# NUTRIENT INTAKE AND LIFESTYLE FACTORS BY DIABETES STATUS OF CIRCASSIANS AND CHECHANS IN JORDAN

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**Objectives:** Diabetes is one of the most prevalent diseases in Jordan. However, little is known about nutrient intakes of minority groups in Jordan with and without diabetes. Our study aimed to examine if the intake of energy, macronutrients and some micronutrients differed between normal and diabetic adults among Circassians and Chechans in Jordan.

**Design, Setting, Participants:** This cross-sectional study was conducted among 437 Circassians (160 males and 277 females) and 355 Chechans (119 males and 236 females) aged ≥18 years. They were recruited from the Chechan and Circassian communities living in Jordan.

**Main Outcome Measures:** A participant was defined as affected by type 2 diabetes mellitus if diagnosis was known to patient or if his or her condition complied with the American Diabetes Association definition. One 24-hour dietary recall for each participant was collected by face-to-face interview.

**Results:** Most of the measured anthropometric and biochemical parameters showed a significant difference between normal individuals and those with impaired fasting glucose or diabetes. Intakes of nutrients involved in the pathogenesis of diabetes including protein, fat and fiber did not differ between stratified participants according to blood glucose status for both Circassians and Chechans.

**Conclusions:** Intake of nutrients did not differ in participants with normal blood glucose from those who had impaired fasting glucose or diabetes in the two studied populations. These two populations may need genetic studies to identify the risk factors other than dietary and lifestyle factors for type 2 diabetes. (*Ethn Dis.* 2014;24[2]:200–206)

**Key Words:** Nutrients, Diabetes, Obesity, Circassians, Chechan

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## INTRODUCTION

Diabetes mellitus is considered a major national and international health problem.[1–3] Obesity often is associated with vascular-damage diseases such as diabetes mellitus. Epidemiological studies in different populations around the world have shown variation in the prevalence of diabetes among different ethnic groups.[4,5] Diabetes is a genetically complex disease in which genetic variants predispose individuals to develop the disease.[2] However, environmental factors play a major role in the development of the disease as the rapid rise of diabetes prevalence over the last few decades suggests.[6–9]

The majority of the populations of Jordan are of Arab descent.[10] The Chechans and the Circassians are two minority groups in Jordan; both populations are among the largest indigenous nationalities of the North Caucasus.[11–13] As a result of the Russian-Circassian War, a large group of Chechans and Circassians immigrated to Jordan 140 years ago.[14] Estimates of the Circassian and Chechan populations in Jordan vary from 20,000 to 80,000 and 12,000 to 30,000 respectively, out of a total population of 5.6 million people.[10] Both populations remain endogamous and relatively isolated in terms of culture and tradition.[11] Thus, providing an excellent opportunity to study risk factors associated with a disease in populations with limited genetic variability. A study by Dajani et al showed that the prevalence of impaired fasting glucose (IFG) among Circassians (16.7%) and Chechans (12.8%) is higher than in the Jordanian population (10.5%).[15] Unhealthy dietary pattern and lifestyle factors as well as genetic predisposition were found to play a role in developing IFG and hence type 2 diabetes.[8,9] On the other hand, diet, medications, and lifestyle changes are the most important factors in preventing diabetes and its complications.[6–9]

To the best of our knowledge, no study has been conducted to estimate nutrient intake among Jordanians or the Circassian and Chechan populations in Jordan or elsewhere. Therefore, the main objective of our study was to

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# METHODS

## Sampling and Participants

A cross-sectional survey was carried out to reach the study objective. The study participants were from the Dajani et al studies on diabetes and metabolic syndrome.[15,16] Participants in the Chechans and Circassians communities living in Jordan were invited to participate in this study; six areas with Circassian and Chechen populations were chosen. Before conducting the survey, a team visited the communities, explained the purpose of the study and invited residents aged $\geq$18 years to visit the survey site after an overnight fast.

The inclusion criteria were self-report of being either Chechan or Circassian, and 8 h of fasting prior to data collection. Participants filled a pedigree survey that included names and ethnicity of both maternal and paternal parents, grandparents, great grandparents. Any Circassian with non-Circassian heritage for even one person in his/her pedigree was excluded. The same was applied for the Chechan participants. The approval to conduct this study was granted by the Institutional Review Board committee at the Center for Diabetes, Endocrinology and Genetics in Amman, Jordan. A consent form was obtained from every subject before proceeding with data collection.

## Measurements

Blood samples withdrawn for biochemical measurements were the same ones used for Dajani et al studies.[15,16] Two sets of fasting blood samples were drawn for glucose, glycated hemoglobin (HbA1c) and lipids. A participant was defined as affected by diabetes mellitus if diagnosis was known to the patient, or if his or her condition complied with the American Diabetes Association definition of diabetes of having a fasting plasma glucose level >126 mg/dL (7.0 mmol/L) or a casual plasma glucose >200 mg/dL (11.1 mmol/L). Impaired fasting glucose was defined as a fasting serum glucose level of $\geq$100 mg/dL. Hypertriglyceridemia was defined as serum triglycerides level >150 mg/dL (1.69 mmol/L). Low HDL cholesterol was defined as serum HDL cholesterol <40 mg/dL (1.04 mmol/L) in men and <50 mg/dL (1.29 mmol/L) in women. Two readings of systolic (SBP) and diastolic blood pressure (DBP) were taken using a standardized mercury sphygmomanometer.[17] Body weight, height and waist circumference were measured according to Gibson.[18] Body mass index (BMI) was calculated for each participant by dividing the weight (kg) by the height ($m^2$).

## Questionnaires

Two research assistants (one male and one female) were trained to ensure cultural sensitivity since many prefer to interact with a research assistant of the same sex. A standard tool was used to collect data on sociodemographic background. The question about following the diabetic diet was explained by asking the participant with diabetes if he/she changed his/her diet to lower simple sugars, fat and calories. Also, they were asked if they increased their intake from vegetables, fruits and whole grains and if they distributed their carbohydrate throughout the day and on all meals. Another question was about their use of artificial sweeteners.

Nutrient intake was assessed using 24-hour recall method. A single 24-hour recall was used to estimate mean nutrient intake of the two large groups with adequate representation of all days of the week due to the difficulty of obtaining another 24-hour recall from the two isolated populations. The interviewer asked the individual to recall information on portion sizes, recipe ingredients, cooking methods, condiments, and beverages for the past 24-hour. Moreover, the sample size of a group that was required to determine their usual intake using a single 24-hour recall was calculated using the following equation[18]: $n$=Sb2/e2 where Sb2 is the between-subject variance of the nutrient of interest, and e is the desired standard of error. The calculation was repeated for each nutrient and the largest $n$ was found to be 740. Our sample size was 792.

Physical activity level was assessed using the Arabic short form of the International Physical Activity Questionnaire (IPAQ).[19] The IPAQ interview focused on collecting data on intensity, time or duration, and type of activity. It covers different levels of physical activity intensity such as walking, aerobic exercise, work-related activities, gardening, recreation, and leisure-time activities. The results were expressed as hours expended in sedentary behavior, walking and moderate and heavy activities $\pm$ standard error.[19]

## Data analyses

Data obtained from the single 24-hour recall was coded and analyzed using the ESHA Food Processor (Version 7.9, 1987–2002: Salem, OR). Foods not listed in ESHA were entered item by item after getting its components and recipe from the participant. Nutrient intakes were adjusted for energy intake using the residuals method.[20] Briefly, for each nutrient, linear regression analysis was performed with nutrient intake as the dependent variable and total energy intake as the independent variable. This regression equation was used to calculate the expected mean nutrient intake of the study population for the mean total energy intake of the study population. Next, for each participant the energy-adjusted intake was calculated by adding the expected mean nutrient intake of the study population to the residual derived from the regression analysis.

Data collected from 37 participants of Circassian and 19 of Chechans were

**Table 1. Sociodemographic and clinical characteristics of Circassians and Chechans participants**

| | Circassians (*n*=400) | | | | Chechans (*n*=336) | | | |
|---|---|---|---|---|---|---|---|---|
| | Normal (*n*=287) | IFG (*n*=74) | Diabetes (*n*=39) | *P* | Normal (*n*=255) | IFG (*n*=49) | Diabetes (*n*=32) | *P* |
| Age category, % (*n*) | | | | .001 | | | | .001 |
| 18–29 years | 86.9 (86) | 10.1 (10) | 3 (3) | | 93.5 (72) | 6.5 (5) | 0 | |
| 30–39 | 88.2 (45) | 11.8 (6) | 0 | | 88.6 (39) | 11.4 (5) | 0 | |
| 40–49 | 73.8 (79) | 22.4 (24) | 3.7 (4) | | 75.0 (51) | 13.2 (9) | 11.8 (8) | |
| 50–59 | 67.1 (51) | 17.1 (13) | 15.8 (12) | | 61.8 (42) | 22.1 (15) | 16.2 (11) | |
| >60 | 39.4 (26) | 31.8 (21) | 28.8 (19) | | 64.6 (51) | 19.0 (15) | 16.5 (13) | |
| Sex, % (*n*) | | | | .005 | | | | .055 |
| Male | 63.1 (89) | 25.5 (36) | 11.3 (16) | | 73.8 (79) | 13.1 (14) | 13.1 (14) | |
| Female | 76.4 (198) | 14.7 (38) | 8.9 (23) | | 76.9 (176) | 15.2 (35) | 7.9 (18) | |
| Marital status, % (*n*) | | | | .086 | | | | .691 |
| Married | 68.8 (216) | 19.7 (62) | 11.5 (36) | | 72.5 (192) | 15.8 (42) | 11.7 (31) | |
| Single | 82.6 (71) | 14.0 (12) | 3.5 (3) | | 88.6 (62) | 10.1 (7) | 1.3 (1) | |
| Years of education, % (*n*) | | | | .019 | | | | .07 |
| ≤12 | 66.2 (129) | 20.5 (40) | 13.3 (26) | | 73.8 (151) | 15.0 (31) | 11.2 (23) | |
| >12 | 77.1 (155) | 16.9 (34) | 6.0 (12) | | 80.8 (101) | 12.8 (16) | 6.4 (8) | |
| Smoking, % (*n*) | | | | .048 | | | | .001 |
| Past | 64.5 (38) | 18.6 (11) | 16.9 (10) | | 67.3 (35) | 15.4 (8) | 17.3 (9) | |
| Current | 64.3 (63) | 25.5 (25) | 10.2 (10) | | 87.3 (55) | 7.9 (5) | 4.8 (3) | |
| No | 76.4 (185) | 15.7 (38) | 7.9 (19) | | 74.7 (165) | 16.3 (36) | 9.0 (20) | |
| Employment status, % (*n*) | | | | .017 | | | | .001 |
| Employed | 75.8 (135) | 19.1 (34) | 5.1 (9) | | 84.3 (97) | 9.6 (11) | 6.1 (7) | |
| Not employed | 68.8 (152) | 17.6 (39) | 13.6 (30) | | 71.6 (156) | 17.4 (38) | 7.2 (24) | |
| Following diabetic diet among those with type 2 diabetes, % (*n*) | 0 | 0 | 77.3 (30) | | 0 | 0 | 68.2 (21) | |
| High triglyceride level, % (*n*) | 35.7 (102) | 58.1 (43) | 79.5 (31) | .002 | 36.9 (94) | 69.4 (34) | 75.0 (24) | .001 |
| Low HDL-cholesterol, % (*n*) | 43.4 (125) | 59.5 (44) | 71.8 (28) | .047 | 62.4 (159) | 79.6 (39) | 84.4 (27) | .001 |
| Time, mean ± SE, spent in (hour/day): | | | | | | | | |
| Inactivity and resting | 3.4 ± .16 | 3.7 ± .31 | 3.5 ± .46 | .746 | 3.3 ± .17 | 3.89 ± .39 | 3.4 ± .47 | .413 |
| Walking | .98 ± .08 | .99 ± .16 | 1.64 ± .22 | .975 | .81 ± .09 | .76 ± .20 | .83 ± .24 | .971 |
| Moderate activity | 2.1 ± .15 | 2.3 ± .29 | 1.86 ± .20 | .601 | 2.2 ± .16 | 2.14 ± .36 | 1.6 ± .45 | .445 |
| Heavy activity | .38 ± .1 | .53 ± .15 | .63 ± .20 | .188 | .51 ± .10 | .71 ± .18 | .66 ± .22 | .766 |

excluded because either of incomplete questionnaires, overestimation (more than 5000 kcal) or underestimation (less than 600 kcal) of total energy intake obtained by the 24-hour recall.

Statistical analysis was conducted using the Statistical Package for Social Sciences (SPSS version 16). Data were described using mean and standard error for continuous variables and proportions for categorical variables. Chi-square test was used to compare proportions. MANCOVA tests were used to assess the difference between the two groups after stratifying them according to blood glucose status. The difference in anthropometric, biochemical and dietary data for the stratified groups was measured using MANCOVA after controlling for energy, age, sex, and BMI. A $P<.05$ was considered statistically significant.

## RESULTS

Table 1 illustrates the sociodemographic and clinical characteristics of Circassians and Chechans while controlling for age and sex. A significant increase ($P<.001$) in the number of participants suffering from diabetes with aging was detected in both groups. Regarding sex, a significant difference between males and females was seen in Circassians with higher prevalence of IFG and diabetes in males. Significant differences in smoking and employment status were detected in the Circassian and Chechan normal participants compared to those having IFG and/or diabetes, after controlling for age and sex. No significant differences were detected in age groups, sex, marital status or any other sociodemographic parameter across the two populations (not shown in tables). A significant difference was seen in the prevalence of low HDL and high triglyceride in both groups. Prevalence of low HDL was 84.4% for diabetic Chechans and 71.8% for Circassians. The prevalence of high triglyceride was significant in both groups as adjusted for age and sex; 79.5% for diabetic Circassians and 75.0% for diabetic Chechans. Regarding the time spent in physical activity, no significant difference could be detected in either group between normal participants and those who had IFG or diabetes.

**Table 2. Anthropometric measurements and biochemical parameters of Circassians and Chechans participants with and without diabetes**

| Parameter | Diabetes Status | Circassians (*n*=400) Mean ± SE | Chechans (*n*=336) Mean ± SE |
|---|---|---|---|
| BMI[b] | Normal | 27.9 ± .31 | 27.18 ± .42 |
| | IFG | 28.7 ± .59 | 29.7 ± .96 |
| | Diabetic | 31.3 ± .86 | 28.9 ± .88 |
| Weight, kg [b] | Normal | 78.4 ± .87 | 77.2 ± .91 |
| | IFG | 78.0 ± 1.6 | 78.2 ± 1.9 |
| | Diabetic | 83.5 ± 2.4 | 77.6 ± 2.4 |
| WC, cm [b] | Normal | 88.5 ± .83 | 88.8 ± 1.08 |
| | IFG | 89.2 ± 1.41 | 92.5 ± 3.2 |
| | Diabetic | 92.9 ± 1.98 | 93.0 ± 4.4 |
| Triglyceride, mg/dL[b] | Normal | 136.3 ± 5.3 | 140.5 ± 5.9 |
| | IFG | 169.1 ± 10.1 | 187.1 ± 12.7 |
| | Diabetic | 201.4 ± 14.3 | 162.9 ± 15.8 |
| LDL, mg/dL[a, b] | Normal | 125.3 ± 2.0 | 108.5 ± 2.5 |
| | IFG | 121.4 ± 3.6 | 116.3 ± 5.9 |
| | Diabetic | 120.9 ± 5.8 | 92.5 ± 6.1 |
| HDL, mg/dL[a, b] | Normal | 52.1 ± .72 | 45.1 ± .85 |
| | IFG | 47.5 ± 1.35 | 43.0 ± 4.8 |
| | Diabetic | 47.0 ± 1.60 | 40.7 ± 2.6 |
| Cholesterol, mg/dL | Normal | 195.8 ± 2.3 | 190.8 ± 2.5 |
| | IFG | 191.2 ± 4.1 | 197.8 ± 5.8 |
| | Diabetic | 192.9 ± 6.9 | 181.7 ± 7.3 |
| HbA1c, %[a, b] | Normal | 5.3 ± .02 | 5.4 ± .04 |
| | IFG | 5.5 ± .09 | 5.7 ± .11 |
| | Diabetic | 7.1 ± .12 | 7.4 ± .14 |
| FBG, mg/dL[a, b] | Normal | 87.1 ± 1.3 | 82.1 ± 1.3 |
| | IFG | 108.1 ± 2.6 | 108.5 ± 3.1 |
| | Diabetic | 162.5 ± 9.8 | 140.6 ± 3.9 |
| DBP, mm Hg[a] | Normal | 79.1 ± .76 | 76.7 ± .78 |
| | IFG | 81.2 ± 1.5 | 79.3 ± 1.8 |
| | Diabetic | 83.6 ± 2.3 | 77.0 ± 2.2 |
| SBP, mm Hg[b] | Normal | 122.1 ± 1.1 | 120.0 ± 1.2 |
| | IFG | 126.7 ± 2.4 | 122.9 ± 2.7 |
| | Diabetic | 130.8 ± 3.2 | 128.2 ± 3.2 |

IFG, Impaired Fasting Glucose; BMI, body mass index; WC, Waist circumference; LDL, low-density lipoprotein; HDL, high-density lipoprotein; HbA1c, glycated hemoglobin; FBG, fasting blood glucose; DBP, diastolic blood pressure; SBP, systolic blood pressure.

[a] Indicates significance in parameters between the two populations.

[b] Indicates the difference between having diabetes categories while controlling for age, sex, and BMI, $P < .05$.

Table 2 shows that participants with IFG or diabetes (in both populations) had a significant higher body weight, waist circumference, and abnormal triglyceride, HDL, LDL, HbA1c, FBG, and SBP values than participants with normal blood glucose levels in both populations.

Table 3 shows the estimated intake of macro- and selected micronutrients adjusted for energy intake and stratified by blood glucose status of the participants. After controlling for age, sex, and BMI the energy-adjusted nutrients intakes in both Circassians and Chechans do not show any significant difference between groups stratified by blood glucose status.

## DISCUSSION

Our study describes nutrient intake among normal and diabetic individuals from genetically isolated, Circassian and Chechan populations in Jordan. In this study, the estimated dietary intakes of the participants with different blood glucose status show that the energy intake from fat was about 32% and 36% in Circassians and Chechans, respectively. This fat percentage is within the recommendation of American Diabetes Association.[21] However, estimated fiber intake was low in all stratified groups. No significant difference was detected in any macro- or micro- nutrient intake between normal, IFG or diabetic Circassians or Chechens. The results of energy intakes of Circassians, revealed a higher calorie intake among Circassians with IFG as compared to normal and diabetics while the lowest value for the calorie intake could be seen in IFG Chechans. In spite of insignificant difference in fat and fat related nutrients between normal, IFG, and diabetic participants, the triglyceride and HDL values for Circassians and Chechans were progressively worse going from IFG to diabetes. Moreover, physical activity was the same among the different subgroups of glucose status. Hence, factors other than dietary factors may be the predominant cause for diabetes in Circassians and Chechans. Nevertheless, other studies on different ethnic groups have shown that environmental factors have an independent effect on hyperglycemia. Anderson et al, in a cross-sectional study, assessed the relationship between dietary factors and blood glucose status among three populations of African origin aged 24–74 years from Cameroon, Jamaica and Manchester, UK, and found that increasing protein and total fat intakes increased

*The results of our study also showed a significant increase in IFG and diabetes prevalence as the participants reached aged 40 to 60 years in both groups with a higher prevalence of IFG*

**Table 3. Change to estimated nutrient intakes of Circassians and Chechans stratified by having diabetes, adjusted for energy and age, sex, and BMI**

| Nutrient | Diabetes | Circassians (*n*=400) Mean ± SE | Circassians (*n*=400) $P^a$ | Chechans (*n*=336) Mean ± SE | Chechans (*n*=336) $P^a$ |
|---|---|---|---|---|---|
| Calorie, kcal | Normal | 1841.5 ± 38.3 | .059 | 1557.8 ± 38.5 | .559 |
| | IFG | 1952.5 ± 88.3 | | 1486.9 ± 79.5 | |
| | Diabetic | 1641.2 ± 81.8 | | 1635.8 ± 121.2 | |
| | Total | 1842.5 ± 33.1 | | 1568.0 ± 32.8 | |
| Protein, gm | Normal | 83.5 ± 2.5 | .360 | 77.0 ± 1.3 | .488 |
| | IFG | 79.6 ± 2.8 | | 78.7 ± 2.7 | |
| | Diabetic | 84.8 ± 3.3 | | 73.8 ± 3.7 | |
| | Total | 84.2 ± 2.0 | | 77.5 ± 1.1 | |
| Carbohydrate, gm | Normal | 212.5 ± 2.8 | .329 | 215.5 ± 3.3 | .490 |
| | IFG | 223.3 ± 7.9 | | 226.9 ± 13.7 | |
| | Diabetic | 209.5 ± 6.1 | | 210.1 ± 9.9 | |
| | Total | 214.3 ± 2.6 | | 216.4 ± 3.3 | |
| Fat, gm | Normal | 44.6 ± 1.3 | .795 | 45.9 ± 1.3 | .720 |
| | IFG | 44.5 ± 2.8 | | 45.4 ± 2.9 | |
| | Diabetic | 42.4 ± 3.1 | | 49.9 ± 5.2 | |
| | Total | 43.9 ± 1.1 | | 46.2 ± 1.2 | |
| Monounsaturated fatty acids, gm | Normal | 10.5 ± .77 | .951 | 12.4 ± 1.0 | .777 |
| | IFG | 10.8 ± 1.60 | | 13.5 ± 2.1 | |
| | Diabetic | 11.7 ± 2.01 | | 15.0 ± 4.7 | |
| | Total | 10.7 ± .7 | | 12.9 ± .9 | |
| Saturated fatty acids, gm | Normal | 11.0 ± .60 | .911 | 10.4 ± .41 | .744 |
| | IFG | 10.8 ± 1.2 | | 9.8 ± .82 | |
| | Diabetic | 10.2 ± 1.0 | | 8.6 ± 1.2 | |
| | Total | 11.1 ± .4 | | 10.1 ± .4 | |
| Polyunsaturated fatty acids, gm | Normal | 5.0 ± .49 | .306 | 4.2 ± .41 | .754 |
| | IFG | 5.3 ± 1.7 | | 3.0 ± .74 | |
| | Diabetic | 2.5 ± .7 | | 2.8 ± .96 | |
| | Total | 4.8 ± .5 | | 4.0 ± .3 | |
| Cholesterol, mg | Normal | 183.2 ± 9.8 | .348 | 166.2 ± 9.4 | .916 |
| | IFG | 155.8 ± 19.1 | | 160.6 ± 18.6 | |
| | Diabetic | 194.9 ± 26.9 | | 147.2 ± 27.4 | |
| | Total | 183.4 ± 8.3 | | 159.8 ± 8.1 | |
| Fiber, gm | Normal | 12.7 ± 1.3 | .870 | 10.8 ± .42 | .054 |
| | IFG | 12.4 ± 1.2 | | 12.0 ± 1.2 | |
| | Diabetic | 12.7 ± 1.1 | | 13.7 ± 1.6 | |
| | Total | 13.0 ± 1.0 | | 11.2 ± .4 | |
| Vitamin B12, μg | Normal | 3.2 ± .66 | .402 | 2.9 ± .43 | .610 |
| | IFG | 2.0 ± 0.22 | | 2.2 ± 0.27 | |
| | Diabetic | 4.2 ± 1.89 | | 1.6 ± 0.37 | |
| | Total | 2.8 ± .5 | | 2.7 ± .3 | |
| Vitamin C, mg | Normal | 55.1 ± 4.4 | .740 | 50.7 ± 3.6 | .151 |
| | IFG | 51.0 ± 7.3 | | 67.6 ± 12.1 | |
| | Diabetic | 49.1 ± 6.5 | | 52.8 ± 8.8 | |
| | Total | 53.4 ± 3.5 | | 55.6 ± 3.4 | |
| Folic acid, μg | Normal | 269.3 ± 10.5 | .704 | 244.3 ± 10.3 | .755 |
| | IFG | 289.4 ± 20.6 | | 249.6 ± 20.0 | |
| | Diabetic | 273.3 ± 23.1 | | 244.5 ± 31.3 | |
| | Total | 267.6 ± 8.7 | | 249.7 ± 8.8 | |
| Iron, mg | Normal | 11.8 ± .4 | .099 | 11.8 ± .36 | .130 |
| | IFG | 14.2 ± .9 | | 12.5 ± .87 | |
| | Diabetic | 14.1 ± 1.2 | | 13.7 ± 1.8 | |
| | Total | 12.4 ± .4 | | 12.3 ± .4 | |
| Selenium, μg | Normal | 67.3 ± 3.7 | .356 | 53.9 ± 2.5 | .293 |
| | IFG | 63.2 ± 5.5 | | 54.7 ± 5.0 | |
| | Diabetic | 73.7 ± 6.6 | | 39.6 ± 6.1 | |
| | Total | 65.9 ± 2.9 | | 53.12 ± 2.2 | |

**Table 3. Continued**

| Nutrient | Diabetes | Circassians (*n*=400) Mean ± SE | Circassians (*n*=400) $P^a$ | Chechans (*n*=336) Mean ± SE | Chechans (*n*=336) $P^a$ |
|---|---|---|---|---|---|
| Zinc, mg | Normal | 6.2 ± .25 | .694 | 6.1 ± .24 | .224 |
| | IFG | 6.4 ± .48 | | 5.9 ± .51 | |
| | Diabetic | 6.9 ± .64 | | 4.6 ± .57 | |
| | Total | 6.4 ± .2 | | 6.1 ± .2 | |

[a] $P<.05$ indicates significance in parameters between the two populations and the significance in stratified parameters according to diabetes status within the same population.

the risk of developing type 2 diabetes among all the studied populations.[22]

Similarly, Wang et al reported that high levels of protein intake were associated with increased odds of diabetes in a sample of South Asian Indians, aged 45–79 years, living in the San Francisco Bay area.[23] Therefore, ours is the first study to identify a genetically isolated population for whom dietary factors seem not to play a major role in the development of diabetes. However, given the nature of the design of our study that does not allow testing for causal effects, the relationship between dietary factors and pathogenesis of diabetes among Circassians and Chechans should be examined using a prospective design.

The results of our study also showed a significant increase in IFG and diabetes prevalence as the participants reached aged 40 to 60 years in both groups with a higher prevalence of IFG; these results are in agreement with Wild et al.[2] They found that in developing countries, the majority of people with diabetes are in the 45- to 64-year age range while, the majority of people with diabetes in developed countries are >64 years of age.[2] Higher educational level could be considered as a significant factor for preventing diabetes as shown in both populations. Results of our study demonstrated that participants with higher educational level had lower prevalence of diabetes. Regarding the other clinical data, low HDL was highly prevalent in normal as well as in diabetic Chechens. A trend of escalation in high triglycerides in both groups was detected as we compared normal participants to those with IFG and diabetes. A low level of HDL and a high level of triglycerides increases the risk of developing cardiovascular diseases.[24] Thus, among the studied population raising HDL-cholesterol, might serve as an important strategy for reducing cardiovascular risk. Moreover, future studies should be directed toward examining the causes of low HDL levels among the Circassian and Chechan populations. Dajani et al have reported a higher prevalence of metabolic syndrome in the Circassian and Chechan populations as compared to the Jordan population.[15,16] The difference between Jordanians and the two groups of our study could be attributed to the culture/ethnicity of these populations, which may play a role in the predisposition to diabetes onset since all populations share similar environmental factors.

The findings of our study also showed that participants with IFG or diabetes (in both populations) had a significant higher BMI, body weight, waist circumference, triglyceride, cholesterol, HbA1c, DBP, and SBP than those with normal blood glucose levels. The DCCT Research Group found a positive correlation between glycemic control and triglyceride, LDL, cholesterol concentrations with higher HbA1c level independent of BMI, sex, duration of diabetes and age at diagnosis for both types of diabetes.[25] Petitti et al found significant trends of higher levels of triglyceride, LDL, cholesterol with higher HbA1c concentration in both types of diabetes.[26] Also, they illustrated that the levels of HDL were lower in their type 2 diabetes patients (mean difference −11.9mg/dL as compared with normal participant).[26] Gaining metabolic control in patients with IFG and diabetes mellitus is crucial in pulling back anthropometric, lipid, and blood pressure values to desired levels in order to attenuate risk factors for cardiovascular diseases.

There are a number of limitations of our study. The study was cross-sectional in nature and hence cause-effect relationships cannot be illustrated. Twenty-four hour recall was taken only one time, however, a single 24-hour recall can be used to estimate mean nutrient intake of a group if a large number of participants is recruited. We overcame this limitation by increasing the sample size to 792 participants from both groups.

In conclusion, nutrient intakes reported here did not differ between those with normal blood glucose, IFG, or diabetes in the two studied populations, Circassians and Chechans. In particular, the intakes of protein, carbohydrate and fat of total calories are within recommended amounts for the general population. Hence, dietary factors may have little impact on diabetes progression in these populations. In the future, genetically studying these two populations could support previous studies that indicate genetic factors playing a role in deterioration of lipid profile and elevation in blood pressure seen in progression to diabetes even while consuming recommended amounts of nutrients.

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