**Title:** **Risk Factors of CVD in Different Ethnic Groups in Kyrgyzstan**

**Hossain Syed Azfar, Kenesh Dzhusupov, Hans Orru, Inga Villa, Kati Orru**

**Corresponding author**: Hossain Syed Azfar, [hossainsyedazfar@icloud.com](mailto:hossainsyedazfar@icloud.com)

https://orcid.org/0000-0003-4235-7211

**Data availability statement**

All relevant data are contained within the manuscript and its supplementary information files

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**Conflict of interest disclosure**

The authors have declared no conflict of interest

**Ethics statement**

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and was approved by the Research Ethics Committee of the International Higher School of Medicine (Approval Number: Ref N10, 28.06.2017). Prior to data collection, written informed consent was obtained from all participants. Participants were fully informed about the purpose of the study, the procedures involved, and any potential risks or benefits associated with their participation. Confidentiality and anonymity of the participants were maintained throughout the study. Personal identifiers were removed or anonymized to ensure that individuals could not be identified in any reports or publications resulting from this research.

**Study participant consent statement**

Informed consent was obtained from all individual participants included in the study. Participants were provided with detailed information about the purpose, procedures, risks, and benefits of the study, and they were given the opportunity to ask questions. Written consent was obtained prior to participation. All data collected were kept confidential and used solely for the purposes of this research.

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**Clinical trial registration**

No clinical trial was conducted in the study.

We, the authors, hereby affirm that this manuscript, titled **Risk Factors of CVD in Different Ethnic Groups in Kyrgyzstan**, adheres to the highest ethical standards as outlined by the Journal of Public Health Challenges. We declare that:

1. **Authorship**: All authors have significantly contributed to the research and preparation of this manuscript and have approved the final version submitted for publication. No individuals who do not meet the criteria for authorship have been included as authors.
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5. **Ethical Approval**: The research involving human participants and/or animals has been conducted following the ethical standards of the institution and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Ethical approval from the relevant institutions has been obtained, and informed consent has been secured from all participants.
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By submitting this manuscript, we agree to abide by the journal's policies on publication ethics and integrity. We appreciate the journal’s commitment to maintaining the highest standards of scholarly integrity and are dedicated to upholding these standards.

Sincerely,

**Hossain Syed Azfar**, Department of Introduction to Internal Medicine and Family Medicine,International Higher School of Medicine, Bishkek, Kyrgyzstan. Email: [hossainsyedazfar@icloud.com](mailto:hossainsyedazfar@icloud.com), ORCID: <https://orcid.org/0000-0003-4235-7211>

Kenesh Dzhusupov, Departement of Public Health, International Higher School of Medicine, Bishkek, Kyrgyzstan. Email: [k.dzhusupov@ism.edu.kg](mailto:k.dzhusupov@ism.edu.kg), ORCID: <https://orcid.org/0000-0002-2213-1373>

**Hans Orru,** Institute of Family Medicine and Public Health, University of Tartu, Taru, Estonia. Email: [hans.orru@ut.ee](mailto:hans.orru@ut.ee), ORCID: <https://orcid.org/0000-0002-7965-9451>

**Inga Villa,** Institute of Family Medicine and Public Health, University of Tartu, Taru, Estonia. Email: [inga.villa@ut.ee](mailto:inga.villa@ut.ee), ORCID: <https://orcid.org/0000-0003-0616-9870>

**Kati Orru,** Institute of Social Studies, University of Tartu, Tartu, Estonia. Email: [kati.orru@ut.ee](mailto:kati.orru@ut.ee), ORCID: <https://orcid.org/0000-0002-4000-4087>

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**Abstract**

*Introduction.* Cardiovascular disease (CVD) is the leading cause of mortality in Kyrgyzstan. The study aimed at exploring the CVD prevalence depending on various risk factors across diverse ethnic groups in Kyrgyzstan

*Materials and Methods*.A cross-sectional study was carried out among six ethnic groups in Kyrgyzstan, aged 18 years and above. The sample was stratified for age, education, family status, and income. We used a questionnaire with 47 questions to explore the health status, behaviour and lifestyle determinants and prevalence of CVD. We used Chi-Square Test to investigate differences between groups, and ANCOVA to determine differences between mean scores on analysed variable. Logistic regression was used to analyse the relationship between independent and dependent variables. Confounding variables were only included if they correlated with both the independent and dependent variables. Interaction analyses were conducted with logistic regression to investigate if there were any differences between the nationalities in the relationships between the independent and dependent variables.

*Results*. Our study confirmed that the CVD prevalence across diverse ethnic groups can be significantly different: In Kyrgyzstan, the most disadvantaged group in this context were East European and the least – Western Asian. There was no difference between studied groups found in the ethnicity-stratified prevalence of such CVD risk factors as low fruit and vegetable consumption, alcohol intake, smoking, and BMI. There was no statistically significant association between educational attainment and CVD risk markers within the studied ethnic groups. The analysis of ethnicity-stratified prevalence of CVD risk markers resulted in a significant difference in physical activity across ethnicity groups.

*Conclusion*. The study results provided an understanding of the ethnicity-stratified prevalence of CVD risk markers in the population in Kyrgyzstan. They could serve as instrumental in tailoring targeted public health interventions to address the burden of CVDs in specific subpopulations.

**Keywords**: CVD, ethnic group, lifestyle, alcohol, BMI, Kyrgyzstan

**Introduction**

Cardiovascular diseases (CVDs) are the leading cause of death, responsible for 17.9 million or 32% of global deaths in 2019 [1]. Among 51 European and Central Asian countries (WHO European Region), Kyrgyzstan has the 3rd highest CVD mortality rate among women and 5th among men [2]. In Kyrgyzstan, more than 19,000 people die each year due to CVD. Mortality rate from CVD accounted for 50.8% of all deaths in the country in 2013 [3]. In the WHO European region, Kyrgyzstan had the highest coronary heart disease (CHD) mortality rate in 2013 and was the only country with an increased CHD mortality rate [4]. Nevertheless, from 2009 to 2019, there was almost a 5% decrease in the total mortality rate due to ischemic heart disease and more than 13% due to stroke [5]. However, the absence of specialists and portable tools in rural Kyrgyzstan might lead to underreporting in CVD prevalence in the country [6].

Numerous studies have shown the relationships between ethnicity/race and various modifiable CVD risk-factors [7, 8, 9]. There are only a few studies on differences in the CVD prevalence between Kyrgyz and Russian patients in Kyrgyzstan with little information on risk factors [10, 11, 12]. Considering the value of knowledge of social determinants of health, particularly ethnicity and behavioral risk-factors for further research, policy, and the development of public health and social measures in the prevention of CVDs among the multinational population of Kyrgyzstan, there is a need to explore various determinants of CVDs in different ethnic groups of Kyrgyzstan as a country with one of the highest CVD prevalence worldwide.

**The present study is aimed** **at** the examination of the main risk factors of CVD, such as dietary habits, physical activity, alcohol use, and smoking among different ethnic groups in Kyrgyzstan.

**Participants and Methods**

**The Study Site**

Kyrgyzstan is located in Central Asia with a population of 6.75 million [13], making it an interesting case study area for analysis of CVD due to its past societal developments and the current mixture of ethnic and cultural groups. Communist rule ended in 1991, and independent Kyrgyzstan has improved in regulatory system and progressed with market reforms. However, the Gini coefficient for Kyrgyzstan was 29 in 2019, indicating relatively well-distributed income or consumption expenditure among individuals or households (World Bank 2020). Ethnic groups in the country include 74.1% Kyrgyzs, 14.8% Uzbeks, 5.0% Russians, 1.1% Dungans, 0.9% Uyghurs, 0.9% Tajiks, 0.7% Turks, 0.6% Kazakhs, 0.4% Tatars, 0.3% Azeris, 0.3% Koreans, 0.1% Ukrainians, 0.1% Germans, and 0.7% others [13].

**Data Collection**

A sample of 694 individuals aged 18 to 60 years and older participated at polyclinics (Centres of Family Medicine) and health care centers in a study called “The health status of ethnic minorities in Kyrgyzstan.” We used a questionnaire with 47 questions to explore the health status, behavior, lifestyle determinants, and prevalence of CVD. Respondents could ask for assistance or explanations from the study leader. Kyrgyz people were taken as a controlled group compared with other ethnic groups. Due to their religious background and geographical origins, we grouped the ethnic groups as follows: (1) East Europeans: Russian, Byelorussian, and Ukrainian; (2) Other Central Asians: Uzbek, Kazakh, Tatar, and Uyghur; (3) East Asians: Korean and Dungan; (4) Western Asians: Georgian, Armenian, Turk, and Azerbaijani; and (5) Other minorities: Dungan, Uyghur. Collected information included age, gender, education level, nationality, family status, income, dietary habits (fruits, vegetables, alcohol), physical activity, smoking, and BMI. The sample was stratified for age, education, family status, and income.

**Questions and Questionnaire Instruments**

The frequency of consumption was given per day, per week, and per month, depending on the food item and drinking. Portion sizes were units such as glasses and cups, and the portion sizes of the different food items were converted based on standard portions. We also included questions about weight, height, physical activity, and smoking habits. The specific questions are described as follows:

Dietary habits were measured by two questions: A) “How often do you eat fruits or berries?” B) “How often do you eat vegetables and salads (except vegetable juices and potatoes)?”

Alcohol consumption was measured with: A) “How often do you drink alcohol?” B) “How many glasses of alcohol do you drink on a typical occasion? One ‘glass’ means 50cl light beer, 33cl strong beer, 1 glass of red or white wine, 1 small glass of strong wine, or 4cl spirit (vodka, whiskey).”

We regrouped the variable: Alcohol consumption: Males who consume at least 2–4 times a month at least 5–6 glasses of alcohol as a risk group; all other less frequent male drinkers as referents. Females who consume at least 2–4 times a month at least 3–4 glasses of alcohol as the risk group; all other less frequent female drinkers as referents.

The question of smoking was: “Do you smoke?” We regrouped the responses: from 1 to 3 as (2) – risk group; 4 as (1) – referents.

Questions on physical activity included: A) “During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling? Days per week” B) “How much time did you usually spend doing vigorous physical activities on one of those days? Hours per day, minutes per day, don’t know/Not sure”. Responses were converted to minutes per week. C) “During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking; days per week” D) “How much time did you usually spend doing moderate physical activities on one of those days? Hours per day, minutes per day? Do not know/Not sure”. Responses were converted to minutes per week. E) “During the last 7 days, on how many days did you walk for at least 10 minutes at a time? Days per week” F) “During the last 7 days, how much time did you spend sitting on a weekday? Hours per day, minutes per day”. Responses were converted to minutes per week.

To calculate total physical activity, the minutes of vigorous physical activity were doubled to equal the minutes of moderate physical activity. Thereafter, the minutes of vigorous and moderate physical activity, as well as walking, were summarized. Individuals with 150 or more minutes of moderate physical activity per week were grouped as (1) – referents; and individuals with less physical activity as (2) – risk group.

Individuals were regrouped according to their body mass index (BMI) as follows: BMI < 25 as (1) – referents; BMI ≥ 25 kg/m² as (2) – risk group.

**Statistical Analysis**

We used Chi-Square Test to investigate differences between groups and ANCOVA to determine whether there were significant differences between mean scores on analyzed variables. Logistic regression was used to analyze the relationship between independent variables (nationality, education, family status, income, dietary habits, physical activity, alcohol use, and smoking) and the dependent variable (CVD). Confounding variables were included if they correlated with both the independent and dependent variables. Interaction analyses were conducted with logistic regression to investigate if there were differences between the nationalities in the relationships between the independent and dependent variables.

**Ethical Concerns**

Ethical approval was received from the Research Ethics Committee of the International School of Medicine Kyrgyzstan (Ref #10 28/06/2017). All study participants gave written informed consent in accordance with the Declaration of Helsinki.

**Results**

Prevalence of CVDs in different socio-demographic groups is presented in Table 1.

**Table 1.** Prevalence of cardiovascular disease in different socio-demographic groups (%), difference between groups

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Factor risks** | **CVD, %(n)** | **No CVD, % (n)** | **Chi Square** | **P= value** |
| **Gender** |  |  | 28.26 | 0.000 |
| Male | 22.8(69) | 77.2(233) |  |  |
| Female | 42.1(165) | 57.9(227) |  |  |
| **Age** |  |  | 373.37 | 0.000 |
| 18-29 | 1.7(3) | 98.3(170) |  |  |
| 30-39 | 4.7(8) | 95.3(161) |  |  |
| 40-49 | 30.0(36) | 70.0(84) |  |  |
| 50-59 | 76.7(92) | 23.3(28) |  |  |
| ≥60 | 84.8(95) | 15.2(17) |  |  |
| **Education** |  |  | 8.372 | 0.039 |
| Primary School | 0.9 (2) | 0 (0) |  |  |
| Secondary School | 3.7 (8) | 8.6(11) |  |  |
| High school(vocational) | 49.1 (106) | 57.0 (73) |  |  |
| University degree | 46.3 (100) | 34.4 (44) |  |  |
| **Family status** |  |  | 0.37 | 0.847 |
| Single | 33.3(104) | 66.7(208) |  |  |
| Married or co-habiting | 34.0(130) | 66.0(252) |  |  |
| **Nationality** |  |  | 17.29 | 0.004 |
| Kyrgyz | 30.9(67) | 69.1(150) |  |  |
| East European | 42.7(102) | 57.3(137) |  |  |
| Central Asian | 26.3(30) | 73.7(84) |  |  |
| East Asian: | 34.2(13) | 65.8(25) |  |  |
| Western Asian: | 39.1(9) | 60.9(14) |  |  |
| Other minorities: | 20.6(13) | 79.4(50) |  |  |
| **Income (KGS, Kyrgyz soms)** |  |  | 27.8 | 0.000 |
| ≤ 8000 | 57.6(83) | 42.4(61) |  |  |
| 8001 to 16000 | 38.7(53) | 61.3(84) |  |  |
| 16100 to 30000 | 31.8(35) | 68.2(75) |  |  |
| ≥30001 | 26.3(21) | 73.8(59) |  |  |

There is significant evidence of different CVD prevalence in gender groups (Chi-square=28.26, p<0.000), with higher prevalence among males. There is also a significant difference in CVD prevalence among different age groups (Chi-square=373.37, p<0.000). Among individuals with CVD, 13% are 18-29 years old, 34% are 30-39 years old, 15.4% are 40-49 years old, 39.3% are 50-59 years old, and 40.6% are 60 years old and above. There is no significant difference in CVD prevalence based on education level. Among individuals with CVD, 4.7% have primary or secondary education, 51.1% have high school or vocational school diploma, and 44.2% have a university degree. There is no significant difference in CVD prevalence among single and co-habiting individuals (Chi-square=0.37, p=0.847).

There is a significant difference in CVD prevalence among different ethnicity groups (Chi-square=17.29, p<0.004). Among individuals with CVD, 28.6% are Kyrgyz; 43.6% - East European; 12.8% - of Central Asian origin; 5.6% - East Asians; 3.8% - Western Asians; and 5.6% are other minorities.

There is a notable difference in CVD prevalence between income groups (Chi-square=27.8, p<0.000). CVD appears among 43.2% of individuals who earn ≤ 8000 KGS; 27.6% among individuals who earn between 8001-16000 KGS; 18.2% among individuals who earn 16001-30000 KGS; and 10.9% among individuals who earn ≥ 30001 KGS.

Prevalence of CVD in different lifestyle groups is given in Table 2.

**Table 2.** Prevalence of cardiovascular disease in different **lifestyle** groups (%), difference between groups.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Factor risks** | **CVD, n (%)** | **No CVD, n (%)** | **Chi Square** | **p value** |
| **Fruits** |  |  | 0.04 | 0.828 |
| Referents | 35.9 (84) | 36.7 (169) |  |  |
| Fruit Intake Deficit Group | 64.1 (150) | 63.3 (291) |  |  |
| **Vegetables** |  |  | 0.24 | 0.621 |
| Referents | 34.6 (81) | 36.5 (168) |  |  |
| Vegetable Intake Deficit Group | 65.4 (153) | 63.5 (292) |  |  |
| **Physical activity** |  |  | 2.72 | 0.099 |
| Referents | 56.8 (133) | 50.2 (231) |  |  |
| Physically inactive group | 43.2 (101) | 49.88 (229) |  |  |
| **BMI** |  |  | 62.91 | 0.000 |
| <25kg/m² | 30.3 (71) | 62.2 (286) |  |  |
| ≥ 25 kg/m² | 69.7 (163) | 37.9 (174) |  |  |
| **Alcohol** |  |  | 3.87 | 0.049 |
| Referents | 94.4 (221) | 97.4 (448) |  |  |
| Risk group | 5.6 (13) | 2.6 (12) |  |  |
| **Smoking** |  |  | 0.02 | 0.8777 |
| Referents | 166 (69.7) | 314 (68.9) |  |  |
| Risk group | 72 (30.3) | 142 (31.1) |  |  |

Based on the results of the Chi-square test, there is no significant difference in fruit and vegetable consumption, physical activity, and smoking rate among people with CVD and without CVD in the population studied (Table 2). However, there was a statistically significant difference in BMI index (Chi-square=62.91, p=0.000) and alcohol consumption (Chi-square=3.87, p=0.049) between the two studied groups.

Ethnicity-stratified prevalence of CVD risk markers, the share of individuals in the risk group (%) and differences between groups are presented in Tables 3 and 4.

**Table 3. Ethnicity-stratified prevalence of CVD risk factors, share of individuals in risk group (%) and difference between groups**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Kyrgyz | East European | Central Asian | East Asian | Western Asia | Other minorities | Chi Square (p-value) |
| **Total N=694** | 217 | 239 | 114 | 38 | 23 | 63 |  |
| Fruit Intake Deficit Group | 59.9 | 65.3 | 64.9 | 55.3 | 69.6 | 69.8 | 4.22 (0,225)  0.082 |
| Vegetable Intake Deficit Group | 61.8 | 66.1 | 67.5 | 55.3 | 65.2 | 63.5 | 2.84 (0.938)  3.483 |
| Smoking | 21.0 | 37.9 | 26.3 | 31.6 | 17.4 | 41.0 | 21.19 (0.055)  0.048 |
| Alcohol consumption | 3.7 | 3.8 | 3.5 | 2.6 | 0.0 | 4.8 | 1.23 (0.93)  3.283 |
| Alcohol less strict | 10.5 | 15.0 | 9.9 | 7.9 | 4.3 | 14.5 | 5.13 (0.93)  3.283 |
| Physical activity | 42.4 | 47.3 | 50.9 | 55.3 | 39.1 | 58.7 | 7.54 (0.029)  0.00132 |
| BMI | 42.9 | 58.6 | 46.5 | 34.2 | 52.2 | 41.3 | 17.22 (0.98)  5.41 |

**Table 4. Ethnicity-Stratified Prevalence of CVD Risk Markers and Group Differences**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Kyrgyz | East European | Central Asia | East Asia | Western Asia | Other minorities |
| **Total N=694** | 217 | 239 | 114 | 38 | 23 | 63 |
| Male | 16(23.9) | 26(25.5) | 10(33.3) | 8(61.5) | 3(33.3) | 6(46.2) |
| Female | 51(76.1) | 76(74.5) | 20(66.7) | 5(38.5) | 6(66.7) | 7(53.8) |
| Chi Sq. (p-value) | 5.29(0.021) | 16.82(0.000) | 3.22(0.073) | 0.32(0.575) | 2.10(0.147) | 3.10(0.078) |
| Age Gr. (18-29) | 1(1.5) | 0(0.0) | 1(3.3) | 1(7.7) | 0(0.0) | 0(0.0) |
| Age Gr. (30-39) | 2(3.0) | 5(4.9) | 0(0.0) | 1(7.7) | 0(0.0) | 0(0.0) |
| Age Gr. (40-49) | 14(20.9) | 9(8.8) | 9(30.0) | 0(0.0) | 1(11.1) | 3(23.1) |
| Age Gr. (50-59) | 36(53.7) | 34(33.3) | 12(40.0) | 2(15.4) | 4(44.4) | 4(30.8) |
| Age Gr. (≥60) | 14(20.9) | 54(52.9) | 8(100.0) | 9(69.2) | 4(44.4) | 6(46.2) |
| Chi Sq. (p-value) | 111.01 (0.000) | 126.66 (0.000) | 55.08 (0.000) | 17.01 (0.002) | 19.50 (0.001) | 52.53 (0.000) |
| Edu: Primary School | 2(3.0) | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) | 0(0.0) |
| Edu: Secondary School | 2(3.0) | 3(3.0) | 3(10.0) | 0 (0.0) | 6(33.3) | 1 (7.7) |
| Edu: High School (Vocational) | 27(40.3) | 53(52.0) | 17(56.7) | 9(69.2) | 3(16.7) | 8 (61.5) |
| Edu:  University degree | 36(53.7) | 46(45.0) | 10(33.3) | 4(30.8) | 9(50.0) | 4 (30.8) |
| Chi Sq. (p-value) | 3.55 (0.315) | 5.30 (0.151) | 1.03 (0.795) | 0.31 (0.576) | 1.59 (0.452) | 0.37 (0.832) |

**Discussion**

The provided data presents an analysis of cardiovascular disease (CVD) prevalence across different demographic groups in Kyrgyzstan, including gender, age, education level, ethnicity, and income.

**Gender and CVD Prevalence**

CVD risk profiles of men and women in low- and middle-income countries vary depending on age, education level, and other factors [14, 15, 16, 17]. High blood pressure is a common condition in Kyrgyzstan among both men and women, with a female disadvantage [18]. Our study confirmed a significant association between gender and CVD prevalence, with a significantly higher prevalence in women (Chi-square=28.26, p<0.000). These results are comparable to earlier research findings from Kyrgyzstan. For instance, Polupanov et al. (2020) found a higher prevalence of cardiovascular risk factors among women (68.2%), which is very close to our findings [12]. This suggests a significant variation in the prevalence of CVD between genders in Kyrgyzstan. In the USA, European countries, and South Asia, the prevalence in women is also higher than in men, but with variation [19, 20, 21].

**Age and CVD Prevalence**

There has been a well-established association between age and CVD risk factors prevalence [22, 23, 24, 25, 26]. Our study also reveals a significantly higher prevalence of CVD in older age groups.

**Educational Attainment and CVD Prevalence**

Several studies have shown a negative correlation of CVD with educational attainment [22, 27, 28, 29]. However, a number of studies have not found any association between CVD prevalence, its risk factors, and education level [30]. In our study, we did not see a statistically significant difference in CVD prevalence based on education level (Chi-square=0.37, p=0.847). However, if we studied those aged 40-95, we saw among individuals with high education a noticeably higher prevalence. This can be explained by the socio-economic transition period in Kyrgyzstan, where the wages of knowledge workers are significantly lower than those in other sectors, leading to higher occupational mental stress. These findings indicate the need for further study; nevertheless, educational attainment is not a direct contributor to the CVD prevalence in the studied population.

**Income and CVD Prevalence**

Our study revealed a notable difference in CVD prevalence between income groups, with CVD more common among individuals with lower incomes. This aligns with earlier studies showing higher CVD prevalence among adults with lower socioeconomic status [16, 31, 32, 33, 34].

**Lifestyle Factors and CVD Prevalence**

There is strong evidence of the role of lifestyle factors such as diet [3, 8, 28, 35, 36, 37], physical activity [3, 34, 38, 39, 40], alcohol use [8, 34, 41], smoking [3, 8, 21, 42, 43, 44], and overweight [21, 45] on CVD outcomes. Our study found no significant association between fruit and vegetable consumption, physical activity rate, and CVD prevalence in the Kyrgyz population (Table 2). However, BMI index and alcohol consumption showed a statistically significant difference between people with and without CVD. This suggests that higher BMI plays a significant role in developing or progressing CVDs in the Kyrgyz population. Higher BMI is a well-known risk factor for various cardiovascular conditions, including hypertension, dyslipidemia, and type 2 diabetes [46]. Therefore, individuals with higher BMI might be at greater risk of developing CVD compared to those with a lower BMI in this population.

Additionally, heavy and moderate alcohol intake has been linked to various cardiovascular risks, including hypertension, cardiomyopathy, and arrhythmias. Thus, individuals with higher alcohol intake may be more likely to develop CVD compared to those with lower alcohol consumption.

Our study did not find sufficient evidence to conclude a statistically significant difference in smoking prevalence (Chi-square=21.19, p=0.055). While the p-value is slightly above 0.05, the results may suggest a potential trend or association worth further investigation in future studies.

**Ethnicity and CVD Risk Factors**

Earlier studies showed evidence for the association between CVD prevalence and ethnicity [7, 11, 12, 47, 48]. Our study examined and presented the relationship between ethnicity and various CVD risk factors, including physical activity, smoking prevalence, fruit and vegetable consumption, alcohol consumption, BMI index (Table 3), gender, age, and education level (Table 4) among different ethnic groups.

Our study showed statistically different CVD prevalence among various ethnic groups, with the highest prevalence among East European origin – 42.7%, then Western Asians – 39.1%, East Asians – 34.2%, Kyrgyzs – 30.9%, Central Asians – 26.3%, and Other minorities – 20.6%. These results are consistent with several studies conducted in Kyrgyzstan [11, 12, 44]. This suggests that ethnicity may play a role in CVD prevalence; however, this association might be driven by different prevalence of risk factors in different ethnic groups.

Our analysis did not show statistically significant differences in fruit and vegetable consumption, alcohol intake, and BMI among the ethnic groups studied, consistent with the findings of Kontsevaya et al. 2018 and Polupanov et al. 2020 [12, 44]. However, our analysis showed a statistically significant difference in physical activity among different ethnic groups, with the lowest prevalence in the Kyrgyz group and the highest in the group of other minorities (Table 3). These findings highlight potential disparities in physical activity levels and suggest the need for targeted interventions to promote physical activity to improve cardiovascular health in specific ethnic communities.

According to Pengpid et al. 2015, avoidance of physical activity in Kyrgyzstan was 21.9% [40]. Later, Polupanov et al. 2020 detected hypodynamia in 15.6% [12] and Kadyralieva et al. 2020 in 29.3% [3]. Our analysis showed strong evidence of a statistically significant difference in physical activity among the groups mentioned above (Chi-square=7.54, p=0.029) with the lowest CVD prevalence in the Kyrgyz group and the highest in the group of other minorities. These findings are essential for identifying potential disparities in physical activity and may be valuable for developing targeted interventions to promote physical activity and improve cardiovascular health in specific ethnic communities.

Our study did not find sufficient evidence to conclude a statistically significant variation in smoking prevalence among the studied groups. However, the borderline p-value suggests a potential trend or link warranting further investigation. Smoking is a long-known CVD risk factor [3, 21, 42], and even elusive differences in smoking prevalence across ethnic groups may have public health implications. For example, Russian men smoke more compared to men of other ethnic groups in Kyrgyzstan [47].

**Gender and CVD Risk Factors Across Ethnic Groups**

The associations between gender and CVD risk markers across various ethnic groups are complex. While there is strong evidence of gender-related differences in some groups, it did not appear among East Asian, Western Asian, and Other minorities groups, possibly due to the small sample size. These findings underline the need to consider age-related differences when analyzing CVD risk factors and the importance of addressing these differences in public health interventions and policies. Further research is needed to explore the underlying mechanisms driving these age-related associations and develop targeted strategies for promoting cardiovascular health in different age groups and ethnic communities.

**Educational Attainment and CVD Risk Factors Across Ethnic Groups**

Educational attainment is an important determinant of health outcomes [20, 21, 27, 28, 29]. Poor educational attainment of disadvantaged ethnic minorities predicts poor health literacy, lack of access to relevant information on CVD risk factors, provider-patient communication barriers, poor employment prospects, and economic instability, which in turn act as barriers to healthy living, food security, and healthcare - all strong determinants of CVD [8]. Although educational attainment modifies the relationship between race and CVH, education does not overcome the effect of race [48]. Ethnic differences in CVD risk profiles cannot fully explain the variability in educational attainment [49, 50]. In our study, we did not see any significant association between educational attainment and CVD risk markers within the studied ethnic groups. Further research is needed to understand the potential complexities of the linkage between education level and CVD risk factors within various ethnic contexts in Central Asia.

**Strengths and Limitations**

Despite the stratified random sampling reflecting the demographic features of the Kyrgyzstani population, the results might have been affected by the relatively small sample size. Another limitation is that information on CVD risk factors was mainly self-reported, introducing response errors and recall bias. This is especially sensitive for socioeconomic level and lifestyle, where participants may not accurately report their income, education level, and daily habits. Self-reported data could introduce measurement error and potentially skew the results. For example, individuals may overestimate their physical activity levels or underestimate their intake of unhealthy foods, affecting the assessment of cardiovascular risk factors.

Furthermore, the study might not have considered some crucial variables related to CVD risk, such as access to healthcare, the quality of healthcare, and environmental factors like air pollution or exposure to hazardous substances. The omission of these factors could limit the comprehensiveness of the findings. Additionally, the research may not have adequately accounted for changes over time, as cardiovascular risk factors can vary throughout a person's life. A cross-sectional study might not capture these variations effectively. Longitudinal studies that track individuals over time can provide more insight into how these risk factors evolve and contribute to the development of cardiovascular disease.

In conclusion, while the stratified random sampling in the study is a valuable approach to reflect the demographic features of the Kyrgyzstani population, it's important to be aware of these limitations in the data collection and analysis. Future research could benefit from larger sample sizes, more objective measures of risk factors, and a broader consideration of variables that may influence cardiovascular disease outcomes.

**Findings of the Study**

There is strong evidence of CVD outcomes from lifestyle factors such as BMI, diet, physical activity, alcohol intake, and smoking. It is recognized that CVD prevalence varies across demographic groups, including age, gender, educational attainment, and income. Ethnicity may play a role in CVD prevalence.

Our study highlights that CVD prevalence across diverse ethnic groups can differ significantly. In Kyrgyzstan, the most disadvantaged group in this context is East European, and the least disadvantaged is Western Asian. There are particularities in the effect of lifestyle factors on CVD prevalence in the studied population.

**Conclusion**

The current study provides valuable insights into the potential CVD risk factors in the studied population. While fruit and vegetable consumption, physical activity, and smoking do not show significant differences between respondents with and without CVD, BMI index and alcohol consumption demonstrate statistically significant associations. The distribution of CVD prevalence across various demographic groups suggests that gender, age, ethnicity, and income are associated with CVD prevalence.

There are associations between ethnicity and various CVD risk factors, with significant variations in physical activity among ethnic groups. This highlights the importance of tailoring interventions to address specific needs and overcome barriers faced by different communities. The study reinforces the need for ongoing surveillance and research to better understand the dynamic relationships between ethnicity and CVD risk factors, which could provide valuable insights for public health policymakers, researchers, and clinicians.

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**Conflict of Interests**

The authors declare no conflict of interest.

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**Author Contributions**

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