Case*	Target Disease	N	Object			Intervention Method	Result	Indicator for evaluation
			Method of selection	Randomization	Control group			
11	Diabetes Mellitus	8473	Annual health checkup			• HbA1c is more than 7.0 percent; Hygienic education • HbA1c is more than 8.0 percent; Restriction for working status (no night shift, for example)	For both groups, statistically significant improvement was observed for HbA1c level, Total Cholesterol level and BMI. On the other hand, there was no improvement observed in the groups with HbA1c level of 60. to 6.9 and of less than 6.0%.	HbA1c, BMI, Blood Pressure, Total Cholesterol, HDL-Cholesterol, Triglyceride
12	Diabetes Mellitus	13	Annual health checkup			• Check sheet (Blood sugar level 2 hours after meal, contents of meal, behavior) • Self-evaluation • Health education • follow-up by e-mails	Statistically significant improvement was observed for average level of BMI(24.9 to 24.3), Weight (70.3kg to 68.7kg), Systolic Blood Pressure (135.3 to 132.3), Diastolic Blood Pressure (79.4 to 77.6), and Blood Sugar after two hours from last meal (212.6 to 118.3) have improved. Life-style was also improved.	2hPG, BMI, Wt, BP, life-style
13	Diabetes Mellitus	884	Annual health checkup		+	• Small group lecture and individual health education by using check sheet (For example, basic knowledge about Diabetes, self check about his risk, goal setting, self measuring of glucose by using small self-check machine, and so on)	In the case of intervention group, improvement was observed for 71.0% of participants. On the other hand, only 53.2% of control group showed improvement.	Blood Sugar
14	Diabetes Mellitus	100	Annual health checkup			• Health education by VTR on prevention of Diabetes (Diet and exercise)	After the intervention, signi cant improvement was observed for BMI, percentage of body fat, and Blood sugar level. No change was observed for abdominal circumference.	75 g OGTT, Weight, Percentage of body fat, examination of urine, Abdominal circumference, HbA1c, F-IRI
15	Diabetes Mellitus	108	Annual health checkup		+	• A group lesson about prevention of DM • Self measuring of Blood glucose	For the group with self-measuring blood sugar, signi cant decrease was observed for HbA1c and BMI. On the contrary the group without self-measuring blood sugar did not show improvement. For HbA1c level, signi cantly decrease was observed for the group with self-measurement of blood sugar level 6 months after the intervention.	BMI, HbA1c, Blood Sugar
16	Diabetes Mellitus	49	75 g OGTT	+	+	• Lecture about the diabetes prevention (2 times Group Lessons, 3 times of nourishment guidance, 1 time of healthy dinner, 6 times of individual education) • A document about weight loss • Control	The intervention group had significantly improvement in weight, BMI, percentage of body fat, circumference of waist and hip. Improvement in HbA1c, insulin resistance, Blood Pressure, Total Cholesterol, HDL-Cholesterol, and Triglyceride were also observed (without statistical significance). After 6 months of the lecture, there were also the tendency of improvement in Weight, BMI, Percentage of body fat, Girth of waist, Girth of hip, F-IRI, Total Cholesterol, HDL-Cholesterol, and Triglyceride for the intervention group. On the contrary, there was no tendency of improvement for control group.	Weight, BMI, Percentage of Body fat, Blood pressure, HbA1c, Total Cholesterol, HDL-C, Triglyceride, Fasting Blood Sugar, F-IRI

Case*	Target Disease	N	Object			Intervention Method	Result	Indicator for evaluation
			Method of selection	Randomization	Control group			
17	Life-style related diseases	57	Recruitment from member of health insurance organization			• Questionnaire • Labo Data • Individual interview • Group health education • Online health education	About behavior modification of exercise, the percentage of "preconteplation stage" and "preparation stage" had decreased (11% to 5% and 53% to 19%, respectively) and the percentage of "action stage" had increased (37% to 75%). About behavior modi cation of nutrition, the percentage of "preconteplation stage" and "preparation stage" had decreased (21% to 11% and 47% to 7%, respectively) and the percentage of "action stage" had increased (32% to 81%). About POMS, as a whole, activity characteristics improved, and minus factors such as strain, depression, anger had decreased.	The stage of behavior modi - cation, POMS
18	Life-style related diseases	762	Voluntary participation from a work-place			• Letter of health education (Published once a month)	After the distribution of evaluation sheet for the program, there were answers from 452 of 762 peoples (correspond rate is 60%). 285 people (64%) replied that they have read the letter. 164 peoples (36%) have not read. The stage of behavior modification was as follows; action stage: 38%, preparation stage: 56%, precontemplation and contemplation stage: 6%. Peoples with action stage read paper more frequently than peoples with low concern stage. The percentage of persons with behavioral change for healthier lifestyle was also more observed for the action stage group.	The stage of behavior modi - cation
19	Life-style related diseases	62	The person who attended the life-style related disease improvement classes			• Labo Data • Individual education • Group education (7 times) • Online education (once a week) • daily elf-report on body weight, blood pressure, physical examination	Weight, blood pressure, and arteriosclerosis-related hormone had tendency to improve for the participants. 42% of participants attend to the online health education. The frequency of attendance for on-line education had shown a positive correlation with change for healthier lifestyle.	Weight, Blood Pressure, arteriosclerosis-related hormone
20	Life-style related diseases	200	Annual health checkup	+		• Annual health checkup only • Annual health checkup and health education (once a year) • Annual health checkup and health education (once a month)	People with more frequently attend to health education class, showed a signi cant decrease in ALT and AST, and significant increase in HDL-Cholesterol. Annual health check-up group showed higher triglyceride level and blood pressure level with statistical significance compared with health education groups. There was no signi cant difference in Uric acid and BMI.	Blood Pressure, AST, ALT, Serum Cholesterol, Uric acid, BMI
21	Life-style related diseases	855	Annual health checkup		+ (Intervention group; 639 persons, Non-intervention group; 216 persons)	• Health education	Comparison of data between 2000 and 1999 showed that only intervention group had signi cant improvement in Total Cholesterol, Triglyceride, HDL-Cholesterol, HbA1c, and Uric Acid. BMI, Glucose, Hb, GOT, and GPT. No signi cant improvement was observed for γ-GTP. Both intervention group and non-intervention group had signi cant improvement in systolic and diastolic Blood Pressure.	Weight, BMI, Blood Pressure, Total Cholesterol, Triglyceride, HDL-Cholesterol, Blood Sugar, HbA1c, Uric acid, Hb, GOT, GPT, γ-GTP

Case*	Target Disease	N	Object			Intervention Method	Result	Indicator for evaluation
			Method of selection	Randomization	Control group			
22	Life-style related diseases	877	The interview after the annual health checkup			• Individual declaration for healthier lifestyle • Questionnaire	According to the answer of questionnaire after three months, 71% people had been keeping their declaration, but after one year, it was only 30% that the healthy declaration was kept. The improvement rate is quite different according to the age category. The young group keep a high improvement rate, and people with 50 years old and more showed low improvement rate. For labo data, GOT, GPT, Total Cholesterol, Triglyceride, FBS and HbA1c had showed signi - cant improvement. The people with healthy life declaration about exercise and drinking showed the improvement in HbA1c level.	GOT, GPT, Total Cholesterol, Triglyceride, FBS, HbA1c
23	Life-style related diseases	437	The person who audited the total health promotion private program		Matched by age, sex, and the percentage of overweight	• Total Health Promotion guidance	Before indentation, there were already signi cant differences between THP group and control group in diastolic Blood Pressure, Healthiness, habit of drinking, and habit of meals. In THP group, Obesity index, Blood Pressure, and life-styles had been improved. Serum Cholesterol had decreased after intervention with THP group. But after one year, there was no signi cant difference in Obesity index, Blood Pressure between the two groups. On the other hand, in control group, smoking prevalence and γ-GTP level had increased. Other data showed no change.	Waist Obesity index, Blood Pressure, Total Cholesterol, Triglyceride, GOT, GPT, γ-GTP, life-style
24	Life-style related diseases	140	Random sampling	+	Matched by the type of occupation, the number of stuff, the average age, and the structure of age (122 people)	• Activity of the making of health that a place of work played a key role that were supported by Public health nurse (Theme: stress, Cholesterol, meal and exercise)	The of ce where wrestled with stress, stress degree by simple questionnaire about occupation-related stress had a tendency to improve. The of ce where wrestled with Cholesterol, abnormal data of Triglyceride was fell down signi cantly ($p<0.05$). The of ce where wrestled with meal and exercise, the life-style was improved significantly. All three offices, consciousness to health and life-style were more improved than control of ce.	Simple questionnaire about occupation-related stress, Cholesterol, Life-style, Percentage of body fat, Liver function
25	Metabolic syndrome	193	unclear			• Educational program for metabolic syndrome (Abdominal obesity) • To recognize the risk of one's health by oneself • To clarify the action that should be improved • Based on the results of learning, choose programs for healthier lifestyle by himself • Social support from a peer group and family member for customizations of healthier lifestyle	For the body weight and waist circumference, yearly improvement was observed. After 4 years intervention, most of the data had been improved significantly (Weight, waist and hip circumference, Waist and Hip ratio, Skin fold thickness, physical fitness test, Blood Pressure, Total Cholesterol, LDL-Cholesterol, phospholipids, Free fatty acid, Blood Sugar). But no improvement was observed for Triglyceride, HDL-Cholesterol, and HOMA-IR..	Weight, Girth of waist, Girth of hip, Waist and Hip ratio, Skin fold thickness, the number of standing from chair, One step width, Blood Pressure, Total Cholesterol, LDL-Cholesterol, HDL-Choresterol, phospholipids, Free fatty acid, Blood Sugar, HOMA-IR

Case*	Target Disease	N	Object			Intervention Method	Result	Indicator for evaluation
			Method of selection	Randomization	Control group			
26	Obesity	unclear	unclear	unclear		• CT examination of visceral fat • health education text • Diet diary • Check sheet about eating habit • Questionnaire about life-style	By the intervention, the visceral fat area was decreased form 170.6 square meter to 97.1 square meter in three months.	CT examination on visceral fat
27	Obesity	97 (37 persons completed the program)	The medical interview of annual health checkup		Completed person and Non-completed person	• Individual health education by public health nurse by using health note (education by correspondence)	Only 37 persons completed the program. The authors examined the differences in characteristics between the completed group and non-completed group. More preparation stage persons were included into the completed group. The average weight of completed group was significantly decreased from 71.7Kg to 70.4kg ($p<0.01$). About the improvement of life-style, it seem that exercise habit was more effective than dietary habit.	Weight, BMI, life-style
28	Obesity	29	Voluntary participation		Matched by age and BMI	• Intranet • Lecture • Questionnaire about life-style • Exhibition of the weight • Group work • Measurement of body weight • circumference of the abdomen • Percentage of body fat • Life skills training for appetite control • The weight measurement 3 times a day	Weight, percentage of body fat, and circumference of Abdomen were decreased signi cantly for the intervention group. On the contrary, only circumference of Abdomen was decreased signi cantly in control group. The ratio of decline in intervention group was signi cantly higher than control group. Furthermore, there was no people whose weight increased in intervention group.	Weight, Percentage of body fat, Girth of Abdomen , Labo data
29	Obesity	51	Participant for obesity control class		Matched by age, sex, and BMI	• Health education about Obesity	According to the comparison of the data between participant group and control group, Diastolic Blood Pressure, Triglyceride, and HDL-Cholesterol were significantly decreased in the participant group after one or two years from intervention.	BMI, Systolic Blood Pressure, Diastolic Blood Pressure, Triglyceride, Total-Cholesterol, HDL-Cholesterol, GOT, GPT, γ-GTP, Uric acid, HbA1c
30	Obesity	200	Annual health checkup			• Campaign about walking • Intranet	2.4% of average weight loss were observed at the end of the campaign.	Weight, BMI

*: Number of case corresponds to the that of reference.

Original

Asian Pacific Journal of Disease Management 2007; 1(1), 34-39

Health Support Program for Coronary Risk in the Occupational Setting

—Evaluation of the Coronary Heart Disease Risk Model for Screening—

Masato Ito[1], Hisashi Hanada[1], Yukako Fujii[2], Ken Takahashi[3]

[1]*Matsushita Electric Industrial Co., Ltd., Minami-Kadoma Health Service Center*

[2]*Matsushita Health Center, Department of Preventive Medicine*

[3]*University of Occupational and Environmental Health, Institute of Industrial Ecological Sciences, Department of Environmental Epidemiology*

Abstract

The prevention of death due to overworking, so called "Karoshi" is one of the most important issue for the Japanese occupational health policy. Most of the Karoshi cases are closely related to coronary heart diseases (CHD). Thus it is very important to assess the coronary risk level of workers. In 2001 the Japanese government implements a new screening program for Karoshi under the Occupational Accident Compensation Law. A worker with all four conditions (hypertension, hyperlipidemia, hyperglycemia and obesity, so called "deadly quartet" must receive the in-depth health examination. However, it has been suggested that deadly quartet model has high false negative rate and that it might be better to adapt more appropriate screening method for the prevention of Karoshi. In this study we compare the appropriateness of several screening models for CHD risks. The results of our study indicated that the screening method based only on the deadly quartet is insufficient. The use of supplementary screening standard such as the CHD Risk Model is considered to be necessary.

Key words: CHD, Karoshi, health risk appraisal, prevention, Lifestyle related diseases

❖ Introduction

The prevention of death due to overworking, so called "Karoshi" is one of the most important issue for the Japanese occupational health policy. Most of the Karoshi cases are closely related to coronary heart diseases (CHD). Thus it is very important to assess the coronary risk level of workers.

In 2001 the Japanese government implements a new screening program for Karoshi under the Occupational Accident Compensation Law. A worker with all four conditions (hypertension, hyperlipidemia, hyperglycemia and obesity, so called "deadly quartet" must receive the in-depth health examination, including urine examination, blood examination, ECG, and IMCT (intima-media complex thickness) measurement by carotid ultrasonography. According to the results of examination, the working condition is arranged for each worker.

Before the implementation of "deadly quartet" concept, we had already implemented the health risk appraisal model for CHD (referred to as "CHD Risk Model" below). The model was developed based on the findings of the Framingham Study[1]. As the original criteria of Framingham study overestimated the high risk population, we have modified the criteria in order to fit it to the Japanese population[1].

Received: December 28, 2006
Accepted: May 16, 2007
Correspondence: M. Ito, Matsushita Electric Industrial Co., Ltd., Minami-Kadoma Health Service Center, 1-15, Matsuo-cho, Kadoma, Osaka 571-8504, Japan
e-mail: itoh.masato@jp.panasonic.com

Using the CHD Risk Model, we have been implementing preventive measures, such as providing in-depth examinations, health guidance and advice on appropriate work. In previous report, we have assessed the effectiveness of CHD Risk Model for the evaluation of atherosclerosis[2]. Our preliminary results showed that deadly quartet model has high false negative rate and that it might be better to adapt more appropriate screening method for the prevention of Karoshi[2].

In this study we compare the appropriateness of several screening models for CHD risks in order to formulate more appropriate models in the occupational setting.

❖ Subjects and Methods

Subjects

In 2000, 427 male employees in our workplace were judged as requiring lifestyle-related disease management and were under clinical observation for high blood pressure, diabetes or hyperlipidemia. The subjects were 368 employees selected from among the 427 who had carotid ultrasonography and excluding people taking internal medication. Employees requiring lifestyle-related disease management are identified using the same criteria in all of Matsushita's group companies and are those whose results of regular health examinations reveal any of the following: (1) systolic blood pressure of 160 mmHg or higher, or diastolic blood pressure of 100 mmHg or higher; (2) for lipids, total cholesterol of 260 mg/dl or higher, or triglyceride of 300 mg/dl or higher; or (3) fasting blood glucose level of 110 mg/dl or higher.

High-risk group screening criteria

Risks relating to the cardiovascular status of the subjects were assessed using the following methods based on the results of regular health examinations in 2000.

1) CHD Risk Model: A CHD Risk Model percentage was calculated for each subject using the Framingham Study coronary heart disease onset prediction model based on risk factors such as gender, age, blood pressure, lipids, blood glucose level and smoking status. As the original Framingham logic overestimates coronary risks in the case of the Japanese, people whose CHD Risk Model was 20 percent or higher were selected according to our previous results[3].
2) Criteria based on risk factors: In this study, we evaluate the 6 risk factors: high blood pressure, diabetes, hyperlipidemia, obesity, age and a smoking habit. After formulating all possible combinations among 6 factors, 56 groups of risk factors, each of which comprised between one and four factors, were selected for the study. According to the guideline of "deadly quartet" by Ministry of Health, Labor and Welfare, the criteria for each positive risk factor are (1) BMI of 25 kg/m^2 or higher, (2) systolic blood pressure of 140 mmHg or higher, or diastolic blood pressure of 90 mmHg or higher, (3) total cholesterol of 220 mg/dl or higher, or HDL cholesterol of less than 40 mg/dl, or triglyceride of 150 mg/dl or higher, (4) fasting blood glucose level of 110 mg/dl or higher, (5) 50 years of age or higher and (6) having a smoking habit. We defined people with all (1)–(4) above as having the "deadly quartet" and those with any three of the risk factors (1)–(6) as having "Matsushita's trio".

Carotid artery ultrasonography

As a major cause of "Karoshi", the atherosclerosis related diseases, i.e., ischemic heart diseases and cerebro-vascular diseases, are important. As a method of evaluation of atherosclerosis, the intima-media thickness (IMT) of internal and external carotid arteries are recently used. O'Leary reported that persons with IMT more than 1.18 mm showed four times more incidence rate of cardio-vascular diseases compared with persons with less than 0.87 mm IMT[4]. Thus we employed IMT as a gold standard of atherosclerosis.

The intima-media thickness (IMT) of internal and external carotid arteries measurable from common carotid arteries of the left and right sides was measured using a multi-purpose sonoscope (Agilent Technologies, Image Point HX M2410B) with a probe (10.0/7.5/5.0 MHz linear transducer), and the maximum value measured (Max IMT) was set as the gold standard for objective atherosclerosis assessment. In principle, measurements were performed in the supine position, anterior oblique position and lateral position with the addition of posterior oblique position while sitting as much as possible. Short-axis image was also examined to ensure reproducibility. It was judged that an IMT of 1.1 mm and greater was positive for atherosclerosis and an IMT of less than 1.1 mm was normal (negative for atherosclerosis).

Table 1 Characteristics of studied population

Item (n=368)	Mean	Standard deviation
Age	51.9	4.8
BMI (kg/m2)	24.0	3.0
Max IMT (mm)	1.53	0.73
CHD Risk (%)	16.1	8.1
Systolic blood pressure (mmHg)	130.8	20.3
Diastolic blood pressure (mmHg)	80.3	12.0
Fasting blood glucose level (mg/dl)	108.9	31.2
Total cholesterol (mg/dl)	222.3	39.4
HDL cholesterol (mg/dl)	49.9	14.0
Triglyceride (mg/dl)	163.6	137.2

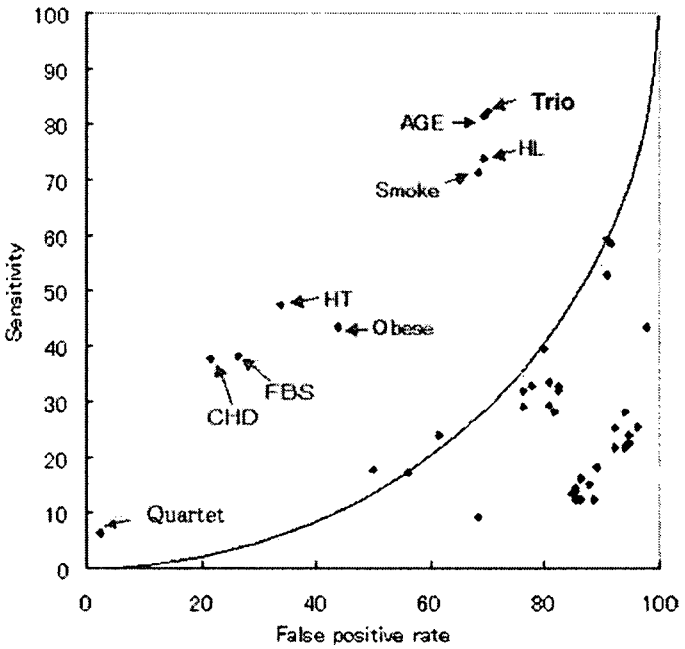


Figure 1. Relationship between sensitivity and the false positive rate (1 - specificity) by screening method

Quartet: the deadly quartet, CHD: CHD Risk Model, FBS: diabetes, HT: high blood pressure, Obese: obesity, Smoke: smoking, HL: hyperlipidemia, AGE: age of 50 and above, Trio: Matsushita's trio.

Epidemiological studies

Epidemiological studies were performed to judge which of the screening methods described above are epidemiologically appropriate, through analyses of sensitivity and specificity and by calculating the rate of positive predictive value.

❖ Results

Table 1 shows the main features of the studied subjects. These were "average value ± standard deviation" for their age 51.9 ± 4.8, BMI 24.0 ± 3.0 kg/m^2, Max IMT 1.53 ± 0.73 mm, CHD Risk Model score 16.1 ± 8.1%, systolic blood pressure130.8 ± 20.3 mmHg, diastolic blood pressure 80.3 ± 12.0 mmHg, fasting blood glucose level 108.9 ± 31.2 mg/dl, total cholesterol 222.3 ± 39.4 mg/dl, HDL cholesterol 49.9 ± 14.0 mg/dl, and triglyceride 163.6 ± 137.2 mg/dl.

Figure 1 shows the relationship between sensitivity and the false positive rate (1-specificity) by screening

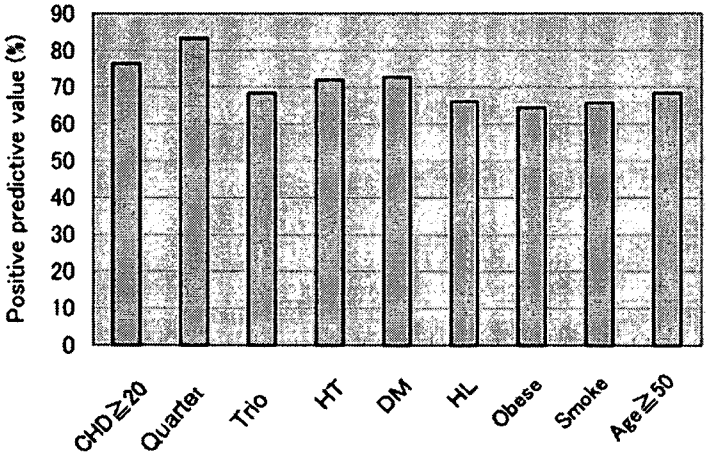


Figure 2. Positive predictive value of each screening standard

Quartet: the deadly quartet, CHD: CHD Risk Model, FBS: diabetes, HT: high blood pressure, Obese: obesity, Smoke: smoking, HL: hyperlipidemia, AGE: age of 50 and above, Trio: Matsushita's trio.

method, which is one of the epidemiological indexes gained from the CHD Risk Model and the other high-risk screening methods based on risk factors. The top left corner where sensitivity is 100 percent and the false positive rate is 0 percent (the origin) is the ideal point according to the concept of the ROC curve. When each of the points and the origin are connected with a straight line, the point with the shortest line is considered to be the best because sensitivity and specificity are traded off. Among the screening methods inside the quarter circle connecting the origin, the top right corner where sensitivity is 100 percent and the false positive rate is 100 percent (covering all of the subjects) and the bottom right corner where sensitivity is 0 percent and the false positive rate is 0 percent (covering none of the subjects), the following nine standards which are relatively close to the origin were examined. These are the deadly quartet, CHD Risk Model, diabetes (FBS), high blood pressure (HT), obesity (Obese), smoking (Smoke), hyperlipidemia (HL), age of 50 and above (AGE) and Matsushita's trio. The standards are separated into three groups, a group giving priority to specificity which includes the deadly quartet, a group giving priority to sensitivity which includes smoking, hyperlipidemia and age of 50 and above, and a group positioned somewhere between the first two groups which includes the CHD Risk Model, diabetes, high blood pressure and obesity. Figure 2 shows the Positive predictive value (PPV) of each screening method. The PPVs were rather high for most of the screening methods, exceeding 60 percent; the reason for this is thought to be that the subjects require lifestyle-related disease management, which means that their atherosclerosis is more likely to be detected.

The sensitivity of the deadly quartet was extremely low at less than 10 percent because of too much emphasis on the specificity. It is considered that if a high-risk strategy for the workplace is implemented based only on the deadly quartet concepts, many problems will remain because of the extremely high false negative rate. The deadly quartet is completely inadequate as a preventive strategy for the workplace because it can detect less than 10 percent of people with atherosclerosis, who indeed have a high risk of cardiovascular disease, in the workplace. In other words, new indices are required, with more balanced sensitivity and specificity.

Concerning the sensitivity group which contains smoking, hyperlipidemia, age of 50 and above and Matsushita's trio, sensitivity is high at around 70 percent, but the false positive rate is also very high at about 70 percent, which indicates extreme inefficiency.

This study shows that it is difficult to select high-risk cardiovascular disease cases based only on classic risk factors. We believe that the intermediate group, which is neither of the groups mentioned above, is the most appropriate at present. In this group, the CHD Risk Model, with a sensitivity of about 40 percent and a false positive rate of 20 percent, is considered to be epidemiologically better than diabetes with the same

percentage of sensitivity but higher false positive rate. High blood pressure and obesity are poor screening criteria because their false positive rates exceed 30–40 percent, although sensitivity is good at approximately 45–50 percent. Taking into consideration the above, the CHD Risk Model is considered to be the most balanced index among the 57 high-risk group screening standards studied.

❖ Discussion

Currently occupational health professionals organize a various kind of health promotion activities according to the Occupational Health and Safety Law. The main problem is life-style related diseases. Especially the prevention of atherosclerosis-related diseases has become an important issue in order to minimize the risk of workers for "Karoshi". This is a reason of the introduction of "deadly quartet" concept in 2001. However, as the present study showed, the deadly quartet is completely inadequate as a preventive strategy for the workplace because it can detect less than 10 percent of people with atherosclerosis, who indeed have a high risk of cardiovascular disease, in the workplace. In other words, new indices are required, with more balanced sensitivity and specificity. Apparently the discussion and evaluation about the validity of "deadly quartet" as a screening criteria for "Kaoroshi" are insufficient before the implementation of program.

In the current study, we did not analyze the effect of different cut-off point and the risk of cerebro-vascular disease (CVD) that is another important cause of Karoshi. As a long-period follow-up is possible in the occupational setting, we would like to analyze the effect of different screening logic and cut-off point and risk of CVD in the following studies.

According to the Health care reform program in 2006, the specified health checkup and follow-up health guidance and intervention program will be introduced from 2008. All insurers, both occupational and community settings have to organize this new program for all insured over 40 years old. The main target of the specified health check-ups is so called Metabolic Syndrome. It is planed that the insured are to be stratified into 3 groups or more for the following health promotion programs according to the checkup results. Although the criteria are different, the screening program of deadly quartet is very similar to that of metabolic syndrome. This similarity will cause some confusion for the occupational health professionals if there is no coordination before the implementation of new program.

Furthermore, according to the opinion from the specialist physician group of Diabetes Mellitus, MHLW changed one of the criteria of metabolic syndrome: 110 mg/dl to 100 mg/dl for hyperglycemia. This change will lower the sensitivity of screening. Thus it is easily imagined that insurers will suffer from a large number of persons who have to receive the follow-up intervention. This situation will cause operational difficulties. It is strongly recommended to re-evaluate the screening logic.

Lifestyle-related disease screening is currently managed and operated by pathology basis or by risk factor basis at most workplaces. Screening standards and decisions whether to begin treatment are often inconsistent. This situation has caused much confusion in the occupational health field. In this meaning, it must be positively evaluated that MHLW has standardized measurement methods and the screening criteria within the new law. As mentioned above, however, it will be necessary some modification in order to it practicable and manageable. Especially it is very important how to reduce the burden of follow-up intervention and to assure the effectiveness. Without the changes in the attitude of recipients, it is very difficult to attain favorable results with limited resources. In order to facilitate this process, it is desirable that the recipients can easily understand his risk level of life-style diseases from the results of health check-up.

The use of the CHD Risk Model, which is a Health Risk Appraisal type tool based on major risk factors, facilitates the setting of personalized health targets and makes possible the implementation of consistent measures based on health examination results. In the new program from 2008, it will be desirable to use a HRA type model in order that recipients can materialize their health problems.

Currently we use the CHD Risk model as a tool for high-risk approach. The high-risk strategy is to meet the employer's obligation to assign appropriate work, and provide health guidance and intense management, to employees with high health risk. This study shows that the CHD Risk Model, which is easily calculated using the results of regular health examinations, is effective as one method to select people for the high-risk strategy who have a high risk of atherosclerosis including coronary heart disease.

However, both population and high-risk strate-

gies need to be implemented equally for health management at the workplace. If the CHD Risk Model, which is calculated for each worker, is standardized and summarized, fluctuations in the risks for the group of all of the workers will be easily understood, and for workplaces with a stable workforce, an effective health or macro index will be obtained[1]. We are now planning to make more accurate epidemiological assessments by increasing the number of cases covering the entire workplace. Of course, the external validity of our model is not assured because this has been constructed based on the data from only one occupational setting. The introduction of he specified health checkup and follow-up health guidance and intervention program is a good opportunity to test the validity of our model. We would like to present the results in the future publication.

❖ Conclusions

1. With regard to the high-risk strategy for cardiovascular diseases at the workplace, selection based only on the deadly quartet is insufficient; the use of supplementary screening standards such as the CHD Risk Model is considered to be necessary.
2. The CHD Risk Model is considered to be effective as an index for atherosclerosis, for health examination screening and for aiding in the allocation of heavy workloads.

❖ References

1) Ito M, Hanada H: Trial of preventive measures based on results of health examinations using coronary heart disease onset risks, Occupational Health Journal 23(5), 50–56 (2000).
2) Muto Y, Hanada H, et al.: Selection of people with high risk of coronary heart disease onset at workplaces - comparative study of coronary heart disease onset prediction model and deadly quartet, Matsushita Medical Journal 40(2), 123–129 (2001).
3) Ito M, Hanada H, et al.: Assessment and application of coronary heart disease onset risks at the workplaces - using the Framingham coronary heart disease onset prediction model, Matsushita Medical Journal 38(2), 169–178 (1999).
4) O'Loery DH: Carotid artery intima and media thickness and risk of myocardial infarction and stroke in older adults. New Engl J Med 340, 14–22 (1999).

Review Asian Pacific Journal of Disease Management 2007; 1(3), 83-89

Development of IT Based Management System for Health Support Program in Japan

Shinya Matsuda, Yoshihisa Fujino, Masayuki Tanaka

Department of Preventive Medicine and Community Health, School of Medicine, University of Occupational and Environmental Health

Abstract

In order to realize a healthy aged society, the Japanese government has established a new law for the health promotion in 2006. The new law will make "the specified health checkup and intervention program" for insureds over 40 years old obligatory for public health insurers from April, 2008. It is planned that the outcomes of this health promotion program will be reflected to monetary contribution of each insurer for the newly created health insurance scheme for the elderly. In order to adapt to this scheme, each insurer must have a capacity to monitor the compliance of insured and to analyze the claim data in oredr to establish appropriate strategeis. Considering the limited manpower of each insurer and the large volume of persons who need health education, it is indispensable to use IT system. For this perspective, we have developed the IT based management system for health support program. The base system is constructed on Cognos 8®, one of the most widely used OLAP software. The base system comprises of the three parts: data input and preparing the cubes, data mining, and reporting. The system supports the management of health education and monitoring. As in the USA, this kind of IT based health support system will be developed by the introduction of "the specified health checkup and intervention program" from April, 2008.

Key words: health support, IT, OLAP

❖ Introduction

In order to realize a healthy aged society, the Japanese government has estbalished a new law for the health promotion in 2006. The new law will make "the specified health checkup and intervention program" for insureds over 40 years old obligatory for public health insurers from April, 2008[1].

The main target of the specified health check-ups is so called "Metabolic Syndrome". It is planed that the insured are to be stratified into 3 groups or more for the following health promotion programs according to the checkup results.

Received: June 29, 2007
Accepted: August 24, 2007
Correspondence: S. Matsuda, Department of Preventive Medicine and Community Health, School of Medicine, University of Occupational and Environmental Health, 1-1 Iseigaoka, Yahata-nishi-ku, Kitakyushu, Fukuoka 807-8555, Japan
e-mail: smatsuda@med.uoeh-u.ac.jp

Figure 1 descrives the new system. Insurers have a responsibility to organize the health promotion program for their insured. All data including results of lab-test are to be electronized in the standardized format (XML and/or CSV). Using this data the insurers have to analyze the effectiveness of health promotion program.

The Japanese health insurance system composes of three schemes, Employee Medical Insurance (EMI) scheme for large enterprizes, Governmentally managed Employee Medical Insurance scheme for small enterprizes, and National Health Insurance (NHI) scheme for the population not coverd by occupational setting[2]. It is planned that the outcomes of this health promotion program are reflected to monetary contribution of each insurer for the newly created health insurance scheme for the elderly. The amount of contribution by each health insurer will be adjusted to reflect the performance of specified health checkup and intervention measures within a range of +/– 10%.

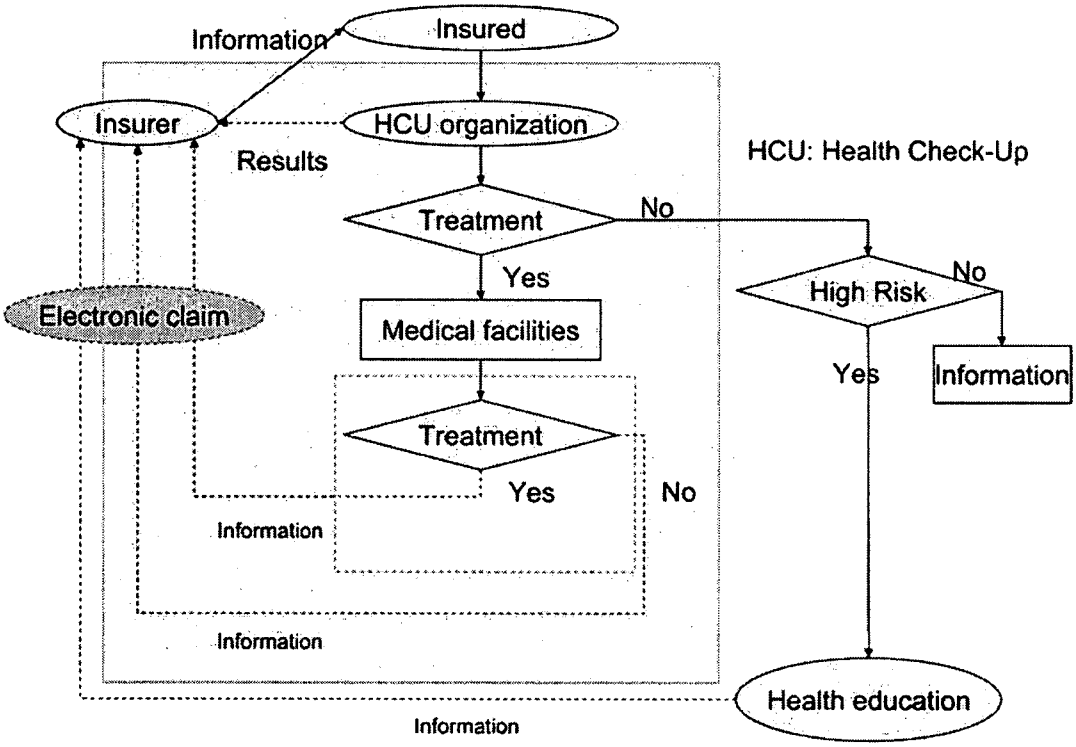
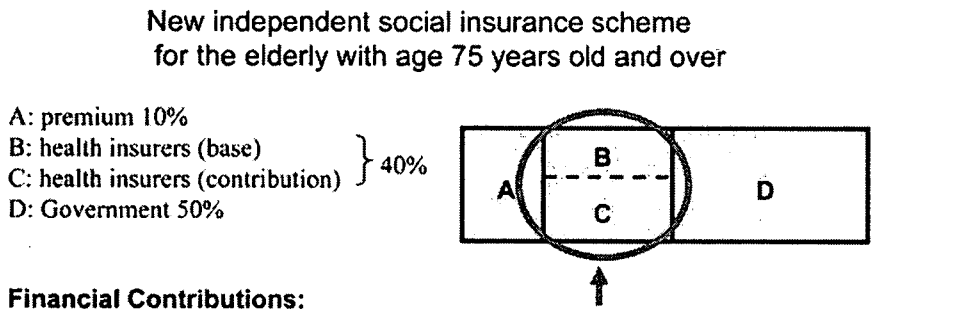


Figure 1. New health check-up program for life-style related diseases from 2008



Financial Contributions:

The amount of contribution by each health insurer will be adjusted to reflect the performance of specified health checkup and intervention measures within a range of +/- 10%. The calculation method of contribution is as follow:

Total health expenditures for the aged covered by insurance in 2004: ¥10,300 billion
Total population between 0-74 years old : 115 million person
Base amount of contribution per person=10300 billion × 0.4/115 million=¥35,000
Contribution of insurer = ¥35,000 × number of members
In the case of insurer with 10.000 members: 35,000 × 10,000 × 0.1=35,000,000
This amount will be paid as a penalty if the insurer cannot attain the target set by government.

Figure 2. Incentive system for health promotion

Figure 2 shows an example of financial adjustment. If the number of insured between 0–74 years old is 10,000, the base amount of contribution of this insurer will be 350 million yen. If this insurer is evaluated as not-enough in the performance, they have to pay at maximum 35 million yen as a penalty. On the contrary if their performance is very good, the contribution will be reduced at maximum 35 million yen.

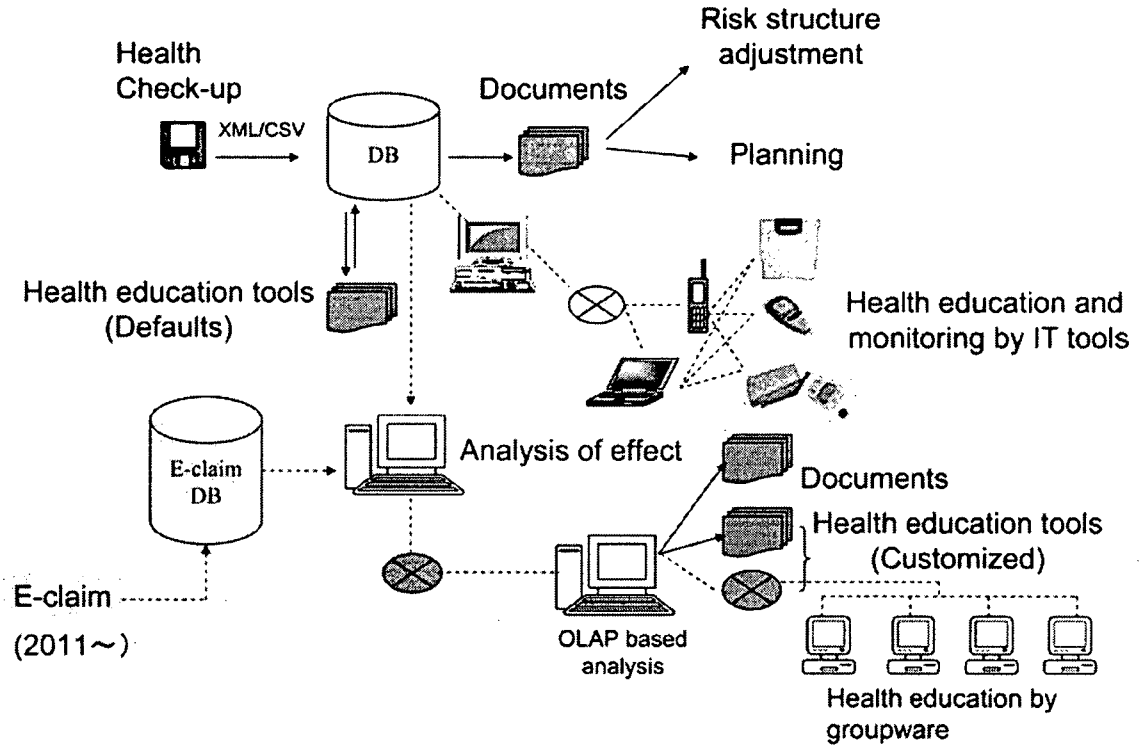


Figure 3. IT based health support system

Thus, it will become an important issue for each insurer how to implement effective health support programs.

In most of the cases, administration offices of insurers are too small to manage the above mentioned health promotion program. They need some kinds of supporting system. Although the outsourcing of health promotion programs is permited by the new law, it will be rather difficult for small size insurers because of financial constraints. Thus it is necessary to prepare a public system in order to help them for the management. If not, the newly introduced health promotion program will face to critical difficulty from the begining.

We have developed such a system under the Health and Labour Sciences Research Grants, Ministry of Health, Labour and Welfare. In this article, the authors explain an overview of this new system.

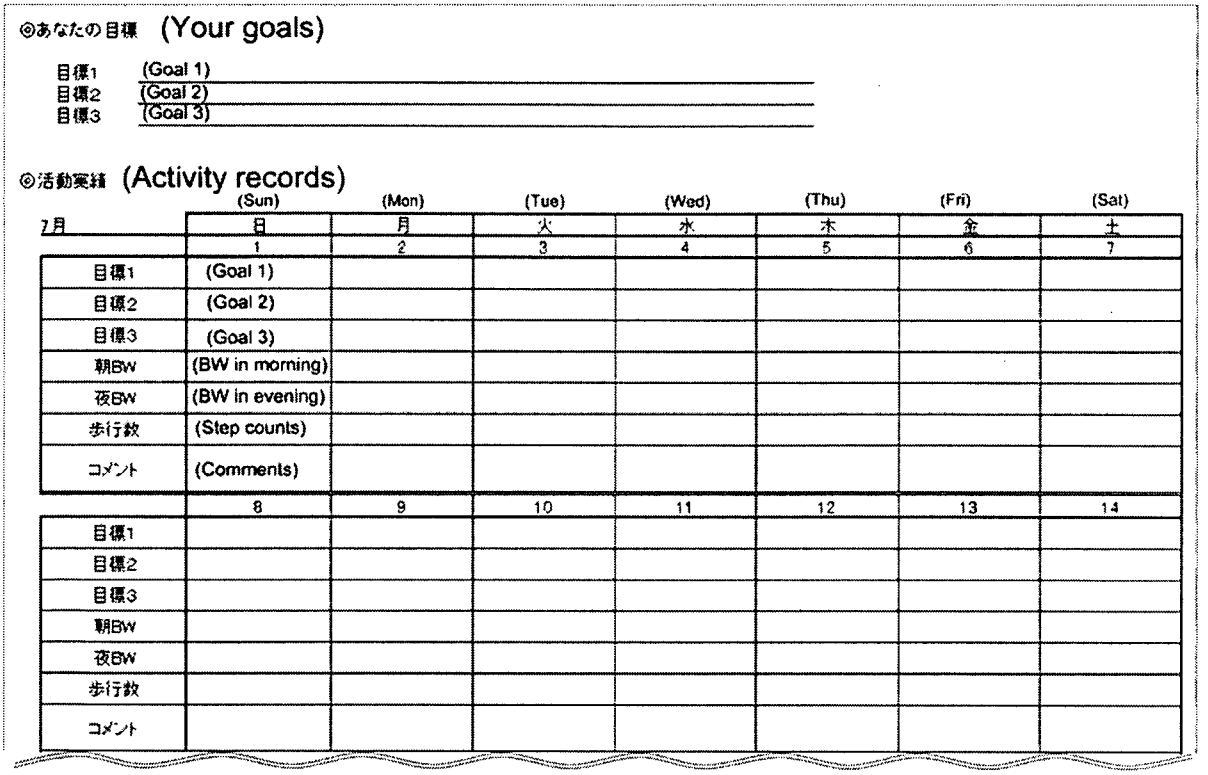
❖ Newly Introduced Health Support Program

As already explained in our previous literature[1], the specified health checkup and follow-up health guidance and intervention program will be introduced from 2008 (Figure 1). All public health insurers have to organize health check-up and the following health promotion programs for the insured over 40 years old. The main target of screening is "Metabolic syndrome".

We have developed the standardized computer program for the stratification of recipients. The insured is categorized into one of three levels according to their risk level; active support required, giving incentive required, only information required. If an insured is evaluated as active support required or giving incentive required, he/she must follow a standardized disease management program that is offered by the health support organization contracted with the insures.

❖ Overview of the IT Based Management System

Figure 3 shows the overview of IT based management system for health support program that we have developed. The base system is constructed on Cognos 8®, one of the most widely used OLAP software. The



◎あなたの目標 (Your goals)

目標1 (Goal 1)
目標2 (Goal 2)
目標3 (Goal 3)

◎活動実績 (Activity records)

7月	(Sun) 日	(Mon) 月	(Tue) 火	(Wed) 水	(Thu) 木	(Fri) 金	(Sat) 土
	1	2	3	4	5	6	7
目標1	(Goal 1)						
目標2	(Goal 2)						
目標3	(Goal 3)						
朝BW	(BW in morning)						
夜BW	(BW in evening)						
歩行数	(Step counts)						
コメント	(Comments)						
	8	9	10	11	12	13	14
目標1							
目標2							
目標3							
朝BW							
夜BW							
歩行数							
コメント							

Figure 4. Personalized notebook diary for monitoring

Participants are required to record their daily performance with self-comments.

system comprises of the three parts: data input and preparing the cubes, data mining, and reporting.

Data input and preparing the cubes

According to the law, all data were erectronized according to the format defined by MHLW. The two types of format are defined; XML and CSV. All health check-up organizations must prepare the data according to the requirement of insurers. The interface of our system can input both types of data and automatically categorized persons into one of three risk levels according to their health data; active support required, giving incentive required, only information required. For persons evaluated as "active support required" or "giving incentive required", the system produce a personal management file in which one registers the goal of health support program for each person (i.e. 5 cm reduction of waist circumference, 5 Kg reduction of body weight), compliance for health education, and final results of lab-test, blood pressure, body weight and waist circumference.

The system produces a personalized notebook diary for monitoring. Figure 4 shows the contents of notebook. In the coversheet, above mentioned goals are written, and in the following pages diary for checking BW in the morning and evening, and self-comments must be registered. Using this diary, Public health nurse can monitor and give appropriate guide for each person.

Besides these health data, the claim data such as medical expenditures one has consumed for one year is also taken into the system.

Using these data, we have developed a default cube for analysis. For example, one can see the distribution of results of lab-test (Figure 5), medical expenditures by risk level (Figure 6), % reduction of waist circumference as a result of intervention (Figure 7).

Data mining

Person in charge of health support program may have interesting in what kinds of differences in characteristics do exist between high-compliance and low-compliance persons. Using this OLAP system, one can conduct the data mining analysis as shown in Figure 8, for example. In this case, the % reduction of waist circumference is compared by compliance level

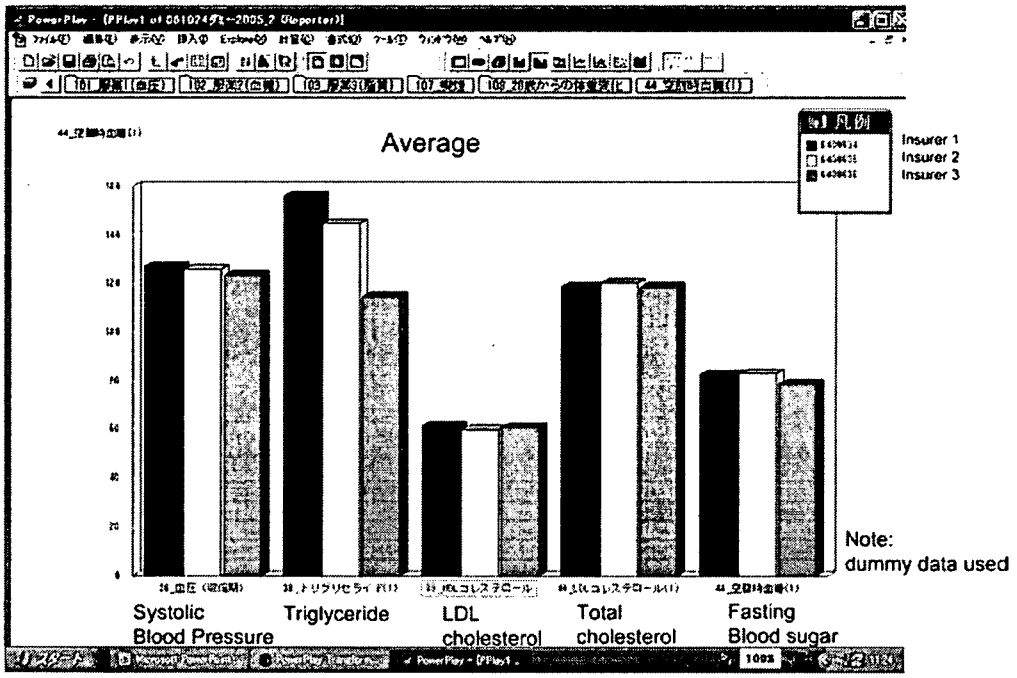


Figure 5. Example of output (1): Comparison of lab-test results by insures

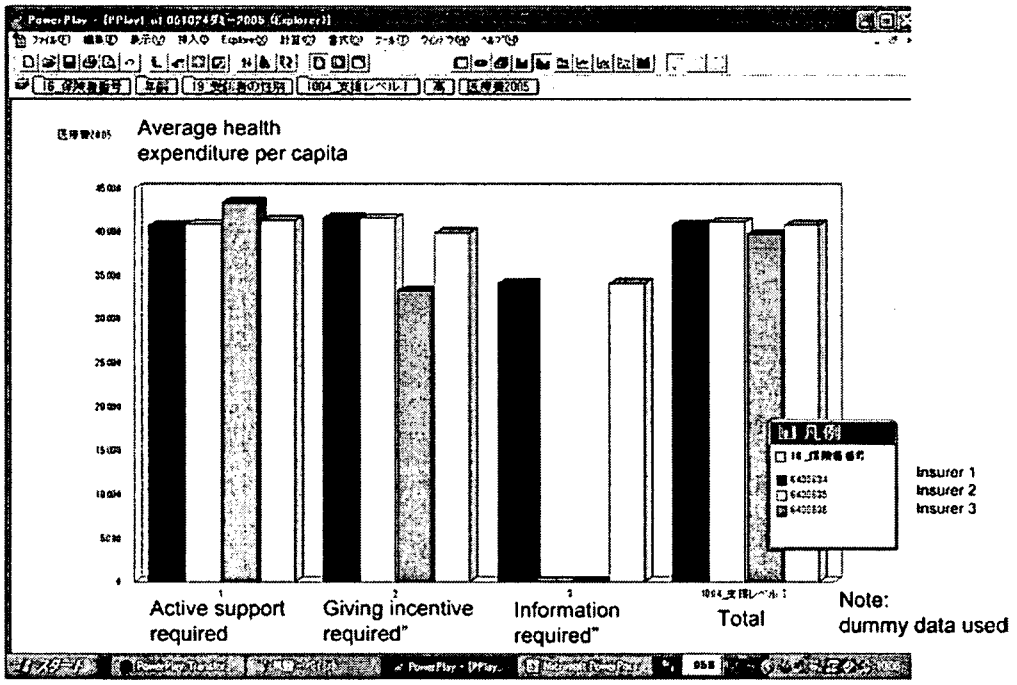


Figure 6. Example of output (2): Comparison of medical expenditures among the assistance levels

and by existence of daily physical fitness activity for middle aged men. The results indicate that the largest reduction was observed for high compliance - physical fitness group. Further analysis (this process is called as drill through) indicates that smoking habit is not related to the reduction.

In this way one can clarify the main target group for further intervention and discuss more appropriate

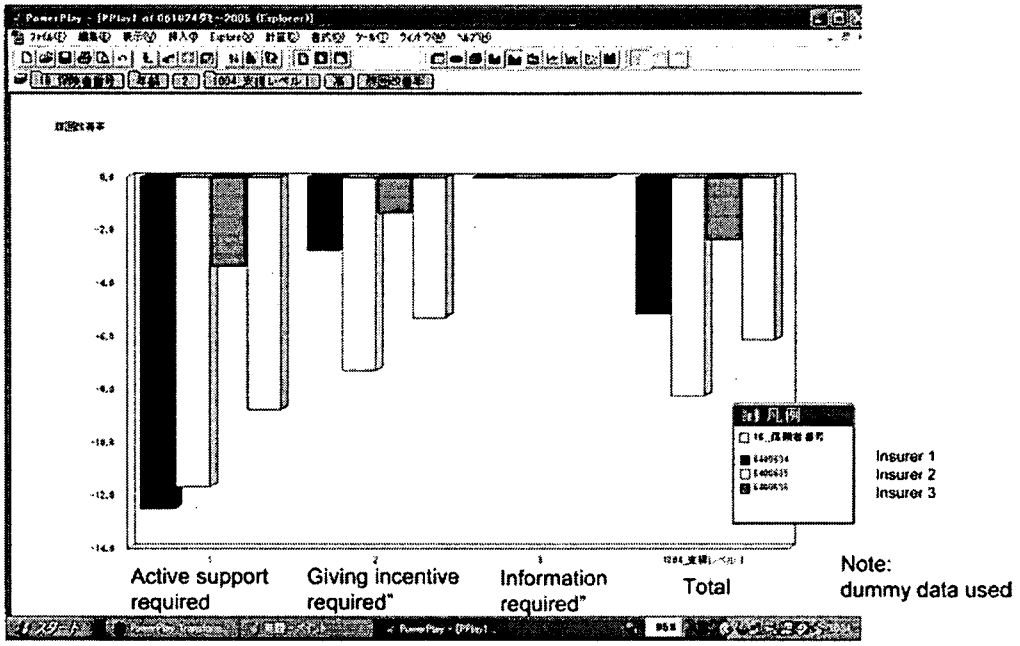


Figure 7. Example of output (3): Comparison of % reduction of waist circumference among the assistance levels

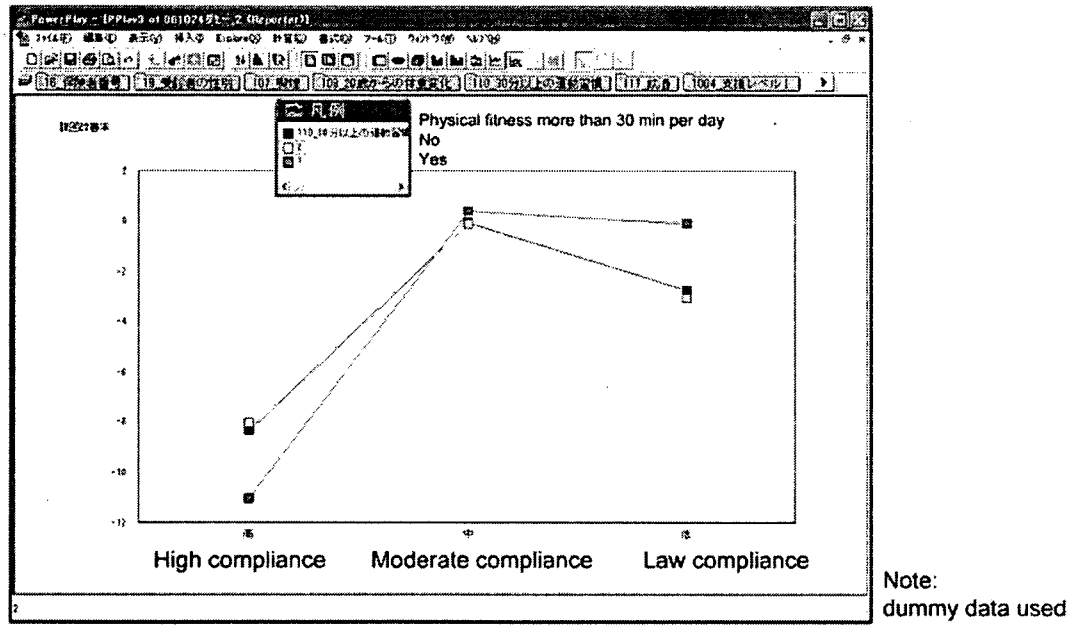


Figure 8. Example of data mining: Comparison of % reduction of waist circumference by compliance levels and physical fitness activity level

approaches for them reflecting their behavioral and/or psychological characteristics.

Reporting

The MHLW requires for all insurers to make a yearly summary report in which each insurer must figure the distribution of insured according to risk level, number of person followed the intervention, and the results of health support programs. As already mentioned, this report is very important because the

amount of contribution to the medical insurance scheme for the aged will be adjusted to reflect the performance of specified health checkup and intervention measures within a range of +/– 10%. At the moment, MHLW does not clarify the detail of summary format, our OLAP system is to be equipped this reporting function.

❖ Discussion

The newly introduced health checkup and follow-up intervention program is a big social experimentation. It requires a large amount of preparation for all insurers. In the case of EMI managed by big companies, such as Hitachi and Panasonic, it will be rather easy to adapt to the new health support program. Under the Occupational Safety and Health Law they have been required to organize various kinds of health support programs for the life-style related diseases. Furthermore, as a main payer for the medical services, they have enough experiences of analyzing the structures of medical expenditures and of taking actions for its control.

In the case of insurers of small and medium sized company, as the management office is too small to analyze the structure of expenditures and to develop some countermeasures for cost control, their main task is to pay for claim without enough review. For this reason, they have been criticized for not playing a role of insurer. The newly introduced health support program must increase their burden of management. It is a very important to prepare the appropriate support system for small insurers because they cover more than 60% of workers and their dependants. More important is the fact that small insurers often cover socially and physically vulnerable groups. This is the main reason why we have developed the IT based support system for their use.

We consider that it will be the most difficult task for the small insurers how to monitor each insured in the new system. One of the possible solutions for them is to use IT based system. We are planning to develop an IT based monitoring system as shown in Figure 3. In this system, health related information is monitored by portable devices such as automatic tonometer, step counter, blood sugar calculator, which are connected to mobile phone or PC. The computer program in the server evaluates the control level of each individual, and if necessary, health staffs have contact with users by telephone, e-mail and home visit and give appropriate guidance.

These kinds of systems have been already developed and used in USA as Disease Management programs[3]. In fact, some Japanese companies have already imported such systems and conducted the preliminary feasibility studies. These programs will support effectively the management of small insurers.

Considering the constraints of human resources, it is indispensable to use IT devices in the new programs. This situation will develop a new health market in Japan. In order to realize a sound market and maximize benefits of users, it is very important to develop health economic studies on the cost-effectiveness of such tools. It is expected that the Japanese Society of Health Support System will contribute to develop the academic background for this field.

❖ References

1) Matsuda S: Health promotion policy in Japan. Asian Pacific J Dis Manag 1 (1), 11–17 (2007).
2) Matsuda S: Health insurance system in Japan. J Econ Med 22 (1-2), 15–26 (2004).
3) Kobayashi A: Development of Disease Management program in USA. In: Tanaka S, Kobayashi A, and Matsuda S, eds. Method and Practice for Health Support (Health Support no Hoho to Jissen). Tokyo: University of Tokyo Press, 2007: 73–141.

Short Communication Asian Pacific Journal of Disease Management 2007; 1(3), 103-106

Analysis of Chronological Fluctuation of Individual Health Check-up Data

Masayuki Tanaka, Yoshihisa Fujino, Shinya Matsuda

Department of Preventive Medicine and Community Health, School of Medicine, University of Occupational and Environmental Health

Abstract

In the case of evaluation of health check-up results, it is common to set the criteria of abnormality accoridng to the population distribution. However, the normal range of lab-data of individual person is usually narrower than that of population data. In this article, the authors have evaluated the chrnological chenges of health check-up data in order to evaluate the possibility of "personally set criteria of abnormality". The used data was those of individuals who have received health check-up all year from 1995 to 1999 consecutively in an Occupational health institute. Total number of persons included into the analysis was 97,945 (Male 65,159, Female 22786). The larger means of CV were observed for Triglyceride, GOT, GPT, gamma-GTP. The smaller means of CV were observed for BMI, SBP, DBP, Total-cholesterol, Ureic acid, Fasting Blood Sugar (FBS) and Hemoglobin (Hb). The present results indicated that one has to pay enough attention to evaluate a cross-sectional data for most of health check-up items excluding blood pressure and BMI because of its chronological variability.

Key words: health check-up, chronological variability, personally set criteria of abnormality

❖ Introduction

In the case of evaluation of health check-up results, it is common to set the criteria of abnormality accoridng to the population distribution. However, as Yoshida reported[1], the normal range of lab-data of individual person is usually narrower than that of population data. For Systolic blood pressure, Diastolic blood pressure, Total-cholesterol, Triglyceride, Fasting Blood Sugar (FBS), GOT, GPT, gamma-GTP and Ureic acid, they showed the standard deviations (SDs) of personal based chronological data were between 40 to 80% of the SD of group data[2]. Thus it is rather difficult to detect the abnormality of inivididual person in its early stage.

Received: July 11, 2007
Accepted: October 24, 2007
Correspondence: M. Tanaka, Department of Preventive Medicine and Community Health, School of Medicine, University of Occupational and Environmental Health, Iseigaoka 1-1, Yahatanishi-ku, Kitakyushu, Fukuoka 807-8555, Japan
e-mail: tanayuki@med.uoeh-u.ac.jp

Furthemore, even though one is evaluated as "abnormal" in a particular year, it is not always a really abnormal values from the chronological point of view because of "return to average" phenomenon.

In order to solve this kind of problem, it is proposed to set a nomal range of value on the individual basis according to the chrnological data of each person.

In this article, the authors will evaluate the chrnological chenges of health check-up data in order to evaluate the possibility of "personally set criteria of abnormality", based on the health check-up data of one Occupational health institution in Japan.

❖ Material and Method

Material

The analyzed data was derived from the health check-up record from 1995 to 1999 of one Occupational health institute in Japan. The used data was those of individuals who have received health check-up all year from 1995 to 1999 consecutively. Total

Table 1 Means and SDs of CV* of health check-up items

	Male			Female		
	N	Mean	SD	N	Mean	SD
BMI	65,159	2.59	1.49	22,786	2.80	1.60
SBP	65,159	5.96	2.53	22,785	6.14	2.62
DBP	65,158	8.04	3.47	22,785	8.27	3.46
Total Cholesterol	46,505	7.40	3.58	16,030	7.55	3.45
Triglyceride	46,285	29.89	15.36	16,002	27.43	13.10
GOT	46,707	18.95	12.99	16,139	16.83	10.72
GPT	46,707	28.57	15.57	16,139	28.97	15.55
γ-GTP	46,457	22.35	14.22	16,092	20.08	13.48
Ureic acid	23,021	9.03	5.19	6,526	10.32	5.17
Hemoglobin	46,532	3.15	1.82	16,199	4.38	3.92
Fasting Blood sugar	24,035	8.67	7.07	6,765	8.20	6.13

*Coefficient of variance (CV) = SD ÷ mean × 100 (%)

number of persons included into the analysis was 97,945 (Male 65,159, Female 22786).

The items of analysis are BMI, Systolic blood pressure (SBP), Diastolic blood pressure (DBP), Total-cholesterol, Triglyceride, Fasting Blood Sugar (FBS), GOT, GPT, gamma-GTP, Ureic acid, and Hemoglobin (Hb).

Method

In order to investigate the chrnological variablity of each item of health check-up, we have calculated mean, SD and Coefficient of Variance (CV) for 5 years data. The relationship of mean and CV was also investigated.

Most of the previous research used only SD for the evaluation of variability. However, as SD is largely influenced by scale (larger mean value, wider SD), we used CV for evaluation of variability.

All statistical analyses were conducted by SPSS ver. 10.0J.

❖ Results

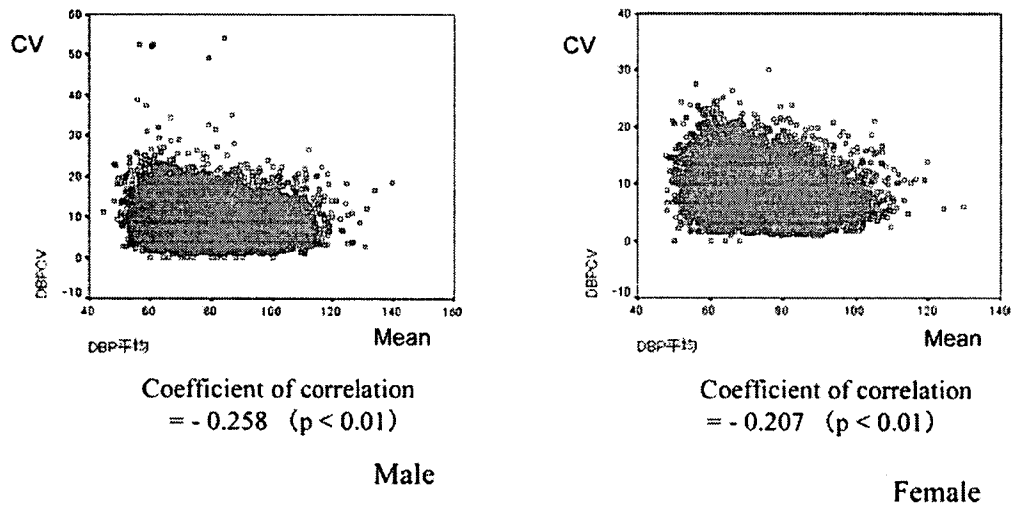
Table 1 shows the mean and SD of CV for each health check-up item. The larger means of CV were observed for Triglyceride, GOT, GPT, gamma-GTP. The smaller means of CV were observed for BMI, SBP, DBP, Total-cholesterol, FBS, Ureic acid and Hb.

So far as the relationship between mean of consecutive five years' data of each person and CV were concerned, the personal means of DBP and Hb showed a statistically significant negative correlation with CV ($p<0.01$). On the contrary, the personal means of Triglyceride, Fasting Blood Sugar, GOT, GPT, gamma-GTP showed a statistically significant positive correlation with CV ($p<0.01$). Figure 1 and Figure 2 show the results of DBP and FBS by sex. These results indicate that the individual with higher value of DBP and Hb tends to show narrower CV, and that the individual with higher value of Triglyceride, Fasting Blood Sugar, GOT, GPT, gamma-GTP tends to show wider CV.

❖ Discussion

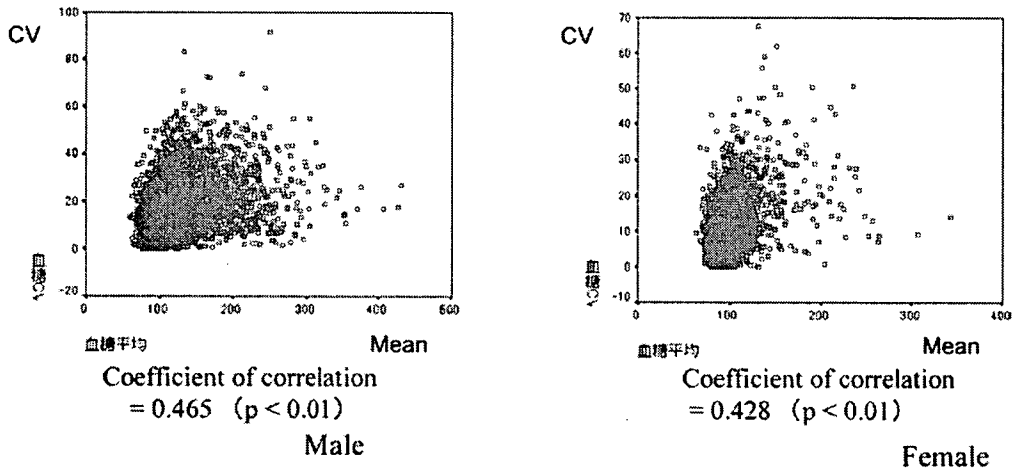
First of all, there are several limitations in the present study. As there was no information about existence of medical treatment in our data, results might be biased; for example, if a person with abnormal lab-data has received a medication, the data may decrease larger than a person with normal data. Furthermore, it will be more reasonable to limit the analyses for persons with complete data. Bearing these limitations in mind, we would like to discuss the present findings.

As Iida and Yoshida reported, one has to distinguish two kinds of health check-up items from the viewpoint of chronological variability[1]. First group is the item with wider chronological variation such as Triglyceride, GOT, GPT and gamma-GTP, and the second is the item with narrower variation such as BMI, SDP, DBP, T-Chol, UA, Hb and FBS. It is well known that the length of fasting and content of pre-



*: CV = Coefficient of variance

Figure 1 Relationship between chronological mean of DBP and its CV* (data from 1995 to 1999)



*: CV = Coefficient of variance

Figure 2 Relationship between chronological mean of FBS and its CV* (data from 1995 to 1999)

health check up meals will influence on the value of TG, and that the drinking habit of the date will influence on the value of GOT, GPT and gamma-GTP. For this reason, Yoshida has recommended that it is preferable to evaluate the abnormality not based on the group criteria but on the individually formulated chronological trend[1].

In order to realize a healthy aged society, the Japanese government has established a new law for the health promotion in 2006. The new law will make "the specified health checkup and intervention program" for insured over 40 years old obligatory for public health insurers from April, 2008. For the criteria to select the persons who need health education, the new law adopts the T-Chol and TG as criteria. As our results indicated, the value of TG will widely fluctuate chronologically. It is needed to investigate the effect of wide intra-personal variation of TG measurement on the validity of selection criteria.

The present results indicated that the individual with higher value of DBP has a higher possibility of abnormality in the consecutive chronological data and that one has to pay enough attention to evaluate a cross-sectional data for other items because of its