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Cardiovascular and metabolic health among an indigenous circumpolar population from Siberia: The effects of economic development and lifestyle change

JJ Snodgrass[1,2], MA Liebert[1,2], WR Leonard[3], LA Tarskaia[4,5], TM Klimova[6], VI Fedorova[6], ME Baltakhinova[6], and VG Krivoshapkin[6]. [1]Department of Anthropology, University of Oregon, Eugene, OR; [2]Institute of Cognitive and Decision Sciences, University of Oregon, Eugene, OR; [3]Department of Anthropology, Northwestern University, Evanston, IL; [4]Institute for Molecular Genetics, Russian Academy of Sciences, Moscow, Russia; [5]Department of Anthropology, University of Kansas, Lawrence, KS; [6]FSRI Institute of Health, Republic of Sakha/Yakutia, Yakutsk, Russia.

INTRODUCTION

As indigenous populations transition away from traditional subsistence-oriented economies and towards more market-oriented and globalized economic systems, they typically experience an increase in chronic health conditions such as obesity, type 2 diabetes, and cardiovascular disease. The health effects of this process of economic development and lifestyle change (referred to as market integration [MI]) among indigenous Siberians is complicated by the social transformations brought about by Soviet collectivization and the more recent devastating changes brought about by the fall of the Soviet Union. Very little data exist with which to assess the current state of indigenous Siberian health and to consider the magnitude of recent health change.

Preliminary studies based on relatively small sample sizes suggest a pattern of chronic disease among Native Siberians that is distinct from that seen among other populations undergoing MI. These studies have documented extremely high blood pressure levels, yet relatively favorable blood lipid profiles and a fairly low prevalence of glucose metabolism irregularities (Snodgrass et al., 2007, 2008; Leonard et al., 2009). This chronic disease risk profile contrasts with that observed among other acculturating populations such as the Pima Indians of the southwestern United States, who show moderate to high cholesterol, extremely high rates of diabetes, yet relatively low prevalence of hypertension (Weyer et al., 2000; Leonard et al., 2009). Despite some progress on documenting the state of cardiovascular and metabolic health among indigenous Siberians and addressing the underlying genetic and social contributors, numerous questions remain such as the magnitude of recent health decline, sex differences in cardiovascular and metabolic risk factors, and the specific lifestyle (e.g., diet, alcohol consumption, chronic psychosocial stress, and physical activity) factors that shape this distinctive pattern of health change.

The present study investigates market integration and risk for chronic, noncommunicable diseases among an indigenous high-latitude herding population from northeastern Siberia in order to: 1) estimate rates of hypertension, obesity, impaired fasting glucose/diabetes, dyslipidemia, and the presence of the metabolic syndrome (MetS), and to compare these prevalence rates with those from previous studies among native Siberians to estimate the magnitude of recent health change; 2) assess risk factor patterning by age and sex; and 3) examine associations between chronic disease risk factors and lifestyle and socioeconomic factors.

METHODS

The Yakut (Sakha) are a large indigenous group (~380,000 people) concentrated in the northeastern Siberian region of the Russian Federation. Their subsistence economy traditionally was dictated largely by regional ecological conditions; in remote parts of the boreal forest (*taiga*), hunting and fishing were the dominant activities, whereas transhumant horse and cattle pastoralism was the subsistence focus in the Lena River Valley. Today, most rural Yakut populations rely on a mixture of subsistence activities (e.g., herding, fishing, and foraging), government wages and pensions, private sector salaries, and "cottage" industry profits (Snodgrass et al., 2005).

The present study was conducted during July-August, 2009 in the rural community of Berdygestiakh (62°N, 127°E; pop. 4,900), Gorny ulus, Sakha Republic/Yakutia, Russia. We collected anthropometric, metabolic, and health data among 300 adults (18 years and older; 150 males, 150 females). Participants were healthy, and pregnant or lactating women were excluded. Complete data were available for 138 males and 144 females. All data were collected in the Gorny Regional Medical Center in Berdygestiakh. The Institutional Review Board of University of Oregon approved the study protocol, and all participants provided informed consent.

These cross-sectional data were compared to cross-sectional data collected in Berdygestiakh by JJS, WRL, LAT, and VGK during 2001 and 2003 using nearly identical methods. Those data have been described elsewhere (Leonard et al., 2005; Sorensen et al., 2005; Snodgrass et al., 2006, 2007, 2008)

Anthropometric dimensions were recorded by one trained observer. Stature, body mass, and body mass index (BMI; kg/m^2) were measured using standard procedures. Sum of skinfolds (SOS) was calculated based on the sum of four skinfolds (triceps, biceps, subscapular, and suprailiac) measured with Lange calipers on participants without clothing. Skinfolds were measured by one experienced observer (LAT) and were repeated three times, with the average of the measurements used in analyses. Body fat was calculated from the sum of four skinfolds. Waist circumference (WC) was measured at its narrowest point.

Fasting glucose and serum lipids (total cholesterol, LDL & HDL cholesterol, and triglycerides) were assessed using a CardioChek PA analyzer (with PTS Panels) from venipuncture-obtained samples of whole blood. This professional glucose and lipid testing system meets standard clinical quality control guidelines for accuracy and precision. Blood pressure (systolic blood pressure [SBP] and diastolic blood pressure [DBP]; mmHg) was measured three times by a physician using a manual sphygmomanometer following a standard protocol (Chobanian et al., 2003).

Standard criteria were used to assess the presence of elevated health markers. BMI categories were used to classify individuals as normal or underweight (<25.0), overweight (25.0–29.9), or obese (30.0 and above) (WHO, 2000). Blood pressure categories were based on the following: normotensive (SBP <120 mmHg and DBP <80 mmHg); prehypertensive (SBP 120-139 mmHg and/or DBP 80-89 mmHg); and hypertensive (SBP ≥140 mmHg and/or DBP ≥90 mmHg) (Chobanian et al., 2003). We followed current American Diabetes Association guidelines for diagnostic thresholds related to fasting plasma glucose: normal (<100 mg/dL); impaired fasting glucose (IFG; 100-125 mg/dL); and diabetes (≥126 mg/dL) (Genuth et al., 2003). Lipid irregularities were based on NCEP (2001) guidelines for high total cholesterol (TC; ≥240 mg/dL) and low HDL cholesterol (<40 mg/dL).

Presence of the metabolic syndrome (MetS) was assessed following updated ATP III criteria (Grundy et al., 2005), and was based on occurrence of any three of the following five measures: elevated waist circumference (≥102 cm in men, ≥88 cm in women); elevated fasting glucose (≥100 mg/dL [or treatment]); elevated triglycerides (>150 mg/dL [or treatment]), reduced HDL cholesterol (<40 mg/dL in men, <50 mg/dL in women [or treatment]); and elevated blood pressure (≥130 mmHg SBP and/or ≥85 mmHg DBP [or treatment]).

Each participant was administered an extensive questionnaire on socioeconomic status and lifestyle; this included questions about subsistence participation, market food consumption, income, and ownership of livestock and consumer goods. Participants were also queried about their medical histories, and asked about their use of alcohol and tobacco. Preliminary statistical analyses focused on the following socioeconomic and lifestyle variables: Market foods as percent of diet (MF; 0-100%); Monthly income (in Rubles); numbers of hours per week of television (TV) viewing; and the MacArthur Scale of Subjective Social Status.

Student's t-tests (two-tailed) were used to examine sex differences in anthropometric and lifestyle measurements, while correlations (bivariate and partial) and regressions (linear and logistic) were used to assess the effects of anthropometric and lifestyle/socioeconomic variables on health measures. Comparisons were considered statistically significant at $P < 0.05$. All statistical analyses were performed using SPSS 19.0.

PRELIMINARY RESULTS

Moderate levels of obesity were documented in this study (males: 13%, females: 21%), with overweight at 36% in males and 33% in females. BMI was not significantly different in males (25.4 ± 4.4) and females (25.9 ± 4.6). WC was significantly greater in males than females (87.2 ± 11.2 cm vs. 82.7 ± 11.1 cm; $P = 0.001$).

Rates of hypertension in this study were 34% in males and 30% in females, and prehypertension at 24% in males and 26% in females. SBP (129.1 ± 25.7 mmHg in males and 125.6 ± 24.0 mmHg in females) and DBP (78.3 ± 14.8 mmHg in males and 78.9 ± 14.8 mmHg) were not significantly different between males and females.

Only two males and two females had fasting glucose levels indicative of diabetes, while 13% of males and 11% of females were classified as having IFG. Fasting glucose levels were significantly higher in men compared to women (92.3 ± 20.2 mg/dL in males and 87.8 ± 13.3 mg/dL in females ; $P < 0.05$)

Only 2% of males and 5% of females had elevated TC, while low HDL was documented in 22% of males and 7% of females. TC levels were significantly higher among women than men (185.3 ± 29.5 mg/dL vs. 177.6 ± 32.8 mg/dL; $P < 0.05$), as were HDL levels (59.8 ± 15.0 mg/dL in females and 53.1 ± 17.9 in males mg/dL; $P = 0.001$).

10% of males and 16% of females were classified as having the MetS.

Increasing age was significantly associated with poorer health markers in nearly every measure in both males and females, except glucose among females.

Correlations between preliminary lifestyle variables (MF, income, TV, and Subjective Social Status) and health variables (SBP, DBP, glucose, TC, and HDL) were adjusted for age and WC. BMI and WC were adjusted for age only. Few of the lifestyle measures were significantly associated with health measures. However, we found trend negative associations between SBP and Subjective Social Status ($P = 0.88$), and DBP and income in women but not men. We found a trend positive association between WC and Subjective Social Status ($P = 0.06$) in men but not women.

PRELIMINARY DISCUSSION POINTS

Present levels of obesity (males: 13%, females: 21%) are relatively modest but substantially higher than those documented in Berdygestiakh in the 2001/2003 sample (males 10%, females 13%; Snodgrass et al., 2006). However, these levels are considerably lower than the prevalence of obesity from the most recent US NHANES data (males: 32%, females 36%; Flegal et al., 2010).

Prevalence rates of hypertension are high, and are slightly greater than those from recent US NHANES data (29% in both males and females; Cutler et al., 2008). Compared to data collected in Berdygestiakh in 2003, hypertension levels are similar for men but considerably higher for women (males: 32%, females 12%).

Irregularities in glucose metabolism were documented in modest number in this study, with minimal presence of diabetes. It is impossible to compare these data to earlier times since no data are available from Berdygestiakh and virtually no data exist for the region with the exception of our research among traditionally-living Yakut in the subsistence herding community of Tyungyulyu (Snodgrass et al., 2010). That study showed a virtual absence of glucose irregularities when data were collected in 2007.

TC levels by age group were generally similar to an earlier study of the Yakut (based on 6 villages studied in 2001; Leonard et al., 2005). However, young males (18-34 years) in the recent study had higher TC (165 mg/dL vs. 139 mg/dL) and women from 2009 in all age groups had higher TC (Figure 3).

These findings suggest that cardiovascular and metabolic health is rapidly deteriorating among rural Yakut, particularly among women. This almost certainly results from the growing consumption of market foods, as well as the relatively low and apparently decreasing levels of physical activity (Snodgrass et al., 2006; Cepon et al., 2011) that result from fewer people at present being actively involved in the subsistence economy. These findings also highlight key differences between native Siberians and other circumpolar populations such as the Inuit of North America, which may reflect the unique social and adaptive histories of native Siberians.

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