Gender differences in patients with metabolic syndrome in coronary artery interventions

Mehmet Rami Helvaci¹, Hasan Kaya¹, Mehmet Gundogdu²

¹School of Medicine of the Mustafa Kemal University, Antakya, ²School of Medicine of the Ataturk University, Erzurum; Turkey

ABSTRACT

Aim We tried to understand whether or not there was a gender difference in coronary artery interventions in coronary heart disease (CHD) cases in the present study.

Methods The study was performed in two phases. The first phase was performed at the Internal Medicine Polyclinic of the Dumlu- pınar University between August 2005 and March 2007. CHD was diagnosed either angiographically or with history of coronary artery stenting (CAS) and/or coronary artery bypass graft (CABG) surgery. The second phase was performed at the Internal Medicine Polyclinic of the Mustafa Kemal University between March 2007 and April 2012. During the second phase, the CHD patients with CAS and/or CABG surgery were detected and divided into two groups according to the gender.

Results Mean age and prevalence of CHD were similar in both genders (p>0.05 for both) in the first phase. Smoking was higher in males with CHD, in 30 cases (54.5%) of males versus six (9.6%) cases of females (p<0.001), as well as chronic obstructive pulmonary disease (COPD), in ten (18.1%) cases of males versus four (6.4%) cases of females (p<0.05). Although the body mass index (BMI) and white coat hypertension (WCH) were insignificantly higher (p>0.05 for both), low density lipoprotein cholesterol (LDL-C) and triglyceride (TG) were significantly higher in females with CHD (p= 0.008 and p= 0.002, respectively). Hypertension (HT) and diabetes mellitus (DM) were higher in females with CHD, too (p<0.001 and p<0.05, respectively). On the other hand, CAS and/or CABG surgery were significantly higher in male CHD cases (21.8% versus 1.6%, p<0.001). Parallel to the first phase cases, majority of CAS and/or CABG surgery cases were males in the second phase cases too (90.2% versus 9.7%, p<0.001).

Conclusion As some components of the metabolic syndrome, smoking and COPD were higher in males whereas BMI, WCH, LDL-C, TG, HT and DM were higher in females. Despite similar prevalences of CHD in both sexes, CAS and/or CABG surgery were significantly higher in males probably due to fear of loss of power required for their dominant roles in life and sexuality.

Key words: coronary artery stenting, coronary artery bypass graft surgery, male sex, smoking, sexuality
INTRODUCTION

An association between systemic atherosclerosis and some metabolic disorders and smoking is known for many years under the title of metabolic syndrome (1,2). The syndrome is characterized by a low-grade chronic inflammatory process, probably initiated in early life (3), and it can probably be slowed down during the early phases with appropriate nonpharmaceutical approaches including lifestyle changes, diet, and exercise (4). However, the syndrome cannot probably be prevented completely, since aging alone may be one of the significant facilitating factors of systemic atherosclerosis. The metabolic syndrome may contain early reversible components including white coat hypertension (WCH), impaired fasting glucose (IFG), impaired glucose tolerance (IGT), hypertriglyceridemia, hyperbetalipoproteinemia, dyslipidemia, overweight, and smoking like risk factors for the development of irreversible diseases including obesity, hypertension (HT), diabetes mellitus (DM), chronic obstructive pulmonary disease (COPD), peripheral artery disease (PAD), coronary heart disease (CHD), and stroke (5). In another view, the syndrome may be the most significant and complex disease of human life decreasing its quality and duration. The syndrome has become increasingly common all over the world, for example 50 million people in the United States may have it (6). The metabolic syndrome induced symptomatic atherosclerosis is probably the leading cause of death for both sexes. For example, CHD is the leading cause of death in the developed countries. During the average life span, males and females probably have the same risk of mortality from CHD (5). Although CHD may be equally seen in both sexes, there may be some gender differences in the risk factors of CHD. On the other hand, beside the risk factors of CHD, coronary artery interventions may also show some gender differences. We tried to understand whether or not there is a gender difference in coronary artery interventions in CHD cases in the present study.

PATIENTS AND METHODS

The study was performed in two phases. The first phase was performed at the Internal Medicine Polyclinic of the Dumlupinar University between August 2005 and March 2007. We took consecutive patients applying for any reason at and above the age of 15 years. Their medical history including smoking habit were learnt, and a routine check up procedure including fasting plasma glucose (FPG), low density lipoprotein cholesterol (LDL-C), triglyceride (TG), and electrocardiography were performed.

Current smokers at least for the last six months with an amount of one pack a day and cases with a previous smoking history of at least five years with an amount of one pack a day were accepted as smokers.

COPD was diagnosed via the pulmonary function tests in suspected cases in which the ratio of forced expiratory volume in the first second of expiration to forced vital capacity is lower than 70%.

Body mass index (BMI) of each case was calculated by the measurements of the same physician instead of verbal expressions. Weight in kilograms is divided by height in meters squared (7).

Office blood pressure (OBP) was checked after 5-minute rest in a seated position with a mercury sphygmomanometer on three visits, and no smoking was permitted during the previous two hours. A 10-day measurement of blood pressure twice a day at home (HBP) was obtained in all cases, even in normotensives in the office due to the risk of masked HT after an education about proper BP measurement techniques (8). A 24-hour ambulatory blood pressure (ABP) monitoring was not required due to its equal effectiveness with HBP measurements (9). Eventually, HT is defined as a mean HBP value of 135/85 mmHg or greater, and WCH as an OBP of 140/90 mmHg or greater, but a mean HBP value of lower than 135/85 mmHg (8).

A stress electrocardiography was performed in cases with an abnormal electrocardiography and/or history of angina pectoris.

A coronary angiography was obtained just for the stress electrocardiography positive cases. So CHD was diagnosed either angiographically or with a history of coronary artery stenting (CAS) and/or coronary artery bypass graft (CABG) surgery.
Eventually, all cases with CHD were divided into two groups according to gender distribution and mean age, weight, BMI, LDL-C, TG values and prevalences of smokers, COPD, WCH, HT, DM, CAS and/or CABG surgery were compared in between.

The second phase was performed at the Internal Medicine Polyclinic of the Mustafa Kemal University between March 2007 and April 2012. During the second phase, the CHD patients with CAS and/or CABG surgery were detected and divided into two groups according to the gender. Mann-Whitney U test, Independent-Samples T test, and comparison of proportions were used as the methods of statistical analyses.

RESULTS

The first phase of the study included 1,240 males and 1,620 females. Mean age was 40.8 and 41.7 years, respectively (p>0.05). There were 117 cases with CHD and 104 of them diagnosed angiographically. Prevalence of the CHD was similar in both sexes, in 55 (4.4%) cases of males versus 62 (3.8%) cases of females (p>0.05) (Table 1).

Mean age of the CHD was 63.5 versus 61.5 years, respectively (p>0.05).

Table 1. Characteristic features of the first phase cases

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male (%) cases with CHD</th>
<th>Female (%) cases with CHD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence</td>
<td>55 (4.4)</td>
<td>62 (3.8)</td>
<td>NS</td>
</tr>
<tr>
<td>Mean age (year)</td>
<td>63.5 ± 10.8 (43-82)</td>
<td>61.5 ± 11.2 (42-48)</td>
<td>NS</td>
</tr>
<tr>
<td>Prevalence of smokers</td>
<td>30 (54.5)</td>
<td>6 (9.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Prevalence of COPD</td>
<td>10 (18.1)</td>
<td>4 (6.4)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Mean weight (kg)</td>
<td>79.1 ± 12.9 (58-116)</td>
<td>74.4 ± 18.7 (42-129)</td>
<td>0.027</td>
</tr>
<tr>
<td>Mean BMI (kg/m2)</td>
<td>28.3 ± 4.7 (20.6-46.9)</td>
<td>29.7 ± 6.7 (19.0-48.6)</td>
<td>NS</td>
</tr>
<tr>
<td>Mean LDL-C (mg/dL)</td>
<td>115.6 ± 38.5 (43-192)</td>
<td>132.6 ± 47.3 (10-232)</td>
<td>0.008</td>
</tr>
<tr>
<td>Mean TG (mg/dL)</td>
<td>150.1 ± 113.4 (53-594)</td>
<td>250.3 ± 233.9 (81-1380)</td>
<td>0.002</td>
</tr>
<tr>
<td>Prevalence of WCH</td>
<td>13 (23.6)</td>
<td>19 (30.6)</td>
<td>NS</td>
</tr>
<tr>
<td>Prevalence of HT</td>
<td>37 (62.8)</td>
<td>36 (58.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Prevalence of DM</td>
<td>21 (38.1)</td>
<td>32 (51.6)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Prevalence of CAS</td>
<td>12 (21.8)</td>
<td>1 (1.6)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

CHD, coronary heart disease; COPD, chronic obstructive pulmonary disease; BMI, body mass index; LDL, low density lipoprotein cholesterol; TG, triglyceride; WCH, white coat hypertension; HT, hypertension; DM, diabetes mellitus; CAS, coronary artery stenting; CABG, coronary artery bypass graft; NS, non-significant

Table 2. Characteristic features of the second phase cases

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male (% cases with CAS and/or CABG surgery)</th>
<th>Female (% cases with CAS and/or CABG surgery)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence</td>
<td>37 (90.2)</td>
<td>4 (9.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean age (year)</td>
<td>62.8 ± 11.6 (43-82)</td>
<td>63.6 ± 1.1 (63-65)</td>
<td>ns</td>
</tr>
</tbody>
</table>

CABG, coronary artery bypass graft; NS, non-significant

Prevalence of smoking was significantly higher in males with CHD, 30 cases (54.5%) of males versus six (9.6%) cases of females (p<0.001). Parallel to the higher prevalence of smoking, prevalence of COPD was also significantly higher in males, in ten (18.1%) cases of males versus four (6.4%) cases of females (p<0.05). Although the mean body weight of the male cases with CHD was significantly higher (79.1 versus 74.4 kg, p=0.027), the female cases with CHD had a higher mean BMI value, but the difference was statistically insignificant probably due to the small sample sizes of the study cases (28.3 versus 29.7 kg/m2, p>0.05). When we looked at the lipid profiles, the mean LDL-C and TG values were significantly higher in females (115.6 versus 132.6 mg/dL, p=0.008 and 150.1 versus 250.3 mg/dL, p=0.002, respectively). Parallel to the higher lipid profiles, prevalences of HT and DM was significantly higher in females. There were 17 (30.9%) cases with HT in males versus 36 (58.0%) cases in females (p<0.001) and 21 (38.1%) cases with DM in males versus 32 (51.6%) cases in females with CHD (p<0.05). Additionally, prevalence of the WCH was also higher in females, but the difference was nonsignificant probably due to the small number of cases with CHD, in 13 (23.6%) cases of males versus 19 (30.6%) cases of females (p<0.05). Despite similar prevalences of CHD in both sexes, as the most significant result of the first phase were prevalences of CAS and/or CABG surgery, which were significantly higher in males with uncertain causes, in 12 (21.8%) cases of males versus just in one (1.6%) case of females (p<0.001). Similarly, we detected 41 CHD cases with CAS (14 cases) and/or CABG surgery performed in between.

Table 3. Associated disorders of the second phase cases

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male (%) cases with CABG surgery</th>
<th>Female cases (% with CABG surgery)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence of smoking</td>
<td>15 (36.5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prevalence of COPD</td>
<td>9 (21.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prevalence of DM</td>
<td>20 (48.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prevalence of HT</td>
<td>11 (26.8)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

BMI, body mass index; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus; HT, hypertension
(28 cases) in the second phase, and 37 (90.2%) of them were males, again (p<0.001) (Table 2). Associated disorders of the second phase of CHD cases were shown in Table 3.

**DISCUSSION**

Although there is no universally accepted definition for the metabolic syndrome, excess weight is probably the initiatory factor of the syndrome (10). Actually the syndrome is a collection of risk factors for the development of systemic atherosclerosis, and the symptomatic atherosclerosis is probably the leading cause of death for human beings. Therefore, the definition of the syndrome includes both reversible risk factors and overweight, smoking, WCH, IFG, IGT, hypertriglyceridemia, hyperbeta-lipoproteinemia, and dyslipidemia and final diseases including aging, obesity, COPD, HT, DM, CHD, PAD, and stroke (11,12). For example, in a previous study (13), prevalences of hypertriglyceridemia, hyperbeta-lipoproteinemia, dyslipidemia, IGT, and WCH showed a parallel fashion to excess weight increasing until the seventh decade of life and decreasing afterwards significantly (p<0.05 nearly in all steps). On the other hand, prevalences of HT, DM, and CHD always continued to increase by aging without any decrease (p<0.05 nearly in all steps) indicating their irreversible properties (13). After the development of one of the final diseases, the nonpharmaceutical approaches will provide little benefit to prevent the development of the others probably due to cumulative effects of the risk factors on systems for a long period of time (11,12). According to our opinion, obesity should be included among the irreversible final diseases since after the development of obesity, pharmaceutical and nonpharmaceutical approaches will provide little benefit either to heal obesity or prevent its complications.

Excess weight probably leads to a chronic and low-grade inflammatory process in many systems, especially the endothelial system of the body, and risk of death from all causes, including cardiovascular diseases and cancers, increases parallel to the range of moderate to severe weight excess in all age groups (14). The effects of weight on BP were also shown previously that the prevalence of sustained normotension (NT) was significantly higher in the underweight (80.3%) than the normal weight (64.0%) and overweight cases (31.5%, p<0.05 for both) in a study (15), and 55.1% of cases with HT had obesity against 26.6% of cases with NT (p<0.001) in another study (16). Therefore, the dominant underlying risk factor of the metabolic syndrome appears as an already existing excess weight or a trend towards excess weight, which is probably the main cause of insulin resistance, dyslipidemia, IGT, and WCH (4). Even prevention of the accelerating trend of weight with diet or exercise, even in the absence of a prominent weight loss, will probably result with resolution of many parameters of the metabolic syndrome (17-18). However, according to our opinion, limitation of excess weight as an excessive fat tissue in and around abdomen under the heading of abdominal obesity is meaningless, instead it should be defined as overweight or obesity via BMI, since adipocytes function as an endocrine organ that produces a variety of cytokines and hormones anywhere in the body (4). The resulting hyperreactivity of sympathetic nervous system and renin-angiotensin-aldosterone system is probably associated with insulin resistance, chronic endothelial inflammation, and elevated BP. Similarly, the Adult Treatment Panel III reported (7) that although some people are classified as overweight with a large muscular mass, most of them also have excess fat tissue, and excess weight does not only predispose them to CHD, stroke, and numerous other conditions, it also has a high burden of other CHD risk factors including type 2 DM, HT, and dyslipidemia.

Smoking-related diseases kill one in every ten adults globally, and if the current trend continues, it will kill one in every six by 2030 (19). It is a major risk factor for the development of cardiovascular diseases especially the CHD (20). Inspite of the known strong atherosclerotic effect of smoking, some studies reported that smoking in humans and nicotine administration in animals are associated with a decreased body weight (21). Evidence revealed an increased energy expenditure while smoking, both at rest and light physical activity (22), and nicotine supplied by patch after smoking cessation decreased caloric intake in a dose-related manner (23). According to an animal study, nicotine may lengthen intermeal time and simultaneously decreases the amount
of a meal eaten (24). Additionally, body weight seems to be the highest in former, the lowest in current and medium in never smokers (25). In another study, there was a relationship between overweight and smoking in men but not in women (26). Smoking may be associated with postcessation weight gain, but evidence suggests that risk of weight gain is the highest during the first year after quitting and declines over the years (27). Similarly, although the CHDs were detected with similar prevalences in both sexes in the present study, prevalences of smoking and COPD were higher in males against the higher prevalences of BMI, WCH, LDL-C, TG, HT and DM in females as the other atherosclerotic risk factors.

This result may indicate both the weight decreasing and strong atherosclerotic roles of smoking. Similarly, the incidence of a myocardial infarction is increased sixfold in women and threefold in men who smoke at least 20 cigarettes per day compared to the never smoked cases (28). In another word, smoking is more harmful for women as far as CHD is concerned probably due to the associated higher BMI and its consequences in women. Similarly to our results, the proportion of smokers is consistently higher in men in the literature (20).

So smoking is probably a powerful atherosclerotic risk factor with some suppressor effects on appetite. However, smoking, as a pleasure in life, may also show the weakness of individuals’ will to control eating, so it comes with excess weight and its complications despite its inhibitory effects on appetite. For example, prevalences of HT, DM, and smoking were the highest in the highest TG group as a significant component of the metabolic syndrome in another study (12).

The male sex has a dominant role in life in many societies, especially in eastern societies. Their dominant roles require physical power nearly in all parts of daily life. The female sex has a relatively passive role requiring less physical power in their lives. There is a feature of the eastern societies that sexual strength may be a significant indicator of their being real males. As already known, the required physical power during the sexual activity is much higher for the male sex. Any decrease in the sexual ability due to the underlying CHD may put males into a great depression. Despite the decreased requirement of the sexual activity because of the aging in both sexes, the males are probably afraid of losing the most significant feature of their gender. Although the fact is known only by their partners, this fear puts them into the efforts about getting the physical power again. Therefore, these coronary artery interventions may be less frequent in single males or widowers, which should be searched in further studies.

As a conclusion, as some components of the metabolic syndrome, prevalences of smoking and COPD were higher in males whereas BMI, WCH, LDL-C, TG, HT and DM were higher in females with CHD. Despite the similar prevalences of CHD in both sexes, prevalences of CAS and/or CABG surgery were significantly higher in males with CHD probably due to fear of loss of power required for their dominant roles in life and sexuality.

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**TRANSPARENCY DECLARATIONS**

Competing interests: none to declare.

**REFERENCES**


