

## Brief Report

# Assessment of Metabolic Risk Factors and Heart-Healthy Lifestyle in Atherosclerotic Coronary Artery Disease Patients Undergoing Percutaneous Coronary Intervention after a 6-Month Follow-Up

### Abstract

**Background:** Mortality due to acute coronary syndrome (ACS) has dramatically diminished because of performing life-saving interventions. This study aims to assess the metabolic risk factors and heart healthy lifestyle following the first episode of ACS under percutaneous coronary intervention (PCI) treatment after the 6-month follow-up. **Materials and Methods:** This is a longitudinal study conducted on 40 patients who underwent PCI because of the first episode of ACS. The patients' information including age, weight, abdominal circumference, smoking, functional capacity, patients' metabolic equivalent of task (METs), and laboratory tests including triglycerides (TGs), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), creatinine, fasting blood sugar (FBS), and hemoglobin A1C were recorded before discharge and reassessed after 6-month follow-up. **Results:** The patients were dominantly male (92.5%) with an average age of  $56.8 \pm 7.11$  years. Physical activity and functional capacity (METs) significantly improved within 6 months ( $P = 0.019$ ). BMI significantly improved; however, although the abdominal circumference decreased, it was not significant ( $P = 0.28$ ). The number of smokers ( $P = 0.12$ ) and the daily number of smoked cigarettes ( $P = 0.37$ ) nonsignificantly decreased within 6 months. However, HDL-C ( $P = 0.013$ ) and LDL-C ( $P = 0.027$ ) changes were not desirable. TG, FBS, and blood pressure did not statistically significant change ( $P > 0.05$ ). **Conclusion:** Although BMI, physical activity, and METs remarkably improved, waist circumference decreased nonsignificantly and lipid profile got worse paradoxically. Although this population is limited for generalization, this study shows that we require further schedules to improve ACS secondary prevention practice in our community.

**Keywords:** *Healthy lifestyle, metabolic, Metabolic Syndrome, risk factors, percutaneous coronary intervention*

### Introduction

In general, based on the recent European Heart Health Charter recommendations, cardiovascular (CV) diseases are eminently preventable through primary prevention, early diagnosis, appropriate treatment approach, rehabilitation schedule, and secondary prevention.<sup>[1]</sup>

By emerging new life-saving interventions, for instance, percutaneous coronary intervention (PCI) and coronary artery bypass grafting (CABG), mortality due to acute coronary syndrome (ACS) has remarkably declined but imposing the burden of a new chronic condition to the health-care system.<sup>[2,3]</sup> A vast majority of survivors would re-experience similar symptoms while ACS recurrence is generally attributed to the modifiable

lifestyle factors, including behaviors, diet, smoking, physical activity, and occupational stress.<sup>[4]</sup> Exercise-based cardiac rehabilitation is considered a Class IA recommendation, whereas physical activity is listed as a Class IB intervention. Structured aerobic exercise, increased lifestyle physical activity, or both, are associated with an improved coronary risk factor profile, including decreased platelet aggregation, resting systolic and diastolic blood pressure, and intra-abdominal and total body fat, improved insulin sensitivity and blood lipid profiles, and enhanced cardiorespiratory fitness.<sup>[5]</sup>

Acute exposure to smoke triggers a cascade of adverse CV responses, including enhanced hypercoagulability, reduced oxygen delivery to the tissues, increased inflammation, and coronary

Seyed Mohammad Hashemi Jazi,  
Armina Radmanesh,  
Masoumeh Sadeghi<sup>1</sup>,  
Asieh Mansouri<sup>2</sup>

Department of Cardiology,  
School of Medicine, Isfahan  
University of Medical Sciences,  
<sup>1</sup>Cardiac Rehabilitation  
Research Center; Cardiovascular  
Research Institute, Isfahan  
University of Medical Sciences,  
<sup>2</sup>Hypertension Research Center,  
Cardiovascular Research  
Institute, Isfahan University of  
Medical Sciences, Isfahan, Iran

### Address for correspondence:

Dr. Armina Radmanesh,  
Department of Cardiology,  
School of Medicine, Isfahan  
University of Medical  
Sciences, Isfahan, Iran.  
E-mail: [arminaradmanesh@yahoo.com](mailto:arminaradmanesh@yahoo.com)

**Received:** 22 August 2020

**Revised:** 19 September 2020

**Accepted:** 03 October 2020

**Published:** 28 February 2022

### Access this article online

**Website:** [www.advbiores.net](http://www.advbiores.net)

**DOI:** 10.4103/abr.abr\_206\_20

### Quick Response Code:



**How to cite this article:** Hashemi Jazi SM, Radmanesh A, Sadeghi M, Mansouri A. Assessment of metabolic risk factors and heart-healthy lifestyle in atherosclerotic coronary artery disease patients undergoing percutaneous coronary intervention after a 6-month follow-up. *Adv Biomed Res* 2022;11:15.

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vasoconstriction.<sup>[6,7]</sup> Compared with the salutary impact of moderate- and high-dose statin therapy in the IDEAL and TNT trials, smoking cessation was associated with more than double the reduction in absolute death rates, further supporting the need for smoking cessation interventions in the secondary prevention.

An estimated 1.1 billion adults worldwide are overweight or obese including 70% of US adults (130 million). Abdominal obesity has been linked with serious metabolic abnormalities, such as insulin resistance, hyperinsulinemia, hypertriglyceridemia, hypertension (HTN), and diabetes mellitus (DM), likely as a result of disrupting normal hormonal balance and increasing systemic inflammation. Waist circumference has a continuous, graded, and highly significant direct correlation with CV risk.<sup>[8]</sup> Body mass index has shown a modest graded association with MI; however, waist circumference is more strongly associated with metabolic risk factors, incident CV events, and death.

The lifetime incidence of HTN has been increasing in recent decades and is now 90% in the United States. Some previous studies show a 50% increase in long-term CV mortality risk for every 20-mm Hg increase in systolic BP above 115-mm Hg. Lowering elevated BP will lower risk of major CV events, regardless of age, race, sex, or other factors.<sup>[9,10]</sup> Aggressive HTN therapy targeted to achieve BP below 130/85 mm Hg is especially important in the presence of comorbid conditions, such as chronic kidney disease, heart failure, and DM.

In the INTERHEART study, the single most powerful CV risk factor was dyslipidemia. The effectiveness of statin therapy for improving the prognosis of patients with coronary heart disease (CHD) is supported by more long-term, high-quality, randomized controlled trial data than is the effectiveness of virtually any other CV treatment.<sup>[11]</sup> The lipid hypothesis has been repeatedly confirmed, demonstrating conclusively that lowering low-density lipoprotein cholesterol (LDL-C) improves the prognosis of patients with CHD. Statins are the drug class of choice for treating dyslipidemia and improving the prognosis of patients with CV disease. Statins lower LDL-C levels by 18% to 55% reduce the number of small dense LDL-C particles, raise high-density lipoprotein cholesterol (HDL-C) levels by 4% to 9%, and lower triglyceride (TG) levels by 7% to 30%. Large randomized trials have shown that intensive lowering of LDL-C levels to a range of 40–70 mg/dL improves the prognosis of patients with CV disease with minimal toxicity and no major safety concerns.

Patients with DM are at markedly increased risk of CHD, cerebrovascular disease, and peripheral arterial disease and thus are considered to have a CHD risk equivalent. CV disease continues to be the leading cause of mortality and morbidity among the DM population, accounting for 70% of all deaths.<sup>[12]</sup> Compared with non-DM patients,

1-month mortality rates after acute MI are 50% higher, and by 5 years, the cumulative mortality among patients with DM is twice the rate of that observed in non-DM post-MI patients. The UKPDS study has shown that regimens reducing average hemoglobin A1C (HbA1C) levels to <7% resulted in sustained reductions in retinopathy, nephropathy, and neuropathy.<sup>[13]</sup> More recent studies indicate that very aggressive regimens targeting HbA1C levels to <6.5% might increase risk of CV events, especially in persons with CHD who are experiencing the episodes of severe hypoglycemia.<sup>[14]</sup>

The current study aims to assess the metabolic risk factors and heart-healthy lifestyle following the first episode of ACS under PCI treatment after 6-month follow-up in our hospital. The main goal of the current study was to evaluate the effects of experiencing of ACS and the resulting procedure (PCI) on patient's lifestyle over 6 months.

## Materials and Methods

The current study is a longitudinal study conducted on 40 patients, based on a study by Gofuchowska and other,<sup>[15]</sup> who underwent PCI because of atherosclerotic arterial disease in the Chamran Hospital, from April 2016 to June 2017. The current study was confirmed by the Research Committee of Isfahan University of Medical Sciences and the Ethical committee has approved it (code of ethics: 397176). The inclusion criteria were as follows: Patients who underwent the first uncomplicated PCI with complete revascularization and written informed consent to participate in this study.

The presentation of the previous history of whether CABG or PCI, complicated PCI, and ST-elevated myocardial infarction were considered as the unmet criteria. Furthermore, patients who did not refer for the 6-month follow-up visits and those who died before 6 months following the PCI were excluded from the study.

All included patients were requested to fill the forms before the hospital discharge and then after 6 months following the PCI. The patients' demographic information, including age, gender, income, educational level, medical history (i.e. DM, HTN, hyperlipidemia, cardiac ischemic diseases, thyroid diseases, and renal diseases ...), and drug history was recorded in the checklist. Cigarette smoking was defined as the number of smoked cigarettes per day and duration. Furthermore, patients' weight (in kilograms using a calibrated digital device), height (in centimeters using a single-height gauge), abdominal circumference (in centimeters using a bar meter by measuring the circumference of the abdomen at the midpoint between the anterior iliac spine and the last intercostal area), systolic and diastolic blood pressure from both hands (in millimeters of mercury (mmHg) using a single upper arm digital blood pressure monitor), patients' metabolic equivalent of task (METs)<sup>[15]</sup> (through exercise

tolerance test according to Bruce protocol), physical activity (based on the Leisure-time Physical Activity Questionnaire categorizing into mild, moderate, and strenuous); also, the number of times per week and duration of each exercise was recorded [Table 1]. High reliability and relatively moderate validity of this questionnaire were found for the Persian population.<sup>[16]</sup>

Moreover, laboratory tests, including fasting blood sugar (FBS), blood urea nitrogen, creatinine, HbA1C, TGs, total cholesterol, HDL-C, low-density lipoprotein (LDL-C), and complete blood count, were recorded from all of the patients before discharge. All of the tests were taken by a targeted laboratory to eliminate the kit-related deviations. Like other patients, they received face to face training for heart-healthy lifestyle modification equally by a cardiology resident. All of the variables above were measured again after 6 months following the PCI as well. In order to minimize the inter-observer bias, the interviews were performed by a single resident of cardiology.

Obtained data were entered into the Statistical Package for the Social Sciences (SPSS) software (version X, IBM Corporation, Armonk, NY) version 21 and analyzed. Continuous and categorical variables were presented in mean  $\pm$  standard deviation and number (percentages), respectively. For analytics, the *t*-test, McNemmar, Wilcoxon test, and Chi-square tests were used.  $P < 0.05$  was considered as statistically significant level.

## Results

In this study, 40 patients treated with PCI were evaluated. The patients were dominantly male (92.5%), married (97.5%) with the average age of  $56.8 \pm 7.11$  years, and education level of the diploma or less (40%). Most of the study population had a monthly income of 1–2 million Tomans (52.5%) [Table 2]. The past medical history of the studied population was recorded on the basis of histories, medications, and associated evidence. Treated hyperlipidemia, ischemic heart disease (chronic coronary syndrome and positive previous noninvasive test), and DM have the highest rates [Table 3]. 32.5% of patients were smoker before the PCI (average duration of smoking:  $15.07 \pm 3.04$  years) while it turned to 22.5% in the 6-month follow-up visit ( $P = 0.12$ ). The number of smoked cigarettes per day did not statistically change within 6 months following the PCI ( $7.75 \pm 6.75$  vs.  $6.87 \pm 6.35$ ;  $P = 0.37$ ).

Twenty-five percent of the patients presented physical activity before the PCI that most of them had moderate physical activity and follow-up assessments showed that 52.5% of patients had physical activity within 6 months. The physical activity performance has changed significantly ( $P = 0.019$ ), while the intensity of physical activity did not statistically alter ( $P = 0.56$ ). Walking (45%) and cycling (31%) were the most prevalent [Table 4].

**Table 1: Leisure time exercise questionnaire**

Activity	Frequency
1. Considering a 7-day period (a week), how many times on the average do you do the following kinds of exercise for >15 min during your free time (write in each circle the appropriate number)	Times per week
A: Strenuous exercise (heart beats rapidly) (i.e. running, jogging, hockey, football soccer, squash, basketball, cross country, skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)	
B: moderate exercise (not exhausting (i.e. fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)	
C: Mild exercise. (minimal effort) (i.e. yoga, archery, fishing from river bank, bowling, horseshoes, golf, snowmobiling, and easy walking)	
2. Considering a 7-day period (a week), during your leisure-time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?	
OFTEN	SOMETIME
NEVER/RARELY	
1. <input type="checkbox"/>	2. <input type="checkbox"/>
3. <input type="checkbox"/>	

**Table 2: Demographic information of the study population**

Variables	Frequency (%)
Gender	
Male	37 (92.5)
Female	3 (7.5)
Marital status	
Married	39 (97.5)
Single	1 (2.5)
Income	
<133\$	29 (72.5)
>133\$	11 (27.5)
Insurance	
Yes	40 (100.0)
No	0 (0.0)
Medical history	
Yes	33 (82.5)
No	7 (17.5)
Educational level	
Illiterate	10 (25.0)
Diploma or less	14 (40.0)
More than the diploma	15 (35.0)

\*Based on the economic studies in Iran, the poverty line in metropolitans is 133\$<sup>[30]</sup>

HDL-C ( $P = 0.013$ ) and LDL-C ( $P = 0.027$ ) changes were not desirable. BMI significantly improved ( $P = 0.003$ ); however, although the abdominal circumference decreased, it was not significant ( $P = 0.28$ ). Among all 40 patients, 38 ones (95%) were under statin treatments (Atorvastatin 40 mg [15.8%], 20 mg [50%], and 10 mg [10.5%]), rosuvastatin 10 mg (7.8%), rosuvastatin 5 mg (13.1%), and lovastatin 10 mg (2.6%). Hence, despite the prevalence of hyperlipidemia, lipid profile levels were in the normal

**Table 3: The past medical history of the studied population**

Past medical history	n (%)
Hyperlipidemia	15 (37.5)
Ischemic heart disease	13 (32.5)
Diabetes mellitus	11 (27.5)
Hypertension	10 (25)
Pulmonary disease	2 (5)
Thyroid disease	2 (5)
Stroke	1 (2.5)
Renal disease	1 (2.5)

**Table 4: Comparison of smoking and physical activity status before the hospital discharge and within 6 months following the percutaneous coronary intervention**

Variables	Before PCI, n (%)	Within 6 months after PCI, n (%)	P
Smoking			
Yes	13 (32.5)	9 (22.5)	0.12
No	27 (67.5)	31 (77.5)	
Physical activity			
Yes	10 (25)	21 (52.5)	0.019
No	30 (75.0)	19 (47.5)	
Physical activity intensity			
Mild	3 (33.3)	2 (10.5)	0.56
Moderate	4 (44.4)	17 (89.5)	
Strenuous	2 (22.2)	0 (0)	

PCI: Percutaneous coronary intervention

**Table 5: Comparison of atherosclerotic risk factors before the hospital discharge and after 6 months follow-up assessments**

Variable	Mean±SD		P
	Before discharge	Within 6 months after PCI	
BMI	28.60±3.54	28.11±3.48	0.003
Waist	98.59±9.25	98.13±8.93	0.28
SBP	117.15±13.58	119.65±14.87	0.27
DBP	73.75±10.01	74.23±10.61	0.45
METS	11.82±2.38	12.97±2.43	0.006
Hb	14.52±1.22	15.09±1.20	0.006
CHOL	136.54±29.73	143.08±39.24	0.14
TG	138.36±60.68	142.40±71.82	0.67
HDL	37.82±8.21	35.30±7.26	0.013
LDL	66.53±21.47	75.55±26.33	0.027
BUN	15.12±3.18	14.35±3.36	0.21
Cr	1.10±0.16	1.11±0.16	-
FBS	106.51±33.72	105.73±27.62	0.85
HbA1C	6.86±0.90	6.57±1.12	0.48

SD: Standard deviation, BMI: Body mass index, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, METS: Metabolic equivalent of task, Hb: Hemoglobin, CHOL: Cholesterol, TG: Triglyceride, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, BUN: Blood urea nitrogen, Cr: Creatinine, FBS: Fasting blood sugar, HbA1C: Hemoglobin A1C, PCI: Percutaneous coronary intervention

ranges at the study initiation before discharge. After 6 months, 3 ones stopped taking the statin because of side

effects (myalgia in one case due to the increased dose of the drug) or improved lipid test result (in two cases).

TG, FBS, and blood pressure did not statistically significant change ( $P > 0.05$ ) [Table 5].

ACEI (captopril 25 mg and enalapril 5 mg) ARB (valsartan 80 mg and 160 mg, losartan 25 mg and 50 mg [Amlodipine 5 mg], Triamterene-H and Hydrochlorothiazide 25 mg and 50 mg) were prescribed to treat HTN. Forty percent of patients received combination of these drugs. Metformin 500 mg, glibenclamide 5 mg, gliclazide 80 mg, and insulin (lantus, regular, NPH, novomix, and novorapid) were prescribed to treat HTN. 22.5% of patients received the combination of these drugs.

## Discussion

We showed that BMI, METS, HDL-C, LDL-C, and hemoglobin changed significantly after 6 months.

Huxley *et al.* pooled 26 papers assessing cigarette smoking statuses following ACS incidence in 2011. Although they presented a 2% increase rate in the smoking status of patients by each year during follow-up, they also reported no change in the rate of smoking patients who were not ex-smokers.<sup>[17]</sup> Consistent with our findings, other studies presented a decrease in both the number of smokers and the intensity of smoking following ACS.<sup>[18-20]</sup>

Here, we showed that the physical activity of patients dramatically increased within 6 months following the PCI performance. We believe that the main cause of this issue is due to the recommendations about the importance of routine physical activities for the prevention of re-experiencing similar life-threatening symptoms,<sup>[5,21]</sup> but patients' caution of intensive activity performance may be attributed to the limitations that they have experienced following heart attack, the recommendations for prohibiting intensive activities, and eventually due to the reluctance of the patients for exercising.<sup>[22,23]</sup>

We observed a remarkable increase in METS that can represent our successful performance of complete revascularization providing condition well-tolerating physical activity and also the increase in the functional capacity reflects an increased level of exercise.<sup>[5,21-23]</sup> Furthermore, a statistically significant decrease in BMI was detected. Although this change was appreciable, the abdominal circumference as an indicator of the metabolic syndrome decreased but had not significantly changed. Moreover, the primary and decreased BMI were both in overweight entities ( $28.60 \pm 3.54$  vs.  $28.11 \pm 3.48$ ;  $P = 0.003$ ). In addition to mentioned factors, FBS ( $106.51 \pm 33.72$  vs.  $105.73 \pm 27.62$ ;  $P = 0.85$ ) and HbA1C ( $6.86 \pm 0.90$  vs.  $6.57 \pm 1.12$ ;  $P = 0.48$ ) were in prediabetic entities and did not considerably improve within 6 months following the PCI. It has been established that baseline glycemic status is a predictor for the ACS recurrence.

A recent study was performed by Kim K-W *et al.* in 2017 on 851 patients over several years. They indicated that there is a significant negative correlation with the length of time since smoking cessation in ex-smokers and insulin resistance; DM and abdominal circumference are the most reliable predictors of insulin resistance. With a longer period of smoking cessation, insulin resistance tended to decrease.<sup>[24]</sup> We believe that this 10% increase in smoking cessation justifies these findings. As reported earlier, the worse condition was observed assessing lipid profile, while the serum levels of LDL-C ( $66.53 \pm 21.47$  vs.  $75.55 \pm 26.33$ ;  $P = 0.027$ ) and HDL-C ( $37.82 \pm 8.21$  vs.  $35.30 \pm 7.26$ ;  $P = 0.013$ ) remarkably increased and decreased. However, the increase in LDL-C level and decrease in HDL-C level did not exceed the demanded levels.

Among all 40 patients, 38 ones (95%) were under statin treatments (atorvastatin 40 mg [15.8%], 20 mg [50%], 10 mg [10.5%]), rosuvastatin 10 mg (7.8%), rosuvastatin 5 mg (13.1%), and lovastatin 10 mg (2.6%). Hence, despite the prevalence of hyperlipidemia, lipid profile levels were in the normal ranges at the study initiation before discharge. After 6 months, 3 ones stopped taking the statin because of side effects (myalgia in 1 case due to the increased dose of the drug) or improved lipid test result (in two cases). Gregory G and others presented that daily use of post-ACS atorvastatin could successfully prevent its recurrence, but its efficacy was not related to the presence or absence of metabolic syndrome.<sup>[25]</sup> This highlights the importance of education for continuing medication despite of improvement.<sup>[26,27]</sup> Koba and others conducted exercise-based rehabilitation in 2016 and declared a remarkable increase in the HDL-C levels.<sup>[28]</sup> These results are not in line with what we reported, and this difference may be due to the differences in the duration of the follow-up or exercise intensity and change in statin use in our study.

Here, we also indicated that hemoglobin significantly increases 6 months after successful PCI ( $14.52 \pm 1.22$  vs.  $15.09 \pm 1.20$ ;  $P = 0.006$ ). Furthermore, in another study by Redfors B *et al.*, they found that 78.7% of patents had a drop in Hgb and  $\Delta$  Hgb  $\leq 1.0$  g/dl was more common.<sup>[29]</sup>

## Conclusion

Here, we showed that the BMI, physical activity, and METS remarkably improved, but the number of smokers, the daily number of smoked cigarettes, and waist circumference decreased none significantly and lipid profile got worse paradoxically addition to mentioned factors, FBS and HbA1C were in prediabetic entities and did not considerably improve within 6 months following the PCI. Although this population is limited for generalization, this study shows that we require further schedules to improve ACS secondary prevention practice in our community. We also lost some samples during the follow-up.

Other limitation of our study was the follow-up duration. We suggest that more studies on larger populations and longer duration of follow-up should be performed.

## Financial support and sponsorship

This study was granted by the Isfahan University of Medical Sciences.

## Conflicts of interest

There are no conflicts of interest.

## References

- Piepoli MF, Corrà U, Benzer W, Bjarnason-Wehrens B, Dendale P, Gaita D, *et al.* Secondary prevention through cardiac rehabilitation: From knowledge to implementation. A position paper from the Cardiac Rehabilitation Section of the European Association of Cardiovascular Prevention and Rehabilitation. *Eur J Cardiovasc Prev Rehabil* 2010;17:1-7.
- Reese C, Nechwatal R, Farin E. What do rehabilitation patients expect from a telemedicine cardiac rehab aftercare? Results from interviews with rehabilitation patients. *Z Evid Fortbild Qual Gesundheitswes* 2019;143:43-8.
- Sanchis-Gomar F, Perez-Quilis C, Leischik R, Lucia A. Epidemiology of coronary heart disease and acute coronary syndrome. *Ann Transl Med* 2016;4:256.
- Roggeri DP, Roggeri A, Rossi E, Cinconze E, De Rosa M, Maggioni AP, *et al.* Direct healthcare costs and resource consumption after acute coronary syndrome: A real-life analysis of an Italian subpopulation. *Eur J Prev Cardiol* 2014;21:1090-6.
- Anderson L, Oldridge N, Thompson DR, Zwisler AD, Rees K, Martin N, Taylor RS. Exercise-based cardiac rehabilitation for coronary heart disease: Cochrane systematic review and meta-analysis. *Journal of the American College of Cardiology*. 2016;67:1-2.
- Brook RD. Is air pollution a cause of cardiovascular disease? Updated review and controversies. *Rev Environ Health* 2007;22:115-37.
- Stejskal D, Václavík J, Lacnáč B, Prosková J. Aspirin resistance measured by cationic propyl gallate platelet aggregometry and recurrent cardiovascular events during 4 years of follow-up. *Eur J Intern Med* 2006;17:349-54.
- Arroyo-Johnson C, Mincey KD. Obesity epidemiology worldwide. *Gastroenterol Clin North Am* 2016;45:571-9.
- Davis EF, Lewandowski AJ, Aye C, Williamson W, Boardman H, Huang RC, *et al.* Clinical cardiovascular risk during young adulthood in offspring of hypertensive pregnancies: Insights from a 20-year prospective follow-up birth cohort. *BMJ Open* 2015;5:e008136.
- Basu R, Krueger PM, Lairson DR, Franzini L. Lifetime medical expenditures among hypertensive men and women in the United States. *Womens Health Issues* 2011;21:246-53.
- Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F, *et al.* Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): Case-control study. *Lancet* 2004;364:937-52.
- Gorter PM, Olijhoek JK, van der Graaf Y, Algra A, Rabelink TJ, Visseren FL, *et al.* Prevalence of the metabolic syndrome in patients with coronary heart disease, cerebrovascular disease, peripheral arterial disease or abdominal aortic aneurysm. *Atherosclerosis* 2004;173:363-9.
- Adler AI, Stevens RJ, Manley SE, Bilous RW, Cull CA, Holman RR, *et al.* Development and progression of nephropathy

- in type 2 diabetes: The United Kingdom Prospective Diabetes Study (UKPDS 64). *Kidney Int* 2003;63:225-32.
14. Murase T, Okubo M, Amemiya-Kudo M, Hiraga T, Oka J, Shimada M, *et al.* Impact of markedly elevated serum lipoprotein (a) levels ( $\geq 100$  mg/dL) on the risk of coronary heart disease. *Metabolism* 2007;56:1187-91.
  15. Nichols S, Gleadall-Siddall DO, Antony R, Clark AL, Cleland JG, Carroll S, Ingle L. Estimated peak functional capacity: an accurate method for assessing change in peak oxygen consumption after cardiac rehabilitation?. *Clinical Physiology and Functional Imaging*. 2018;38:681-8.
  16. Delshad M, Ghanbarian A, Ghaleh NR, Amirshakeri G, Askari S, Azizi F. Reliability and validity of the modifiable activity questionnaire for an Iranian urban adolescent population. *Int J Prev Med* 2015;6:3.
  17. Huxley RR, Woodward M. Cigarette smoking as a risk factor for coronary heart disease in women compared with men: A systematic review and meta-analysis of prospective cohort studies. *Lancet* 2011;378:1297-305.
  18. Bakker EC, Nijkamp MD, Sloot C, Berndt NC, Bolman CA. Intention to abstain from smoking among cardiac rehabilitation patients: The role of attitude, self-efficacy, and craving. *J Cardiovasc Nurs* 2015;30:172-9.
  19. Berndt NC, Hayes AF, Verboon P, Lechner L, Bolman C, De Vries H. Self-efficacy mediates the impact of craving on smoking abstinence in low to moderately anxious patients: Results of a moderated mediation approach. *Psychol Addict Behav* 2013;27:113-24.
  20. Berndt N, Bolman C, Mudde A, Verheugt F, de Vries H, Lechner L. Risk groups and predictors of short-term abstinence from smoking in patients with coronary heart disease. *Heart Lung* 2012;41:332-43.
  21. Anderson L, Oldridge N, Thompson DR, Zwisler AD, Rees K, Martin N, *et al.* Exercise-based cardiac rehabilitation for coronary heart disease: Cochrane systematic review and meta-analysis. *J Am Coll Cardiol* 2016;67:1-2.
  22. Hambrecht R, Niebauer J, Marburger C, Grunze M, Kälberer B, Hauer K, *et al.* Various intensities of leisure time physical activity in patients with coronary artery disease: Effects on cardiorespiratory fitness and progression of coronary atherosclerotic lesions. *J Am Coll Cardiol* 1993;22:468-77.
  23. Gielen S, Laughlin MH, O'Conner C, Duncker DJ. Exercise training in patients with heart disease: Review of beneficial effects and clinical recommendations. *Prog Cardiovasc Dis* 2015;57:347-55.
  24. Kim KW, Kang SG, Song SW, Kim NR, Rho JS, Lee YA. Association between the time of length since smoking cessation and insulin resistance in asymptomatic Korean male ex-smokers. *J Diabetes Res* 2017;2017:6074760.
  25. Schwartz MG, Olsson AG, Szarek M, Sasiela WJ. Relation of characteristics of metabolic syndrome to short-term prognosis and effects of intensive statin therapy after acute coronary syndrome. *Diabetes Care* 2005;28:2508-13.
  26. Montazerifar F, Bolouri A, Mahmoudi Mozaffar M, Karajibani M. The prevalence of metabolic syndrome in coronary artery disease patients. *Cardiol Res* 2016;7:202-8.
  27. Parsa AF, Jahanshahi B. Is the relationship of body mass index to severity of coronary artery disease different from that of waist-to-hip ratio and severity of coronary artery disease? Paradoxical findings. *Cardiovasc J Afr* 2015;26:13-6.
  28. Koba S, Ayaori M, Uto-Kondo H, Furuyama F, Yokota Y, Tsunoda F, *et al.* Beneficial effects of exercise-based cardiac rehabilitation on high-density lipoprotein-mediated cholesterol efflux capacity in patients with acute coronary syndrome. *J Atheroscler Thromb* 2016;23:865-77.
  29. Redfors B, Génereux P, Witzenbichler B, Kirtane AJ, McAndrew T, Weisz G, *et al.* Bleeding severity after percutaneous coronary intervention. *Circ Cardiovasc Interv* 2018;11:e005542.