

## The change in lifestyle data during 9 years: the reliability and continuity of baseline health practices

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### Abstract

**Objectives** To reveal change patterns in self-reported lifestyle data for 9 years, and examine the characteristics of changes by type of lifestyle and ageing.

**Methods** The authors used the lifestyle data of 7,080 male workers aged 20–59 who received checkups for 9 years. The proportions of change patterns during the 9 years were determined in seven health practices; smoking, eating breakfast, sleeping hours, working hours, physical exercise, eating nutritional balanced diets, and mental stress.

**Results** Among seven health practices, the keep rate of good health practice was highest for the non-smoking (90.8 %), followed by eating breakfast (69.0 %); and the lowest was physical exercise (13.7 %). The keep rate of poor health practice was highest for smoking (73.8 %), followed by non-physical exercise (67.1 %). The lowest rate of multiple changes during 10 years was smoking (7.1 %); the highest was mental stress (68.5 %).

**Conclusions** As for the life style on smoking and eating breakfast seemed to be stable, using the data obtained at a specific point in time wouldn't much affect the results. On the contrary, for other life styles, they showed poor

continuity during 9 years, so it would be necessary to take into consideration the time point of data collection.

**Keywords** Lifestyle · Health practices · Smoking · Change patterns · Continuity

### Introduction

When using baseline information to estimate the relative risk of mortality or incidence of a disease, the baseline information usually remains fixed during the study period [1]. Attributes such as sex and age necessarily continue during the study period, but it is difficult to think that lifestyle data obtained at baseline will continue during the study period for all the subjects [1, 2]. In the long-term cohort studies, changes of baseline information will be subject to more change [1–3]. If exposure data obtained at baseline changed over time, the estimates of relative risk may be binned by inappropriate information of exposure [1, 2]. Analysis that takes into account changes in the baseline lifestyle data that occur during the study period is thus required. However, there has been little study to clarify the changes of baseline data [1, 2, 4]. In this study, we study lifestyle change patterns that easily occur during the study period. And we examine particular characteristics of the changes due to ageing and the type of lifestyle.

### Materials and methods

#### Subjects

In Japan, employees generally undergo regular annual checkups at their companies or at company-designated

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clinics. In this study we used checkup data belonging to the Japanese Foundation that performed the checkups under contract from companies. Records of 7,080 male workers aged 20–59 who received checkups at the Foundation continually for 9 years from 1995 to 2004 were used. We received electronic data that cannot specify those who took a checkup from this Foundation. This study was approved by the ethical committee of the course of Health Science, Osaka University Graduate School of Medicine.

### Lifestyles

The lifestyle factors were assessed by using a self-administered questionnaire that asked about eight health practices, which has been used by Morimoto et al. [5–9]. Subjects answered eight questions shown in Table 1 by “true” or “false”. In this study, we analyzed changes that occurred in a 9-year period for seven health practices (smoking, physical exercise, sleeping hours, mental stress, hours of work, eating breakfast, and eating nutritional balanced diets) excluding alcohol consumption. The rate of subjects with a poor health practice of alcohol consumption was less than 10 %. When classifying by the pattern of change, the number of subjects for the each category became too low. So alcohol consumption was excluded from this analysis.

### Analysis

Subjects were separated by their age in 1995 into groups of 10 years each. For each age group of 10 years, we analyzed change patterns for the seven health practices using the following procedure. First, we divided the subjects into two groups, the good health practice group and the poor health practice group, based on their health practice characteristics in 1995. Next, each group was further divided into three groups: the keep health practice group, which maintained their habits during the 10-year period; the deteriorate/improve health practice group, whose habits either worsened or improved; and the multiple changes group, whose habits fluctuated back and forth between good

health and poor health. For both the good health practice group and the poor health practice group, we calculated the proportion of the keep health practice group members (the keep rate), the proportion of the deteriorate/improve health practice group members (the deterioration rate/improvement rate), and the proportion of the multiple changes group members (the multiple changes rate). Using the keep rate, the deterioration/improvement rate, and the multiple changes rate, we revealed each health practices' particular characteristics of change by age group. We also examined differences in the characteristics of change between health practices and between age groups.

### Results

Table 2 shows the proportion of change patterns by age. Shown are the proportions of good health practice members and poor health practice members, and within each of the two groups, the proportion of each change pattern. The total multiple changes rate is also shown. Figure 1 shows the proportion of good health practice and poor health practice members for all age groups in 1995. In Fig. 2, the keep rate, the deterioration rate, and the multiple changes rate for the good health practice group (taken as 100 %) are shown for all age groups. In Fig. 3, the keep rate, the improvement rate, and the multiple changes rate for the poor health practice group (taken as 100 %) are shown for all age groups.

The health practice with the highest proportion of good health practice members was eating breakfast, with more than 70 %, followed by mental stress at 52.9 %. The health practice with the lowest proportion was physical activity, with less than 20 %.

Comparing the proportion of change patterns among health practices, in the good health practice group, the keep rate was the highest for the smoking for all age groups. Next highest was eating breakfast; the lowest was physical activity. For the other four health practices, for total subjects, the keep rate decreases in order of eating nutritional balanced diets, mental stress, sleeping hours, and working hours. However, the order of these four health practices differs between age groups. In the poor health practice group, the keep rate was highest for smoking for all age groups. Next highest were physical activities, sleeping hours, and eating nutritional balanced diets (in the order given). Excluding subjects aged 50–59, the next order was working hours, eating breakfast, and mental stress. Subjects aged 50–59 showed the next order as eating breakfast, mental stress, and working hours. Figure 4 shows proportions of total multiple changes of members for the good health practice and poor health practice groups (the total multiple changes rate). For all age groups, the total

**Table 1** Good health practices in eight health practices

1. Not smoking
2. Not drinking more than daily 46 g ethanol per day every day
3. Eating breakfast every morning
4. Sleeping 7–8 h per night
5. Working 9 h or less per day
6. Exercising at least twice a week
7. Eating a nutritionally balanced diet
8. Keeping a moderate level of mental stress

Each factor was scored 1 for true and 0 for false

**Table 2** Distribution of change patterns in seven health practices by age, Japan, 1995–2004 (%)

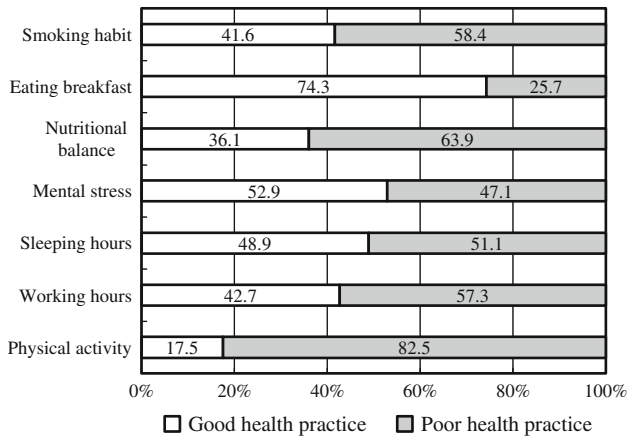
	Age	Good Health Practice			Poor Health Practice			Total multiple		
		Keep	Deterioration	Multiple change	Keep	Improvement	Multiple change			
Smoking habit	a	b	c	d	e					
	20-29	38.3	86.4	6.2	7.4	61.7	72.7	16.4	10.9	9.6
	30-39	44.2	91.1	3.7	5.1	55.8	74.9	16.7	8.4	7.0
	40-49	40.5	92.9	2.8	4.3	59.5	74.3	19.2	6.6	5.7
	50-59	47.4	94.1	2.2	3.7	52.6	70.7	21.7	7.7	5.8
	total	41.6	90.8	3.9	5.3	58.4	73.8	17.8	8.4	7.1
Eating breakfast										
	20-29	73.1	68.7	6.0	25.3	26.9	30.7	29.3	40.1	29.3
	30-39	74.9	68.7	6.0	25.3	25.1	32.5	27.0	40.5	29.1
	40-49	75.1	69.5	4.9	25.6	24.9	29.5	30.2	40.3	29.3
	50-59	71.9	69.0	6.6	24.4	28.1	25.0	31.9	43.1	29.6
	total	74.3	69.0	5.6	25.4	25.7	30.3	29.1	40.5	29.3
Sleeping hours										
	20-29	40.0	12.8	26.0	61.2	60.0	52.5	5.1	42.4	49.9
	30-39	46.4	16.3	21.4	62.3	53.6	55.6	4.1	40.3	50.5
	40-49	55.0	23.0	15.9	61.1	45.0	51.4	6.3	42.2	52.6
	50-59	61.2	29.8	9.7	60.5	38.8	38.9	12.7	48.4	55.8
	total	48.9	19.5	19.1	61.4	51.1	52.4	5.6	42.0	51.5
Working hours										
	20-29	42.2	13.3	26.1	60.7	57.8	48.0	28.7	23.3	39.0
	30-39	37.9	13.8	20.2	66.0	62.1	47.2	4.9	47.9	54.8
	40-49	44.2	24.2	12.3	63.5	55.8	35.3	11.0	53.7	58.0
	50-59	56.1	33.8	7.8	58.4	43.9	14.8	21.6	63.6	60.7
	total	42.7	19.5	17.6	62.9	57.3	41.4	7.6	51.0	56.1
Physical activity										
	20-29	21.1	8.9	39.3	51.8	78.9	65.9	4.2	29.9	34.5
	30-39	15.3	15.8	32.8	51.3	84.7	68.4	5.3	26.3	30.1
	40-49	15.8	15.9	30.6	53.5	84.2	68.9	6.1	25.0	29.5
	50-59	22.1	15.9	19.0	65.1	77.9	57.4	6.3	36.3	42.6
	total	17.5	13.7	32.8	53.5	82.5	67.1	5.1	27.8	32.3
Nutritional balance										
	20-29	25.0	20.6	20.4	58.9	75.0	52.1	8.3	39.6	44.4
	30-39	36.1	27.8	14.6	57.6	63.9	51.3	5.8	42.9	48.2
	40-49	40.8	33.5	8.8	57.7	59.2	42.3	10.4	47.2	51.5
	50-59	51.6	40.8	5.8	53.4	48.4	36.2	11.2	52.5	53.0
	total	36.1	30.2	12.4	57.4	63.9	47.7	8.4	43.9	48.7
Mental stress										
	20-29	52.0	22.6	10.2	67.3	48.0	22.4	8.5	69.1	68.1
	30-39	53.0	22.6	10.2	67.2	47.0	23.3	9.2	67.5	67.3
	40-49	53.8	19.7	11.6	68.7	46.2	19.8	8.5	71.7	70.1
	50-59	51.6	19.4	11.2	69.4	48.4	22.8	11.6	65.6	67.5
	total	52.9	21.3	10.8	67.9	47.1	21.9	9.0	69.2	68.5

a The proportion of subjects in the good health practice group out of all subjects (set as 100%) in 1995  
 b Proportions of change patterns for ten years among all good health practice members (set as 100%)  
 c The proportion of subjects in the bad health practice group out of all subjects (set as 100%) in 1995  
 d Proportions of change patterns for ten years among all bad health practice members (set as 100%)  
 e The proportion of total multiple changes (for both good health practice and bad health practice) out of all subjects (set as 100%)

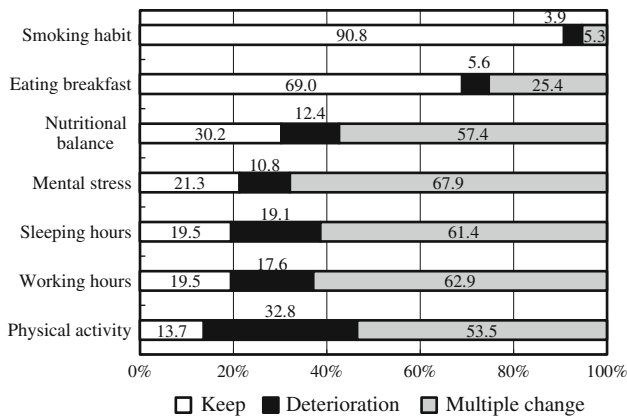
a The proportion of subjects in the good health practice group out of all subjects (set as 100 %) in 1995  
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multiple changes rate was lowest for smoking, followed by eating breakfast and physical activity. The total multiple changes rate was highest for mental stress. After mental stress, except for subjects aged 20–29, the order was working hours, sleeping hours, and eating nutritionally balanced diets. For subjects aged 20–29, the order was sleeping hours, eating nutritionally balanced diets, and working hours.

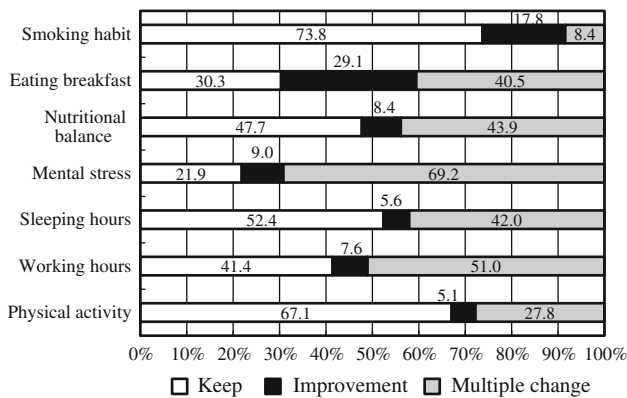
Comparing the proportion of change patterns between age groups, for smoking, a constant trend in proportion of good health practice members could not be seen. The keep rate in the good health practice group increased with age. For the poor health practice group, the keep rate reached a peak in the 30–39 age group, then declined. The total multiple changes rate declined as age increased. For change patterns for eating breakfast, the proportion of good



**Fig. 1** The proportion of good health practice and poor health practice members for all subjects in 1995

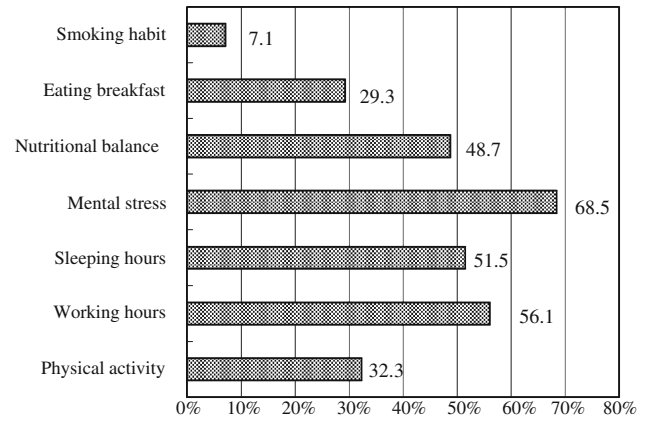


**Fig. 2** Proportions of subjects in each change pattern in the good health practice group for all subjects



**Fig. 3** Proportions of subjects in each change pattern in the poor health practice group for all subjects

health practice members and the keep rate both were almost constant for all age groups, with the proportion of good health practice members of about 70 % and the keep rate of about 69 %. For the poor health practice group, the



**Fig. 4** Proportions of total multiple changes members for the good health practice and the poor health practice groups

keep rate was a bit lower for the 50–59 age group compared to other age groups. For all age groups the poor health-practice keeping rate was constant at about 30 % and the total multiple changes rate was constant at about 29 %. For mental stress, for all age groups the proportion of good health practice members (about 53 %), the good health practice keep rate (about 21 %), and the total multiple changes rate (about 68 %) was almost constant. The keep rate in the poor health practice group was slightly lower for the 40–49 age group than any other group, with 19.8 % compared to about a constant 22 % for the other groups. For physical activity, the proportion of good health practice members was low for the 30–39 and 40–49 age groups compared to the 20–29 and 50–59 age groups. The keep rate in the good health practice group was lowest for the 20–29 age group compared to other age groups, with a low 8.9 %. For other age groups the rate was a steady 15 %. For the 30–39 and 40–49 age groups, the keep rate in the poor health practice group was high and the total multiple changes rate was low. Sleeping hours, working hours, and eating nutritional balanced diets showed almost the same trends for changes. As age increased, the proportion of good health practice members and the good health practice keep rate increased, the poor health practice keep rate decreased, and the total multiple changes rate increased.

**Discussion**

This study clarified the proportions of change patterns for lifestyle by age group based on the lifestyle data of approximately 7,000 male workers nationwide in a 9-year period. We found that the change patterns differed depending on health practices, that the change patterns changed as age increased, and that change due to increase in age differed depending on health practices.

If the keep rate of a health practice is low, changes occur easily within a period of investigation, and the characteristic of the health practice obtained at a point in time is difficult to maintain. Thus, the continuity of data is considered low. Also, if the multiple changes rate of a health practice is high, the possibility of responses being different depending on the point in time of the study is high. Thus, the reliability of the data obtained at a specific point in time is considered low. We examined results of this study from these points.

For smoking, the total multiple changes rate was low compared to other health practices, and the keep rate was high, so responses concerning smoking obtained at a specific point in time are believed to be high in reliability and continuity. Also, as age increased, the proportion of good health practice members increased, as did the keep rate in the good health practice group, so the reliability and continuity of data both rose. In many previous studies, a positive correlation between increasing age and smoking cessation has been discussed [4, 10, 11]. We consider that analysis of smoking habit using data from a point in time is suitable, and that, the older the ages of the subjects, the more suitable the analysis.

For eating breakfast, the keep rate in the poor health practice group was low compared to other health practices, presenting a problem for the continuity of poor health practice responses. However, the proportion of good health practice and the keep rate in the good health practice group were extremely high and the total multiple changes rate was low, so it is considered that both the continuity and reliability of responses obtained at a point in time are high. There was no change of change pattern as age increased, and change patterns of each age group showed a constant trend regardless of age. For all age groups, using data obtained at a specific point in time is considered relatively suitable.

For mental stress, the keep rate in both the good health practice and the poor health practice groups were both relatively low. The total of the multiple changes rates was high, so the continuity and reliability of responses obtained at a specific point in time are both considered to be low. Responses may vary depending on the time of study, so care must be taken with analysis using data from a specific point in time. Also, there was no change of change patterns as age increased, so the same care must be taken regardless of age groups.

Because the proportion of the good health practice group and their keep rate for physical activity were extremely low, the continuity of good health practice responses obtained at a specific point in time is considered to be low. There is a high possibility that subjects with the good health practice may migrate to subjects with the poor health practice. However, the keep rate in the poor health practice group was high, so the continuity of poor health

practice response is considered to be high. Because the total of the multiple changes rate was low, the reliability of responses overall is considered to be high. The proportion of poor health practice group was high among the 30–39 and 40–49 age groups, and it was easy to maintain the poor habits. For subjects in the 20–29 and 50–59 age groups, they more easily moved to the good health practice group from the poor health practice group compared to subjects in the 30–39 and 40–49 age groups. The continuity of poor health practice response and reliability are both considered to be high, but the continuity of the good health practice response are considered to be extremely low, so care must be taken when dealing with analysis using data taken at a specific point in time. Also caution must be paid to the change patterns of subjects with poor health practice in the 20–29 and 50–59 age groups.

Among the seven health practices, because sleeping hours, working hours, and eating nutritional balanced diets, had an intermediate keep rate and the total multiple changes rate, then the continuity and reliability of their data obtained at a specific point in time can also be said to be intermediate. There was a trend to move from the poor health practice group to the good health practice group as age increases, so the continuity of the poor health practice response decreases as age increases. Therefore, the higher the age, the more attention must be paid to poor health practice response.

It should be noted that there are several limitations to our study. There are biases in the character of subjects. Firstly, most of these subjects are workers of the major company of a tertiary industry. Secondly, many of the data were excluded due to subjects dropping out of the follow-up, because of resignation or occupational changes, subjects not getting medical checkups for some reason, and so on. Subjects who dropped out have the possibility of dropping out due to the disease caused by a poor lifestyle. It is thought that the results in this study clarified the change of lifestyle of workers who continued working without suffering serious illness.

Many studies had examined risks of mortality or developing a disease using lifestyle data obtained at a specific point in time [12–18]. Significant relations for smoking and eating habits are reported in many studies [12–15]. However, for other health practices, the study where a significant relation is described is less than for smoking and eating habits [16–18]. It is thought that these results can be explained from the continuity and reliability characteristics of each health practice. We found that among the seven health practices, analysis using data obtained at a specific point in time is suitable for smoking and eating breakfast. Other health practices have a high possibility of changing during the study period, and their changes during the study period are considered to easily influence later health conditions.



For actual investigations, because it is difficult to obtain responses multiple times during the study period, many studies are analyzed based on only the baseline data. However, this study and some previous studies showed that depending on the health practice, there are problems with responses obtained at a specific point in time [1, 2, 4]. We think that, even if the changes during the period of study are not grasped, by taking the possibility of changes sufficiently into account during discussion of results, it is possible to properly elucidate the effects of lifestyle. Also, if it is possible to estimate the changes within the study period of data obtained at a specific point in time, it will be possible to incorporate the changes in the analysis without increasing the number of times for questioning. To estimate changes is for our future study. We believe that the results of this study will be useful for the study of estimation methods.

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