J Behav Health 2012; 1(4):294-301 *ISSN: 2146-8346*

GESDAV

Journal of Behavioral Health

available at www.scopemed.org

Original Research

Some anthropometric risk factors of cardiovascular disease in Oravian adults (Central Slovakia): gender and age differences

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Received: January 13, 2012

Accepted: August 24, 2012

Published Online: September 14, 2012

DOI: 10.5455/jbh.20120824093710

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Key words: Anthropometry, obesity, hypertension, males, females, adults, age

Abstract

Background: Slovaks are known to be a population at high risk of cardiovascular disease (CVD).

Objective: The aim of the study was description of gender and age differences in relation to anthropometric CVD risk factors among Oravian adults.

Participants: The study population consisted of 100 participants (50 males and 50 females) representing three age groups: 49% young adults (18-35 yrs), 30% middle-aged adults (36-59 yrs) and 21% of elderly adults (60-80 yrs) from the central-Slovakian region of Orava.

Methods: Anthropometric measurements, including weight, height (for BMI), waist and hip circumference (WHR), triceps and subscapular skinfold were used to calculate percentage body fat (BF). Measured blood pressure (BP) was used to classify for hypertension.

Results: The males (in comparison with the females) had higher means of BMI (25.58±3.51 kg/m^2), WHR (0.91±0.07), sBP (145±16.57 mmHg) and dBP (87.5±13.67 mmHg), higher prevalence of overweight, obesity and hypertension (50%), cigarette smoking (36%), and lower levels of physical fitness (64%) and education and socioeconomic status (18%). The highest means of BF (32.5± 3.50%) and BMI (28.95±4.98 kg/m^2) were recorded in elderly females (6% of them were morbidly obese), who had the greatest prevalence of high-risk WHR (75%) and body fat (87.5%). The highest means of WHR (0.96±0.08) and sBP (153.85 ±14.6 mmHg) were determined in elderly males. 14.3% of the eldery participants were obese and 9.5% morbidly obese and 50% the middle-aged men showed the highest prevalence of hypertension II., and 53.8% of the eldery men showed the highest prevalence of hypertension I.

Significant gender differences were found in WHR, BF, sBP ($p<0.001$), BF, BMI ($p=0.04$) and significant age differences were shown in sBP and BMI ($p=0.001$), WHR and obesity ($p<0.001$), dBP ($p<0.02$) and BMI ($p=0.04$). We found the strongliest relation BMI and BF in the elder group ($r=0.793$**) and relation WHR and BMI in males ($r=0.551$**). A significant correlation between CVD family history and high-risk BF ($p=0.006$) was determined in males and a significant correlation between cigarette smoking and high-risk BF ($p=0.04$) in females. We also detected statistically significant association of education and age ($p<0.001$), especially in females.

Conclusion: *The results of the study emphasize the need for comprehensive prevention of CVD risk factors among Oravian adults.*

INTRODUCTION

High-risk anthropometric values of body fat percentage (BF), body mass index (BMI), waist-to-hip ratio (WHR), blood pressure (BP) and unhealthy lifestyle (cigarette smoking, stress, low physical activity) are widely used as major modifiable indicators of cardiovascular disease (CVD), which is the primary cause of mortality in Slovakia (54.5% of deaths) (noted in 48.1% of mortalities among Slovak males and 62% among Slovak females, 1).

By Slovak Statistic office (2011), 28.265 of Slovaks dead on CVD last year. The most frequent cause was chronical ischaemic heart disease (13 277 of deaths), similarly in males and females. Acute myocardial infarction was second cause of deaths (3431), further infarcts (2805), heart collapse (1506), heart attack (1371), encephalorrhangia (907), atherosclerosis (673), hypertension (625) and pulmonary embolism (551) (2).

Slovakia is evaluated as one of the worst level in CVD mortality in Europe (second place after Russia, OECD Health data 2011) - 508 of deaths/ 100.000 inhabitants. In comparison with neighbour states Slovakia had tho lowest dynamic of decrease level (in years 1981-2005). By Slovakian cardiology society, CVD consider to be the most important factor of lower lifespans (about 10 years lower in Slovakian males and females than average in Eurozone) (3).

Slovakia is also considered to have a relatively high risk of CVD which was demonstrated by Countrywide Integrated Non-communicable Disease Intervention Programme (CINDI 1998) and by monitoring of trends and determinants of CVD in Slovakia (MONIKA program, study based on the WHO, 2002/2003) (4) In the central Slovakian Orava region, there has not yet been consistently examined CVD factors (only a few reports of national population prevalence estimated for CVD). It is necessary to know real epidemiological information about Oravians because of known low socioeconomic level which can be associated with cigarette smoking, overnutrition by cheap energetic diet, sedentary life style etc influenced poorer health and participating in the development CVD. Detailed analyses of epidemiological and life style interaction could help to clarify the real health status in this socially disadvantaged regional sample.

Many epidemiological studies distinguish sex and age differences in CVD risk. A study of Coronary Artery Risk Development in Young Adults (CARDIA) points out that middle-aged men are typically a-high risk population overall (5). Men are characterized as having abdominal fat distribution (compared women having gluteofemoral body fat distribution) (6). CVD is considered to be more prominent in men (7). It was found 19.5% of obese and 27. 7% of hypertensive males and 20.8% of obese and 16.2% of hypertensive females (25-64 aged) by monitoring of trends and determinants of CVD in Slovakia. More risk values of WHR and BMI /and higher prevalence of obesity/ were detected in the Slovak women in comparison with the Slovak men. In age groups /15 to 64 yrs. /, the obesity and hypertension prevalence increased in both gender /MONICA program/. Lower lifespan is typical for Slovak males with basic education (1993-95; 66-67 aged in Orava) and differents in regions (about 4 years in life span variation were determined in regions, which distance is only a few kilometers) (8).

Unfavourable gender (male/female), age (young adults/geronts) variation in predictive biomarkers demand comparative and relevant evidence in Oravians. The lack of information about gender- and age- differences in the CVD risk predictors among Oravians has prompted us to analyze the excessive anthropometric values in the association with environmental factors.

The goal of this study is to characterize Oravian males and females of three age categories (young adults, middle-aged adults and the elderly) by anthropometry (BF, BMI, WHR and BP) to evaluate hypertension and various degrees of obesity. The monitoring of CVD family history and exogenous condition (cigarette smoking, stress, physical fitness) can provide more up-to-date information on their health status to implement preventive intervention.

STUDY POPULATION AND METHODS

In the research (2009-2010), the examined population consisted of 100 participants (50 males and 50 females; total response rate was 99% with the highest rate of recruiment) from central Slovakian region- Orava (in time of the study 134 000 Oravians 50% of males and 50% of females) lived in Slovakia (with 5 400 000 inhabitants) (9) , between the ages of 18 and 80. Participants were classified into three age groups: young adults (aged 18-35 yrs.), adult of middle age (aged 36-59 yrs.) and geronts (aged 60-80 yrs.). The cut-off point for ages is the end of January so all participants must be of a certain age on 1st February. The examined group was randomly selected to represent the healthy population. The subjects in this research were all volunteers from Orava region. Participants come from Dolný Kubín (86,5% of inhabitants/ km^2), the town with the highest density of population (in comparison with the other Oravian towns). Information on lifestyle was obtained from a questionnaire which was designed to evaluate how daily physical activities, stress, cigarette smoking, socioeconomic and educational levels etc. can affect CVD (the evaluation of psychometric properties included estimations of validity, reliability, and responsiveness). Only non-lipid anthropometric CVD risk indicators were determined: BF, BMI, WHR, systolic and diastolic BP.

All anthropometric data were measured in two separated times and recorded the average values. Skin folds were measured at triceps and subscapula using a standard caliper. Calculations of body fat percentage were performed with standard equations (evaluated BF >30% for female and BF >20% for male). Anthropometric measurements (height and weight)

were taken using a stadiometer. Height was measured barefoot in standing position to the nearest 0.5 cm using a secured metal ruler and also weight was measured in light clothing using calibrated scales. BMI, used for assessment of the prevalence of overweight (BMI >25 kg/m^2; overweight group is having BMI between 25.0 kg/m^2 and 29.99 kg/m^2), the prevalence of obesity (BMI >30 kg/m^2) and the prevalence of morbidly obese (BMI >35 kg/m^2), was calculated as a quotient of weight and squared height in meters (kg.m^{-2}). Waist circumference was measured at a level midway between the lower rib margin and the ilic crest to the nearest half-centimeter. Hip circumference was measured at the maximum protuberance of the buttocks. WHR was calculated as derived waist-to-hip circumference. Waist circumference was measured in the middle between the arch of the10th rib and the top of the iliac crest (WHR>90 for male and WHR>85 for female).

Blood pressure was measured from the right arm using a standard mercury sphygmomanometer with the subject in sitting position (both values were taken after 5 min rest). Over-values of tension was defined as sBP >130 mmHg, and diastolic blood pressure as >85 mmHg, hypertension I. as sBP >140 mmHg dBP >90 mmHg and hypertension II. as sBP >160 mmHg dBP >100 mmHg

The results are expressed as mean ± SD. Statistical information about population was obtained by Omnibus statistic (an analysis of variance showed statistically significant values in all anthropometric variables by gender and age), evaluation of response rate (percentage composition) and degrees of freedom . A normality test was performed with the Kolmogorov-Smirnov test. When the variables were not normally distributed, we used the Kruskal-Wallis and Mann Whitney Test and evaluated the variables' distribution in gender- and age- related groups. A "p" value of < 0.05 was considered to indicate statistical significance. Spearman correlation coefficient (r) tested association between anthropometric parameters. Statistical analyses were performed using the SPSS System software package.

RESULTS

Characteristics of study population

The anthropometric values in adults (N=100), divided according to different sex and age groups, are given in Table 1.

Table 1. Anthropometric values related to gender and age differences in Oravian adults.

parameter	populations (n=100)								whole population
	females (n=50)				males (n=50)				
	18-35 yrs (n=26)	36-59 yrs (n=16)	60-80 yrs (n=8)	all	18-35 yrs (n=23)	36-59 yrs (n=14)	60-80 yrs (n=13)	all	
body fat in %	22.38±1.83	27.01±3.37	**32.5±3.5**	25.48±4,57	21.78±4.52	21.93±4.84	21,95±7.26	21,87±5,32	23.68±5.26
>20% for ♂ >30% for ♀	0,00	43.8	**87.5**	28	65.2	71.4	69.2	68	48
BMI (kg/m^2)	22.11±2.17	25.6±5.55	**28.95±4.98**	24.32±4,69	26.06±3.40	24.92±3.63	25.45±3.74	25.58±3,51	24.95±4.17
above 25 kg/m^2	7.70	43.8	0	34	**52.2**	50	46.2	50	42
WHR	0.77±0.06	0.86±0.07	0.93±0.12	0.82±0.09	0.89±0.06	**0.97±0.07**	0.96±0.08	0.91±0,07	0.87±0.95
>0,9 for ♂ (%) >0,85 for ♀ (%)	11.50	68.8	**75**	40	52.2	28.6	61.5	48	44
sBP (mmHg)	124.23±15.28	136.56±27.97	132.5±15.11	129.5±20.59	135.88±11.93	151.79±17.93	**153.85±14.6**	145±16,57	137.25±30.16
dBP (mmHg)	80.19±12.92	87.81±14.49	80.63±11.78	82.7±13.49	84.35±11.41	**93.93±14.17**	86.15±14.43	87.5±13,67	85.10±13.73
Hypertension I. (>140/90) % /hypertension II. (>160/100) %	15.4/0	25/**12.5**	62.5/0	26/4	43.5/4.3	35.7/**50**	**53.8**/38.5	44/26	11.5/4.9

mean±SD

The means of BMI, WHR, sBP and dBP in the Oravian males are higher in comparison to the females (who show higher body fat than males). Males were generally more obese and more hypertensive than the Oravian females (however, they were more frequently morbidly obese especially in the elder age, illustrated in Table 2).

Table 2. Degrees of obesity in the examined Oravian population.

degrees of obesity	all population %	males %	females %	young participants %	middle participants %	elder participants %
overweight ≥25 kg/m^2	28	30	26	16.3	36.7	42.9
obese ≥30 kg/m^2	10	18	2	10.2	6.7	14.3
morbidly obese ≥35 kg/m^2	3	0	6	0	3.3	9.5

By age, the highest means of BF, BMI (and high-risk BF and WHR) were recorded in females (aged 60-80 yrs.) and the highest means of WHR and sBP in males (aged 60-80 yrs). The highest-risk values of dBP were measured in middle-aged adults (these males show a 50% prevalence of hypertension II. and 53.8% of the males show prevalence of hypertension I.).

Generally, the means of BF were above the acceptable range in females of all age groups. Excessive means of BMI were also recorded in middle-aged and elderly females and young and middle-aged males. The values of BP were above the acceptable range in middle-aged males (71.4%) .

Statistically significant differences of $p< 0.05$ were shown in the values of BF, WHR, BMI and sBP in relation to gender and age by the non-parametric Mann-Whitney test, Table 3.

Table 3. CVD risk parameters according to gender- related and age differences (tested by Mann –Whitney, Kruskal-Wallis and chi square tests).

parameter	gender differences	age differences
BF	<0.001	0.001
%	0.003	<0.001
BMI	0.041	0.04
obesity	0.016	<0.001
WHR	<0.001	<0.001
%		
sBP	<0.001	0.001
dBP		0.02
hypertension	<0.001	<0.001

The most significant differences in WHR and sBP ($p\leq0.001$) were found in relation to the gender. The most significant differences in WHR ($p<0.001$), BF and sBP ($p=0.001$) were found in relation to the age.

The variables listed in Table 4. showed that BMI was strongly related to BF in both gender groups. We found the strongliest relation BMI and BF in the elder group compared with other age groups (r= 0. 793**). When comparing WHR and BF, weaker relation was found in males (r=0.484**).

CVD family history and environmental factors in central-Slovakian males and females

Further considering life style factors were evaluated in Oravians by gender and age aspect (Table 5).

Male population (in comparison with the female) showed a higher prevalence of cigarette smoking, lower physical inactivity, and lower levels of socioeconomic status and education. Females exhibit higher rates of CVD family history and a higher stress rate than males.

Young population (in comparison with the other age groups) showed more representation cigarette smoking. Elderly population showed lower level of education, higher level of stress and exhibit higher rates of CVD family history. The middle –aged population has lower level of leisure time physical activity and show lower level of socioeconomic status.

Statistically significant differences among gender ($p=0.04$) and age groups ($p=0.016$) were found in cigarette smoking. We found statistically significant association of education and age ($p<0.001$), especially in females.

A correlation between exogenous factors and anthropometric indicators was determined by x^2 test. In males, a significant relation CVD family history and BF ($p=0.006$) was determined and a significant relation cigarette smoking and BF ($p=0.04$) was noted in Oravian females.

Table 4. Spearman correlation coeficients of some variables in males and females, in young middle and old Oravian population (r).

parameter	gender		age			all
	male	female	young	middle	old	
BF	BMI(0.809**)	BMI (0.803**)	BMI(0.611**)	BMI(0,639**)	BMI(0.793**)	BMI(0.692**)
WHR	BF(0.484**)		BMI(0.511**)		BMI(0.551**)	sBP (0.273 **) dBP(0.253*)
sBP	dBP(0.594**), BMI (0.292**)	dBP(0.713**) sBP(0.648**)	dBP(0.648**) dBP(0.730**)			sBP(0.692**)

Statistical significance **r <0.01

Table 5. Family history of CVD and lifestyle according to gender and age differences.

	males (n=50)	females (n=50)	young (N=49)	middle (N=30)	old (N=21)
age (mean ± SD)	42.74±18	37.62±16.60	25±5.6	47.2±6.6	65.57±6.6
family history of CVD	60%	**74%**	55.1%	76.7%	**81%**
cigarette smoking p 0,044/ 0,016	**36%**	18%	**36.7%**	26.7%	4.8%
high level of stress	22%	**28%**	26.5%	20%	**28.6%**
physical inactivity	**64%**	54%	51%	**70**%	52.9%
low level of socioeconomic status	**18%**	10%	14.3%	**16.7%**	9.5%
low level of education	**18%**	14%	6.1%	13.3%	**38.1%**

DISCUSSION

In the present study, we found that the males (in comparison with the females) had higher means of BMI (25.58±3.51 kg/m^2), WHR (0.91±0.07), sBP (145±16.57 mmHg) and dBP (87.5±13.67 mmHg), higher prevalence of overweight, obesity and hypertension (50%), cigarette smoking (36%), and lower levels of physical fitness (64%) and education and socioeconomic status (18%). The highest means of BF (32.5± 3.50%) and BMI (28.95±4.98 kg/m^2) were recorded in elderly females (6% of them were morbidly obese), who had the greatest prevalence of high-risk WHR (75%) and body fat (87.5%). The highest means of WHR (0.96±0.08) and sBP (153.85 ±14.6 mmHg) were determined in elderly males. 14.3 % of the elder participants were obese and 9.5% morbidly obese and 50% of the middle-aged men showed the highest prevalence of hypertension II and 53.8% of the elderly men showed hypertension I.

Significant gender differences were found inWHR, BF, sBP ($p<0.001$), BF ($p=0.003$), BMI ($p=0.04$) and significant age differences were shown in sBP and BF ($p=0.001$), WHR and obesity ($p<0.001$) and dBP ($p=0.04$). We found the strongliest relation BMI and BF in the elderly group (r=0.793**) and relation WHR and BMI in males (r=0.551**). A significant correlation between CVD family history and high-risk BF ($p=0.006$) was determined in males and a significant correlation between cigarette smoking and high-risk BF ($p=0.04$) in females. We also detected statistically significant association of education and age ($p<0.001$), especially in females.

Sex and age differences in anthropometric parameters are important determiners of CVD risk. In the Slovak population, men (in comparison to women) have higher means of BMI (prevalence of obesity) and sBP (prevalence of hypertension) (10), which is consistent with their generally higher CVD risk (on the other hand, women tend to have relatively less risk factors than men) (11).

Particularly alarming is the systemic increase of obesity, especially among Slovak men, which may be connected to their low physical fitness, high rate of cigarette smoking and unhealthy diet. Comparisons of Slovak epidemiologic studies show an abnormal increase of obesity in men and women. But it is worth noting that all values of anthropometric indices worsen with age (12). The generally established fact, that women usually have more body fat than men (Slovak women had higher prevalence of obesity in comparison with the Slovak men in CINDI) was confirmed only in the Oravian elderly group of morbidly obese females. The highest degree of obesity among elderly women may be attributed their low education level /50% of them have only basic education/, predispositon to CVD /87.5% / and sedentary life style /35%/.

Other studies have shown an association between adiposity and sex and age in adults (13, 14). WHR was the best predictor for assessing the risk of CVD in both gender and age group ($p<0.001$) what was also

strenghthened in previous studies (15).

The prevalence of obesity was higher among males (18%) than among females (2%; noteworthy, 6% of them were morbidly obese). Surprisingly, the youngest group of men were threefold more obese (21.7%) than ten years ago (7%, 16). The CARDIA Study participants aged 25-30 have higher means of BMI than the younger participants (aged 18-24 years) (17). Interestingly, in our study, mean values of BMI among young and middle –aged generation decreased with age, which could result from the increasing prevalence and earlier onset of obesity in the younger generations. In our study, the highest correlation BF and BMI was found, which is consistent with the findings modern studies (18, 19).

The highest values of BP were measured in the southern Slovaks. 50% of the examined men were hypertensive (20). In our results, higher prevalence of hypertension I. showed women. Higher prevalence of hypertension II. was also recorded among men (in all age categories) compared to women. Moreover, middle-aged and old men have the higher prevalence of hypertension II than women. Hypertension among males (especially in middle age) may be related to higher body fat distribution and WHR (pathogenesis of obesity-related hypertension was confirmed by the Bogalusa Heart Study) and also high rates of cigarette smoking (21). Lower rate of hypertension among women may be attributed by protective estrogen (a lot of females were non-smokers). Absence of protective estrogen levels may be one cause of the hypertension I. increase.

Our result are in agreement with other worldwide studies, which have reported that anthropometric parameters are positively correlated with blood pressure (22). However, much higher prevalence of hypertension was shown in females (especially in the middle-aged and elderly), which may be related to their higher means of BMI. Mild correlation BMI and dBP (r=0.312*) BF and sBP (r=0.373**) showed the interaction between body fat and blood pressure in Oravian females, which can surely affect other CVD risk factors (increased serum lipid levels, glucose etc).

Lifestyle factors such as cigarette smoking, inactivity and a diet rich in fat are also important causes of obesity and hypertension in the Slovak population. They can affect CVD risk according to the significant gender differences in the barriers to lifestyle change (money, stress, knowledge, skills) (22).

Approximately 24% of the Slovak adult population regularly smoke (MONICA and CINDI projects examined during 2002-2003 in 15-64 aged participants, 23), which was similarly confirmed in our results. Cigarette smoking associated age (the greatest rates of smoking was among young adults 36.7%, as expected). By Jurkovičová et al. (2003), men showed a 31.7% prevalence of cigarette smoking (our examined males exhibited an approximately 4.3% higher prevalence), which was higher than in females (22.5%), (24). Although the latest Slovak studies document a higher prevalence of cigarette smoking in younger women than men), our central-Slovakian men were twice as likely to smoke than the women. It could be influenced by regional aspect (Oravian vs.general Slovak population).

Although sedentary behaviour is more apparent in Slovak women than in men (25), low energy expenditure was shown in the Oravian males than females. The prevalence of sedentary life increased with age and was independently associated with CVD risk. Being aerobically fit may reduce the negative health consequences of obesity and hypertension in youth (26).

Stress is an important contributing factor in CVD risk. Women are generally more burdened by stress than men, which was noted in the examined Oravian females (about 6% more than males). Finally, we could make a strong claim that stress is associated with high means of sBP in middle-aged, as expected (this productive age group is usually characterized by more active life).

Overnutrition play a role in unhealthy eating habits in the Slovak population which direct to overweight and obesity. Previous Slovak studies recommend changes in eating habits coupled with physical activity and general modification of unhealthy lifestyles, which are widespread, especially in urban areas.

Decreases in vegetable and fruit consumption accompanied by diets consisting of increasing animal fat and sugar characterize the Slovak population's eating habits. Another previous Slovak study reports that the nutrition status of Slovak inhabitants result in unhealthy eating habits, connected with a generally low level of leisure-time physical activity, which leads to a 25% higher energy intake and overweight (50% males, 33% females) and obesity (20% males and 20% females). Older males' have the unacceptable diets (evident in their rates of obesity and WHR) (27). Young and older women differ in diet (young women prefer healthy diets and regularly make food selections) which is strongly associated with their education ($p<0.001$). Weight gain is the greatest among less educated populations (28) Specific educative nutritional intervention could help to modify high – energy diet (especially in the youth).

The presence of anthropometric CVD risk factors and unhealthy lifestyles in the Oravian adult population can be associated with other disorders such as

dyslipidaemia, insulin resistance atherosclerosis and metabolic syndrome (researchers did not investigate biochemical factors which could not be analyzed). They can contribute to an increased risk of CVD, which is demonstrable in Slovakian adults in recent years. Slovakia is among the European Union countries with higher means of BMI (after Malta, Greece, Great Britain, Slovenia, Finland, Austria) – 25.9 kg/m^2, (29).

However, there have been no detailed studies analyzing gender and age differences in Oravians. Because of the financial resources available and time, a limitation of this study regarding the numbers of gender and age groups (relatively small) exist. This study number (n=100) is not enough to represent Oravian adults. The study sample is dealt with Oravian adults and pilot results may not be generalizable to the Central-Slovakian population. The larger number of participants could find more reliable the results in further study.

To summarize, the Orava population has relatively high prevalence of obesity associated with considering life style factors as cigarette smoking, physical inactivity and predisposition to CVD (family history). Cigarette smoking related genetic factors in the Oravian males and cigarette smoking related to education was found in the Oravian females (significant relationship between education and age was determined in the females).

Statistically significant gender and age differences in most anthropometric parameters were confirmed (however, nonsignificant sex differences in dBP). Obesity indicators (BMI, WHR) correlated with blood pressure values (BF in the females and the elder population).

Economic world crise surely influences life style (nutrition, socioeconomic level, stress) and psychological factors (anxious, depressed and stressed inhabitants) which can lead to worsen of the health conditions, decrease the health care and an increase of CVD morbidity and mortality in regions with lower level of socioeconomic state such Orava .

Non-communicable diseases can increase at alarming rates among Oravians, stressing the urgent need for intervention programs targeting CVD risk factors, especially towards high-risk individuals.

ACKNOWLEDGMENTS

The research work oganized by Katarína Strapcová-Rošťáková University Mathias Belli in Banská Bystrica (Slovakia) is gratefully acknowledged

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