Journal of Surgery and Medicine

Relationship between cardiovascular risk factors and coronary artery disease severity assessed by coronary angiography in Turkish patients

Koroner anjiyografi ile değerlendirilmiş Türk hastalarda kardiyovasküler risk faktörleri ve koroner arter hastalığı ciddiyeti arasındaki ilişki

Şeyda Günay [1], Seçkin Dereli [2], Osman Akın Serdar [1], Güven Özkaya [3], Serhat Çalışkan [4]

[1] Bursa Uludağ University, Faculty of Medicine, Department of Cardiology, Bursa, Turkey
[2] Ordu University Education and Research Hospital Department of Cardiology, Ordu, Turkey
[3] Bursa Uludağ University, Faculty of Medicine, Department of Biostatistics, Bursa, Turkey
[4] Istanbul Bahcelievler State Hospital, Istanbul, Turkey

ORCID ID of the author(s)

ŞG: 0000-0003-0012-345X
ŞD: 0000-0003-0090-3835
OAS: 0000-0003-3529-5649
GÖ: 0000-0003-0297-846X
SÇ: 0000-0002-0260-5463

Corresponding author/Sorumlu yazar:
Şeyda Günay
Address/Adres: Bursa Uludağ Üniversitesi Tıp Fakültesi Kardiyoloji Anabilim Dalı, Görükle, 16059, Bursa, Türkiye
E-mail: seydagunaymedical@yahoo.com

Abstract

Aim: Established coronary risk factors are good predictors of the occurrence of coronary artery disease (CAD), but their correlation with angiographic seriousness of the disease is argumentative and may vary among ethnic groups. In this study, we examined which of these factors are associated with the angiographic seriousness in Turkish patients with attested CAD.

Methods: A total of 2433 patients who underwent coronary angiography and were diagnosed with critical lesions in at least one coronary artery were included in the study. Coronary risk factors were determined by retrospectively scanning the patient records and the relationship with the angiographic severity of coronary artery disease was investigated.

Results: Most patients (36.4%) were between 60-69 years of age and approximately two thirds of patients (76.8%) were men. Hypertension, diabetes mellitus and hyperlipidemia were common cardiovascular risk factors (CRFs), present in 54.8%, 43.2% and 50.3% of patients, respectively. Multiple logistic regression analysis showed that diabetes mellitus, male sex and age since 6th decade significantly raised the risk of multivessel CAD (Odds ratios: 1.29 (1.08-1.54; P=0.004), 1.35 (1.1-1.66; P=0.004), 3.53 (1.85-6.75; P<0.001), respectively). Hypertension and hyperlipidemia were not correlated with CAD angiographic severity.

Conclusion: Diabetes mellitus appeared as the modifiable coronary risk factor forecasting multivessel coronary artery disease in Turkish patients.

Keywords: Turkish, Ethnic, Angiography, Risk, Multi vessel

Öz

Amaç: Koroner arter hastalığı risk faktörleri, koroner arter hastalığının (KAH) ortaya çıkışının iyi öngördürücülerdir, ancak bunların hastalığın anjiyografik ciddiyeti ile korelasyonları tartışmalıdır ve etnik gruplar arasında farklılık gösterebilir. Bu çalışmada, kanıtlanmış KAH olan Türk hastalarda kardiyovasküler risk faktörlerinin hastalığın anjiyografik ciddiyeti ile ilişkisi araştırıldı.

Yöntemler: Koroner anjiyografi ile değerlendirilerek en az bir koroner arterde kritik lezyon saptanan 2433 hasta çalışmaya dahil edildi. Hasta kayıtları retrospektif taranarak hastaların koroner risk faktörleri tespit edildi ve koroner arter hastalığının anjiyografik ciddiyeti ile ilişkisi araştırıldı.

Bulgular: Çalışma popülasyonunda hastaların çoğu (%36,4) 60-69 yaşları arasındaydı ve hastaların yaklaşık üçte ikisi (%76,8) erkekti. Hipertansiyon, diyabetes mellitus ve hiperlipidemi hastaların sırasıyla% 54,8,%43,2 ve %50,3'ünde mevcuttu. Çoklu lojistik regresyon analizinde, diabetes mellitus, erkek cinsiyet ve 6. dekattan itibaren yaşın, çok damarlı KAH riskini önemli ölçüde artırdığı saptandı (odds oranları sırasıyla 1,29 (1,08-1,54; P=0,004), 1,35 (1,1-1,66; P=0,004), 3,53 (1,85-6,75; P<0,001). Hipertansiyon ve hiperlipidemi, KAH'ın anjiyografik ciddiyeti ile ilişkili değildi.

Sonuç: Türk hastalarda çok-damar koroner arter hastalığını ön gördüren düzeltilebilir koroner arter hastalığı risk faktörü diabetes mellitustur.

Anahtar kelimeler: Türk, Etnik, Anjiyografi, Risk, Çoklu damar

Introduction

One of the leading causes of morbidity and death is coronary artery disease. Male sex, advancing age, hypertension, dyslipidemia, obesity, abnormal glucose metabolism, family history of ischemic heart disease and smoking are well known risk factors of coronary artery atherosclerosis [1].

The correlation between these cardiovascular risk factors (CRFs) and the occurrence of CAD and clinical outcomes is consistent [2,3]. Nonetheless, the association between these risk factors and the coronary angiography findings is less coherent with research showing contradictory findings [4-10]. Previous studies have also indicated that effects of these risk factors may vary across different ethnic groups [11,12].

Few data about the effects of CRFs on disease severity in angiographically assessed Turkish patients is available [13,14]. The purpose of our research was therefore to investigate which CRFs are correlated with the severity of atherosclerosis, assessed by coronary angiography, in Turkish patients.

Materials and methods

Study population

Hospital records of consecutive patients who underwent coronary angiography at Bursa Uludag University Faculty of Medicine between 2002 and 2012 were examined. Ethics approval was obtained from the local ethics committee of Bursa Uludag University, Faculty of Medicine (Approval number: 2012-26/4). Information about the presence of CRFs (diabetes mellitus, hypertension and hyperlipidemia) could be gained from the hospital registry system only for 4368 patients. Among these patients, according to the coronary angiography results, we excluded 1100 patients with normal coronary angiograms and 790 patients with non-critical coronary lesions. Data regarding CRFs of 45 patients were not complete and they were also excluded. Finally, a total of 2433 patients were included. According to drug information records, patients taking antihypertensive drugs, oral antidiabetics and/or insulin, statins or fenofibrate were grouped as hypertensive. diabetic and hyperlipidemic, respectively.

Coronary angiography

Selective coronary angiography views of the study population were analyzed by two interventional cardiologists independently. In all epicardial vessels we described a critical coronary lesion and significant CAD as atherosclerotic luminal involvement of more than 50% in a major coronary artery or its major branches. The diameter and degree of lumen narrowing of the vessels were measured into a guiding catheter's lumen (6 French). Patients were grouped into one vessel CAD group and multivessel CAD group (patients with ≥2 vessel disease).

Statistical analysis

For comparisons, we categorized the patients into two groups in conformity with the presence of one or multiple (≥2) vessel disease. Normality tests were performed for the distributions of the data to select parametric or non-parametric tests. Logistic regression analysis was used to investigate the relationship between CRFs and the angiographic severity of CAD as the dependent variable. Odds ratios (ORs) and 95% confidence intervals were calculated. The risk factors studied were diabetes mellitus, age, gender, hypertension, and hyperlipidemia. SPSS Statistics software, version 19 was used and a P-value <0.05 was assumed to be statistically significant. All tests were two-sided.

Results

A total of 2433 patients were included in the study. Most of the patients were males (76.9 %). The most frequently involved vessel was the left anterior descending artery (55.8%) in patients with one-vessel disease (Figure 1).
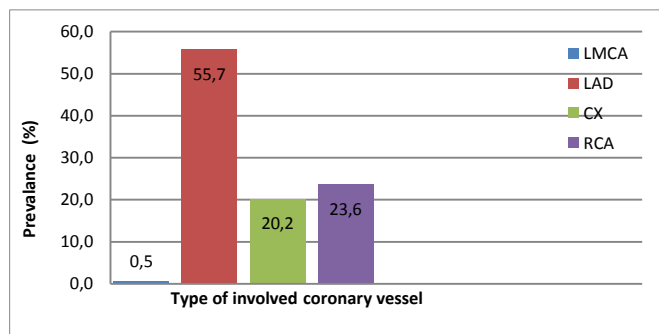

Figure 1: Distribution of involved coronary artery in one vessel coronary artery disease patients (LMCA: left main coronary artery, LAD: Left anterior descending coronary artery, Cx: Circumflex coronary artery, RCA: Right coronary artery)

The CRFs and angiographic severity of CAD were shown in Table-1. Diabetes mellitus was more prevalent in multivessel CAD patients than in one vessel CAD patients (45.2% versus 39.2%, respectively, P=0.005). A logistic regression analysis involving gender, age, diabetes mellitus, hypertension and hyperlipidemia as independent variables displayed that male gender, diabetes mellitus and increasing age since 6th decade significantly raised the risk of multivessel involvement by 1.35 (1.1-1.66, P=0.004), 1.29 (1.08-1.54, P=0.004), 3.53 (1.85-6.75, P<0.001), 4.52 (2.37-8.63, P<0.001), 6.01 (3.08-11.73, P<0.001), and 9.33 (3.83-22.73, P<0.001), respectively (Table 1).

After subdivision of the population according to type of involved coronary vessels, we also investigated the relationship between coronary risk factors and involved coronary artery type in patients with one vessel disease (Table 2). We noted that involvement of all types of coronary arteries are associated with male sex and existence of diabetes mellitus. Although left main coronary artery (LMCA) involvement was increasing since the 8th decade, involvement of left anterior descending (LAD) artery, circumflex (Cx) artery and right coronary artery (RCA) were associated with an earlier age, which is since the 5th decade.

Table 1: Characteristics of patients and logistic regression analysis for multivessel coronary artery disease

	All (n=2433)	Two or three vessel disease			Multivariable logistic regression		
		Yes (n=1636)	No (n=797)	P-value	Odds ratio	95% CI	P-value
Male sex	1870 (76.8)	1274 (77.8)	596 (74.7)	0.09	1.35	(1.1-1.66)	0.004
Diabetes mellitus	1053 (43.2)	740 (45.2)	313 (39.2)	0.005	1.29	(1.08-1.54)	0.004
Hypertension	1334 (54.8)	897 (54.8)	437 (54.8)	0.99	-	-	-
Hyperlipidemia	1226 (50.3)	823 (50.3)	403 (50.5)	0.9	-	-	-
Age 4.decade	44 (1.8)	15 (0.9)	29 (3.6)	-	-	-	-
5.decade	267 (10.9)	136 (8.3)	131 (16.4)	-	-	-	-
6.decade	744 (30.5)	485 (29.5)	259 (32.4)	<0.001	3.53	1.85-6.75	<0.001
7.decade	888 (36.4)	625 (38.2)	263 (32.9)		4.52	2.37-8.63	
8.decade	422 (17.3)	319 (19.4)	103 (12.9)		6.01	3.08-11.73	
9.decade	68 (2.7)	56 (3.4)	12 (1.5)		9.33	3.83-22.73	

Data: number (%), CI: confidence interval

Table 2: Relationship between type of involved coronary vessel and coronary risk factors

		Logistic regression		
		OR	95 % CI	P-value
LMCA involvement	Male sex	4.25	2.46-7.37	<0.001
	Diabetes mellitus	2	1.37-2.91	<0.001
	5.decade	-	-	-
	6.decade	-	-	-
	7.decade	-	-	-
	8.decade	8.24	1.11-61.13	0.039
	9.decade	15.01	1.79-125.36	0.012
LAD involvement	Male sex	2.48	2.17-2.84	<0.001
	Diabetes	1.26	1.11-1.44	<0.001
	5.decade	1.85	1.25-2.73	0.002
	6.decade	3.81	2.62-5.54	<0.001
	7.decade	5.27	3.63-7.66	<0.001
	8.decade	8.58	5.76-12.78	<0.001
	9.decade	12.33	6.68-22.76	<0.001
CX involvement	Male sex	2.94	2.56-3.39	<0.001
	Diabetes	1.21	1.07-1.38	0.003
	5.decade	1.69	1.07-2.66	0.024
	6.decade	3.64	2.36-5.61	<0.001
	7.decade	4.61	2.99-7.1	<0.001
	8.decade	6.53	4.17-10.24	< 0.001
	9.decade	17.54	9.34-32.93	<0.001
RCA involvement	Male sex	2.6	2.27-2.99	<0.001
	Diabetes	1.28	1.12-1.45	<0.001
	5.decade	1.95	1.22-3.11	0.005
	6.decade	4	2.56-6.25	<0.001
	7.decade	5.18	3.33-8	<0.001
	8.decade	6.94	4.38-11	<0.001
	9.decade	13.87	7.46-25.81	<0.001

OR: odds ratio, CI: Confidence interval, LMCA: Left main coronary artery, LAD: Left anterior descending artery, CX: Circumflex coronary artery, RCA: Right coronary artery

Below are our findings.

LMCA involvement

Male patients had more common LMCA involvement by 4.25 (2.46-7.37, P<0.001). Also, diabetes mellitus and advanced age since 8th decade increased the prevalence of LMCA involvement. Odds ratios were 2 (1.37-2.91, P<0.001), 8.24 (1.11-61.13, P=0.039), 15.01 (1.79-125.36, P=0.012) for diabetes mellitus, 8th and 9th decades, respectively.

LAD involvement

Male patients had more common LAD involvement by 2.48 (2.17-2.84, P<0.001). Also, diabetes mellitus and advanced age since 5th decade increased the prevalence of LAD involvement: Odds ratios were 1.26 (1.11-1.44, P<0.001), 1.85 (1.25-2.73 P=0.002), 3.81 (2.62-5.54 P<0.001), 5.27 (3.63-7.66 P<0.001), 8.58 (5.76-12.78 P<0.001), 12.33 (6.68-22.76, P<0.001) respectively, for diabetes mellitus, 5th-9th decades.

Cx involvement

Male patients had more common Cx involvement by 2.94 (2.56-3.39, P<0.001). Diabetes mellitus and advanced age since 5th decade increased the prevalence of Cx involvement. Odds ratios were 1.21 (1.07-1.38, P=0.003), 1.69 (1.07-2.66 P=0.024), 3.64 (2.36-5.61, P<0.001), 4.61 (2.99-7.1 P<0.001), 6.53 (4.17-10.24, P<0.001), 17.54 (9.34-32.93, P<0.001) respectively, for diabetes mellitus, 5th-9th decades.

RCA involvement

Male patients had more common RCA involvement by 2.6 (2.27-2.99, P<0.001). Also, diabetes mellitus and advanced age since 5th decade increased the prevalence of RCA involvement. Odds ratios were 1.28 (1.12-1.45, P<0.001), 1.95 (1.22-3.11 P=0.005), 4 (2.56-6.25, P<0.001), 5.18 (3.33-8 P<0.001), 6.94 (4.38-11, P<0.001), 13.87 (7.46-25.81, P<0.001) respectively, for diabetes mellitus, 5-9th decades.

Discussion

The most common cause of death is coronary artery disease (CAD). Established cardiovascular risk factors (CRFs) like gender, obesity, smoking, age, diabetes mellitus,

hypertension, hyperlipidemia and family history are well known [3,15,16]. Nonetheless, the angiographically assessed association between CRFs and atherosclerotic burden is not as well known, with studies resulting varying and inconsequent findings [5,6,8,10,17-20].

In this study, we mainly searched for the correlation between multivessel CAD and CRFs in Turkish patients who underwent conventional coronary angiography electively. Our study displayed that diabetes mellitus, male gender and advanced age were significantly associated with multi vessel coronary artery disease, while hypertension, and hyperlipidemia were not.

The results of a former study by Veeranna et al, which stated that diabetes mellitus was the unique forecaster of the CAD burden in a cohort of 631 elderly patients (mean age 73 years) are consistent with our study [21]. The significance of diabetes mellitus as a risk factor for angiographic CAD progression has been noted in previous studies [22]. Metabolic disorders seen in diabetics may contribute to high CAD severity [23]. Impaired glucose tolerance and an impaired fasting glucose status are also independently correlated with the extent of CAD [24].

Our results support the idea that established cardiovascular risk factors may not have the same treasure in foretelling the severeness of angiographic findings. While most of the well-known cardiovascular risk factors are thought to be strong predictors of the severity of CAD assessed angiographically [7], some studies revealed that only few of these factors are effective forecasters of CAD severity [8]. Different ethnic characteristics and designs of studies may define these conflicting results.

Several studies reported the impact of ethnic differences on the relationship between CRFs and CAD severity [25]. Presentation of CAD can also vary among ethnic groups [11,26]. We need further angiographic data of other ethnic groups to compare.

These findings state that the comparative effect of established risk factors on the angiographically assessed severity of CAD may differ depending on the selected population.

Limitations

Our analysis was firstly limited with its retrospective design. However, selective coronary angiography technique also has limitations. It gives us information about the arterial lumen only, not the vessel wall and plaque volume, like intravascular ultrasound.

The study was conducted to determine the relationship between established CRFs and multivessel CAD, but it did not give information about clinical outcomes including cardiovascular morbidity and mortality.

Finally, while our study is a single center study, our conclusions cannot be extrapolated to entire population.

Conclusions

Diabetes is an independent modifiable risk factor related to multivessel coronary artery disease in Turkish patients. The underlying mechanisms need further studies, which may give way to preventing and managing CAD risk factors in different ethnic groups.

References

1. D'Agostino RB Sr, Vasan RS, Pencina MJ, Wolf PA, Cobain M, Massaro JM, et al. General cardiovascular risk profile for use in primary care: the Framingham Heart Study. Circulation. 2008 Feb 12;117(6):743-53. doi: 10.1161/CIRCULATIONAHA.107.699579. Epub 2008 Jan 22. PMID: 18212285.

2. Murray CJ, Lopez AD. Evidence-based health policy--lessons from the Global Burden of Disease Study. Science. 1996 Nov 1;274(5288):740-3. doi: 10.1126/science.274.5288.740. PMID: 8966556.

3. Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F, et al. INTERHEART Study Investigators. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet. 2004 Sep 11-17;364(9438):937-52. doi: 10.1016/S0140-6736(04)17018-9. PMID: 15364185.

4. Banerjee A, Lim CC, Silver LE, Heneghan C, Welch SJ, Mehta Z,et al. Family history does notpredict angiographic localization or severity of coronary arterydisease. Atherosclerosis. 2012;221:451-7.

5. Guo YH, Zhang WJ, Zhou YJ, Zhao D, Zhou ZM, Zhang H. Study of the relationship between cardiovascular risk factors and severity of coronary artery disease in patients underwent coronary angiography.Zhonghua Xin Xue Guan Bing Za Zhi. 2005;33:415-8.

6. Hasin Y, Eisenberg S, Friedlander J, Lewis BS, Gotsman MS. Relationship between extent of coronary artery disease and correlative risk factors. Am Heart J. 1979 Nov;98(5):555-61. doi: 10.1016/0002-8703(79)90279-5. PMID: 227261.

7. Koliaki C, Sanidas E, Dalianis N, Panagiotakos D, Papadopoulos D, Votteas V, et al. Relationship between established cardiovascular risk factors and specific coronary angiographic findings in a large cohort of Greek catheterized patients. Angiology. 2011 Jan;62(1):74-80. doi: 10.1177/0003319710370960. Epub 2010 May 24. PMID: 20498145.

8. Krishnaswami S, Jose VJ, Joseph G. Lack of correlation between coronary risk factors and CAD severity. Int J Cardiol. 1994 Nov;47(1):37-43. doi: 10.1016/0167-5273(94)90131-7. PMID: 7868283.

9. Tacoy G, Balcioglu AS, Akinci S, Erdem G, Kocaman SA, Timurkaynak T, et al. Traditional risk factors are predictive on segmental localization of coronary artery disease. Angiology. 2008 Aug-Sep;59(4):402-7. doi: 10.1177/0003319708318379. Epub 2008 May 27. PMID: 18505741.

10. Wang XL, Tam C, McCredie RM, Wilcken DE. Determinants of severity of coronary artery disease in Australian men and women. Circulation. 1994 May;89(5):1974-81. doi: 10.1161/01.cir.89.5.1974. PMID: 8181120.

11. Chaturvedi N. Ethnic differences in cardiovascular disease. Heart. 2003 Jun;89(6):681-6. doi: 10.1136/heart.89.6.681. PMID: 12748237; PMCID: PMC1767706.

12. Harding S, Rosato M, Teyhan A. Trends for coronary heart disease and stroke mortality among migrants in England and Wales, 1979-2003: slow declines notable for some groups. Heart. 2008 Apr;94(4):463-70. doi: 10.1136/hrt.2007.122044. Epub 2007 Aug 9. PMID: 17690159; PMCID: PMC2565582.

13. Onat A. Risk factors and cardiovascular disease in Turkey. Atherosclerosis. 2001 May;156(1):1-10. doi: 10.1016/s0021-9150(01)00500-7. PMID: 11368991.

14. Kutlu R., Memetoğlu ME, Evaluation of cardiovascular risk factors among university students in Turkey: a cross-sectional survey. Russian Open Medical Journal. 2013;2:3-7.

15. Rosamond W, Flegal K, Furie K, Go A, Greenlund K, Haase N, et al. Heart disease and stroke statistics--2008 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Circulation. 2008 Jan 29;117(4):e25-146. doi: 10.1161/CIRCULATIONAHA.107.187998. Epub 2007 Dec 17. Erratum in: Circulation. 2010 Jul 6;122(1):e10. Kissela, Bret [corrected to Kissela, Brett]. PMID: 18086926.

16. Greenland P, Knoll MD, Stamler J, Neaton JD, Dyer AR, Garside DB, et al. Major risk factors as antecedents of fatal and nonfatal coronary heart disease events. JAMA. 2003 Aug 20;290(7):891-7. doi: 10.1001/jama.290.7.891. PMID: 12928465.

17. Phillips GB, Pinkernell BH, Jing TY. Are major risk factors for myocardial infarction the major predictors of degree of coronary artery disease in men? Metabolism. 2004 Mar;53(3):324-9. doi: 10.1016/j.metabol.2003.11.008. PMID: 15015144.

18. Vlietstra RE, Kronmal RA, Frye RL, Seth AK, Tristani FE, Killip T 3rd. Factors affecting the extent and severity of coronary artery disease in patients enrolled in the coronary artery surgery study. Arteriosclerosis. 1982 May-Jun;2(3):208-15. doi: 10.1161/01.atv.2.3.208. PMID: 6979996.

19. Anderson AJ, Barboriak JJ, Rimm AA. Risk factors and angiographically determined coronary occlusion. Am J Epidemiol. 1978 Jan;107(1):8-14. doi: 10.1093/oxfordjournals.aje.a112511. PMID: 623092.

20. Opherk D, Scola R, Morgenstern W, Stockmann G, Nüssel E, Kübler W. Beziehungen von "Risikofaktoren" der Arteriosklerose zum Schweregrad der angiographisch nachweisbaren Koronarsklerose [Coronary risk factors and extent of angiographically proven coronary artery stenoses (author's transl)]. Z Kardiol. 1979 Jun;68(6):369-74. German. PMID: 463194.

21. Veeranna V, Pradhan J, Niraj A, Fakhry H, Afonso L. Traditional cardiovascular risk factors and severity of angiographic coronary artery disease in the elderly. Prev Cardiol. 2010 Summer;13(3):135-40. doi: 10.1111/j.1751-7141.2009.00062.x. PMID: 20626669.

22. Alderman EL, Corley SD, Fisher LD, Chaitman BR, Faxon DP, Foster ED et al. Five-year angiographic follow-up of factors associated with progression of coronary artery disease in the Coronary Artery Surgery Study (CASS). CASS Participating Investigators and Staff. J Am Coll Cardiol. 1993 Oct;22(4):1141-54. doi: 10.1016/0735-1097(93)90429-5. PMID: 8409054.

23. Kirpichnikov D, Sowers JR. Diabetes mellitus and diabetes-associated vascular disease. Trends Endocrinol Metab. 2001 Jul;12(5):225-30. doi: 10.1016/s1043-2760(01)00391-5. PMID: 11397648.

24. Nurkalem Z, Hasdemir H, Ergelen M, Aksu H, Sahin I, Erer B, et al. The relationship between glucose tolerance and severity of coronary artery disease using the Gensini score. Angiology. 2010 Nov;61(8):751-5. doi: 10.1177/0003319710373747. Epub 2010 Jun 21. PMID: 20566575.

25. LaRosa JC, Brown CD. Cardiovascular risk factors in minorities. Am J Med. 2005 Dec;118(12):1314-22. doi: 10.1016/j.amjmed.2005.04.041. PMID: 16378771.

26. Hasan RK, Ginwala NT, Shah RY, Kumbhani DJ, Wilensky RL, Mehta NN. Quantitative angiography in South Asians reveals differences in vessel size and coronary artery disease severity compared to Caucasians. Am J Cardiovasc Dis. 2011;1(1):31-7. Epub 2011 Apr 20. PMID: 22254183; PMCID: PMC3253512.