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The Effect of Job Stress and Lifestyle on Blood Lipid Levels in Male Aircrew Personnel

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Introduction. Cardiovascular disease has the potential to lead to sudden in-flight incapacitation and permanent grounding. The aims of this study are to examine the relationships between lifestyle, job stress and blood lipid levels of male aircrew personnel of a Korean airline and to identify which factors influence their hyperlipidemia.

Methods. Two hundred sixteen male aircrew personnel completed a questionnaire by self-report and consented to participate in the study. The questionnaire collected data related to job stress, life style, serum cholesterol levels and general characteristics of the aircrew. The cholesterol levels of the subjects were collected from their most recent health check-up records. Subjects were divided into two groups (the desirable group and the risk group) based on their serum cholesterol level, 200 mg/dl.

Results. Mean age and marital status were significantly different between the two groups. More subjects in the risk group had habits of eating high lipid foods, while more subjects in the desirable group exercised more frequently than the risk group. In logistic regression analysis, after controlling age and marital status, types of working situation (domestic duty or international duty, odds ratio=.390, p=.018), diet (odds ratio=.429, p=.037), and exercise (odds ratio=.320, p=.055) were influencing factors on aircrew's serum cholesterol levels.

Conclusions. The cholesterol level of aircrew personnel is closely related to their lifestyle, such as lipid diet and exercise. The type of work situations, e.g. staying in an airplane for long periods of time or staying abroad, may influence these diet patterns and exercise habits.

Key Words : Serum cholesterol, Job stress, Life style

INTRODUCTION

The recent dramatic development of the Korean economy has had a profound impact on the people's lifestyles. For example, the purchase of cars has contributed to decreased individual physical activity, westernized diet patterns increased the ingestion of lipids, and job related stress caused an increase in alcohol consumption. Due to the changes in lifestyle, the disease patterns and causes of death in Korea have changed significantly. For example, the death rate related to artherosclerosis, ischemic heart disease, and cerebrovascular disease has increased six times compared to ten years ago. In particular, Korean men in their forties and fifties have the highest prevalence rate in diseases related to cardiovascular risk factors (Korea National Statistical Office, 2002).

Cardiovascular disease is considered one of the potential causes of sudden in-flight incapacitation. This was re-

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vealed in a study by Taneja and Wiegmann (2000) to detect a relationship between cardiovascular abnormalities of pilots and fatal aviation accidents. They discovered that 44% (234 pilots) of autopsies performed on pilots who were involved in fatal fixed-wing general aviation accidents revealed the presence of cardiovascular abnormalities, and 7.67% (41 pilots) showed evidence of severe artherosclerosis of the left coronary artery.

Hyperlipidemia is a main risk factor developing coronary heart disease. Levels of serum HDL, serum LDL, and total serum cholesterol have been used to screen this risk factor (Keech & Sleight, 1992; Uhl, Troxler, Montgomery & McGranahan, 1981) by airline companies in France, Germany, Canada, and Denmark. All airline companies in Korea also strictly check blood lipid levels of potential aircrew candidates before recruitment because of the possibility of developing coronary heart diseases. In addition to considering blood lipid levels of aircrew candidates during recruitment, the companies required aircrew to keep their blood lipid levels within a desirable range by strict individual health management (diet and exercise) after their employment (Keech & Sleight, 1992). Although they tried to maintain a good health management routine, cardiovascular disease was the most common cause for groundings of commercial flight aircrew between 1970-1990 in South Korea (Lee, Kay, Park, & Kwak, 1992).

To train a pilot it costs about one hundred and fifty million won. Pilot trainees are required to do more than two years of additional training after graduation from an aviation university program. Therefore, proper health management for aircrew personnel especially pilot and flight engineers is important for personal health maintenance as well as for the economy as a whole. It is necessary to investigate factors that affect cardiovascular diseases in aircrew and to implement interventions that control those influencing factors.

Hyperlipidemia is developed by inherent variables such as age, gender and race (Aronown, 1999; Rosenberg, Palmer, Rao & Adams-Campbell, 1999), as well as by lifestyle choices such as diet, smoking, obesity, exercise, and stress which are controllable by personal efforts (Kawada, 2002; Keech & Sleight, 1992; Niedhammer, Goldberg, Leclerc, David & Bugel, 1998). Consequently, this study had two main aims: (1) to examine the lifestyle, job stress and blood lipid levels of male Korean aircrew personnel, and (2) to identify which factors influence their hyperlipidemia.

METHODS

Research Design

This study is a descriptive survey that identifies the influencing factors on cholesterol levels of Korean airline aircrew personnel.

Subjects and Data Collection Procedures

The accessible population of this study was an aircrew (e.g. captain, first officer, flight engineer) working for a commercial flight company in Korea and currently participating in a flight. Flight attendants were not included in this study as subjects. The subjects were 216 male aircrew who completed a questionnaire by self-report and consented to participate in the study. They were informed that individual results were strictly confidential and anonymous and agreed that their regular health check-up data were used for this study. Job stress, lifestyle, and other demographic information were acquired by means of a questionnaire. Data on serum lipid levels were collected from each aircrew's most recent health check-up record.

Instrument

Job stress

Job stress can be defined as the imbalance between the recognition of one's own capabilities on his or her job and the demands of the job itself (Seward, 1997). Job stress was measured using Job Content Question-naire that was developed by Karasek, et al. (1998). The original questionnaire has been used to predict job-related stress and coronary heart disease in the U.S. and Sweden (Karasek et al., 1998). There were nine items for decision latitude and five items for job demand used for this study. Each item consists of the four point Likert scale from strongly disagree to strongly agree. Finally, job stress was calculated with this method, job demand scores divided by job latitude scores. A higher score means that they experience a higher level of job stress. Cronbach's α·coefficient for the instrument was .71 in this study.

Life style

This study investigated the lifestyle related to high levels of cholesterol. The lifestyle of subject was categorized based on previous studies (Kwon, 1992; Lee et al., 1992; Lee, Lee, Lee & You, 1997). The usual habit of fat ingestion was also investigated as low fat diet, medium fat diet, and high fat diet. If the subjects ate fish, veg-

etable, and chicken without skin, they were categorized as a low fat ingestion group. Subjects who usually ate meat without fat and chicken with skin were categorized into the medium fat diet group. The subjects who enjoyed foods like pork, beef, liver, internal organs, hamburger, and squid, were categorized into the high fat group. The frequency of exercise within the last six months was also asked. The categories were 1) more than three sessions of strenuous exercise (e.g. accompanying sweating and shortness of breath) per week; 2) more than one session of strenuous exercise per week; 3) light exercise; and 4) almost never exercising.

In addition to diet habits and exercise, alcohol consumption habit within a six months period was investigated. Subjects did not count light alcohol consumption but only reported the frequency that they drank heavily (e.g. they staggered after drinking). The categories for the alcohol consumption were 1) never for last six months; 2) once within six months; 3) once within three months; and 4) once within a month. Subjects checked their smoking habits in one of the three categories: non-smoker, ex-smoker and smoker.

Blood cholesterol level

According to an Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in U.S. Adults (2001), risk blood cholesterol level for individuals without CHD is below 200mg/dl. The cholesterol level of 200 - 239mg/dl is classified as "borderline-high blood cholesterol" and the cholesterol level of 240mg/dl and above is classified as "high blood cholesterol". When the subjects had greater than 200mg/dl in total serum cholesterol, they were classified as a risk group in this study.

Data Analysis

Data for two female aircrew personnel out of the total

Table 1. Total Cholesterol Level of Subjects (N=216)

	n (%)	Cholesterol level (mg/dl)		
		M (SD)	Min	Max
All Subjects	216	191.79±31.00	95	282
Desirable group (<200 mg/dl)	125 (57.9)	171.09±20.32	95	199
Risk group (200mg/dl)	91 (42.1)	220.23±17.70	200	282

Table 2. Differences in General Characteristics and Characteristics Related to Aviation Between Two Groups

	Total subjects n (%)	Desirable group n (%)	Risk group n (%)	X^2 test	p-value
Education (N=215)					
College graduate	16 (7.4)	9 (7.3)	7 (7.7)	0.014	.552
University graduate and higher	199 (92.6)	115 (92.7)	84 (92.3)		
Marital status (N=207)†					
Single	11 (5.3)	10 (8.5)	1 (1.1)		.025‡
Couple	196 (94.7)	107 (91.5)	89 (98.9)		
Religion (N=216)¶					
Christian	61 (28.3)	28 (22.4)	33 (36.3)	0.150	.105
Buddhist	30 (13.9)	21 (16.8)	9 (9.9)		
Catholic	42 (19.4)	27 (21.6)	15 (16.5)		
Others	83 (38.4)	49 (39.2)	34 (37.4)		
Type of work situation (N=216)**					
Domestic duty	52 (24.1)	35 (28.0)	17 (18.7)	2.502	.077
International duty	164 (75.9)	90 (72.0)	74 (81.3)		
Crew status (N=215)††					
Captain	93 (43.3)	52 (41.6)	41 (45.6)	3.138	.208
First Officer	113 (52.6)	70 (56.0)	43 (47.8)		
Flight engineer	9 (4.2)	3 (2.4)	6 (6.7)		
	Total subjects M±(SD)	Desirable group M±(SD)	Risk group M±(SD)	t-test	p value
Age	42.48±7.37	41.40±7.25	43.96±6.95	-2.547	.012§
Flight time (for last 6 months)	358.82±141.52	361.14±149.30	355.65±130.82	0.281	.779

*, , ¶, **, †† Numbers of total subjects are different by items because of missing data

†Fisher's exact test was performed.

‡indicates significant ($p<0.05$) differences between the two groups.

number of subjects was excluded in the final analysis for homogeneity of the sample. Subjects were divided into two groups (desirable group and risk group) by the level of total serum cholesterol. The serum cholesterol level of the subjects was analyzed using descriptive statistics. Chi-square tests and t-test were used to analyze differences between the two groups in terms of general characteristics, characteristics related to aviation, life style, and job stress. Logistic regression analysis was employed to determine influencing factors of hyperlipidemia among the aircrew.

RESULTS

Total Cholesterol Level of the Subjects

Cholesterol level of the subjects is presented in Table 1. The range of cholesterol level in the risk group was from 200 mg/dl to 282 mg/dl. The range of cholesterol level in the desirable group was from 95 mg/dl to 199 mg/dl.

Characteristics of Subjects

Employment periods of the subjects in the airline company ranged from one year and one month to thirty-two years (M=9.9 years). Differences in general characteristics and features associated with aviation between the two groups are shown in Table 2. The mean age of the desirable group was less than that of the risk group and this difference was significant (p=.012). More subjects in the desirable group were married than those in the risk group, and this difference was also significant (p=.025). Most subjects completed a university education and higher. The majority of the subjects were working in international duty. Mean flight time of the desirable group and the risk group for last six months was 36.114±149.30 and 355.65±130.82, respectively. There were no significant differences between the two groups in other variables such as crew status, flight time for last six months, and type of work situation.

Their work situation usually moved between international duty and domestic duty followed by standardized rules. First two years of working in domestic duty as captain and first officer followed by next seven or eight years of international duty.

Comparison between the Desirable Group and Risk Group in Lifestyle and Job Stress

Differences in lifestyle between both groups are shown

Table 3. Differences in Lifestyle and Job Stress Between Two Groups (N=216)

	Total subjects n (%)	Normal group n (%)	Risk group n (%)	X^2 test	*p*
Diet					
low lipid diet	74 (34.3)	49 (39.2)	25 (27.4)	3.258	.196
moderate lipid diet	68 (31.5)	37 (29.6)	31 (34.1)		
high lipid diet	74 (34.3)	39 (31.2)	35 (38.5)		
Smoking habit					
non-smoker	34 (15.7)	19 (15.2)	15 (16.5)	0.885	.642
ex-smoker	79 (36.6)	49 (39.2)	30 (33.0)		
smoker	103 (47.7)	57 (45.6)	46 (50.5)		
Heavy drinking					
never for last 6 months	101 (51.9)	56 (48.3)	45 (54.9)	1.391	.710
once for 6 months	44 (22.2)	26 (22.4)	18 (22.0)		
once for 3 months	28 (14.1)	17 (14.7)	11 (13.4)		
more than once for a month	25 (12.6)	17 (14.7)	9 (9.8)		
Strenuous Exercise					
more than 3 times for a week	49 (22.7)	26 (20.8)	23 (25.3)	1.991	.574
less than 2 times for a week	71 (32.9)	41 (32.8)	30 (33.0)		
light exercise	74 (34.3)	47 (37.6)	27 (29.7)		
no exercise	22 (10.2)	11 (8.8)	11 (12.0)		
	Total subjects M±(SD)	Normal group M±(SD)	Risk group M±(SD)	t-test	*p*
Job stress (demand/latitude)	0.4937±8.3E-02	0.4868±7.9E-02	0.5032±8.82E-02	-1.433	.153
demand	31.412±4.349	31.280±4.328	31.593±4.417	-.521	.603
latitude	64.380±7.927	64.896±7.485	63.670±8.487	1.123	.263

in Table 3. In general, life style routines, such as lipid diet pattern, smoking behavior, alcohol consumption, and exercise were related to cholesterol level. In this study, more subjects in the risk group had habits of eating high lipid foods. More subjects in the desirable group had exercised more frequently than the subjects in the risk group. However, these differences were not statistically significant. The mean demand score of the risk group (31.593±4.42) was greater than that of the desirable group (31.280±4.33) and the mean decision latitude score of the risk group (63.670±8.49) was less than that of the desirable group (64.896±7.49). However, the job stress (demand/latitude) of the risk group was not significantly different with the job stress of the desirable group (t =-1.433, p=.153).

Influencing Factors on Cholesterol Levels of the Aircrew

In logistic regression, independent variables included types of working situations, smoking, diet, alcohol consumption, exercise, age, job stress, and marital status. With the exception of age and job stress, other variables were labeled as dummy variables for analysis (Table 4). Whether cholesterol level is within the desirable range or above the desirable range was entered as the dependent variable with 1 = the cholesterol level is above 200 mg/dl and 0 = cholesterol level is below 200 mg/dl. The logistic regression model was significant (X^2 =34.482, p=.002). The significant predictors of high cholesterol level were the types of working situation, lipid diet, exercise and age. Whenever age is increasing by every unit, the odds ratio of abnormal cholesterol level is increased as much as 1.066 times. The odds ratio of high cholesterol level is .429 when subjects enjoyed a low lipid diet rather than high lipid diet. Compared to no exercise, when subjects had light exercise, the odds ratio of abnormal cholesterol level was reduced (odds ratio=.320). The odds ratio of higher cholesterol level also decreased

Table 4. Prevalence Odds Ratios and Their 95% Confidence Intervals of Affecting Variables on High Cholesterol Level in Logistic Regression Analysis

Variables	B	95% Confidence Interval		*p*	odds ratio
		Lower	Upper		
Marital Status					
Currently Single					
Couple	1.519	.490	42.556	.182	4.568
Age	.064	1.016	1.118	.010*	1.066
Types of work situation					
International duty					
Domestic duty	-.941	.180	.848	.018*	.390
Smoking habit					
Smoker					
Ex-smoker	-.679	.242	1.065	.073	.507
Non-Smoker	-.548	.203	1.646	.305	.578
Diet					
High lipid diet					
Moderate lipid diet	-.641	.234	1.182	.120	.527
Low lipid diet	-.847	.193	.950	.037*	.429
Heavy drinking					
More than once for a month					
Once for 3 months	.486	.464	5.694	.447	1.626
Once for 6 months	.782	.677	7.057	.191	2.186
Never for last month	.862	.826	6.787	.108	2.368
Strenuous Exercise					
No exercise					
Light exercise	-1.139	.100	1.024	.055*	.320
Less than 2 times for a week	-.868	.133	1.325	.139	.420
More than 3 times for a week	-.202	.246	2.711	.741	.817
Job Stress	3.722	.825	2072.86	.062	41.346

*indicate a significant ($p < 0.05$) differences between the two groups

when subjects worked in domestic duty (odds ratio=.390).

DISCUSSION

This research was undertaken to identify which factors relating to aircrew's lifestyle caused the development of hyperlipidemia after recruitment. The study shows lifestyle modification would be useful in preventing coronary heart disease.

In the study, 42.1% of individuals were in the risk group. This was 21% higher than the U.S. army aircrew (Fitzpatrick & Shannon, 1992), but similar to the U.S. combat aircrew, which was around 40% (Copp & Green, 1991). As the results indicate, around half of the individuals are in the risk group, so it is essential to carry out intervention by trying to control each individual's blood cholesterol level.

Currently in South Korea, any member of an aircrew whose annual health check up result is over 200 mg/dl of total serum cholesterol level or has HDL level lower than 40 mg/dl is to be the subject of management for follow-up. Health management for aircrew basically has to be approached with a primary prevention scheme not with tertiary prevention, carrying out follow-up care for risk individuals. Prevention of development into risk group individuals by lifestyle modification is also important.

The result of comparative analysis of general characteristics between the desirable group and the risk group showed that there were significant differences in age and marital status. The risk group mean age was 2.5years higher than that of the desirable group. Cholesterol level was increasing with age because of the decreasing function of the fat metabolism in the body (Aronow, 1999). Therefore, the U.S. air force applied different cholesterol limitation criteria according to age when implementing every two-year CARE (Coronary Artery Risk Evaluation) program, i.e., 200 mg/dl for those in their 20 s, 220 mg/dl in their 30 s, 240 mg/dl in their 40 s. Also, they implemented the detailed lipid test when someone had a history of hyperlipidemia in one's family or total cholesterol was above 230 mg/dl and total cholesterol vs. high density lipoprotein was above 60 (Steinhouser & Stewart, 1989). In South Korea, as the age of aircrew has increased, the number of tests (TMT test, EKG Holter monitor, Echo test, etc.) and the frequency of health check-ups for their health management have also increased (Lee et al., 1992; Park, 2000). In addition to the age specific health assessment, rules considering aging for the management of serum cholesterol levels should be standardized.

There was a significant difference in marital status. The risk group had more individuals who are not married compared to individuals in the desirable group. According to study done on aircrew by Lee, et al. (1997), marital status influences individual's activity level. This was also mentioned by Dishman (1982) whose findings indicated that the spouses of individuals may help increase activity levels of individuals by providing various forms of encouragement. Hence, by considering these factors, spousal support may cause active exercise of individuals and might indirectly influence the total serum cholesterol level.

Cholesterol level may also be influenced by uncontrollable risk factors such as genetics and age, but recent literature suggests that it is mostly influenced by the lifestyle of individuals (Oh, 2000). Thus, this research considered possible controllable variables in both desirable and risk groups. Results indicated that for all the categories of controllable variables of lifestyle, the risk group generally had bad patterns for lifestyle compared to the desirable group, without a statistically significant difference between them. However, after the logistic regression analysis with consideration of covariate age and marital status, the results were clear that the type of diet, exercise, and work situation are risk factors influencing hyperlipidemia. This result relates to LaRosa, He, & Vupputuri's (1999) work, which suggested that low fat and high fiber diets along with exercise should be considered for controlling hyperlipidemia.

The aircrew's meal pattern is closely related to the type of work situation for each individual. Those aircrew members working on international duty will either have their meals on board with crew meals or abroad most of the time, making it is difficult to control their meal pattern or consider a low fat diet (Cho, Lee & Kim, 2002). The fact that they are staying abroad or eating crew meals means that they may not have a choice for the meals and may have to take a high fat diet or too many meals, which could potentially cause hyperlipidemia. Lipid Research Clinic (1984) indicated that, having a low fat diet alone might reduce total cholesterol level up to 5.2 %. In order to control hyperlipidemia, a low fat and high fiber diet must be considered (LaRosa et al., 1999). Research results indicate that 34.3%, over one-third of

total aircrew study participants, were having high fat diets. The importance of having a low fat diet in relation to hyperlipidemia must be emphasized not only to the risk group, but to each aircrew member- considering, general diet are providing for simple hyperlipidemia aircrew while they are staying in airplane. There must also be a transition to low fat diet crew meals, and the importance of having a low fat diet must be taught in the regular training programs taken annually to fulfill requirements of the aviation act. An aircrew's exercise pattern is also indicated as an important factor influencing cholesterol level. Research results show that 22.7% of aircrew were having three exercise sessions per week, which were similar to Lee and Suh's (1995) results indicating that 22.8% of individuals were having two or more exercise sessions per week. However, it was lower than the 30.8% of Shim's (2000) results of research carried out on male workers in their 40 s.

Additionally, exercise increases the level of HDL-C and may control hypertension, obesity, etc., resulting in the prevention of heart disease (Lee et al., 1997; Menson, Hu, Rich-Edwards & Golditz, 1999). Namkung (2000) carried out research on aircrew and their exercise pattern, and concluded that maximum O2 consumption is positively related to HDL-C, so it is essential to carry out aerobic exercises. In South Korea, health care centers provide exercise prescription and implementation programs that may improve the cardiopulmonary function of aircrew. However, many aircrew personnel do not work out regularly because of their patterns of working hours (e.g. five times long distance flight, taking three to five days, per month). As exercise is an important factor preventing hyperlipidemia, it is essential to develop a systemic exercise program for aircrew. Further investigations are needed to understand why frequent strenuous exercises were not an influencing factor on hyperlipidemia.

CONCLUSION

This research concludes that the cholesterol level of aircrew is closely linked to lifestyle behavior especially diet pattern and exercise. Both diet pattern and the type of work situation may influence or interfere with one's exercise routine, as long distant flights or staying abroad may result in the difficulty of controlling eating habits and working out regularly. Hence, effective health care management for different types of work should be considered in future research.

Careful consideration of crew meals on long distant flights must be taken into account, as well as teaching aircrew to identify low fat food while staying abroad. Commercial aircrew should also be educated about the importance of a low fat diet on overall health. They must be encouraged to record calories and nutritional composition of crew meals and meals while abroad. This record must be examined with a dietician to understand their calorie and nutritional requirement, and to achieve a low fat diet.

Methods of reinforcing regular exercise must be investigated further. A tactical strategy to make sure flight crews have more than three required exercise sessions per week, and for continuous exercise, motivation reinforcement is crucial. Exercise should be planned individually, based on each individual's favorite exercise, and be flexible so that everyone may be actively involved in the program.

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