPIP was studied at the end of 8 weeks.

Material and Methods

The study was divided in two parts, the descriptive study, to define the cause of failure in risk reduction by personal interview, and the quasi-experimental study, to analyze the result of applying 8-week FPIP. **Inclusion criteria:** Asymptomatic male AF officers, of age range 35-60 years, who had persistent high mCRC risk (predicted 10-yr CVD risk > 20%) for two consecutive years, had no CVD and had an available spouse to participate in the FPIP. **Exclusion criteria:** We excluded any symptomatic officers, age < 35 or > 60 years, who had CVD or serious illness such as cancer, psychological disease, secondary causes of hyperlipidemia and had unavailable family members. After approval by the research committee, these persistent high risk AF officers voluntarily enrolled in the Preventive clinic, Division of Preventive Medicine, Directorate of Medical Office, Royal Thai Air Force.

The detail of the study flow is shown in Figure 1. The personal interview and discussion were conducted in a separate room of the Preventive Clinic in additional time allocated to their regular physician visit. The candidate life styles were focused in five areas: dietary habit, smoking cessation, stress by self-evaluation, exercise pattern and compliance of medication. Results of pre and post intervention after eight weeks of FPIP were compared for both behavioral risk profiles and the biochemical variables included fasting blood glucose, total cholesterol, triglycerides and HDL cholesterol. The continuous variables were displayed by mean ± standard variation and median. The categorical data was shown by percent proportion. The median variables before and after intervention were compared by the Wilcoxon signed - rank test. Statistical significance was considered if the p value was below 0.05. The Family Partnership Intervention Program (FPIP) was created to bring family members (spouse) participating in life style modification by recognizing the pre-existing risk, setting a common goal and supporting the program. In this study, no home visit was done due to the time constraints and to prevent inconveniencing candidates.

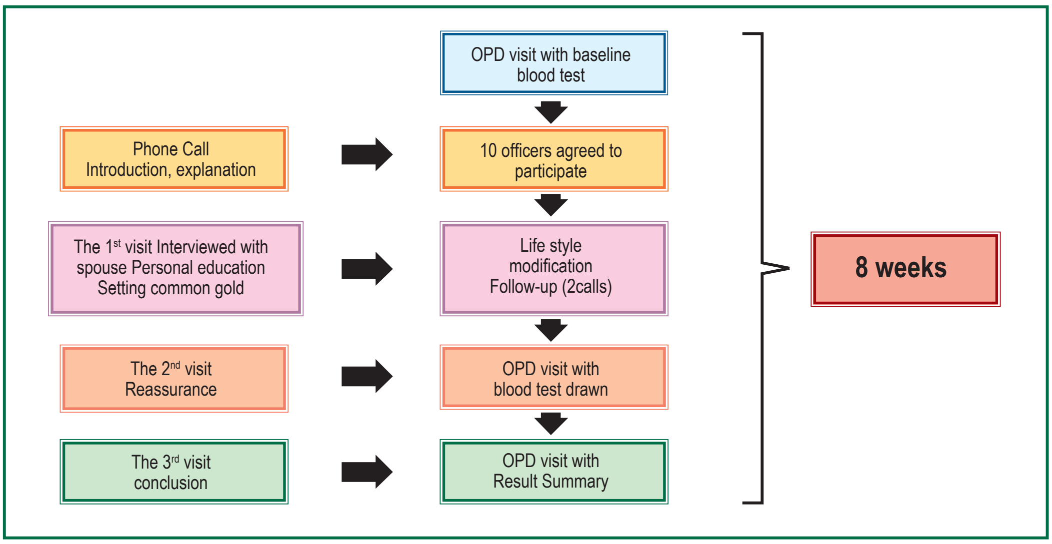

Figure 1: The study work flow

The definition of major coronary risk factors[5,6] included: hypertension (defined as blood pressure, BP > 140/90 mmHg taking after rest for at least 10 minutes on two separate occasions), hypercholesterolemia (total serum cholesterol ≥ 200 mg/dl), hypertriglyceridemia (serum TG ≥ 180 mg/dl), low high density cholesterol (HDL-C < 39 mg/dl in men and < 43 mg/dl in women), impaired fasting glucose (plasma glucose > 100, < 125 mg/dl after fasting for 12 hours), diabetes mellitus (fasting glucose was ≥ 126 mg/dl). Heart healthy life style recommendations were adapted from the 2016 European Preventive Guideline[8] which we simplified into five areas: healthy diet (low cholesterol, high fiber and low sugar), encourage smoking cessation, self-management stress reduction, regular aerobic exercise for 30 minutes at least three times a week and regular medication.

Results

Ten participants voluntarily signed the informed consent for participation. All of them met the above criteria and had an average age of 55.2 ± 5.3 years. Most of them (70%) had a sedentary job and all of them were overweight with the mean body mass index of 26.3. The common pre-existing risk factors were hypercholesterolemia 80%, hypertension 60%, Diabetes Mellitus 40% and impaired fasting glucose 40%. Interviewed data analysis indicated that all of them did not know the details of a heart healthy life style. All candidates (100%) frequently took atherogenic (low fiber, high cholesterol and high sugar) diet and most of them (90%) exercise less than twice a week, see Table 1. Cigarette smoking was found in 30% and one -third of cases admitted having mental stress. Six of seven cases (85.7%) who had prescribed medication had full compliance. None of the candidates took any supplement drugs.

After eight weeks of FPIP, all but one (90%) of them had changed their dietary pattern by reducing animal fat (90%), carbohydrate (60%), oily food (30%), adding more vegetables (70%), see Table 2. Most (80%) of them exercised more than three times a week and improved medical compliance to 100%, see Table 2. However, mental stress and cigarette smoking remained unchanged. While the HDL cholesterol (HDL-C) and triglycerides (TGs) were not statistically significantly different, the median total cholesterol and blood glucose reduced from 224 ± 26.1 to 191 ± 30.7 mg/dl, $p = 0.005$ and from 118 ± 22.0 to 103 ± 15.4, $p = 0.016$ respectively, see Table 3. After intervention, 60% of these high risk participants were able to lower their risk to 10-20% in five cases and very low risk (< 5%) in another

Table 1: The baseline parameters of ten persistent high CVD risk candidates is shown below. The laboratory values were obtained from the day of risk assessment. Seven cases (70%) took current prescribed medication but only six of them (87.5%) had full compliance. Case no. 8 and 10 were on diet control.

Case (Age (Years))	FBS	T. chol	SBP	TG	HDL-C	BMI	Atherogenicdiet	Cigarett smoking	Mental stress	Exercis >3/wk	Reg. Med.	CVD risk
1 (52)	103	205	140	119	53	26.1	Yes	No	No	No	Yes	> 20%
2 (58)	124	229	161	176	51	25.9	Yes	No	No	No	Yes	> 20%
3 (58)	156	246	142	154	48	26.9	Yes	No	Yes	No	Yes	> 20%
4 (55)	106	226	140	262	35	26.6	Yes	No	Yes	Yes	No*	> 20%
5 (57)	140	180	161	99	51	25.6	Yes	No	No	No	Yes	> 20%
6 (59)	98	265	132	114	59	27.4	Yes	No	No	No	Yes	> 20%
7 (51)	91	213	135	252	47	25.8	Yes	No	No	No	Yes	> 20%
8 (57)	128	240	136	117	61	26.2	Yes	Yes	No	No	Diet	> 20%
9 (57)	101	196	138	217	33	27.5	Yes	Yes	No	No	Yes	> 20%
10 (41)	105	246	132	353	45	25.7	Yes	Yes	Yes	No	Diet	> 20%
Med.	109	229.5	138	186.5	48	26.1	100%	30%	30%	10%	87.5%	100%

Abbreviation: FBS: fasting blood sugar, T.Chol: serum total cholesterol, SBP: systolic blood pressure, TG: serum triglyceride, HDL-C: serum high density cholesterol, BMI: body mass index, Cig: cigarette smoking, Reg. Med.: regular medication, CVD: Cardiovascular Disease

Table 2: The outcome parameters after 8 weeks of FFP are displayed below. All but one of the participants reduced animal fat which was the major source of cholesterol-rich diet. Most of them (80%) exercised more than three times a week. Full medical compliance was achieved in all who received prescription medication.

Case (Age (Years))	FBS	T. chol	SBP	TG	HDL-C	Healthy Diet	Cigarett smoking	Mental stress	Exercis >3/wk	Reg. Med.	CVD risk
1 (52)	98	192	125	145	50	Less fat, oil, more veg	No	No	Yes	Yes	<5%
2 (58)	126	194	157	128	47	less fat, oil, more fish, veg	No	No	No	Yes	> 20%
3 (58)	119	120	136	75	48	Less fat, carb, oil, more veg	No	Yes	Yes	Yes	10-20%
4 (55)	83	188	142	137	42	Less fat, carb, more veg	No	Yes	Yes	Yes	10-20%
5 (57)	119	171	140	153	50	Less fat, carb, no soda	No	No	Yes	Yes	10-20%
6 (59)	99	218	140	135	46	Less fat, carb, more veg	No	No	Yes	Yes	10-20%
7 (51)	89	207	141	600	30	Less fat, oil, more veg	No	No	Yes	Yes	10-20%
8 (57)	111	227	147	174	47	Less fat, carb, more veg	Yes	No	Yes	Diet Control	> 20%
9 (57)	83	181	153	283	31	Less fat, carb, oil, more veg	Yes	No	Yes	Yes	> 20%
10 (41)	103	217	142	344	48	uncharged	Yes	Yes	No	Diet Control	> 20%
Med.	101	193	141.5	149	47	90%	30%	30%	80%	100%	

Abbreviation: see Table 1, carb: carbohydrate), veg: vegetable, med: median value

Table 3: The biochemical parameters at baseline and after 8-wk of FPIP were compared. The median total cholesterol and fasting glucose were significantly reduced with the *p*-value of below 0.05.

	Pre Mean	Post Mean	Pre Median	Post Median	*p*
Systolic BP (mmHg)	138 ± 15.6	141 ± 8.6	138	141.5	0.477
Fasting glucose (mg/dl)	118 ± 22.0	103 ± 15.4	109	101	0.016*
Total cholesterol (mg/dl)	224 ± 26.1	191 ± 30.7	229.5	193	0.005*
Serum triglyceride (mg/dl)	186 ± 83.0	217 ± 156.1	186.5	149	0.575
Serum HDL-C (mg/dl)	48.3 ± 9.0	43.8 ± 7.4	48	47	0.123

*$p < 0.05$

Table 4: The major coronary risk profiles of our case study and the ACS patients in the Thai ACS Registry [12] were compared.

	This Study	TACSR[12]
n	10	9,373
Year study	2017 - 2018	2002 - 2005
Mean age	55.2	65.3
Men (%)	100	59.8
DM (%)	40	44.2
IFG (%)	40	NA
High Cholesterol (%)	80	75.7
Hypertension (%)	60	13.9
Smoking (%)	30	32

Discussion

CVD has multifactorial causes and a long latent period of manifestation. The cardiovascular risk increased by the time of exposure to underlying risk factors. While age, gender and genetic background could not be modified, other risk factors (high serum cholesterol, hyperglycemia, cigarette cessation, sedentary life style, mental stress etc.) are still correctable.[9] Previous epidemiological studies had confirmed the impact of controlling these risk factors in CVD events reduction.[5,10,11] In Finland, the decline of CAD mortality (1972-92), 55% in men and 68% in women, were mostly due to the reduction of three major risk factors, hypercholesterolemia, hypertension and smoking.[10] Controlling similar risk factors in US men also contributed to 44% reduction of age-adjusted death rate of CAD, from 542.9:100,000 in 1980 to 266.6:100,000 in 2000.[11]

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In Thailand, the 10-year prevalence of ACS and stroke in intermediate and high risk AF officers has been reduced after controlling their major risk factors.[5]

Our studied population truly represented the high-risk candidates for developing future CVD. Their pre-existing major risk profiles were close to those of the ACS patients in the Thai ACS Registry (2002-5)[12] except they were ten years younger but had more hypertension, see Table 4. In addition, an impaired fasting glucose (IFG 100-125 mg/dl, pre-diabetes) or diabetes mellitus and hypercholesterolemia were found in 80% of our study cases. The impact of pre-diabetes condition on CVD risk has been documented in previous studies.[13,14] In the four-year cohort study of the Framingham offspring, the rate of CAD events increased along with the level of plasma glucose, from 2.9% (100-109 mg/dl), 3.0 % (110-125 mg/dl) and 8.7 % (for 126 mg/dl or more).[15] Systemic review of 8 publications also confirmed the modest relative risk of IFG (100-125 mg/dl) of 1.18 (95% CI:1.09-1.28).[16] Combinations of these risk factors were synergistic and increased the likelihood for development of CVD in future.[5-9]

By analysis of the interviewed data, it was clear that our candidates still had insufficient knowledge for healthy life style. Most cases not only had a sedentary job but all of them exercised less than twice a week. Sedentary lifestyle and physical inactivity are known modifiable risk factors for CVD.[9,15] In addition, all candidates had regular atherogenic diet i.e. high animal fat (cholesterol-rich), high sugar and low fiber. Cigarette smoking and self-admitted stress was observed in 30% of cases. All of these findings not only explained why they could not improve their CVD risk but also reflected the failure of previous group education. By sitting with all candidates and spouses, common target goals were set and planned. They were followed by two additional phone calls and two more visits.

At the end of eight weeks, 90% of candidates reduced dietary animal fat, carbohydrate (sugar), oily food and added more vegetable by 90%, 60%, 30% and 70% respectively. In addition, full compliance was observed in all seven cases who took prescribed medication and moderate aerobic exercise (at least three times a week) was performed in 80% of cases. Retarding or even regression of atherosclerosis had been reported in CAD patients after vigorous risk factor modification[16] including regular exercise, low fat,[17] vegan diet and medication.[18] Regular aerobic exercise could increase coronary microcirculation, improve endothelial, muscular function and glucose utilization [19,20]. All of these changes contributed to the decline of the median total cholesterol from 229.5 to 193 mg/dl, p = 0.006, plasma fasting glucose from 109 to 101 mg/dl, p = 0.016 and the CVD risk status in 60% of cases. However, two metabolic parameters remained unchanged, the HDL-C and TGs. Although regular aerobic exercise could increase the HDL-C level,[21,22] it required continuous endurance training such as marathon runner or triathlon[21-23] and for at least 20 weeks duration.[24] So we did not expect the increment of HDL-C in our study. From Table 2, three candidates (case no.7,9,10) still had remarkably high triglycerides, ranging from 283-600 mg/dl on the final blood test. One case (no.10) did not change diet and later he admitted having alcohol beverage three days a week which was likely the cause of hypertriglyceridemia. One case (no.7) had very high triglycerides and was lost at follow-up after the study. It was common that officers did not want to report drinking alcohol in their medical files. Another case (no.9) had stopped alcohol for two years and had been followed up in clinic so the cause of dyslipidemia remained to be established. Obviously, these failure groups needed more time and probably additional programs to lower their risk.

Several limitations existed in our study including the small number of cases, the short term of the study (8 weeks) and including only AF officers. Results might not be applicable to other population groups. In addition, the long term success in CVD reduction remained to be established. Despite having spouse involvement, smoking and mental stress remained unchanged in 30% of cases so more effective programs such as smoking cessation, stress reduction should be provided. Metabolic evaluation should be improved, for example measurement of HbA1C or serial lipid values would be more accurate to assess the average plasma glucose and lipid during the preceding eight weeks. Candidates should be more strictly informed not to take alcohol during the study period.

Conclusion

Despite the above limitations, this is the first study in asymptomatic AF officers to clarify the probable causes of persistent high CVD risk. It also offers a better way of risk reduction by FPIP. It was clear that all six successor candidates did exercise more frequently (100%), taking regular medication (100%) and changed to a healthier diet (100%). Other options for lowering CVD risk in non-successor group should be initiated such as coaching by a patient expert (a volunteered former CAD case), stress reduction program and smoking cessation with nicotine supplement should be provided. Long term study is mandatory to establish the success of CVD risk reduction. Finally, we would like to sincerely thank all candidates and their spouses for their dedication, members of Preventive clinic, Division of Preventive Medicine, Directorate of Medical Office, Royal Thai Air Force and all advisors for their tremendous support.

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