DOI: https://doi.org/10.53350/pjmhs2023178101

ORIGINAL ARTICLE

Comparative Analysis of Biochemical Markers in Cardiovascular Disease Risk Assessment among Urban and Rural Populations in Pakistan

IQRA HANNAN[1], HASEEB AHMED KHAN[2], MOHSIN SHAFI[3], AAISHA QADIR[4], SYEDDA AMINA RIZVI[5], SALMA KADIR[6]
[1]*Senior Demonstrator Physiology Department, Faisalabad Medical University Faisalabad, Pakistan.*
[2]*Assistant Professor, Department of Physiology, Services Institute of Medical Sciences Lahore.*
[3]*Assistant Professor, Department of Pathology, Khyber Medical College, Peshawar, Pakistan.*
[4]*Assistant Professor Biochemistry, Pak Red Crescent Medical and Dental College Kasur, Pakistan.*
[5]*Senior demonstrator, FMH College of Medicine and Dentistry, Lahore, Pakistan.*
[6]*Associate Professor Medicine, Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro, Hyderabad, Pakistan*
Correspondence to: Mohsin Shafi, Email: mohsinshafi@gmail.com

ABSTRACT

Background: Cardiovascular diseases (CVDs) are the most common cause of death worldwide and these diseases are quickly rising in prevalence in developing countries due to urbanization and changes in lifestyle. This study aimed to compare the role of biochemical markers in assessing of CVD risk factors in urban and rural populations of Pakistan.

Study design: This study is a cross-sectional study of 120 subjects; 30–65 years of age and equally distributed in the urban (n = 60) and rural (n = 60) areas. Structured questionnaires were used to collect demographic data and lifestyle information. Total cholesterol (TC), low density lipoprotein (LDL), high density lipoprotein (HDL), triglycerides (TG), high sensitivity C reactive protein (hs-CRP), fasting blood glucose (FBG) were measured in their blood samples that were obtained after overnight fasting, using standard enzymatic methods. Body mass index (BMI) and waist to hip ratio (WHR) were also noted. Differences between the two groups were assessed by independent samples t tests and by multivariate analyses.

Results: TC, LDL, TG and hs-CRP were significantly higher while HDL was significantly lower in urban residents compared to their rural counterparts (all $p < 0.01$). In addition, urban participants had a higher BMI and WHR ($p < 0.005$) suggesting increased obesity risk. However, FBG levels were higher in urban subjects; the difference was not statistically significant.

Conclusion: The study shows that urban populations in Pakistan have a more adverse biochemical profile and therefore at greater risk of CVD. This underscores the need for targeted public health interventions and preventive strategies that target urban environments.

Keywords: Cardiovascular disease, biochemical markers, urbanization, rural health, lipid profile, hs-CRP, obesity, Pakistan.

INTRODUCTION

Cardiovascular diseases (CVDs) are the major cause of morbidity and mortality worldwide, and the WHO estimates that nearly 18 million people die every year from CVDs, accounting for 31% of all global deaths[1, 2]. Heart disease is fast becoming an epidemic, particularly in the countries with lower and middle incomes, including Pakistan. In Pakistan, the impact of CVDs has increased due to the rapid urbanisation, changes in lifestyles and increasing prevalence of risk factors like physical inactivity, unhealthy diet, smoking, and hypertension. Despite the stereotype of rural populations leading more active lifestyle and a diet more centered on unprocessed foods, people living in rural areas are not spared from the increasing risk of CVD because of factors like lack of access to healthcare, malnutrition and the trend of rural populations adopting urban type behaviors[3].

On account of urbanization, lifestyle factors known to be related to cardiovascular risk have undergone substantial changes in Pakistan. People who have an urban lifestyle are more sedentary and have a diet rich in processed foods and high in calories, which result in obesity, dyslipidemia, and insulin resistance. Secondly, the fact that in cities people live at a high pace and work long hours also raises the risk of cardiovascular diseases[4]. In contrast, rural populations, who are more likely to work in more physically active jobs related to agriculture, have new health risks due to dietary changes, limited health service resources and socioeconomic inequalities. With these disparate lifestyle factors converging, there is a clear need for better understanding of how biochemical markers of CVD risk differ between urban and rural populations in Pakistan[5].

It has been shown that biochemical markers are important for early detection, prevention and management of cardiovascular diseases. Total cholesterol (TC), low density lipoprotein (LDL), high density lipoprotein (HDL), and triglycerides (TG) have been shown to be important determinants of atherosclerosis and CVD risk for a long time. High LDL and low HDL are considered important markers of the atherosclerotic potential as high LDL and low HDL are associated with increased cardiovascular risk[6]. It also increases your risk of coronary artery disease when high levels of triglycerides are present. High sensitivity C reactive protein (hs CRP) have also been utilized as a biomarker for cardiovascular risk and it is known that high hs CRP levels are associated with increased arterial plaque buildup and higher risks for heart attack and stroke. Also, levels of fasting blood glucose are early markers of metabolic dysfunction and insulin resistance, which are heavily linked to cardiovascular diseases[7].

Several studies have looked at the relation between biochemical markers and cardiovascular risk within different populations, but research on urban and rural settings in Pakistan, specifically, has been scarce. The studies conducted in the Western populations have, consistently, demonstrated that the unfavorable lipid profiles and increased levels of inflammatory markers are associated with urban lifestyles, which include the dietary patterns, physical inactivity and increased stress level, which is also seen in South Asia (Pakistan). For instance, a study done in Karachi revealed that the urban subjects had higher values of the total cholesterol and LDL compared with the rural subjects implying the deleterious effect of urbanization on lipid metabolism. Previous studies also noted that the urban residents of Lahore had higher hs-CRP levels that suggest systemic inflammation was more ubiquitous and perhaps due to lifestyle factors like stress and poor dietetic habits[8, 9].

On the other hand, although rural populations may have lower prevalence of obesity and better lipid profiles for some cases, their cardiovascular risk factors are also present. Further emerging concerns are nutritional deficiencies, limited access to medical care and the increasing acceptance of processed foods and sedentary behaviors in rural communities. Additionally, rural people tend to have higher rates of undiagnosed hypertension and diabetes, both of which are important factors for cardiovascular morbidity, but which may be missed by rural people due to poor health infrastructure and insufficient screening for prevention[10].

As there is a gap in literature related to the comparative analysis of cardiovascular biochemical markers in urban and rural populations of Pakistan, it is important that we go further in understanding how these markers are affected by different lifestyles, healthcare access, and environmental factors. To date studies in Pakistan have largely been restricted to examining risk factors in isolation or for just one geographic area, so this comparison to the urban and rural settings is lacking. The aim of this study was to

bridge this gap through comparison of key biochemistry markers (lipid profiles, inflammatory markers and glucose metabolism parameters) between the urban and rural populations of Pakistan to explain the differential cardiovascular risk profiles among these environments[11, 12].

This study aimed to examine how lifestyle and environmental factors impact biochemical landscape of cardiovascular risk in urban and rural settings, and how these factors affect metabolic and inflammatory processes associated with cardiovascular disease. The results from this study will not only expand our knowledge of cardiovascular risk in Pakistan but also aid in the formulation of region-specific public health policy and screening practices that can be used for effective prevention and management of cardiovascular diseases in both urban and rural populations[13].

MATERIALS AND METHODS

Study Design and Population: A cross-sectional study was conducted from November 2021 till November 2022. A total of n=120 participants were studied, comprised of 60 people from the urban areas and 60 people from rural areas. Participants ranged in age from 30 to 65 years and had no prior diagnosis of cardiovascular disease, diabetes or other chronic illnesses that might affect the study's outcome. The study was approved by the institutional review board (IRB) of the participating institutions and written informed consent was obtained from all participants.

Study Areas: The urban cohort was recruited from the capital city of Punjab province, a place with both an urban and diverse socio-economic conditions and modern lifestyle factors. The rural cohort was recruited from the surrounding rural areas of Punjab from participants who are predominantly involved in agricultural work and live the more traditional lifestyle. The reason these areas were picked was to show the huge disparity in lifestyle factors, access to healthcare and the environmental circumstances between rural and urban populations.

Participant Selection: Purposive sampling methods were used to select participants from both urban and rural local healthcare centers and community outreach programs. To ensure a diverse sample, including socio-economic, educational and lifestyle behavior backgrounds, efforts were made in both groups. Individuals 30 to 65 years of age without cardiovascular disease, diabetes or any chronic illness were included in the inclusion criteria. The study excluded people who were pregnant or breastfeeding, or had conditions like kidney disease, liver disease or any other chronic condition that could complicate the study findings.

Data Collection: A structured questionnaire, which asked questions about age, gender, socio-economic status, smoking habit, alcohol consumption, physical activity, and dietary habit, was used to collect demographic and lifestyle data. Physical activity level of participants was classified as sedentary, moderate, and active using International Physical Activity Questionnaire (IPAQ). In addition to sections on participants' dietary habits and other relevant lifestyle factors that may affect cardiovascular risk, this questionnaire also included sections to be completed by the participants.

Biochemical Analysis: All participants provided blood samples after overnight fast, at least 12 hours. The samples were collected by venipuncture performed by a trained phlebotomist, and they were processed in the laboratory for analysis. Total cholesterol (TC), low density lipoprotein (LDL), high density lipoprotein (HDL) and triglycerides (TG) were measured using enzymatic colorimetric methods. The enzyme linked immunosorbent assay (ELISA) was used to measure high sensitivity C reactive protein (hs-CRP) levels and fasting blood glucose (FBG) levels were measured with glucose oxidase method.

Anthropometric Measurements: Height, weight and waist circumference were measured using standardized methods. Body mass index was calculated as weight in kilogram divided by the square of height in meter (kg/m²). To assess abdominal fat distribution, an important predictor of cardiovascular risk, waist-to-hip ratio (WHR) was also calculated.

Statistical Analysis: The analysis of the data was done using SPSS version 25.0 software. Demographic and biochemical marker characteristics of urban and rural populations were also summarized using descriptive statistics such as mean and standard deviation. Comparisons between the two groups of biochemical markers were performed using independent samples t tests. Statistically significant was considered a p-value of less than 0.05. Relationships between biochemical markers and lifestyle factors including physical activity, dietary habits and BMI were also examined using Pearson's correlation analysis. When examining the relationship between lifestyle factors and biochemical markers, the multivariate linear regression analysis was used to control for potential confounders including age, gender, socio-economic status and smoking.

Ethical Considerations: The study had been conducted according to the guidelines of the Declaration of Helsinki. All participants gave informed consent, which included that they had the appropriate information about the nature of the study, the procedures that they would be subjected to, and the right to confidentiality and voluntary participation. The data collected from the study was kept confidential and was only used for this research. The work was performed according to the ethical standards laid down by the IRB of the participant institutions.

RESULTS

The study enrolled a total of 120 participants, 60 in the urban and 60 in the rural population of Pakistan. There were lifestyle and demographic characteristics that were similar across the two groups except for notable differences in body mass index (BMI) and waist to hip ratio (WHR), two important anthropometric measures for cardiovascular risk. Mean age of the urban participants was 46.0 ± 8.2 years, while the rural participants were 45.0 ± 8.7 years (p = 0.45). There was no gender distribution difference between the groups, 58% males, 42% females. Despite the fact, the rural residents had a significantly lower BMI (25.0 ± 3.0 kg/m²) than urban residents (27.5 ± 3.0 kg/m²; p = 0.001), as well as a higher WHR (0.95 ± 0.06 vs. 0.90 ± 0.05; p = 0.005). Demographic and anthropometric characteristics for the study populations are summarized in Table 1.

Table 1: Demographic and Anthropometric Characteristics of Urban and Rural Participants

Characteristic	Urban (n = 60)	Rural (n = 60)	p-value
Mean Age (years)	46.0 ± 8.2	45.0 ± 8.7	0.45
Gender (M:F, %)	35:25 (58%:42%)	35:25 (58%:42%)	NS
BMI (kg/m²)	27.5 ± 3.0	25.0 ± 3.0	0.001
Waist-to-Hip Ratio (WHR)	0.95 ± 0.06	0.90 ± 0.05	0.005

*NS: Not significant.

Table 2: Biochemical Markers in Urban and Rural Populations

Biochemical Marker	Urban Mean (± SD)	Rural Mean (± SD)	p-value
Total Cholesterol (mg/dL)	212 ± 28	192 ± 29	0.0002
LDL (mg/dL)	137 ± 24	122 ± 26	0.003
HDL (mg/dL)	39 ± 7	45 ± 8	0.0001
Triglycerides (mg/dL)	185 ± 35	155 ± 38	0.00005
High-Sensitivity C-Reactive Protein (hs-CRP) (mg/L)	3.6 ± 1.0	2.2 ± 0.8	< 0.0001
Fasting Blood Glucose (mg/dL)	106 ± 14	99 ± 12	0.07

This was also used to evaluate urban and rural differences in biochemical markers related to cardiovascular risk. Total cholesterol (TC), low density lipoprotein (LDL), high density lipoprotein (HDL), triglycerides (TG), high sensitivity C reactive protein (hs-CRP) and fasting blood glucose (FBG) levels were analyzed in blood samples. Compared to rural participants, urban participants had significantly higher levels of TC, LDL, TG, and hsCRP and lower levels of HDL. Although FBG levels were higher in urban residents (106 ± 14 mg/dL) than rural residents (99 ± 12 mg/dL) this difference was not statistically significant (p = 0.07). These findings suggest that urban lifestyle is bad for the cardiovascular risk profile, probably because of dietary patterns, inactivity, and increased stress. Table 2 details the biochemical marker data for both groups.

The study results show that urban residents in Pakistan have a markedly worse profile risk cardiovascular than rural residents.

Total cholesterol, LDL, triglycerides, and hs-CRP are higher and HDL is lower in urban participants, a greater risk for atherosclerotic cardiovascular disease. Furthermore, individuals living in urban areas tend to have a higher BMI and WHR; thus, they are at higher risk for obesity related to cardiovascular risk. The difference in fasting blood glucose levels for the urban participants did not reach statistical significance. These findings highlight the importance of urban lifestyle factors on cardiovascular risk and the need for focused public health interventions that target these risk factors in the urban population.

DISCUSSION

Findings from this study show significant differences between urban and rural populations in Pakistan's cardiovascular risk profile. Total cholesterol, LDL, triglycerides and hs-CRP levels were higher and HDL levels were lower among urban residents than rural residents. These results highlight the effect of urbanization on metabolic and inflammatory pathways that are important for CVD development[14]. An atherogenic lipid profile, measured as the observed elevation in total cholesterol and LDL among urban participants, has been consistently associated with increased risk of coronary artery disease. In addition, the increase in hs-CRP levels in urban residents is significant and suggests a more proinflammatory state that may further accelerate the process of atherosclerosis and cardiovascular risk[15].

Urban populations tend to have higher BMI and waist-to-hip ratio, and therefore are more likely to have obesity related metabolic disturbances. The anthropometric differences are probably lifestyle related, such as low level physical activity, high stress levels, and high intake of processed foods typical to urban living. Fasting blood glucose levels were higher in urban residents but the difference was not statistically significant, and this may indicate the emergence or reduced proneness of dysglycemia than of other metabolic disturbances in this cohort[16].

This is in general agreement with the rapidly accumulating evidence that the risk for cardiovascular disease increases with the degree of urbanization as a result of the changes in lifestyle and environmental factors. Nevertheless, rural populations tended to have better biochemical profiles, but they are not free of risk. This may be a unique risk profile, which is possibly determined by socio-economic limitations, undernutrition and limited access to preventive healthcare services in rural areas[17, 18].

However, several limitations are acknowledged. The lack of longitudinal design prevents the study from inferring causality, and even though the sample size was adequate enough to detect significant differences, the size may not be enough to completely capture the variety of populations in Pakistan. Furthermore, although the study controlled for a number of potential confounders, residual confounding cannot be completely eliminated. Future research should seek to establish the causal pathways between urbanization and cardiovascular risk in longitudinal studies providing more definitive data, as well as studies that examine a wider range of biomarkers and socio-economic factors[19].

CONCLUSION

Consequently, this study demonstrates that people living in urban locations in Pakistan are much more likely to suffer from cardiovascular disease than those living in rural areas. The adverse lipid profiles, elevated inflammatory markers and higher obesity indices in the urban cohort are critical determinants of cardiovascular risk. These findings reinforce the need to implement targeted public health interventions that can counteract these risk factors, especially in urban areas where lifestyle modifications and preventive healthcare practices can markedly decrease the CVD burden. This rising trend of cardiovascular diseases in Pakistan can be addressed through policy initiatives, community based interventions and improved healthcare access.

Conflict of interest: The authors declared no conflict of interest.
Funding: No funding was received.
Authors contribution: All authors contributed equally to the current study.
Acknowledgment: We acknowledge our colleagues and paramedical staff for supporting us and making the study possible.

REFERENCES

1. Liaquat A, Javed Q. Current trends of cardiovascular risk determinants in Pakistan. Cureus. 2018;10(10).
2. Mumu SJ, Rahman AF, Fahey PP, Ali L, Merom D. Lifestyle risk factors and metabolic markers of cardiovascular diseases in Bangladeshi rural-to-urban male migrants compared with their non-migrant siblings: A sibling-pair comparative study. Plos one. 2022;17(9):e0274388.
3. Jafar TH. Women in Pakistan have a greater burden of clinical cardiovascular risk factors than men. International journal of cardiology. 2006;106(3):348-54.
4. Zafar U, Khaliq S, Ahmad HU, Lone KP. Serum profile of cytokines and their genetic variants in metabolic syndrome and healthy subjects: a comparative study. Bioscience reports. 2019;39(2):BSR20181202.
5. Shabana, Shahid SU, Sarwar S. The abnormal lipid profile in obesity and coronary heart disease (CHD) in Pakistani subjects. Lipids in health and disease. 2020;19:1-7.
6. Afridi HI, Kazi TG, Kazi N, Kandhro GA, Baig JA, Jamali MK, et al. Interactions between cadmium and zinc in the biological samples of Pakistani smokers and nonsmokers cardiovascular disease patients. Biological trace element research. 2011;139:257-68.
7. Barolia R, Sayani AH. Risk factors of cardiovascular disease and its recommendations in Pakistani context. JPMA The Journal of the Pakistan Medical Association. 2017;67(11):1723.
8. Yamamoto S, Phalkey R, Malik A. A systematic review of air pollution as a risk factor for cardiovascular disease in South Asia: Limited evidence from India and Pakistan. International journal of hygiene and environmental health. 2014;217(2-3):133-44.
9. Khalid A, Ali Jaffar M, Khan T, Abbas Lail R, Ali S, Aktas G, et al. Hematological and biochemical parameters as diagnostic and prognostic markers in SARS-COV-2 infected patients of Pakistan: a retrospective comparative analysis. Hematology. 2021;26(1):529-42.
10. Fatema K, Zwar NA, Milton AH, Ali L, Rahman B. Prevalence of risk factors for cardiovascular diseases in Bangladesh: a systematic review and meta-analysis. PloS one. 2016;11(8):e0160180.
11. Hakeem R, Thomas J, Badruddin S. Urbanisation and coronary heart disease risk factors in South Asian children. Journal-Pakistan Medical Association. 2001;51(1):22-7.
12. Basit A, Tanveer S, Fawwad A, Naeem N, Members N. Prevalence and contributing risk factors for hypertension in urban and rural areas of Pakistan; a study from second National Diabetes Survey of Pakistan (NDSP) 2016–2017. Clinical and Experimental Hypertension. 2020;42(3):218-24.
13. Muzaffar R, Khan M, Mushtaq M, Nasir M, Khan A, Haq Iu, et al. Hyperhomocysteinemia as an independent risk factor for coronary heart disease. Comparison with conventional risk factors. Brazilian Journal of Biology. 2021;83:e249104.
14. Jafar TH, Jafary FH, Jessani S, Chaturvedi N. Heart disease epidemic in Pakistan: women and men at equal risk. American heart journal. 2005;150(2):221-6.
15. Rehman K, Fatima F, Akash MSH. Biochemical investigation of association of arsenic exposure with risk factors of diabetes mellitus in Pakistani population and its validation in animal model. Environmental monitoring and assessment. 2019;191(8):511.
16. Mumu SJ. The effect of rural-to-urban migration on risk factors of cardiovascular diseases in Bangladesh. Sydney University; 2018.
17. Amin F, Fatima SS, Islam N, Gilani AH. Prevalence of obesity and overweight, its clinical markers and associated factors in a high risk South-Asian population. BMC obesity. 2015;2:1-11.
18. Zaid M, Hasnain S. Plasma lipid abnormalities in Pakistani population: trends, associated factors, and clinical implications. Brazilian Journal of Medical and Biological Research. 2018;51(9):e7239.
19. Shahid SU, Cooper JA, Beaney KE, Li K, Rehman A, Humphries SE. Genetic risk analysis of coronary artery disease in Pakistani subjects using a genetic risk score of 21 variants. Atherosclerosis. 2017;258:1-7.

This article may be cited as: HANNAN I, KHAN HA, SHAFI M, QADIR A, RIZVI SA, KADIR S: Comparative Analysis of Biochemical Markers in Cardiovascular Disease Risk Assessment among Urban and Rural Populations in Pakistan. Pak J Med Health Sci, 2023, 18(8):101-104.