14 BLOOD PRESSURE, BIOCHEMICAL ANALYSIS AND CUTANEOUS MICROTOPOGRAPHY

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14.1 INTRODUCTION

In order to describe the different study populations and to allow a rough comparison between countries, some medical data were obtained from the subjects studied, together with demographic and psychosocial data described elsewhere in this publication. Such data can serve as valuable background factors for the description of the nutritional situation, which is the main purpose of this book. Some medical factors are discussed in other parts of the book such as the disease patterns of different countries. This chapter deals with blood pressure, some biochemical analyses and cutaneous microtopography.

The different measurements and analyses were performed in various extensions at the different study sites. An attempt was made to make the methodology as similar as possible by providing thorough information to the principal investigators, mediated via the coordinating centre in Melbourne, Australia. Apart from an interobserver variation study between Melbourne and Gothenburg, Sweden, regarding the skin microtopography method, regular interobserver and intercountry studies were, however, not performed. This is the reason why we decided not to perform statistical analyses regarding possible differences, but confined ourselves to a pure description of average values and comments on obvious similarities or differences.

14.2 THE CONCEPT OF AGEING

Obviously the populations studied can be expected to show differences in functional and biological age. The average life expectancy at birth varies, for example, between 68 and 71 years (China) and 75 and 81 (Sweden) for males and females, respectively (Table 14.1).

Table 14.1. Average life expectancy (yrs) at birth in Australia (1988), China (1988), Greece (1980), and Sweden (1992).

	Males	Females
Australia	73	80
China	68	71
Greece	72	76
Sweden	75	81

Sources: The 1991 Britannica Book of the Year, Encyclopedia Britannica Inc., Chicago, 1991, and Swedish National Census Records.

In the different IUNS studies, elderly aged 70 and over were studied, and in Beijing, Chinese subjects below the age of 70 were also studied. Thus chronological age is not strictly comparable between the study sites. However, all elderly populations are heterogeneous and psychosocial, health and other factors vary markedly both between and within countries. Furthermore, obvious generational differences exist between elderly populations belonging to different birth cohorts [1,2]. The younger elderly of today (age 65-75) seem, thus, to be mentally and physically somewhat more vital than persons of the same age just a few decades ago. There are, however, also opposite tendencies in the western world towards an increase of the incidence of some diseases, for example hip fractures. It seems that the young elderly up to about the age of 75 are a group of individuals where the description "elderly" might be inappropriate. Another finding from recent population studies is that functional variation is very large at any given age and chronological age seems to be increasingly less valuable with advancing age as information about an individual's functional ability.

Chronological age, i.e. the time elapsed since birth, is related to functional and biological age, but there is a large interindividual variation. Functional age, i.e. the age similar to the chronological age of a population of individuals with the same average function, should be a better measure of true age compared to the chronological age. However, despite certain efforts being made by gerontologists, there are marked difficulties in creating functional age indices, partly because there are differences between functions in the same individual and partly because different organs and organ functions do not age in the same order in all individuals. Another concept, namely biological age, can also be mentioned in this context. Biological age is inversely related to the time left in the genetically determined life span (genotype). A 70 year-old person with a genetically determined life span of 80 years is, thus, biologically older than an individual with the same chronological age, whose genetically determined life span is 100 years. *Biological age* cannot be measured with sufficiently high accuracy in living individuals. Obviously, diseases also interfere with the expected life time of any individual, irrespective of chronological, functional and biological age.

14.3 BLOOD PRESSURE

Arterial blood pressure shows age-associated changes in both systolic and diastolic pressure and there is general agreement that pressure increases up to the beginning of old age, especially regarding systolic blood pressure. In a report based on a longitudinal follow-up within the framework of three different representative population samples of 2,550 individuals aged 38 to 79, observed for up to 12 years in Gothenburg, Sweden, Landahl et al. [3] found an increase in systolic blood pressure after age 75 in both sexes. It is well known that high blood pressure is a risk factor for death and cardiovascular mortality in young and middle-aged people [4]. The importance of increased blood pressure and treatment of hypertension in the elderly is, however, not settled. The Gothenburg group studied the association between blood pressure levels and mortality up to 11 years in 1,951 individuals from the gerontological and geriatric population studies in Gothenburg, Sweden [5]. A significant association between blood pressure and mortality remained when background factors such as treatment for hypertension, heart failure, coronary heart disease, diabetes, cholesterol, body mass index and smoking habits were kept constant after 80 years of age. The prevalence of treatment with antihypertensive drugs is high in older age groups, although the prevalence of treatment differs between countries. In one Swedish study, the prevalence of treatment with antihypertensive drugs increased from 2% at age 50 to 37% at age 79 among men, and from 1% at age 38 to 61% at age 79 among women [3]. In the following, the crude average systolic and diastolic blood pressure values are given from the different IUNS study centres (Table 14.2).

Table 14.2. Average blood pressure in IUNS study centres (mmHg).					
		Males		Females	
		Systolic	Diastolic	Systolic	Diastolic
GRK-M	Age 70-79	152	82	155	82
	Age 80+	153	79	155	83
GRK-S	Age 70-79	148	78	147	75
	Age 80+	146	77	162	80
SWE	Age 70-79	152	85	153	81
	Age 80+	153	80	157	81
CTJ-U	Age 70-79	143	83	145	83
	Age 80+	144	83	146	82
CTJ-R	Age 70-79	141	84	148	82
	Age 80+	144	83	147	77
CBJ	Age <70	144	85	148	85
	Age 70+	152	81	156	83
ACA	Age 70-79	147	84	152	84
	Age 80+	155	83	159	79

GRK-M: Greeks in Melbourne GRK-S: Greeks in Spata SWE: Swedes in Gothenburg CTJ-U: Chinese in urban Tianjin CTJ-R: Chinese in rural Tianjin CBJ: Chinese in Beijing ACA: Anglo-Celts in Melbourne.

The average systolic blood pressure levels varied from 141 mmHg (Chinese in rural Tianjin, age 70-79) to 155 mmHg (Anglo-Celts in Melbourne, age 80+) in males, and from 145 mmHg (Chinese in urban Tianjin, age 70-79) to 162 mmHg (Greeks in Spata, age 80+) in females. The average diastolic blood pressure levels varied from 77 mmHg (Greeks in Spata, age 80+) to 85 mmHg (Swedes in Gothenburg, age 70-79, and Chinese in Beijing, age <70) in males, and from 75 mmHg (Greeks in Spata, age 70-79) to 85 mmHg (Chinese in Beijing, age <70) in females. As mentioned above, the results are presented as average values without any statistical tests for differences, since no interobserver variation studies were performed separately and since, therefore, it is unknown to what extent observed differences depend on methodological errors. There were few obvious differences between the centres, between the two age groups or between the sexes. However, when comparing the different geographic sites a small trend in numerical terms can be seen towards lower systolic blood pressure in the Chinese populations than in Greeks and Anglo-Celts in Melbourne, Greeks in Spata and Swedes in Gothenburg.

14.4 BIOCHEMICAL ANALYSES

The sets of biochemical variables were slightly different in the different countries and some study sites were unable to perform certain laboratory analyses. The total data bank can be found in the appendices. In this section some results are given for selected blood compounds, namely haemoglobin, glucose, cholesterol, the ratio between low and high density lipoprotein cholesterol, triglycerides, cobalamines and folate (Tables 14.3-14.9). As mentioned in the blood pressure section of this chapter, no inter-laboratory variation studies were made. Therefore, the extent of such variation is unknown and the differences obtained should be interpreted with great caution. For the same reason, no statistical tests for possible differences between centres were performed.

The average haemoglobin levels (Table 14.3) varied from 142 g/l (Greeks in Spata, age 70-79) to 151 g/l (Anglo-Celts in Melbourne, age 70-79) in males and from 127 g/l (Greeks in Spata, age 70-79) to 141 g/l (Anglo-Celts in Melbourne, age 70-79) in females. Females generally showed lower values at all study sites. There were no obvious differences between the two age groups. However, there was a numerical tendency for higher haemoglobin values in Anglo-Celts in Melbourne and lower values in the Spata Greeks compared to the IUNS average.

Table 14.3. Average blood haemoglobin in IUNS study centres (g/l).

	Males		Females	
	70-79	80+	70-79	80+
GRK-M	149	145	136	137
GRK-S	142	143	127	131
SWE	149	145	139	134
ACA	151	149	141	135

GRK-M: Greeks in Melbourne, GRK-S: Greeks in Spata, SWE: Swedes in Gothenburg, ACA: Anglo-Celts in Melbourne.

Fasting blood glucose levels (Table 14.4) are given irrespective of diabetes and antidiabetic treatment. They varied from 4.7 mmol/l (Swedes in Gothenburg, age 80+) to 6.3 mmol/l (Greeks in Melbourne, age 70-79) in males and from 4.5 mmol/l (Swedes in Gothenburg, age 70-79) to 7.4 mmol/l (Anglo-Celts in Melbourne, age 80+) in females. The values tended to be numerically higher in the highest age groups. The Swedes in Gothenburg had numerically lower and the Greeks in Melbourne higher values than in the other study sites.

Table 14.4. Average fasting blood glucose in the IUNS study centres (mmol/l).				
	Males		**Females**	
	70-79	**80+**	**70-79**	**80+**
GRK-M	6.3	6.0	5.9	6.8
GRK-S	5.5	5.8	5.8	
SWE	5.0	4.7	4.5	4.8
ACA	5.1	5.4	5.5	77.4

GRK-M: Greeks in Melbourne, GRK-S: Greeks in Spata, SWE: Swedes in Gothenburg, ACA: Anglo-Celts in Melbourne.

The average total serum/ plasma cholesterol levels (Table 14.5) varied from 4.6 mmol/l (Anglo-Celts in Melbourne, age 80+) to 6.6 mmol/l (Greeks in Spata, age 80+) in males, and from 6.1 mmol/l (Greeks in Melbourne, age 80+) to 7.9 mmol/l (Anglo-Celts in Melbourne, age 80+) in females. Males showed clearly lower total cholesterol values than females. No overall age differences were seen. Anglo-Celtic males in Melbourne showed a numerical tendency to lower and female Greeks in Spata to higher levels than other groups.

Table 14.5. Average total serum/ plasma cholesterol in the IUNS study centres (mmol/l).				
	Males		**Females**	
	70-79	**80+**	**70-79**	**80+**
GRK-M	6.1	6.1	6.3	6.1
GRK-S	6.0	6.6	7.1	7.2
SWE	6.3	6.0	7.0	6.6
ACA	5.6	4.6	6.6	7.9

GRK-M: Greeks in Melbourne, GRK-S: Greeks in Spata, SWE: Swedes in Gothenburg, ACA: Anglo-Celts in Melbourne.

The LDL/HDL ratio (Table 14.6) varied from 1.8 (Anglo-Celts in Melbourne, age 80+) to 3.5 (Greeks in Spata, age 80+) in males, and from 2.9 (Greeks in Spata, age 70-79) to 3.7 (Anglo-Celts in Melbourne, age 80+) in females. Regarding the LDL/HDL ratio no overall differences between the two age groups or between the centres could be seen. There was a slight overall numerical tendency towards higher values in women.

Table 14.6. Average plasma low/ high density lipoprotein cholesterol ratio (LDL/HDL).				
	Males		**Females**	
	70-79	**80+**	**70-79**	**80+**
GRK-M	3.6	3.2	2.9	3.2
GRK-S	2.9	3.6	2.9	3.5
ACA	3.3	1.8	3.1	3.7

GRK-M: Greeks in Melbourne, GRK-S: Greeks in Spata, ACA: Anglo-Celts in Melbourne.

The fasting triglyceride levels (Table 14.7) varied from 1.3 mmol/l (both age groups of Anglo-Celts in Melbourne, Greeks in Melbourne, age 80+, and Swedes in Gothenburg, age 80+) to 1.7 mmol/l (Greeks in Spata, age 80+) in males, and from 1.3 mmol/l (Greeks in Melbourne, age 70-79) to 2.2 mmol/l (Anglo-Celts in Melbourne, age 80+) in females. There was a striking similarity between the triglyceride levels obtained. No obvious overall differences were seen between the age groups. There was a slight numerical tendency to higher levels in women.

Table 14.7. Average fasting plasma triglycerides in IUNS study centres (mmol/l).

	Males		Females	
	70-79	80+	70-79	80+
GRK-M	1.4	1.3	1.3	1.4
GRK-S	1.6	1.7	1.4	1.6
SWE	1.4	1.3	1.8	1.5
ACA	1.3	1.3	1.6	2.2

GRK-M: Greeks in Melbourne, GRK-S: Greeks in Spata, SWE: Swedes in Gothenburg, ACA: Anglo-Celts in Melbourne.

Plasma vitamin B-12 levels (Table 14.8) varied from 232 pmol/l (Anglo-Celts in Melbourne, age 80+) to 358 (Swedes in Gothenburg, age 80+) in males, and from 253 pmol/l (Greeks in Melbourne, age 80+) to 580 pmol/l (Greeks in Spata, age 80+) in females. Greek women in Spata tended to have the numerically highest levels and men had the lowest numerical levels except in Swedes in Gothenburg, where the opposite was the case. There were no obvious general age differences.

Table 14.8. Average plasma vitamin B-12 in IUNS study centres (pmol/l).

	Males		Females	
	70-79	80+	70-79	80+
GRK-M	287	239	311	253
GRK-S	285	244	439	580
SWE	356	358	285	343
ACA	256	232	288	305

GRK-M: Greeks in Melbourne, GRK-S: Greeks in Spata, SWE: Swedes in Gothenburg, ACA: Anglo-Celts in Melbourne.

The plasma folate levels (Table 14.9) varied from 11.3 nmol/l (Anglo-Celts in Melbourne, age 80+) to 23.9 nmol/l (Swedes in Gothenburg, age 70-79) in males, and from 13.3 nmol/l (Anglo-Celts in Melbourne, age 80+) to 21.7 nmol/l (Swedes in Gothenburg, age 80+) in females. Anglo-Celts in Melbourne showed the lowest and Swedes in Gothenburg the highest numerical tendency. There was a slight overall numerical tendency to lower values in females.

Table 14.9. Average plasma folate (nmol/l) in IUNS study centres.

	Males		Females	
	70-79	80+	70-79	80+
GRK-M	17.3	18.4	19.2	15.9
GRK-S	19.9	17.3	21.9	21.9
SWE	23.9	23.7	19.6	21.7
ACA	14.7	11.3	16.3	13.3

GRK-M: Greeks in Melbourne, GRK-S: Greeks in Spata, SWE: Swedes in Gothenburg, ACA: Anglo-Celts in Melbourne.

To summarise the biochemical analyses, surprisingly small overall differences were found between the age groups, sexes and centres in the IUNS study. However, some trends could be seen, such as numerically higher fasting glucose values in the highest age groups. Examples of sex difference trends were on average lower fasting triglyceride, lower vitamin B-12, and higher folate levels in men. Examples of tendencies towards geographical differences were on average lower fasting glucose levels in Gothenburg and higher levels in the Melbourne Greeks and lower folate levels in the Melbourne Anglo-Celts and higher levels in Gothenburg.

The average values are consistent with good health in these respects. However, variation - not reported here - was sometimes considerable. For details of the complete set of analyses, see appendices. In the EURONUT study [9] the haemoglobin levels did not indicate that the subjects were in poor health. The assays on blood lipids revealed significant differences between participating centres and between sexes for serum cholesterol and the LDL/HDL ratio. For triglycerides, significant differences were found between centres, but not among the sexes. The trends of the study regarding serum lipid levels indicated that on average the participants of the Mediterranean countries had lower serum lipid levels. The results in the study of blood levels of vitamins (such as vitamin B-12 and folic acid) showed large variations within and between centres, but no geographical pattern. The vitamin status for folic acid was adequate in all centres.

14.5 CUTANEOUS MICROTOPOGRAPHY

It is well known that the appearance and properties of the skin change with age due to a combination of ageing processes and environmental damage (such as sun exposure). The changes include dryness, wrinkling, laxity and uneven pigmentation due predominantly to changes in the epidermis and dermis. Skin changes with age are important in some areas of the body, since there is an increased vulnerability to pressure sores and trauma. Pruritis is common due to dryness of the skin, even in the absence of skin disease. Thermoregulation may be impaired because of a deranged vascular response to heat or cold, decreased sweat production, and/ or loss of subcutaneous fat.

Photo 14.1. West Australia, Fitzroy Crossing, Junjuwa (1988): the skin test using silicon rubber material on the back of the hand as a measure of sun exposure which is taken into account when determining biological age from the forearm imprint.

Photo 14.2. Melbourne, Australia (Greek) (1990-91): woman on the right had few wrinkles, in contrast to the woman on the left (both aged 80); the skin test measures skin texture as hypothetical measure of 'biological age'.

Daniell [6] described a method of visual grading of facial skin wrinkling and found that smoking, age and outdoor exposure had significant and independent effects on the production of "crow's feet". IUNS centres used the method described by Beagley and Gibson [7] to grade cutaneous microtopographs from the right upper arm and right dorsum of the hand. According to Beagley and Gibson [7] the microtopographs were graded according to a 6-step scale using a binocular microscope at x 10 magnification. A high grade indicated extensive wrinkling. An interobserver study between two observers in Melbourne and one in Gothenburg showed that the measurements of the two observers in Melbourne did not significantly differ, while the Gothenburg observer showed significantly lower values.

The results from four IUNS study centres are shown in Table 14.10. The average gradings varied for the inner forearm between 1.9 (Greeks in Spata, age 70-79) and 2.8 (Swedes in Gothenburg, age 80+) in males, and between 1.9 (Anglo-Celts in Melbourne, age 70-79) and 3.0 (Anglo-Celts in Melbourne, age 80+) in females.

Table 14.10. Average cutaneous microtopography grading in IUNS study centres.

		Males		Females	
		Arm	**Hand**	**Arm**	**Hand**
GRK-M	70-79	2.4	4.8	2.2	4.9
	80+	2.4	4.8	2.6	4.9
GRK-S	70-79	1.9	4.8	2.0	5.1
	80+	2.2	5.3	2.4	5.3
SWE	70-79	2.3	4.9	2.7	4.6
	80+	2.8	4.8	2.8	4.8
ACA	70-79	2.3	5.2	1.9	5.0

80+		2.5	5.8		3.0	5.5

GRK-M: Greeks in Melbourne, GRK-S: Greeks in Spata, SWE: Swedes in Gothenburg, ACA: Anglo-Celts in Melbourne.

The average values for the dorsum of the hand varied between 4.8 (Greeks in Melbourne, Greeks in Spata, age 70-79, and Swedes in Gothenburg, age 80+), and 5.8 (Anglo-Celts in Melbourne, age 80+) in males and between 4.6 (Swedes in Gothenburg, age 70-79) and 5.5 (Anglo-Celts in Melbourne, age 80+) in females. There were no obvious overall sex differences, but a numerical trend towards higher values in the higher age groups. At the forearm level, Swedes in Gothenburg showed numerically slightly higher and Greeks in Spata lower levels than probands at the other study sites. However, at the hand level Greeks in Spata and Anglo-Celts in Melbourne showed higher values.

An analysis of the differences and similarities should be made with caution. Sun exposure can be the explanation for higher values, either because of the climate, but also (Sweden) because of deliberate sun tanning instead of protection from the sun. In spite of the lower values in the Melbourne/ Gothenburg interobserver study, Swedish subjects showed relatively high gradings. The results do not allow an evaluation of the relative role of age, sun exposure or protection and smoking. Such analyses are in progress.

14.6 SUMMARY

- The Asian communities tended to have the lowest systolic blood pressure values, but the highest diastolic values; the reverse was true for the Caucasian elderly (except Swedes also had high diastolic pressures).

- Blood tests were only performed on Caucasian elderly.

- CA elderly had the highest haemoglobin values and GRK-S the lowest.

- Average fasting plasma blood glucose was greatest amongst GRK-M, followed by GRK-S, ACA and SWE elderly. The women tended to have higher values than the men and the 80+ elderly higher values than subjects aged 70-79.

- The ACA men had the lowest average total serum cholesterol (5.8 mmol/l) compared to other Caucasian communities (6-6.5 mmol/l). Cholesterol values tended to be higher in women and amongst the 80+.

- Age group or centre differences were not apparent for the LDL/HDL ratio or triglyceride values. There was a slight overall numerical tendency towards higher values in women.

- Plasma folate levels were highest amongst the Swedes, followed by GRK-M, GRK-S and lowest amongst ACA. Women tended to have lower values than the men.

- Skin ageing (as a possible measure of biological age) was more evident amongst SWE, followed by ACA and GRK-M - it was least evident in GRK-S.

14.7 REFERENCES

1. Steen B. The elderly in the changing world. In: Barac B, Lechner H (eds). Neurologica, 1990; 39(2): 19-20.

2. Steen B. Environment and the elderly - the European perspective. In: Picton C, Chiu E (eds). Environment, Health and the Elderly. Australian Rotary Health Research Fund, Melbourne, 1991: 19-21.

3. Landahl S, Bengtsson C, Sigurdsson J, Svanborg A, Svardsudd K. Age-related changes in blood pressure. Hypertension, 1986; 8: 1044-1049.

4. Svardsudd K, Tibblin G. Mortality and morbidity during 13.5 years' follow-up in relation to blood pressure. The study of men born in 1913. Acta Med Scand, 1979; 205: 483-492.

5. Lernfelt B, Landahl S, Svanborg A, Wikstrand J. Overtreatment of hypertension in the elderly? J Hypertension, 1990; 8: 483-490.

6. Daniell HW. Smoker's wrinkles. A study in the epidemiology of "crow's feet". Ann Intern Med, 1971; 75: 873-880.

7. Beagley J, Gibson IM. Changes in skin condition in relation to degree of exposure to ultraviolet light. School of Biology, Western Australian Institute of Technology, Perth, 1980.

8. Holman CDJ, Armstrong BK, Evans PR, Lumsden GJ, Dallimore KJ, Meehan CH, Beagley J, Gibson IM. Relationship of solar keratosis and history of skin cancer to objective measures of actinic skin damage. Br J Dermatol, 1984; 110: 129-138.

9. de Groot LPGM, van Staveren WA, Hautvast JGAZ (eds). EURONUT - SENECA. A Concerted Action on Nutrition and Health in the European Community. European J Clin Nutr, 1991; (45)3.

14.8 ILLUSTRATIONS

Photo 14.1. West Australia, Fitzroy Crossing, Junjuwa (1988): the skin test using silicon rubber material on the back of the hand as a measure of sun exposure which is taken into account when determining biological age from the forearm imprint.

Photo 14.2. Melbourne, Australia (Greek) (1990-91): woman on the right had few wrinkles, in contrast to the woman on the left (both aged 80); the skin test measures skin texture as hypothetical measure of 'biological age'.

CHAPTER 14

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