Original Article

Lifestyle Risk Charts Illustrating the 10-year Risk of Death in a Japanese Small Community：The JMS Cohort Study at Wara

Hideo Hirose[1], Shizukiyo Ishikawa[1], Tadao Gotoh[1], Kazunori Kayaba[2], and Eiji Kajii[1]

[1]Division of Community and Family medicine, Jichi Medical University, Tochigi, Japan 329-0498
[2]Saitama Prefectural University

Abstract

Risk assessment charts are visualized and easy to use in patient education by public health nurses. The aim of our study was to assess the risk factors and for death and lifestyles to construct risk assessment charts for death using the data from a small community. From June 1992, we conducted the JMS cohort study in Wara town, Gifu, Japan. Participants were tested for systolic blood pressure, total cholesterol, high-density lipoprotein-cholesterol and blood glucose. Information about medical history, food frequency, and lifestyle was obtained by a questionnaire. Physical activity was assessed according to the criteria used in The Framingham Study. All participants were followed up annually during an annual health care check, visits, phone call, and mailings. Risk charts were created based on calculations of the 10-year absolute risk that were associated with all cause death.

A total of 1,371 participants（615 males and 756 females）were analyzed in this study. Total all-cause death was 356. In males, the physical activity index was associated with all-cause death（Hazard ratio 0.92 95% CI 0.87-0.97）and showed a tendency towards low mortality in females（HR 0.92 95% CI 0.82-1.01）. In both sexes, the risk of death was lower in participants who frequently consumed citrus fruit（HR for the infrequent intake group versus the normal intake group, and infrequent intake group vs the high intake group：0.63 95% CI 0.35-1.14 and 0.23 0.09-0.55 for males, 1.02, 0.51-2.06 and 0.39, 0.19-0.90 for females）. We constructed risk-assessment charts for death in Wara town on the basis of hazard ratios.

We used data from the Wara area, a Japanese rural population, to develop risk charts that estimated the 10-year risk for all-cause mortality.

（Keywords：Cohort study, citrus fruit, life style, risk charts）

Introduction

Risk charts are easy to use in patient education in health promotion settings and can show several risk factors in one illustration. Some risk assessment charts were reported in the Framingham study[1)], SCORE project[2)], NIPPON data[3)], and Jichi Medical School（JMS）cohort study[4), 5)].

To change health behavior, risk charts mentioning lifestyle are more important than those with classical risk factors such as blood pressure, total cholesterol, and fast glucose. However, few reports assessed lifestyle risk factors.

An epidemiologic study with a large-scale population is not suitable for making lifestyle risk charts because of diversity and considerable changes in lifestyle, and the possibility of underestimation. A survey of a rural area is suitable for making risk charts that assess way of life due to a homogeneousness lifestyle and low population changes.

Wara town was in the JMS cohort study and is a small community with a population of less than 3,000 in the baseline period. However, this area has been active in health promotion and has historical databases on health information. In 2000, the average life expectancy in males was the highest of all Japanese municipalities[6)].

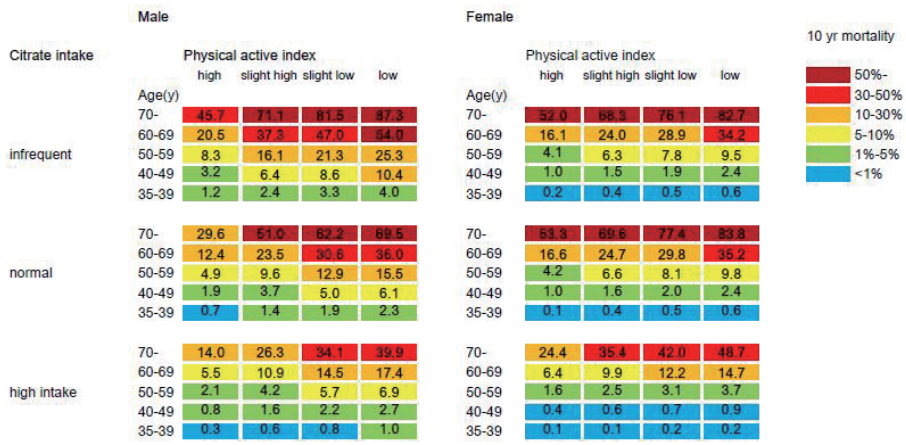
In this analysis, we made risk charts that assessed the association between all-cause mortality and lifestyle using the Wara town database.

Methods

The cohort study in the present analysis comprised

Correspondence to：Hideo Hirose, Division of Community and Family medicine, Jichi Medical University, Tochigi, Japan 329-0498,
E-mail：hideohirose@h8.dion.ne.jp
Received：24 September 2012, Accepted：12 April 2013

Figure Risk Chart of all cause mortality



Risk chart for all-cause mortality

residents in one community in Gifu prefecture called Wara as a part of the JMS cohort study. Residents aged 40-74 years underwent this examination. All were followed up annually by interview during annual health care checks, visits, phone call, and mailings.

The JMS cohort study is a prospective population-based cohort study that was designed to explore the risk factors for cerebro-cardiovascular disease in 12 Japanese communities. Mass screening for CVD has been conducted in Japan since 1983 in accordance with the health and medical service law for the aged, and we used this system to collect data for this study. The study design and some descriptive data have been presented previously[7]. In June 1992, the local government office mailed invitations to eligible individuals.

The Institutional Review Board of Jichi Medical University of Medicine approved this study and written informed consent was obtained from all subjects.

Systolic blood pressure（SBP）was measured with a fully automated sphygmomanometer, BP203RV-II（Nippon Colin, Komaki, Japan）, placed on the right arm of the subjects who had rested while seated for 5 minutes before measurement.

Total cholesterol levels were measured by enzymatic methods（Wako, Osaka, Japan；inter assay CV：1.5%）. High-density lipoprotein-cholesterol（HDL-C）was measured using the phosphotungstate precipitation method（Wako, Osaka, Japan；inter assay CV：1.9%）. Blood glucose was measured with an enzymatic method（Kanto Chemistry, Tokyo, Japan；inter assay CV：1.9%）.

Information about medical history and lifestyle was obtained by a questionnaire. The usual dietary intakes of the participants were ascertained by employing an FFQ composed of the 28 different foods most likely to be consumed. The FFQ was created based on that used in the Japan Collaborative Cohort（JACC）Study that demonstrated acceptable reproducibility and validity[8]. By using the FFQ, participants' frequencies of intake for each food were assessed by five-level scale questions：1：seldom, 2：1-2 times per month, 3：1-2 times per week, 4：3-4 times per week, and 5：almost every day. In this analysis, we made three groups：1 and 2 were infrequent intake, 3 was normal intake, and 4 and 5 were high intake.

The physical activity index was assessed according to criteria used in the Framingham Study[9]. A self-questionnaire was administered in an interview conducted by trained reviewers. Information obtained included average working time, sleeping hours, and types of activities conducted during a typical workday and during leisure time in a normal weekday. We classified activities into 4 groups according to the level of exertion. Each level of exertion was assigned a coefficient based on the Framingham Study's physical activity index weighting factors. The coefficients and time spent on an activity were then multiplied. We then summed the multiplied values to produce the Physical Activity Index（PAI）over 24 hours.

Information on deaths was collected using data from death certificates and the national vital statistics database with the permission of the Agency of General Affairs and the Ministry of Health, Labor and Welfare, Japan. In addition, municipal governments obtained information annually on participants who moved to other areas.

Statistical analysis

To calculate the 10-year absolute risk of mortality for each risk factor, we used Cox proportional hazards models. Using the Cox proportional hazards model, the survival probability Sp（T：X）of a person with a risk X at time T is defined as Sp（T：X）= {[Sp0（T）] exp（BX）} exp（B（X − Xm））, where Sp0（T）is survival probability corresponding to the standard hazard, B is the regression coefficient, and Xm is the population mean of risk X. The 10-year absolute risk of a person with risk X is thus 1-S（10：X）7）. In this analysis, risk charts were illustrated for 10 year probability of all-cause mortality in both sexes. Age was classified into 5 groups：（1）under 40,（2）40-49,（3）50-59,（4）60-

Table 1 Baseline characteristics

	male	female
mean age	58.3 (57.3-59.3)	58.3 (57.4-59.3)
mean physical active index	35.2 (34.3-36.1)	30.1 (29.9-30.4)
number of smokers (%)	245 (39.8%)	41 (5.4%)
mean systolic blood pressure (mmHg)	126.6 (124.8-128.3)	129.0 (127.0-130.7)
total cholesterol (mg/dl)	187.5 (184.9-190.2)	195.3 (193.0-197.6)
HDL-cholesterol (mg/dl)	47.3 (46.3-48.4)	50.1 (49.3-50.9)
blood glucose (mg/dl)	96.6 (95.1-98.2)	92.9 (91.8-94.1)

Numbers are expressed as the mean (95% confidence interval)

Table 2 Hazard ratios for all-cause mortality

Male	Physical active index	Citrus intake	
		infrequent vs normal intake	infrequent intake vs high intake
Crude	0.90 (0.85-0.95)	0.81 (0.46-1.42)	0.36 (0.15-0.87)
Model 1	0.92 (0.87-0.97)	0.61 (0.34-1.07)	0.26 (0.11-0.63)
Model 2	0.92 (0.87-0.97)	0.63 (0.35-1.14)	0.23 (0.09-0.55)
Female	Physical active index	Citrus intake	
		infrequent vs normal intake	infrequent intake vs high intake
Crude	0.88 (0.79-0.99)	0.70 (0.36-1.36)	0.32 (0.14-0.73)
Model 1	0.91 (0.82-1.01)	1.00 (0.51-1.99)	0.40 (0.17-0.92)
Model 2	0.92 (0.82-1.01)	1.04 (0.52-2.10)	0.42 (0.18-0.96)

Data are expressed as the mean (95% confidential interval)
Model 1：Adjusted for age
Model 2：Adjusted for age, smoking status, systolic blood pressure, total cholesterol level, HDL cholesterol level, and blood glucose.

69, and (5) over 70. Citrus fruit intake grouped into 3 categories：(1) infrequent intake, (2) normal intake, and (3) highly intake. Physical activity indices were grouped into 4 categories：(1) high (2) slight high (3) slight low, and (4) low. The risk charts were color-coded so that users could estimate the probability of all-cause mortality. Statistical analyses were carried out using the Statistical Package for Social Science® (SPSS) for Windows (SPSS Japan Inc., version 11.5, Tokyo, Japan).

Results

A total of 1,371 participants (615 males and 756 females) were analyzed in this study. Of the participants from 1992, 356 had (including 24 sudden deaths), and 11 were lost to follow up. The baseline characteristics of the participants are shown in Table 1. The mean duration of follow up was 10.7 years (male：10.6 years；female：10.8 years).

For lifestyle and intake of 30 different foods, the physical activity index and citrus fruits were associated with all-cause mortality. Table 2 shows hazard ratios (HRs) calculated by Cox's proportional hazard models with physical active index and citrus intake.

In males, the physical activity index was associated with all-cause mortality (Hazard ratio 0.92 95% CI 0.87-0.97) and tended towards low mortality in females (HR 0.92 95% CI 0.82-1.01). In both sexes, the risk of death was lower in participants who frequently consumed citrus fruit (HR for the infrequent intake group versus the normal intake group, and the infrequent intake group vs the high intake group：0.63 95% CI 0.35-1.14 and 0.23 0.09-0.55 in males, 1.02, 0.51-2.06 and 0.39, 0.19-0.90 in females) adjusted for age, smoking status, systolic blood pressure, total cholesterol level, HDL cholesterol level, and blood glucose..

The Figure shows the color-coded 10-year absolute risk for all-cause death. All charts were prepared in the same manner, according to age, citrus intake and physical activity index.

Discussion

In this study, we originally constructed risk assessment charts based on lifestyle. The charts showed high physical activity and high citrus fruit intake were associated with low mortality. We can extrapolate these risk charts worldwide using the database from a small rural area.

Many risk charts were reported that that assessed an individual's risk of stroke, CHD, and all CVD. The Framingham CHD risk score, and New Zealand and European charts have been formulated and are now tools used in patient education[10),11)]. In Japan, the NIPPON DATA80 Research Group constructed original charts based

on the findings from NIPPON DATA80 that are suitable for assessing CHD, stroke, and all CVD death risk in the general Japanese population[3]. Previously, Ishikawa and Matsumoto et al. reported risk charts illustrating the 10-year risk of myocardial infarction and stroke in the JMS cohort study, a large population-based prospective cohort study[4,5].

However, these risk charts focused on objective parameters such as blood pressure, total cholesterol level, glucose level and we need risk charts that include lifestyle. These risk charts may be useful for lifestyle modification in the setting of patient education and health care checks. In our study, the risk chart with a physical activity index and food intake was useful for patient education.

The chart showed high physical activity and high citrus fruit intake were associated with low mortality. In a cohort study, Hayasaka et al. reported that increased physical activity lowered the risk for all-cause death in Japanese[12]. Many previous studies have examined the health benefits of physical activity[13].

Few reports have mentioned the association between all-cause mortality and citrus fruit consumption. Yamada T et al. reported that citrus fruit intake was associated with a reduction in cardiovascular disease in our JMS cohort study[14]. Other cohort studies also reported the association between citrus fruit and cardiovascular disease[15,16]. There has been some speculation. As compared with these other fruits, citrus fruit is richer in antioxidants such as beta-cryptoxanthin and Vitamin C[17]. These antioxidants may protect against CVD or cerebral infarction and contribute to a marked reduction in incidence levels[18,19]. As compared with the results from previous studies on the association of citrus fruit intake with the incidences of CVD and cerebral infarction, the reductions in these incidences associated with frequent citrus fruit intake were more marked in the present analysis. Consumption of fruit is also associated with changes of other food intake during meals. Thus, the apparent benefit of fruit could be a consequence of the substitution of fruit and vegetables for unhealthy foods.

Wara town has a small rural and population but addressed health promotion for over 40 years. In 2005, the "Mamenakana Wara 21 Plan" was released as health planning for Wara town using the PRECEDE-PROCEED model[20]. In this study, it was very useful to demonstrate that a small rural area could be used for risk assessment charts in larger prevailing areas.

The present study has several limitations. First, the patient population was relatively small that other factors were underestimated. In this study, sample size was only 1,300. We need to analysis in whole cohort sample. Second, 10 year mortality of elderly people was very high, so it is difficult to use risk charts in patient education. Third, this risk chart may be specific for Asian people, especially Japanese rural people, so more studies are needed to assess lifestyles of multiethnic populations.

In conclusion, we used data from the Wara area, a Japanese rural population, to develop risk charts that estimated the 10-year risk for all-cause mortality.

Declaration of interest：The authors have no conflict of interest to declare.

References

1）Wilson PW, D'Agostino RB, Levy D, et al. Prediction of coronary heart disease using risk factor categories. *Circulation* 1998；97：1837-1847

2）Conroya RM, Pyörälä K, Fitzgeralda AP, et al. Estimation of ten-year risk of fatal cardiovascular disease in Europe：the SCORE project. *Eur Heart J* 2003；24：987-1003

3）NIPPON DATA80 Research Group. Risk assessment chart for death from cardiovascular disease based on a 19-year follow-up study of a Japanese representative population-NIPPON DATA80. *Circ J* 2006；70：1249–1255

4）Ishikawa S, Matsumoto M, Kayaba K, et al. Risk Charts Illustrating the 10-year Risk of Stroke among Residents of Japanese Rural Communities：The JMS Cohort Study. *J Epidemiol* 2009；19：101-106

5）Matsumoto M, Ishikawa S, Kayaba K, et al. Risk Charts Illustrating the 10-year Risk of Myocardial Infarction among Residents of Japanese Rural Communities：The JMS Cohort Study. *J Epidemiol* 2009；19：94-100

6）http://www.mhlw.go.jp/toukei/saikin/hw/life/ckts00/3.html

7）Ishikawa S, Gotoh T, Nago N, et al. The Jichi Medical School（JMS）Cohort study：Design, baseline data and standardized mortality ratios. *J Epidemiol* 2002；12：408-417

8）Date C, Fukui M, Yamamoto A, et al. Reproducibility and validity ofa self-administered food frequency questionnaire used in the JACC study. *J Epidemiol* 2005；15（suppl 1）：S9–23

9）Kannel WB, Sorlie P. Some health benefits of physical activity：The Framingham Study. *Arch Intern Med* 1979；139：857–861

10）Wallis EJ, Ramsay LE, Haq IU, et al. Coronary and cardiovascular risk estimation for primary prevention：Validation of a new Sheffield table in the 1995 Scottish health survey population. *BMJ* 2000；320：671-676

11）Wood D, De Backer G, Faergeman O, et al. Prevention of coronary heart disease in clinical practice：Recommendations of the Second Joint Task Force of European and other societies on coronary prevention. *Eur Heart J* 1998；19：1434–1503

12）Hayasaka S, Shibata Y, Ishikawa S, et al. Physical Activity and All-cause Mortality in Japan：The Jichi

Medical School（JMS）Cohort Study. *J Epidemiol* 2009；19：24-27
13）Paffenbarger RS Jr, Hyde RT, Wing AL, et al. The association of changes in physical activity level and other lifestyle characteristics with mortality among men. *N Engl J Med* 1993；328：538-545
14）Yamada T, Hayasaka S, Shibata Y, et al. Frequency of Citrus Fruit Intake Is Associated With the Incidence of Cardiovascular Disease：The Jichi Medical School Cohort Study. *J Epidemiol* 2011；21：169-175
15）Martínez-González MA, Lamuela-Raventos RM. The unparalleled benefits of fruit. *Br J Nutr* 2009；102：947-8
16）Johnsen SP, Overvad K, Stripp C, et al. Intake of fruit and vegetables and the risk of ischemic stroke in a cohort of Danish men and women. *Am J Clin Nutr* 2003；78：57-64
17）Tribble DL. AHA Science Advisory. Antioxidant consumption and risk of coronary heart disease：emphasison vitamin C, vitamin E, and beta-carotene：A statement for healthcare professionals from the American Heart Association. *Circulation* 1999；99：591–595
18）Dauchet L, Amouyel P, Dallongeville J. Fruit and vegetable consumption and risk of stroke A meta-analysis of cohort studies. *Neurology* 2005；65：1193–97
19）Steffen LM, Jacobs DR Jr, Stevens J, et al. Associations of whole-grain, refined-grain, and fruit and vegetable consumption with risks of all-cause mortality and incident coronary artery disease and ischemic stroke：the Atherosclerosis Risk in Communities（ARIC）Study. Am J Clin Nutr 2003；78：383–390
20）Gotoh, T, Nakashima A, et al. Mamenakana Wara 21 Health Plan. http://rhino.med.yamanashi.ac.jp/sukoyaka/todofu21.html（in Japanese）

Jichi Medical University Journal 2013, 36, 57-62

10年間死亡率をエンドポイントにした生活習慣による リスクチャートの作成―和良地域におけるJMSコホート研究より

廣瀬　英生[1]，石川　鎮清[1]，後藤　忠雄[1]，萱場　一則[2]，梶井　英治[1]

[1]自治医科大学 地域医療学教室，〒320-0498 栃木県下野市薬師寺3311-1
[2]埼玉県立大学

要　約

地域独自かつ生活習慣に根差したリスクチャートを作成することは患者教育に有用であると考えられる。

1992年６月からJMSコホートの対象地区の一つとして岐阜県和良町において調査を開始した。参加者は，収縮期血圧，総コレステロール，HDLコレステロール，血糖値を測定し，既往歴，生活習慣をアンケートにて聴取した。

1371人（男性615名，女性756名）に対して解析，総死亡は356例であった。男性において，physical activity indexは総死亡率と関連があった（Hazard ratio 0.92 95％信頼区間0.87-0.97），女性においては，死亡率が少ない傾向であった（HR0.92 95％ CI 0.82-1.01）。男女において，柑橘類の摂取は，死亡の低下と関連があった。（柑橘類低摂取群vs通常摂取群，低摂取群vs高摂取群：男性0.63 95％CI 0.35-1.14及び 0.23 0.09-0.55, 女性 1.02, 0.51-2.06及び0.39, 0.19-0.90）。この有意であった２つの因子を基に10年間総死亡率に対するリスクチャートを作成した。

この研究を通じて，日本のへき地である和良地域独自の生活習慣を基にしたリスクチャートを作成した。

（キーワード：コホート研究，リスクチャート，生活習慣，柑橘類）

連絡先：廣瀬英生，自治医科大学 地域医療学教室，〒320-0498 栃木県下野市薬師寺3311-1，E-mail：hideohirose@h8.dion.ne.jp
受付：2012年９月24日，受理：2013年４月12日