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Relationships between blood pressure, anthropometric characteristics and blood lipids in high- and low-altitude populations from Central Asia

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Summary. We studied the relationships between blood pressure, anthropometric characteristics and blood lipids in 72 low altitude (LA) Uighurs (600 m), 91 LA-Kirghizs (900 m), 117 medium altitude (MA) Kazakhs (2100 m) and 94 high altitude (HA) Kirghizs (3200 m). All subjects were male and had a similar age ($p =$ ns, ANOVA; range for all 374 subjects: 18–66 yr). Body weight (Wt), body mass index (BMI) and the sum of four skinfolds (4SF) were significantly lower in HA-Kirghizs than the remaining groups ($p < 0.0005$, $p < 0.0005$ and $p < 0.05$ respectively, ANOVA). However, no difference was found in body fat distribution as detected by waist: hip circumference (WHR) and triceps: subscapular skinfold ratios (TSR; $p =$ ns, ANOVA). Stage 1 hypertension was detected in 18% of LA-Uighurs, 2% of LA-Kirghizs, 4% of MA-Kazakhs and 1% of HA-Kirghizs; stage 2 hypertension was detected in 2% of LA-Uighurs and none of the remaining groups; no subject had stage 3 hypertension (The Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure 1997). Blood cholesterol (CH) and triglycerides (TG) did not differ between groups ($p =$ ns, ANOVA). The relationships between systolic (SBP) or diastolic (DBP) blood pressure and age, Wt, BMI, 4SF, WHR, TSR, CH and TG were independent from altitude ($p =$ ns, ANCOVA). In the pooled sample ($n = 374$), age explained 1 and 3% of SBP ($p < 0.05$) and DBP ($p < 0.005$) variance respectively, Wt was the best predictor of SBP and DBP explaining 11 and 10% of their variance respectively ($p < 0.0001$) and CH explained 5% of DBP variance ($p < 0.0001$). In conclusion, hypertension is more frequent in LA- than MA- and HA-subjects from Central Asia. However, anthropometric characteristics and blood lipids do similarly contribute to explain blood pressure in these subjects.

1. Introduction

An age-related increase in blood pressure (BP) is so common in industrialized populations to be considered as a consequence of normal ageing (Borkan and Norris 1980). However, BP is often lower and weakly associated with age in non-industrialized populations so that it has been hypothesized that modernization and urbanization may play a role in the pathogenesis of hypertension (Page 1976, James and Baker 1995). This hypothesis is supported by the observation that, in developing countries, the subjects at major risk of hypertension are those that more rapidly assimilate the Western culture lifestyle (Reddy 1998). Socio-cultural changes of non-industrialized populations have therefore attracted the interest of researchers interested in the pathogenesis of hypertension (Reddy 1998). Few data are available, however, on the study of the relationships between genetic and environmental factors and BP in these populations (James and Baker 1995).

Comparison of subjects living at high (> 2500 m; HA) and low (LA) altitude offers the possibility of investigating the influence of the physical environment on BP (James and Baker 1995). In spite of their generally higher cardiac volume, pulmonary pressure and blood viscosity, highlanders (HL) frequently show lower values

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of BP as compared to lowlanders (LL) (Penaloza, Sime, Banchero *et al.* 1963, Frisancho 1993, Heat and Williams 1995). HA natives also do not generally show significant increases in BP with age (Ward, Milledge and West 1989, Beall, Gebremedhin, Brittenham *et al.* 1997). Moreover, the incidence of cardiovascular disease is characteristically lower in HL than LL (Baker 1978, Ward *et al.* 1989). However, Sun (1986) has detected an higher prevalence of hypertension and a greater increase in BP with age among native Tibetans than Han (Chinese) migrants living in Tibet at 2500–5000 m of altitude.

On the basis of data collected in industrialized populations, an association between BP, blood lipids and anthropometric dimensions has been shown. Anthropometric dimensions are often associated with serum cholesterol which is thought to play a pathogenetic role in atherosclerosis and hypertension (Libby 1998). For example, body mass index (BMI), waist: hip ratio (WHR) and serum cholesterol are predictors of the risk of hypertension (The Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure 1997). The available data show that cholesterol values are often lower in HL than LL (Jackson, Turner and Ward 1966, Baker 1978). However, the relationships between BP, anthropometric characteristics and blood lipids in HL vs LL have not been studied thoroughly.

The Central-Asia High-Altitude Populations (CAHAP) study was aimed to characterize from an anthropological and nutritional point of view selected high- and low-altitude populations from Central Asia for which scant information was available in the international literature (Battistini, Facchini, Bedogni *et al.* 1995, Bedogni, Battistini, Severi *et al.* 1997, Facchini, Toselli, Fiori *et al.* 1997b, Facchini, Toselli, Ismagulov *et al.* in press). CAHAP allowed the investigation of the relationships between BP, anthropometric characteristics and blood lipids in low- vs high-landing populations that settled only recently in the HA environment and for which absence of genetic adaptation can be assumed (Pettener, Facchini, Luiselli *et al.* 1997).

2. Subjects and methods

2.1. Subjects

Kirghizs, Kazakhs and Uighurs are Turkish-speaking (Altaic linguistic family) populations that settled in the Pamir and Tien Shan mountains during the last 4–5 centuries. They are anthropologically classified as Turko-Mongolic populations (Alekseev and Gochman 1983). Kirghizs, Kazakhs and Uighurs share common genetic characteristics (Pettener *et al.* 1997, Comas, Calafell, Mateu *et al.* 1998). A number of 374 male subjects between 18 and 66 years of age were studied. LA-subjects were 72 Uighurs from Pendjem (600 m) and 91 Kirghizs from Talas (900 m), medium-altitude (MA) subjects were 117 Kazakhs from the Keghen Valley in the Tien Shan mountains and HA-subjects were 94 Kirghizs from the Sary Tash village in Pamir (3200 m). The economy of HA-Kirghizs and MA-Kazakhs is based on grazing sheep and goats or raising yaks and horses while that of LA-Kirghizs and LA-Uighurs is based on farming and cattle raising.

2.2. Study protocol

All CAHAP subjects underwent a clinical examination to exclude the presence of disease. This examination was performed by an Italian physician (A.R.) with the help of a local English-speaking physician. Systolic (SBP) and diastolic blood pressure (DBP) were measured by the same trained physician (A.R.) following the guidelines of the American Heart Association (Perloff, Grim, Flack *et al.* 1993). Blood pressure was classified as: (1) optimal; (2) normal; (3) high-normal; (4) stage 1 hypertension; (5) stage 2 hypertension and (6) stage 3 hypertension, according to the criteria proposed by the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (1997). Fasting plasma cholesterol (CH), triglycerides (TG), haemoglobin (Hb) and haematocrit (Hct) were measured by the same operator (D.P.) using Spotchem dry-chemistry kits and an Emo-Flash spectrophotometer (Menarini, Italy). Anthropometric measurements (weight (Wt), height (Ht), triceps skinfold (TSF), biceps skinfold (BSF), subscapular skinfold (SSF), suprailiac skinfold (SISF), waist circumference (WC) and hip circumference (HC)) were performed by the same experienced operator (F.F.) following the Anthropometric Standardization Reference Manual (Lohman, Roche and Martorell 1988). BMI was calculated as Wt (kg)/Ht^2 (m^2) (Garrow and Webster 1985). The sum of four skinfolds (4SF) was obtained by summing TSF, BSF, SSF and SISF (Durnin and Womerseley 1974, Frisancho 1990). WHR was calculated as WC (cm)/HC (cm) and triceps:subscapular ratio (TSR) as TSF (mm)/SSF (mm) (Van Itallie 1992).

2.3. *Statistical analysis*

Statistical analysis was performed using the Statview 5.0 and SuperANOVA 1.1 software packages (SAS Institute, Cary, NC, USA) on a MacOS computer. BMI, 4SF and WHR were log-transformed to make them reach (4SF) or better approach (BMI, WHR) the normal distribution. Between-group differences in anthropometric characteristics, BP and blood lipids were evaluated by ANOVA using the Games-Howell test for post-hoc analysis. The study hypothesis that determinants of BP were similar in LA-Uighurs, LA-Kirghizs, MA-Kazakhs and HA-Kirghizs was tested using a general linear model (GLM) in which SBP or DBP was entered as the dependent variable and age, Wt, Ht, BMI, 4SF, WHR, TSR, CH, TG, Hb or Hct as the independent variable. An interaction term consisting of the covariate and of a purposely built 'altitude factor' (0: LA-Uighur; 1: LA-Kirghiz; 2: MA-Kazakh; 3: HA-Kirghiz) was added to the model in order to test the effect of altitude on the relationship of interest. Statistical significance was set to a value of $p < 0.05$.

3. Results

The measurements of the subjects are given in table 1.

Age was similar in all groups ($p =$ ns; range for the pooled sample: 18–66 years). Wt and BMI were lower in HA- than LA- and MA- subjects ($p < 0.0005$). Ht was similar in all groups ($p =$ ns), partly reflecting the common genetic background of Kirghizs, Kazakhs and Uighurs. 4SF was higher in LA- than MA- and HA-subjects ($p < 0.05$) while WHR and TSR were similar in all groups ($p =$ ns). SBP and DBP were higher in LA-Uighurs and MA-Kazakhs than HA- and LA-Kirghizs ($p < 0.05$). Cholesterol and triglycerides were similar in all groups ($p =$ ns). Hb and Hct were significantly higher in MA-Kazakhs and HA-Kirghizs than LA-Uighurs and in these latter than LA-Kirghizs ($p < 0.0005$).

In table 2, values of SBP and DBP are classified according to the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (1997). Twenty per cent of LA-Uighurs, 2% of LA-Kirghizs, 4% of MA-Kazakhs and 1% of HA-Kirghizs had clinically relevant hypertension ($\geqslant$ stage 1).

Table 1. Characteristics of study subjects. Values are given as mean ± sd unless specified otherwise. Abbreviations: LA = low altitude; MA = medium altitude; HA = high altitude; Wt = body weight; Ht = body height; BMI = body mass index; 4SF = sum of 4 skinfolds according to Durnin and Womersley (1974); WHR = waist: hip ratio; TSR = triceps: subscapular ratio; SBP = systolic blood pressure; DBP = diastolic blood pressure; CH = cholesterol; TG = triglycerides; Hb = haemoglobin; Hct = haematocrit.

	LA-Uighurs (600 m)	LA-Kirghizs (900 m)	MA-Kazakhs (2100 m)	HA-Kirghizs (3200 m)
n	72	91	117	94
age (yr)	33 ± 12	33 ± 11	32 ± 9	35 ± 10
Wt (kg)	67.3 ± 10.9[a]	66.4 ± 9.8[a]	66.7 ± 8.7[a]	60.3 ± 8.4[b]
Ht (m)	1.68 ± 0.57	1.69 ± 0.50	1.69 ± 0.64	1.68 ± 0.63
BMI (kg/m^2)*	23.4[a]	23.0[a]	23.1[a]	21.2[b]
4SF (mm)*	33.1[c]	28.4[c]	27.0[d]	22.5[e]
WHR*	0.91	0.88	0.89	0.87
TSR	0.7 ± 0.2	0.8 ± 0.2	0.8 ± 0.2	0.7 ± 0.2
SBP (mm Hg)	126 ± 13[c]	114 ± 14[d]	120 ± 10[c]	112 ± 12[d]
DBP (mm Hg)	84 ± 9[c]	78 ± 7[d]	81 ± 7[c]	78 ± 7[d]
CH (mg/dL)†	150 ± 28	158 ± 32	153 ± 29	153 ± 28
TG (mg/dL)††	116 ± 70	107 ± 69	107 ± 72	103 ± 57
Hb (g/dL)**, †††	14.8 ± 0.9[f]	14.1 ± 1.1[g]	16.1 ± 1.0[h]	16.0 ± 1.2[h]
Hct (%) **	45.0 ± 2.5[f]	43.7 ± 2.2[g]	48.1 ± 2.9[h]	46.5 ± 2.7[h]

* Value given as geometric mean (variable was log-transformed for statistical analysis).
** Hb and Hct data are available for 63 LA-Uighurs, 86 LA-Kirghizs, 107 MA-Kazakhs and 88 HA-Kirghizs.

[a,b] Values not sharing the same superscript are significantly different at the $p < 0.0005$ level.
[c,d] and [c,d,e] Values not sharing the same superscript are significantly different at the $p < 0.05$ level.
[f,g] and [h] Values not sharing the same superscript are significantly different at the $p < 0.0005$ level.

† To convert to SI units (mmol/L) multiply by 0.025 86.
†† To convert to SI units (mmol/L) multiply by 0.011 29.
††† To convert to SI units (g/L) multiply by 10.

Table 2. Classification of blood pressure of study subjects according to the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (1997). Values are given as percentages. Abbreviations: LA = low altitude; MA = medium altitude; HA = high altitude.

	LA-Uighurs	LA-Kirghizs	MA-Kazakhs	HA-Kirghizs
Optimal (%)	11	41	10	42
Normal (%)	33	32	45	36
High-normal (%)	36	25	41	21
Stage 1 hypertension (%)	18	2	4	1
Stage 2 hypertension (%)	2	0	0	0
Stage 3 hypertension (%)	0	0	0	0

The relationships between BP, age, anthropometric characteristics and blood lipids are given in table 3. Since the interaction between covariates (age, Wt, Ht, BMI, 4SF, WHR, TSR, CH, TG, Hb and Hct) and the 'altitude factor' was not significant ($p =$ ns), values of r^2 were calculated for the pooled sample ($n = 374$).

Age explained 1% and 3% of SBP ($p < 0.05$) and DBP ($p < 0.005$) variances respectively (figure 1).

Wt was the best predictor of BP explaining 11% and 10% of SBP and DBP variances ($p < 0.0001$) respectively. It was slightly superior to BMI and 4SF, both explaining about 9% of the same variances ($p < 0.0001$). WHR and TSR explained no variance of both SBP and DBP ($p =$ ns). CH explained no variance of SBP

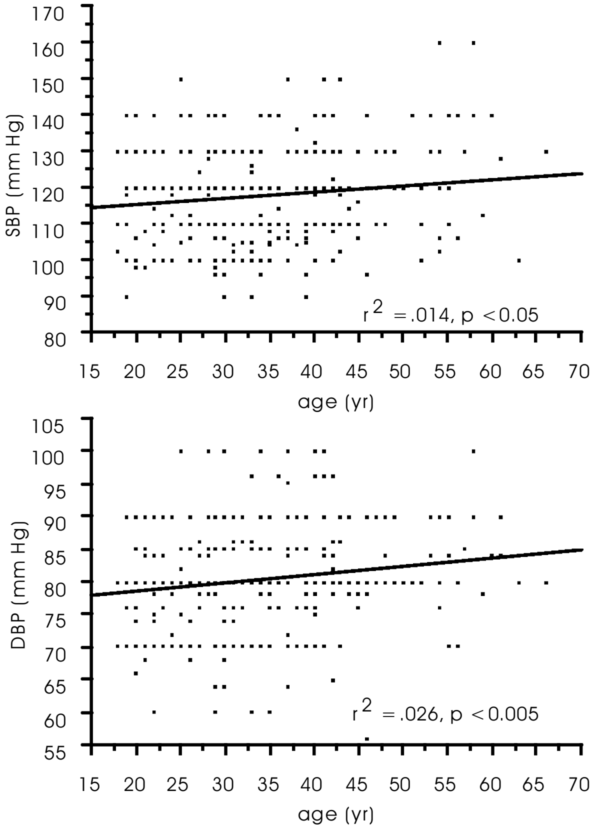

Figure 1. Effect of age variation on systolic (SBP) and diastolic blood pressure (DBP) in the pooled sample ($n = 374$).

($p =$ ns) and 5% of DBP variance ($p < 0.0001$) while TG explained 3% and 6% of SBP ($p < 0.005$) and DBP variances ($p < 0.0001$) respectively. Finally, no association was found between Hb, Hct and BP ($p =$ ns for both SBP and DBP).

The relationships between blood lipids, age and anthropometric characteristics are given in table 4.

Also for CH and TG, the interaction of the 'altitude factor' with covariates was not significant ($p =$ ns). Thus, further analyses were performed on the pooled sample ($n = 374$). Age explained 17% of CH variance ($p < 0.0001$) but no variance of TG ($p =$ ns). Anthropometric characteristics explained a portion of CH variance between 7% (Wt) and 15% (WHR; $p < 0.0001$ for both) and a similar interval was seen for TG variance (from 7% for Wt to 14% for 4SF; $p < 0.0001$ for both). However, after correction for age, WHR was no more significantly associated to CH and 4SF emerged as the best predictor of this latter ($r^2 = .06$, $p < 0.0001$).

Forty-seven per cent of the study subjects were cigarette-smokers. As compared to non-smokers, they showed significantly higher values of SBP (120 ± 13 *vs* 115 ± 13 mm Hg, $p < 0.01$) and DBP (81 ± 8 *vs* 79 ± 7 mm Hg, $p < 0.05$). Despite their statistical significance, however, these differences are not clinically relevant. Moreover, no difference was found in CH and TG levels between smokers and non-smokers (data not shown). Salt intake was supposedly similar in Kirghizs,

Table 3. Values of r^2 for the regression of systolic and diastolic blood pressure vs age, anthropometric characteristics and blood lipids in the pooled sample (n= 374). Abbreviations: SBP = systolic blood pressure; DBP = diastolic blood pressure; Wt = body weight; Ht = body height; BMI = body mass index; 4SF = sum of 4 skinfolds according to Durnin and Womerseley (1974); WHR = waist: hip ratio; TSR = triceps: subscapular ratio; CH = cholesterol; TG = triglycerides; Hb = hemoglobin; Hct = haematocrit.

	SBP		DBP	
	adj r^2	p	adj r^2	p
Age	0.014	0.016	0.026	0.002
Wt	0.110	< 0.0001	0.097	< 0.0001
Ht	—	ns	—	ns
BMI *	0.087	< 0.0001	0.086	< 0.0001
4SF *	0.083	< 0.0001	0.087	< 0.0001
WHR *	—	ns	—	ns
TSR	—	ns	—	ns
CH	—	ns	0.047	< 0.0001
TG	0.028	0.003	0.058	< 0.0001
Hb	—	ns	—	ns
Hct	—	ns	—	ns

* Log-transformed.

Table 4. Values of r^2 for the regression of cholesterol and triglycerides vs anthropometric characteristics in the pooled sample (n= 374). Abbreviations: Wt = body weight; Ht = body height; BMI = body mass index; 4SF = sum of 4 skinfolds according to Durnin and Womerseley (1974); WHR = waist : hip ratio; TSR = triceps : subscapular ratio.

	CH		TG	
	adj r^2	p	adj r^2	p
Age	0.165	< 0.0001	—	ns
Wt	0.074 (0.029)†	< 0.0001 (0.019)†	0.069	< 0.0001
Ht	—	ns	—	ns
BMI*	0.105 (0.043)†	< 0.0001 (0.0002)†	0.079	< 0.0001
4SF*	0.117 (0.064)†	< 0.0001 (< 0.0001)†	0.144	< 0.0001
WHR*	0.146(0.024)†	< 0.0001(0.221)†	0.066	< 0.0001
TSR	—	ns	—	ns

* Log-transformed.
† Value of r^2(p) after correction for age.

Kazakhs and Uighurs since iodized salt is furnished to them by health services with the aim of preventing goitre. In this respect, it should be noted that no differences were found in thyroid function between HL and LL Kirghizs in a previous study (Facchini, Pettener, Rimondi *et al.* 1997a).

4. Discussion

This study was aimed at ascertaining whether living at low, medium or high altitude is associated with differences in the relationships between BP, anthropometric characteristics and blood lipids.

Our HA subjects were leaner than MA and LA subjects, as shown by lower values of BMI and 4SF. (The effects of the HA environment on body composition are discussed in major detail elsewhere (Facchini *et al.* 1997b, Facchini *et al.* in press).) However, body fat distribution—as detected by WHR and TSR—was similar in the three groups.

SBP and DBP were lower in HA than LA and MA subjects. To appreciate the clinical relevance of this finding, subjects were classified on the basis of their degree of BP (The Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure 1997). (Although the employed criteria were developed in Western industrialized populations, their use is nonetheless suggested wherever no local reference standards are available.) Using these criteria, it appeared that 20% of LA-Uighurs, 2% of LA-Kirghizs, 4% of MA-Kazakhs, and 1% of HA-Kirghizs had clinically relevant hypertension ($\geqslant$ stage 1). The BP profile of our subjects follows, therefore, a clear altitude gradient.

Our observations are in agreement with previous studies showing a lower prevalence of hypertension in HL than LL. Independence of BP from age was observed in both South-American and Ethiopian HA natives (Ward *et al.* 1989, Beall *et al.* 1997). As regards Asiatic HA natives, Tibetans from Buthan, Sherpas from Nepal and populations from Pamir and Tien-Shan do not present age-associated increases in BP with the exception of some HL Tibetans studied by Sun (1986) and Ward *et al.* (1989). However, the study of Sun (1986), showing a greater prevalence of hypertension in native Tibetans than Han migrants living at 2500–5000 m of altitude, suggests that the relationship between HA and BP may differ in different regions of the world. (These authors suggested that the higher salt intake of native Tibetans may partly explain their higher prevalence of hypertension as compared to Han migrants.) However, also in this study, a greater incidence of hypertension was observed in urban (around Lhasa) than rural population.

In our study, age explained only 1 and 3% of SBP and DBP variance respectively offering a further demonstration of the fact that BP is often weakly associated to age in non-industrialized populations. Anthropometric characteristics and blood lipids were variably associated with BP but none of them was able to explain a portion of SBP or DBP variance greater than 11%. Wt was a better predictor of BP than BMI and 4SF, leaving, however, a substantial portion of unexplained variance (89%). Also the contribution of serum lipids to BP was low, being able to explain at best 6% of DBP variance for CH.

The mean BP values of our HA-Kirghizs were very similar to those of the HA-Ethiopians (3530 m) studied by Beall *et al.* (1997) (SBP: 112 *vs* 109 mm Hg and DBP: 78 *vs* 75 mm Hg) and the same was true for Hb levels (15.9 g/dL in both samples). Moreover, as observed by Beall *et al.* (1997), we found no association between haematocrit and BP. (This finding is commonly explained by a decrease in peripheral vascular resistance which counterbalances the increase in haematocrit and blood viscosity due to the hypoxia associated with the HA environment (James and Baker 1995).)

In our subjects, age explained 17% of CH variance. After correction for age, WHR lost its association with CH while 4SF emerged as the best predictor of CH (explained variance = 6%). Thus, overall adiposity was a better predictor of CH than body fat topography.

Interestingly, of the four populations examined, Uighurs appear to be those undergoing the more rapid assimilation of the Western culture lifestyle, as could be observed by us during the study. Although the design of the present study does not allow us to define the causes of the greater frequency of hypertension among Uighurs, a possible role of urbanization in the pathogenesis of hypertension would be in agreement with previous studies (Reddy 1998). Since Kirghizs and Kazakhs settled in the HA environment only a few centuries ago, one should also consider the fact that BP is generally lower in LL living at high altitude than at sea level (Ward *et al.* 1989). Moreover, the observation that BP was similar in Kirghizs independently of altitude suggests that genetic characteristics may be partly responsible for this similarity.

We conclude that: (1) hypertension is more common in LA- than MA- and HA-subjects from Central Asia; (2) age contributes very little to BP in these subjects ($\leq$ 3%); (3) Wt allows the best prediction of their BP leaving, however, a substantial portion of unexplained variance (89%); (4) the contribution of CH and TG to their BP is low ($\leq$ 6%); (5) age has some effect on their CH values (17%) and the best predictor of CH after correction for age is 4SF (6%).

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Zusammenfassung. An Bewohnern des Tieflandes (LA), mittlerer Höhen (MA) und an Hochlandbevölkerungen (HA) wurde der Zusammenhang zwischen dem Blutdruck, anthropometrischen Charakteristika und Blutlipiden untersucht. Im einzelnen handelt es sich bei den untersuchten Bevölkerungen um 72 LA-Uiguren (600 m), 91 LA-Kirgis (900 m), 117 MA-Kasaks (2100 m) und 94 HA-Kirgis (3200 m). Es handelt sich ausschließlich um männliche Probanden ähnlichen Alters ($p =$ ns, ANOVA; Variationsbreite für alle 374 Probanden: 18–66 Jahre). Das Körpergewicht (Wt), der Body Mass Index (BMI) und die Summe von vier Hautfaltendicken (4SF) war bei den HA-Kirgis signifikant niedriger als in den übrigen Gruppen ($p < 0.0005, p < 0.0005$ bzw. $p < 0.05$, ANOVA). In der Verteilung des Körperfetts, die über das Verhältnis von Taillen- zu Hüftumfang (WHR) sowie das Verhältnis von Trizeps-Hautfaltendicke zur Dicke der subskapularen Hautfalte (TSR; $p =$ ns, ANOVA) erfaßt wurde, ließen sich jedoch keine Unterschiede beobachten. Ein Bluthochdruck im Stadium 1 ließ sich bei 18% der LA-Uiguren, 2% der LA.Kirgis 4% der MA-Kasaks und 1% der HA-Kirgis beobachten; ein Bluthochdruck des Stadiums 2 wurde lediglich bei 2% der LA-Uiguren beobachtet, während er in den übrigen Bevölkerungen nicht vorkam; ein Bluthochdruck des Stadiums 3 wurde in keiner Bevölkerung beobachtet (The Joint National Committee on Prevention, Detection, Evaluation and Treatment of Hypertension 1997). In den Blutkonzentrationen von Cholesterin (CH) und Triglyzeriden (TG) wurden keine Unterschiede zwischen den Gruppen beobachtet ($p =$ ns, ANOVA). Der Zusammenhang zwischen dem systolischen (SBP) bzw. dem diastolischen Blutdruck (DBP) und dem Alter, Wt, BMI, 4SF, WHR, TSR, CH und TG war von der Höhenlage des Wohnortes unabhängig ($p =$ ns; ANCOVA). In der gepoolten Stichprobe ($n = 374$), erklärte das Alter 1 bzw. 3% der Varianz des SBP ($p < 0.05$) bzw. des DBP ($p < 0.005$). Das Gewicht erwies sich als bester Prädiktor des SBP und DBP, es erklärte 11 bzw. 10%

der Varianz ($p < 0.0001$). CH erklärte 5% der Varianz des DBP ($p < 0.0001$). Zusammenfassend läßt sich festhalten, dass Bluthochdruck in Zentralasien bei LA-Bevölkerungen häufiger vorkommt als in MA- und HA-Bevölkerungen. Anthropometrische Charakteristika und Blutfette tragen jedoch in ähnlicher Weise zur Erklärung des Blutdruckes bei allen Probanden bei.

Résumé. On a étudié les associations entre la pression artérielle, les caractéristiques anthropométriques et les lipides sanguins chez 72 Ouïgour d'altitude basse (AB) (600 m), 91 AB-Khirghiz (900 m), 117 Kazakhs d'altitude moyenne (AM) (2100m) et 94 Kirghiz d'altitude haute (AH) (3200 m). Tous les sujets étaient des hommes adultes de moyenne d'âge similaire ($p =$ ns, ANOVA; étendue de variation pour l'ensemble des 374 sujets: 18–66 ans). Le poids corporel (Pds), l'indice de masse corporelle (IMC) et la somme des quatre plis cutanés (S4PC) étaient significativement plus bas chez les AH-Kirghiz que dans les autres groupes (respectivement $p < 0.0005$, $p < 0.0005$ et $p < 0.05$ ANOVA). Cependant, on n'a pas trouvé de différence dans la distribution de la graisse corporelle telle que déterminée par les rapports des circonférences taille/hanches (RTH) et par le rapport des plis cutanés triceps/sous-scapulaire (RTS; $p =$ ns, ANOVA). L'hypertension de niveau 1 est présente chez 18% des AB-Ouïgour, 2% des AB-Kirghiz, 4% des AM-Kazakh et 1% des AH-Kirghiz. Le niveau 2 d'hypertension a été détecté chez 2% des AB-Ouïgour seulement. Aucun des sujets n'avait atteint le niveau 3 d'hypertension (Comité de Prévention, Détection, Evaluation et Traitement de la Haute Pression Artérielle, 1997). Le cholestérol sanguin (CS) et les triglycérides (TG) ne différaient pas entre groupes ($p =$ ns, ANOVA). Les associations entre pressions artérielles systolique (PAS), diastolique (PAD) et l'âge, le Pds, l'IMC, la S4PC, le RTH, le RTS, le CS et les TG sont indépendantes de l'altitude ($p =$ ns, ANCOVA). L'âge expliquait respectivement 1 et 3% des variances de la PAS ($p < 0.05$) et de la PSD ($p < 0.005$), le Pds étant le meilleur prédicteur de la PAS et de la PAD, expliquant respectivement 11% et 10% de leur variance ($p < 0.0001$), le CS expliquant 5% de la variance en PAD ($p < 0.0001$). En conclusion, l'hypertension est plus fréquente chez les sujets d'AB- que d'AM- et d'AH- en Asie Centrale. Les caractéristiques anthropométriques et les lipides sanguins contribuent de manière semblable à expliquer la pression artérielle chez les sujets examinés.