Anthropometry, Physical Fitness and Daily Habits with Regard to Ageing

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Abstract One thousand eight hundred male workers in an industrial factory were examined in 1981 using anthropometric measurements (height, weight, abdominal girth, chest girth, and skinfold thickness), physical fitness tests (vertical jump, hand grip force, respiratory function, and blood pressure) and a questionnaire about daily habits (cigaret smoking, alcohol consumption, and physical activity), and they were reexamined to compare in 1984.

ROHRER's indices (weight/height³) of the same individuals in 1984 were larger than those in 1981 at the 44 year old age or younger. Vertical jump, hand grip force, and forced vital capacity (FVC) declined with increasing age. FVC in 1984 declined significantly as compared with the values in 1981 at the over-30 age group. There were no remarkable differences in vertical jump between 1981 and 1984.

The rate of non-smokers was highest at the 40-44 year age group. The rate of daily smoking in 1984 was about 60 percent which was less than that in 1981. The rate of daily alcohol consumption in 1984 was 45 percent, which was higher than in 1981. More than 50 percent of workers over 45 years old had no regular physical activity. The rate of daily sports activity in 1984 decreased as compared with that in 1981 at each age group.

FVC and blood pressure in non-smokers were fairly good over 45 years of age. Blood pressure in non-drinkers was generally lower than in drinkers. There were definite relationships between health and daily life habits in workers, although physical fitness generally declined with increasing age.

Keywords Ageing, Anthropometry, Physical fitness, Daily habits, Blood pressure

Introduction

The ageing of the population has become a serious problem in Japan. Today, people must work till a more advanced age than in the past. It is thus important to know the physical and mental abilities and the anthropometry of older people. The ageing process brings about changes in the size and shape of the human body. These phenomena are associated with many variables such as sex, socioeconomic background, diet, health and so on. (LESSER *et al.*, 1963; STOUT, 1981; TANAKA *et al.*, 1984, YOKO-MIZO, 1985).

Existing data about the physical ability or anthropometry of people were generally provided from cross-sectional studies, i.e. those in which a single population was studied at one point in time and the data were reported from different age groups.

In the present study, one thousand eight hundred male workers in an industrial factory were medically examined and subjected to the anthropometric measurements (body weight, height, abdomen and chest girth, skinfold thickness), physical fitness tests (vertical jump, hand grip strength, respiratory function, blood pressure, etc.), and a questionnaire about daily life habits (cigaret smoking, alcohol consumption, and athletic activities) in 1981 and 1984.

Methods

The subjects were 1,789 male workers from 23 to 58 years of age (in 1984), in an industrial factory. Eight hundred and twenty two were white-collar workers, and the remaining 967 were blue-collar workers. The number of subjects at each age group of <29, 30-39, 40-49, and >50 years were 131, 722, 701, and 235 respectively (Table 1).

Skinfold thickness at the triceps, subscapula, and abdomen were measured with a Caliper (Eiken Comp.). Chest girth was measured at the nipple line at mid-tidal volume. Abdominal girth was measured at the level of the umbilicus at mid-tidal volume with the subject in the upright position. Blood pressure was measured in the left arm with the subject in the sitting position. Respiratory function was measured with an autspirometer (AS-4500 type, Minato Medical Science Co. Ltd.). The measurements were done in May, 1981 and May, 1984 using the same subjects.

Results

The values are for the same subject groups, that is, the same subjects as in 1981 were used in 1984. Fig. 1 shows the changes in ROHRER's index (weight/height³) in 1981 and 1984. The values for body height were almost the same in 1981 and 1984. Therefore, the change in ROHRER's index was essentially that of the change in body weight. ROHRER's index tended to increase with increasing age. The index in 1984 increased significantly in the age groups of 25-29, 30-34, and 40-44 years ($P < 0.01$) compared to that in 1981. But in the 55-59 year group, it decreased significantly ($P < 0.01$). There were similar tendencies in the ROHRER's indices for white-collar and blue-collar workers, but the indices for blue-collar workers were higher than those for white-collar workers at 55-59 years of age.

Fig. 2 shows the changes in the abdomen to chest girth ratio (A-C ratio) for white-collar and blue-collar workers. A-C ratio increased with increasing age. The ratio for blue-collar workers tended generally to be smaller than that for white-collar workers, but there were no significant differences at

Table 1. The numbers of white-collar workers and blue-collar workers with age in 1984.

Age (year)	~29	30~34	35~39	40~44	45~49	50~54	55~59	total
White-collar worker	55	127	147	188	160	78	67	822
Blue-collar worker	76	283	165	201	152	73	17	967
Total	131	410	312	389	312	151	84	1789

Fig. 1. The changes in Rohrer's index with age. **Fig. 2.** The changes in abdomen to chest girth ratio with age.

each age group.

Fig. 3 shows the changes in skinfold thickness on the abdomen. The values in

1984 were larger than in 1981 at each age group. At both times, the values for white-collar workers were larger than for blue-collar workers. The changes in skinfold thickness on the subscapular area showed a similar tendency to the changes at the abdomen. The triceps measurement changed little with age.

Fig. 4 shows the values for vertical jump. The values decreased steadily with increasing age. The values in 1984 were generally higher than in 1981. There were significant differences between the values in 1984 and 1981 for blue-collar workers in the age ranges of 25-29, 45-49, and 50-54 years and for white-collar workers in the 35-39 range ($P < 0.05$). The values for white-collar workers over 35 years old were higher than those for blue-collar workers.

Fig. 5 shows the values for grip strength in the right hand. The values for blue-collar workers were higher than for white-collar workers at less than 40 years of age. Thereafter, the values declined generally with increasing age. The values in 1981 were generally higher than in 1984: there were significant differences between the values in 1984 versus 1981 for blue-collar workers in the 30-34 age group, and for white-collar workers in the 25-29 and 45-49 year age groups ($P < 0.05$ and 0.01).

Fig. 6 shows forced vital capacity. The values declined with increasing age. The values in blue-collar workers were slightly lower than those in white-collar workers.

Fig. 3. The changes in skinfold thickness at the abdomen with age.

Fig. 5. The changes in hand grip strength with age.

Fig. 4. The changes in vertical jump with age.

Fig. 6. The changes in forced vital capacity with age.

The values in 1984 were significantly lower than those in 1981 in both groups over 30 years of age ($P < 0.01$).

Fig. 7 shows the changes in systolic and diastolic blood pressure with age. Systolic blood pressure in those over 50 years increased remarkably. The values in 1984 were lower than those in 1981, with especially significant declines at 25–39 years old ($P < 0.01$), and at 40–44 and 55–59 years of age ($P < 0.05$). The values in blue-collar

and white-collar workers showed similar tendencies.

Diastolic blood pressure increased gradually with increasing age. The values in 1984 were generally lower than those in 1981, with an especially significant decline in the groups of 25–34 and 55–59 years ($P < 0.05$). The values of blue-collar and white-collar workers were similar.

Fig. 7. The changes in systolic and diastolic blood pressure with age.

Table 2 shows the results of questionnaires about cigaret smoking, alcohol drinking and physical activity. The amount of cigaret smoking was classified into six grades; non-smoking, occasional smoking, fewer than 10 cigarets per day, 11-20, 21-30, and over 31 cigarets per day.

The rates of non-smoking in 1984 were the highest in the age group of 40-44 years: 43.2 percent. The rates of smoking over 31 cigaret per day in 1984 were the greatest in the 35-39 year group: 9.3 percent. The other age groups varied around 3-7 percent. The rate of non-smoking in white-collar workers in 1984 was 42.0 percent, which was higher than that in blue-collar workers: 32.0 percent. The rates of non-smoking in 1984 were higher than those in 1981 in both white-collar and blue-collar groups.

The level of alcohol consumption was classified into four grades: non-drinking, 1-2

Table 2. The results of questionnaires about cigaret smoking, alcohol drinking and sports activity (%).

Year	Cigaret smoking	Alcohol drinking	Sports activity
1981	non-smoking	non-drinking	over 3 days per week
1984	32.0	18.2	27.2
	36.7	19.5	21.2
1981	occasional smoking	1-2 times drinking per week	1-2 days per week
1984	3.8	22.9	19.0
	4.1	18.9	17.9
1981	below 10 cigarets per day	3-5 times drinking per week	1-2 days per month
1984	6.1	16.4	19.3
	5.4	16.7	17.0
1981	11-20 cigarets per day	every day drinking	non-sports habits
1984	33.6	41.5	34.5
	30.0	44.9	43.8
1981	21-30 cigarets per day		
1984	18.4		
	17.8		
1981	over 31 cigarets per day		
1984	6.1		
	6.0		

times drinking per week, 3-5 times drinking per week, and daily drinking.

The rate of non-drinking in 1984 was 19.5 percent which was higher than that in 1981. There was no difference between the rate of non-drinking for white-collar and that of blue-collar workers in 1984, and little difference among the age groups: 17-24 percent. The rate of every day drinking in 1984 was 44.9 percent which was higher than in 1981. Particularly, the rate of every day drinking was the highest in 1984 for workers 55 years of age or older, 62 percent; and the lowest in 1981 for workers 25-29 years of age, 15.5 percent.

The level of athletic or physical activity was classified into four grades: no activity, 1-2 times per month (light activity), 1-2 times per week (medium activity), and over 3 times per week (heavy activity).

The rate of heavy activity was 21.2 percent in 1984, which was lower than that in 1981 for both blue-collar and white-collar workers. The rate of no activity in 1984 was 43.8 percent; higher than that in 1981. The rate of no activity was higher in the older age groups, and the rate of heavy activity was higher in the younger age groups.

Discussion

Many variables are related to blood pressure (OHNAKA *et al.*, 1984): body size, obesity, body weight, age, food intake, sex, race, habits of daily life, and so on. As shown in Fig. 7, blood pressure increased with increasing age, but blood pressure levels in 1984 were lower than those in 1981. Figs. 8, 9 and 10 show the systolic blood pressure in 1984 in relation to cigaret smoking, alcohol consumption, and physical activity, respectively. The increase in blood

Fig. 8. The changes in systolic blood pressure with age in relation to cigaret smoking.

Fig. 9. The changes in systolic blood pressure with age in relation to alcohol drinking.

Fig. 10. The changes in systolic blood pressure with age in relation to sports habits.

pressure in non-smoking groups was smaller than in other groups. The differences in blood pressure were especially larger between smoking and non-smoking groups in those over 45 years of age. There was a similar tendency with regard to both systolic and diastolic blood pressure.

Blood pressure was generally higher in those drinking every day and lower in non-drinkers in each age group. Blood pressure in those heavily active in sports tended to be lower than in those inactive, with especially large differences at the 35-39, 40-44, and 55-59 age groups.

Certainly, blood pressure increases with increasing age; however, the degree of increase is effected by daily life habits: cigaret smoking, alcohol consumption, and athletic or physical activity. This is particularly true after middle age.

There is a profound relation between pulmonary function and the amount of dust pollution in the air in a factory (JOHNSON

et al., 1985; NAGANUMA, 1984). DOUGLAS *et al.* (1985) reported that the forced vital capacity (FVC) and forced expiratory volume in one second fell more rapidly in those over 40 years of age, and that cigaret smoking had a strongly harmful effect on pulmonary function in a longitudinal study of a group of firemen.

As shown in Fig. 6, FVC declined with increasing age, and the values in 1984 declined significantly in comparison with the values in 1981. Fig. 11 shows FVC in 1984 in relation to cigaret smoking. FVC in the non-smoking group tended to be slightly higher than in the smoking group, especially over 45 years of age. There was no clear relationship between FVC and the number of cigaretts smoked.

SHEPHARD (1978) reported that the hand grip force of men remained relatively constant at an average of 54 kg from age 25 to age 45. Thereafter, it declined by 20

Fig. 11. The changes in forced vital capacity with age in relation to cigaret smoking.

percent to a figure of 44 kg at age 65. As shown in Fig. 5, the hand grip force of blue-collar workers from 25 to 39 years were about 50 kg; declining thereafter to 45 kg at age 55, where there were no difference between blue-collar and white-collar workers.

Fig. 12 shows the values of vertical jump in 1984 in relation to physical activities. The values of each group declined with increasing age. The values of those with a habit of high physical activity tended to be slightly higher at age 49, and the values of those with little activity tended to be lower at each age-group. Although physical fitness declined with increasing age, there were certain relationships between health states and daily life habits.

Fig. 12. The changes in vertical jump with age in relation to sports habits.

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抄 録

加齢ともなう体格、体力、生活習慣の変化について

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加齢に伴う体格、体力の変化を、日常生活習慣との関連において検討した。被験者は同一集団、某工場労働者約1800名とし、1981年と1984年についての値を比較した。

体格面では身長、体重、胸囲、腹囲、皮下脂肪厚等を計測し、体力面では垂直跳び、握力、呼吸機能、血圧等を測定した。生活習慣については、タバコ、アルコールや運動、スポーツなどを中心にアンケート調査をおこなった。

計測、測定、アンケート調査結果は、項目や年齢により、3年後においても変化の状態がことなる。加齢とともに呼吸機能は低下し、血圧値には上昇がみられるが、日常の生活習慣に影響される場合も大きい。

References

- DOUGLAS, D.B., R.B. DOUGLAS, D. OAKES, *et al.*, 1985: Pulmonary function of London firemen. *Br. J. Ind. Med.*, 42: 55-58.
- JOHNSON, A., M. CHAN-YEUNG, L. MACLEAN, *et al.*, 1985: Respiratory abnormalities among workers in an iron and steel foundry. *Br. J. Ind. Med.*, 42: 94-100.
- LESSER, G.T., I. KUMAR and J.M. STEELE, 1963: Changes in body composition with age. *Ann. N.Y. Acad. Sci.*, 110: 578-588.
- NAGANUMA, S., 1984: Pulmonary function test on employees exposed to factory dust. *J. Showa Med. Assoc.*, 44: 381-389.
- OHNAKA, T., Y. TOCHIHARA, S. YAMAZAKI, *et al.*, 1984: Relationship of blood pressure to multiple personal characteristics of workers in a factory. *Annals Physiol. Anthropol.*, 3: 297-302.

- STOUDT, H. W., 1981: The Anthropometry of the elderly. *Human factors*, 23: 29-37.
- TANAKA, M., S. NAGANUMA, T. OHNAKA, *et al.*, 1984: Living and sports habituation and physical fitness of labour. *J. Science of Labour*, 60: 79-87.
- YOKOMIZO, Y., 1985: Measurement of ability of older workers. *Ergonomics*, 6: 843-854.

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