Are Medical Human Resources Related to Longer Life in Japan?

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Key words : Life expectancy, Medical human resources, Medical doctors, Nurses, Correlation coefficient

Abstract

Japan has been a leading country in terms of life expectancy at birth both in males and females since the beginning of 1980s. Inside Japan, however, there is a big discrepancy in life expectancy by prefectures. Various factors, such as climate, socio-economic conditions, medical expenditures, medical resources, major causes of deaths, nutrition and the like have been examined as determinants of discrepancy. Among these factors, we paid special attention to the medical resources, including human resources. Data on life expectancies at birth and age 65 by gender for 47 prefectures in 2005 were obtained from the Ministry of Health, Labor and Welfare. We also consulted a database on the levels of medical resources, listed according to the numbers of hospitals, clinics, dental clinics, pharmacies, beds in hospitals, beds in clinics, medical doctors, dentists, pharmacists, nurses, public health nurses, midwives, dieticians and physical therapists per 100,000 population, and a medical doctors' index. Ecological correlation analysis between life expectancies and these variables in 47 prefectures of Japan was made by using either Pearson's or Spearman's correlation coefficients. The significance level was set at 5% ($p<0.05$). There are distinct discrepancies between males and females in the results of expectancy at birth and age 65. In males, there was no index of medical resources that showed a positive correlation with life expectancy at birth and age 65. In females, however, there were positive correlations with medical resources, such as medical doctors, nurses, public health nurses, midwives, dieticians and physical therapists per 100,000 population.

Introduction

Japan has been known as the leading country in the world with regard to life expectancy at birth. In 2006, the values of life expectancy at birth in Japan were 79.00 years in males and 85.81 years in females, which ranks 2nd after Iceland and in 1st place, respectively, among the developed countries in the world. In spite of the quite good values for whole Japan, however, a considerable difference is recognized in life expectancy among 47 prefectures.

Several reasons have been investigated in regards to the long life expectancy in Japan. Successful restructuring of the country's economy after World War II and the introduction of a national health insurance system for all the people may have played an important role on the longevity of life in Japan (Marmot & Smith, 1989; Okura, 2004).

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As to a big discrepancy in life expectancy by prefectures and genders, there have been many arguments published to explain the determinants. Watanabe and Kano (1983), and Sunami (1986) reported that climate factors, especially temperature, were correlated with longevity of life. Gao and Kakehashi (2006) reported the results of correlation analysis, in which working conditions in the household, medical resources, average wages, amount of nutritional intake, obesity and other factors were taken into account, and the authors were interested to note that the numbers of nurses and midwives per 10 million population were positively related to the life expectancy at birth only in females, while there was no correlation between the number of medical doctors and life expectancy in either in males or females.

Nowadays in Japan, there is a concern about the low number of medical doctors per 100,000 population compared with the OECD (Organisation for Economic Co-operation and Development) average as well as the geographically uneven distribution of medical doctors. Based on this concern, we examined whether medical human resources are involved in prolonging life among 47 prefectures in Japan. Besides human resources, medical resources, such as the numbers of hospitals and clinics and the number of beds are also added to evaluate the correlation with life expectancy in Japan.

Materials and Methods

Data on life expectancies at birth and age 65 by gender for 47 prefectures in 2005 were obtained from the Ministry of Health, Labor and Welfare. We also consulted a database on the levels of medical resources, including human medical resources listed according to the numbers of hospitals, clinics, dental clinics, pharmacies, beds in hospitals, beds in clinics, medical doctors, dentists, pharmacists, nurses, public health nurses, midwives, dieticians and physical therapists, and medical doctors' index. The medical doctors' index (Ishi-su Shisu in Japanese) was newly adopted by an ad hoc committee organized by the Ministry of Finance Japan (2009). This index is a combined score calculated from not only numbers of medical doctors per population, but also the area size of each prefecture.

This is a cross-sectional study in descriptive epidemiology, also known as an ecological correlation study. If the distribution of data was considered to follow to normal distribution, Pearson's correlation analysis was employed, and if not, Spearman's rank correlation analysis was applied. The significance level was set at 5% ($p<0.05$). The statistical package Excel Statistics, 'Statcel2' was used for both analyses. A stepwise regression analysis was not attempted to cross-sectional data.

Results

The indices showing normality of distributions were the following: all the life expectancies at birth and age 65 for males and females, numbers of clinics, pharmacies, beds in hospitals, medical doctors, public health nurses, midwives and dieticians. Other indices did not follow to normal distribution.

Table 1 shows the correlation coefficients between indices of medical resources and life expectancies at birth for males and females in 47 prefectures of Japan. There was no index that showed a positive correlation to life expectancy in males, while those of hospitals ($r = -0.390$), beds in hospitals ($r = -0.351$) and beds in clinics ($r = -0.479$) showed negative correlations. In females, however, the opposite pattern was recognized; there were correlations between life expectancy at birth and the indices of medical doctors ($r = 0.344$), nurses ($r = 0.525$), public health nurses ($r = 0.441$), midwives ($r = 0.296$), dieticians ($r = 0.495$) and physical therapists ($r = 0.447$). There was no index with a negative correlation in females.

Table 2 shows the correlation coefficients as to life expectancies at age 65. None of the variables in males were correlated to life expectancy. In females, there were 8 variables that showed a positive correlation; those of hospitals (r = 0.406), beds in hospitals (r = 0.407), medical doctors (r = 0.348), nurses (r = 0.613), public health nurses (r = 0.481), midwives (r = 0.300), dieticians (r = 0.501) and physical therapists (r = 0.526).

Table 1 Correlation coefficients between indices of medical human resources and life expectancy at birth by 47 prefectures of Japan.

Index	Life expectancy (male)	Life expectancy (female)
Hospitals	-0.390**	0.264
Clinics	-0.052	0.094
Dental clinics	0.051	-0.216
Pharmacies	-0.272	-0.008
Beds in hospitals	-0.351*	0.274
Beds in clinics	-0.479**	0.132
Medical doctors	-0.006	0.344*
Medical doctors' index	0.141	0.284
Dentists	0.040	-0.104
Pharmacists	0.265	0.018
Nurses	-0.214	0.525**
Public health nurses	-0.155	0.441**
Midwives	-0.073	0.296*
Dieticians	-0.072	0.495**
Physical therapists	0.277	0.447*

Index: Numbers per 100,000 population except for Medical doctors' index

* p<0.05, ** p<0.01

Table 2 Correlation coefficients between indices of medical human resources and life expectancy at 65 years by 47 prefectures of Japan.

Index	Life expectancy (male)	Life expectancy (female)
Hospitals	-0.063	0.406**
Clinics	-0.046	0.043
Dental clinics	-0.034	-0.188
Pharmacies	-0.087	-0.042
Beds in hospitals	-0.041	0.407**
Beds in clinics	-0.158	0.251
Medical doctors	0.126	0.348*
Medical doctors' index	0.184	0.267
Dentists	0.014	-0.081
Pharmacists	0.045	0.007
Nurses	0.113	0.613**
Public health nurses	0.143	0.481**
Midwives	0.038	0.300*
Dieticians	0.176	0.501**
Physical therapists	0.167	0.526**

Index: Numbers per 100,000 population except for Medical doctors' index

* p<0.05, ** p<0.01

Discussion

Most of the studies on factors influencing life expectancy are based on ecological correlation analysis. For example, one can perform a correlation analysis between the life expectancy at birth and various geographical characteristics.

Ecological correlation analysis is usually based on information at the population level. First of all, life expectancy is a comprehensive index of the health status in a community or a country and useful for comparing health conditions as a whole. It is calculated from the life table analysis, which is a summarizing method to show the pattern of mortality and survival in populations. In the current life table analysis, the model population of 100,000 births and 100,000 deaths is used and cumulative probabilities of survival rates throughout life are calculated. In this model, it is possible for all the people to formulate a life table, if the age-specific mortality rates for a given reference year are available. The current life table, therefore, represents only the total mortality experiences in a given population. Generally speaking, the high mortality rates for newborns and infants definitely deteriorate the life expectancy at birth as well as those for the aged, of course. Other variables used in this study are also based on the population level. This is why the term, "ecological", is used for this type of study. This study is very useful for exploring crude associations for making a hypothesis, but we should be cautious to point out the individual risk, because information at the individual level is not collected.

In the present study, there are distinct discrepancies between males and females in expectancy at birth and age 65. In males, there was no index of medical resources involved in life expectancy at birth and age 65. A few negative correlations were only evident in the case of life expectancy at birth. In contrast, the positive correlations were recognized in females regarding with various medical resources, and there was no negative correlation in life expectancies at birth and age 65.

A study of the related literature disclosed that the present findings in males and females were generally consistent with the previous findings. In particular, there are several reports indicating the positive relationship between life expectancies in females and medical human resources, including nurses and midwives (Gao & Kakehashi, 2006), and public health nurses (Mizushima et al., 2004; Hasegawa & Hoshi, 2007). Although we found a positive correlation between medical doctors and life expectancies in females at birth and age 65, this relationship seems to have occurred by chance, since most of the reports did not indicate such a relationship (Watanabe & Kato, 1983; Gao & Kakehashi, 2006; Mizushima et al., 2004; Suzuki, 2003).

If we were allowed to make inferences based on these findings, we would say that the greater the number of medical resources, especially of professional medical personnel, the longer the longevity of females is. This relationship favors those aged 65 years and older. On the contrary, males do not seemed favored in the same way by these medical resources. But, this inference may be remained until further testing of the working hypothesis can be conducted. As for the medical human resources, information at the individual level, such as the availability and accessibility of the professionals, could not be obtained. There is a possibility of bias, called ecological fallacy in the analysis of correlation at the population level. Analysis of a cohort life table instead of period life table may pave the way to determining the real meaning of this statistical association.

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