

## Findings of periodic health examination and risk of mortality in a cohort of elderly people in Taiwan

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### Abstract

**Aim:** Comprehensive periodic health examination of elderly people is popular in Taiwan. The purpose of this study is to identify predictors of mortality of the elderly from the findings of their periodic health examination.

**Methods:** From the period 1996–1999, 4794 elderly people aged 65 and older underwent periodic health examination in our institution. The status of survival of these 4794 subjects up to 31 December, 2000 was ascertained. Cox proportional hazard regression was performed to estimate the hazard ratio of mortality of the findings in the health examination.

**Results:** The median follow-up time was 34 months. In the multivariate model, significant findings associated with increased mortality included: smoking daily (hazard ratio [HR]: 1.401; 95% CI = 1.000–1.963); intake less than three dishes of vegetables and two fruits per day (HR: 1.434; 95% CI = 1.049–1.960); urine protein > 0.3 g/L (HR: 2.184; 95% CI = 1.399–3.411); low hemoglobin (HR: 1.924; 95% CI = 1.423–2.602); serum albumin < 40 g/L (HR: 2.108; 95% CI = 1.514–2.935); globulin > 35 g/L (HR: 1.421; 95% CI = 1.034–1.952); serum aspartate transaminase level > 40 IU/L (HR: 2.468, 95% CI = 1.571–3.878); and blood urea nitrogen level > 7.8 mmol/L (HR: 1.427; 95% CI = 1.025–1.988).

**Conclusions:** Lifestyle, dietary habit and some findings of the blood and urine tests done in the periodic health examination were found to be significantly associated with the mortality of people aged 65 years or older in Taiwan.

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**Key words:** elderly, mortality, periodic health examination, risk factors

### Introduction

The demands and needs of the healthcare services of the elderly population has increased rapidly in Taiwan. By the end of 2002 there were more than 2 million elderly people aged 65 years and older, approximately 9% of the total population. The burden of illness is very high in this elderly population. Periodic health examination has been widely promoted to promote early detection of diseases and illnesses.

Two of the most important evidence-based guidelines for periodic health examination were published by the US Preventive Services Task Force and the Canadian Task Force on the Periodic Health Examination.<sup>1,2</sup> The screening tests recommended for people aged 65 and older are limited, probably due to inadequate evaluation of the cost-effectiveness of all the available screening tests in the elderly population. In general, from the available evidences, screening of blood pressure, faecal occult blood, mammography, Pap smear, bone density screening

for older women, vision and hearing screening, were all found to be cost-effective. Many other screening tests are controversial and are not recommended for elderly people.

In Taiwan there was little information and evidence available to assess the effectiveness of the periodic health examination of elderly people, although the number of people doing periodic health examination increased rapidly in the past 10 years. In the year 2001, it was estimated that approximately 37% of elderly people underwent free health examination offered by the government.

Previous studies showed that smoking was a significant predictor of mortality for adults, including elderly people.<sup>3-5</sup> Consumption of alcohol is another lifestyle factor that has been associated with mortality. Light to moderate drinking was found to be associated with a reduction in overall mortality.<sup>6-8</sup> Healthy dietary habits such as adequate intake of vegetables, fruits and milk were found to be associated with good health. Obesity and overweight were also found to be associated with mortality,<sup>9-11</sup> while their association in elderly people was found to be different from that in the younger population.<sup>12-14</sup> High blood pressure and diabetes mellitus (DM) were the two chronic diseases associated with increased mortality of elderly people.<sup>15-21</sup> The results of laboratory tests commonly performed in the Periodic Health Examination were found to be associated with mortality, such as white blood cell count,<sup>22-25</sup> haemoglobin,<sup>26-29</sup> serum albumin level,<sup>30-34</sup> renal

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function tests,<sup>35</sup> urine protein,<sup>36–40</sup> uric acid level,<sup>41</sup> serum cholesterol level,<sup>42,43</sup> serum triglyceride level,<sup>44</sup> and levels of serum enzymes aspartate transaminase (AST) and alanine transaminase (ALT).<sup>45–47</sup>

The aim of this study is to identify the significant predictors of mortality of the study subjects from the findings of a periodic health examination for elderly people so that health providers can follow up and care for these people more effectively.

## Methods

### Study population

Since the year 1994, elderly people aged 65 and older were eligible to attend a free periodic health examination covered by National Health Insurance in a community hospital located in the Taipei County of Taiwan. They participated voluntarily and attended annually in a 'first-come, first-serve' basis. In this study, we performed analyses on the findings of the first health examination of these elderly people who attended this hospital between the years 1996–1999.

### Study design

In this study, only the findings of the first examination of the participant during the study period were used for analysis. Elderly people voluntarily made an appointment and came on the day of examination in a fasting state. The health examination included the completion of a questionnaire, a physical examination and laboratory tests. With the help of an assistant or a nurse, a questionnaire about medical history (hypertension, diabetes mellitus, renal disease, lung disease, cerebrovascular disease, lipid disorder, hepatitis B infection, cardiovascular diseases, peptic ulcer disease and history of regular drug usage) and lifestyle (smoking, alcohol consumption, intake of fruits, vegetables and milk) were administered. Blood pressure, heart rate, height, weight and vision acuity were measured. A completed physical examination was then performed by a family physician. Finally, a panel of blood and urine tests was done, including complete blood count, fasting sugar, lipid profile (cholesterol and triglyceride), renal function profile (blood urea nitrogen, creatinine and urine albumin), liver profile (serum AST and ALT), serum albumin, globulin and uric acid.

The reliability of the questionnaire was estimated by comparing the responses of the first health examination and subsequent examinations of those subjects who attended more than once during the study period. The correlation of their answers to the questionnaire in the first and repeated examinations was regarded as a representation of the test-retest reliability. The mean duration between the test and retest was 13 months. The mean correlation coefficient was 0.62. All laboratory tests were performed in the institution's laboratory. Blood pressure was measured once by a standard sphygmomanometer by a nurse after sufficient rest by the participant. The same automatic device was used to measure the height and weight of the subjects throughout the 4 years of study.

The status of survival of the subjects was ascertained by linkage to the national mortality database. The date and the cause of death were noted for each participant who died on or before 31 December, 2000. Personal information on each subject was kept confidential and anonymous in data linkage and processing. Ethical review was not required for secondary data analysis when the study was conducted.

### Statistical methods

Statistic software SPSS V.10.0 was used for the data analysis. Cox proportional hazard regression procedure was performed to estimate the hazard ratio of mortality of the findings. Wald test was used to determine the significance of this hazard ratio. All statistical tests were regarded as significant if  $P < 0.05$ . The duration of follow-up was calculated in months and the event was the death of the elderly subject. Multivariate analysis was performed and the significant variables of a prediction model were identified by backward elimination in the regression procedure.

## Results

Between 1996–1999, 4794 subjects aged 65 and older (2781 male and 2013 female) underwent the periodic health examination in our institution (**Table 1**). Of these, 2426 subjects had repeated the examination in the subsequent several years and 2368 subjects did the health examination once only during the study period. By the end of 2000, there were 271 deaths in the overall cohort of 4794. The mortality rate was 5.65% and the main causes of death were cancer and cardiovascular diseases (**Table 2**). The standardized mortality rate of the participants was estimated to be 6.19%. The cross-sectional findings of the periodic health examination in this study were similar to other studies in Taiwan (**Tables 3,4**). The standardized mortality rate and the distribution of the causes of mortality were also similar to the national data. Total follow-up time of all participants was 16 7331 person-months and the median follow-up time was 34 months (mean = 34.9 months, SD = 10.9 months, interquartile range = 24 months).

**Table 1** Age and sex of the participants

Age	Male	Female	Total
65–69	900 (32.4%)	755 (37.5%)	1655 (34.6%)
70–74	952 (34.3%)	661 (32.8%)	1613 (33.6%)
75–79	578 (20.7%)	383 (19%)	961 (20%)
≥ 80	351 (12.6%)	214 (10.7%)	565 (11.8%)
Total	2781 (100%)	2013 (100%)	4794 (100%)

High blood pressure, cardiovascular diseases and diabetes mellitus were the three most common medical histories reported by the participants; 54.5% regularly took medication. Most did not smoke, did not consume alcohol regularly and reported that they ate a lot of fruits and vegetables (**Table 3**). Overweight and high blood pressure were the most common abnormal physical findings. High serum level of total cholesterol, uric acid and blood sugar were the three most common findings in the laboratory examination (**Table 4**).

**Table 2.** Number and causes of death by the end of the study (31 December, 2000)

Deaths	Male	Female	Total (%)
Cancer mortality	51	30	81 (29.9%)
Cardiovascular mortality	45	34	79 (29.2%)
Respiratory mortality	21	10	31 (11.4%)
Diabetes mellitus mortality	10	10	20 (7.4%)
All other causes mortality	38	22	60 (22.1%)
All causes mortality	165	106	271 (100%)
Number of survived subjects	2616	1907	4523
Total subjects	2781	2013	4794
Percentage of deaths	5.93%	5.26%	5.65%

**Table 3.** Self-reported medical histories and lifestyle factors of the participants

Self-reported medical histories and lifestyle factors	Prevalence of the conditions (n = 4794)
Hypertension	34.20%
Diabetes Mellitus	11.50%
Renal diseases	2.70%
Lung diseases	3.20%
Cerebro-vascular diseases	2.70%
Lipid disorders	8.80%
HBV infection	2.30%
Cardiovascular diseases	17.70%
Peptic ulcer diseases	11.10%
Regular drug usage	54.50%
No smoking	82.90%
Smoking occasionally	3.10%
Smoking everyday	14.00%
Not consume alcohol	76.30%
Consume alcohol occasionally	18.50%
Consume alcohol frequently	5.20%
Drink milk everyday	65.40%
Eat fruits and vegetables frequently (at least 3 dishes of vegetable and 2 fruits)	83.20%

The following factors were found in the multivariate model significantly associated with increased risk of mortality: daily smoking; eating less than three dishes of vegetable and two fruits every day; urine protein > 0.3 g/L; low hemoglobin level (men  $\leq$  130 g/L, women  $\leq$  120 g/L); serum albumin < 40 g/L and globulin > 35 g/L; serum AST level > 40 IU/L; and blood urea nitrogen level > 7.8 mmol/L (Table 5).

## Discussion

In this study, we found that daily smoking, intake of less than three dishes of vegetables and two fruits every day, low hemoglobin, excretion of moderate amounts of urine protein, low serum albumin level, high serum globulin level, elevated serum AST and high blood urea nitrogen (BUN) level were significant independent predictors of mortality in the multivariate model.

The hazard ratio of mortality was 1.401 in the elderly who smokes daily. Smoking is similarly hazardous to elderly people as in the younger population. Education of elderly patients to quit smoking is important in daily practice. Nutrition deficiency is common in elderly people. Encouragement of elderly people to eat adequate

**Table 4.** Abnormal findings of the periodic health examination in this study

Abnormal findings	Prevalence of the conditions (n = 4794)
BMI ( $\geq$ 24 and < 27)	32.20%
BMI ( $\geq$ 27)	22.20%
Systolic BP (< 140 mmHg)	62.20%
Systolic BP ( $\geq$ 140 mmHg)	37.80%
Diastolic BP (< 90 mmHg)	76.10%
Diastolic BP $\geq$ 90 mmHg)	23.90%
Hypertension (positive history or SBP $\geq$ 140 mmHg or DBP $\geq$ 90 mmHg)	58.40%
Urine protein (< 0.3 g/L)	89.70%
Urine protein (= 0.3 g/L)	6.60%
Urine protein (> 0.3 g/L)	3.70%
White blood cells ( $> 10.0 \times 10^9/L$ )	2.20%
Hemoglobin (male < 130 g/L, female < 120 g/L)	13.90%
Albumin (< 40 g/L)	11.20%
Globulin (> 35 g/L)	16.00%
Serum AST (> 40 IU/L)	3.80%
Serum ALT (> 60 IU/L)	5.30%
Sugar (> 6.1 mmol/L and < 7 mmol/L)	6.30%
Sugar ( $\geq$ 7 mmol/L)	11.00%
Diabetes or glucose intolerance (positive history or fasting sugar > 6.1 mmol/L)	20.60%
Cholesterol ( $\geq$ 5.20 mmol/L and < 6.20 mmol/L)	36.10%
Cholesterol ( $\geq$ 6.20 mmol/L)	15.00%
Triglyceride ( $\geq$ 1.7 mmol/L and < 2.26 mmol/L)	10.20%
Triglyceride ( $\geq$ 2.26 mmol/L)	9.00%
BUN (> 7.8 mmol/L)	11.20%
Creatinine (> 124 mol/L)	6.30%
Uric Acid (> 446 mol/L)	21.40%

BMI, Bodymass index; BP, blood pressure; AST, aspartate transaminase; ALT, alanine transaminase; BUN, blood urea nitrogen

**Table 5.** Hazard ratios of mortality of the significant factors in the multivariate model

Factors	Hazard ratios	CI (95%)
Smoking everyday	1.401	1.000–1.963
Intake less than 3 dishes of vegetable and 2 fruits per day	1.434	1.049–1.960
Urine protein > 0.3 g/L	2.184	1.399–3.411
Hemoglobin (male < 130 g/L, female < 120 g/L)	1.924	1.423–2.602
Serum albumin < 40 g/L	2.108	1.514–2.935
Serum globulin > 35 g/L	1.421	1.034–1.952
AST > 40 IU/L	2.468	1.571–3.878
BUN < 7.8 mmol/L	1.427	1.025–1.988

AST, aspartate transaminase; BUN, blood urea nitrogen

and balance food is important. Increased intake of fruits and vegetables was shown to be protective in this study. Obesity is a risk factor for many adult diseases. However, in the elderly population of this study, body mass index (BMI) was not found to be a significant risk factor of mortality. Alcohol consumption was also not shown to increase the mortality in this study. In general, inquiry

about the lifestyle issues is still very important in the periodic health examination. Intervention to change an unhealthy lifestyle should be considered.

Anaemia is an independent factor strongly associated with mortality. In this study, the hazard ratio of mortality for low haemoglobin was 1.924. Underlying diseases unable to be adjusted might explain part of the increasing risk of mortality of low haemoglobin. Identification of the causes of the anaemia and treatment of the underlying causes may increase the survival rate of the patient. Serum albumin levels were found to be significantly associated with mortality. The hazard ratio of mortality found in this study for serum albumin < 40 g/L was 2.108. Elderly people with low serum albumin levels should be further investigated for underlying illnesses and be treated accordingly. Elevated serum globulin > 35 g/L was also found to be a risk factor for mortality with a hazard ratio of 1.421. Raised serum AST level was significantly associated with mortality. The hazard ratio was 2.468 in people with AST > 40 IU/L. Elderly people with elevated AST should be followed-up closely, even if the patient does not have liver disease. Further investigation is warranted if the abnormalities persist without good explanation.

Excretion of urinary protein was an important independent indicator for health, being significantly associated with mortality. The hazard ratio was 2.184 in this study. Elderly people with proteinuria should be followed-up closely and other cardiovascular risk factors should be found and modified. Treatment with angiotensin-converting enzyme (ACE) inhibitors may be considered. Serum level of blood urea nitrogen was also found to be associated with increased mortality, with a hazard ratio of 1.427. Supportive treatments and correction of underlying illnesses may correct the elevated level of BUN

Based on the results of the health examination, we can identify high-risk elderly people. Further treatment or management of the high-risk group may reduce their mortality. The findings of this study also suggest that many results in the periodic health examination are not predictors of mortality among the elderly. This may imply that the contents of the periodic health examination may need to be revised accordingly. In this health examination, additional serological tests (hepatitis B surface antigen, hepatitis C antibody, etc.), imaging studies (chest X-ray, abdominal sonography, etc.), and other screening tests (electrocardiogram, thyroid stimulating hormone, alpha-fetoprotein, etc.) were selectively performed. The findings of these tests were not included in our analysis due to the incompleteness of data. It is not known whether the results of these screening tests were predictors of mortality. More studies should be done to evaluate the cost and effectiveness of the contents of periodic health examinations in the future.

This study has the following limitations. First, the median follow-up time was only 34 months. The confounding effects of the underlying illnesses or other factors can remain after such a short follow-up time. The statistical power may not be enough for some factors with small differences in relative risk or with small percentage rates of positive findings. Second, the subjects may be self-selective in presenting voluntarily for the health examination. However, the demographic structure,

mortality rate and the distribution of the causes of mortality were similar to the national data. As a result, the generalization of the findings of this study to the elderly population in Taiwan may be acceptable. Third, we did not have information on time-dependent and changeable predictors which may be more useful in patients' care. We will update the information and undertake longer follow-up to solve this problem in future studies.

## Conclusions

A number of abnormal tests (urine protein, serum albumin and globulin, serum AST, haemoglobin and BUN) performed in the routine periodic health examination can provide us with valuable information to predict the mortality of elderly people. Lifestyle factors such as smoking, intake of vegetables and fruits are also predictors of mortality in the elderly population. Individualized risk management plan should be formulated according to the findings of periodic health examination in order to maximize the benefit of a periodic health examination. The results of this study may provide evidence for the design and revision of periodic health examinations for the elderly in the future.

## Summary of implications for GPs

- Lifestyle such as smoking and intake of fruits and vegetables are important to the health of elderly people, as noted in the findings of this study. GPs should play a central role in educating and motivating elderly patients to pursue healthy lifestyles.
- Many patients will ask their family doctors to explain the results of their health check-up. With the recognition of significant predictors of mortality, GPs can better explain and manage their patients in the context of the findings in the health check-up.
- When patients ask GPs to perform tests as a part of routine check-up, GPs can select appropriate tests that may predict mortality. The check-up may then be more cost-effective.

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